



## SAMPLE MODULE Class IX & X



## School Excellence + Competition Nurturing

911, Subhash Nagar II, Near Bombay Yojna, Rangbari Mukti Dham, KOTA

website : [www.vededucational.in](http://www.vededucational.in) | 7891105056 | 7665780536

# PRE-FOUNDATION

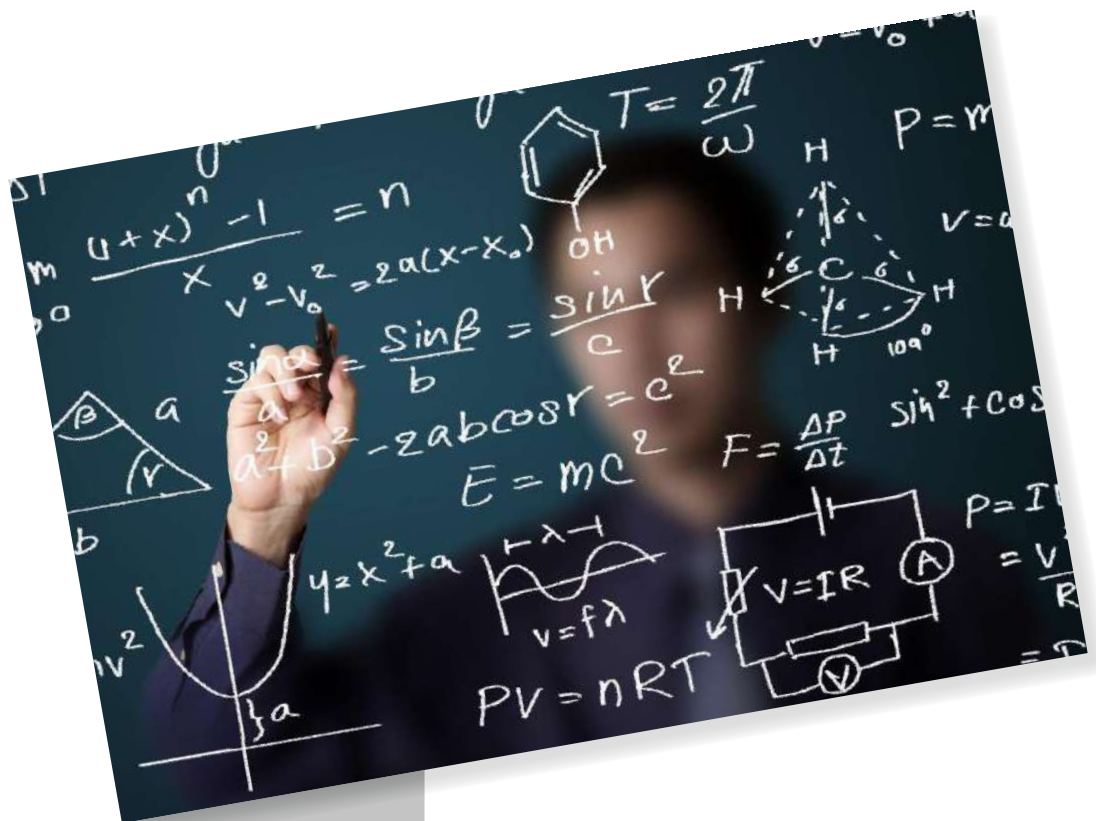
---

## CLASS IX

---

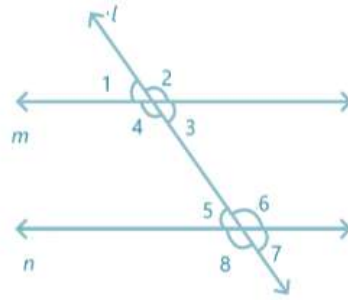
SAMPLE

# MATHEMATICS



# CHAPTER-6

## Lines and Angles



### Chapter Flow

1. Introduction
2. Line, line-segment and Ray
3. Angles and Their Properties
4. Parallel Lines
5. Triangle
  1. Classification of Triangles
  2. Relation Between the Angles of a Triangle
6. The Polygon

DPP-1

DPP-2

DPP-3

DPP-4

Exercise-1 NCERT Basics

Exercise-2 Concept Mastery

Exercise-3 Accuracy Booster

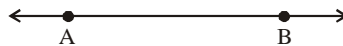
# Lines and Angles

## 1. Introduction

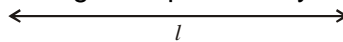
You have already studied about points, lines and angles in our earlier classes. In this chapter, you will study the properties of the angle formed when two lines intersect each other, and also the properties of the angles formed when a line intersects two or more parallel lines at distinct points.

## 2. Line, line-segment and Ray

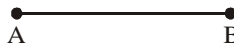
Line is a set of infinite points that has no end point. If A and B are any two points on line l then we denote the line as  $\overleftrightarrow{AB}$  and is represented as



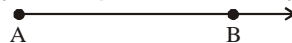
We also denote the line by a single small English Alphabet say l and represented as



Line-Segment is a part of a line that has two end points. It is of finite length and cannot be extended further. Line segment is denoted as  $\overline{AB}$  where A, B are its end points and is represented as



Ray is a part of a line with one end point. It can be extended infinitely on one side. Ray is denoted as  $\overrightarrow{AB}$  where A is the end point and B is any other point on the ray is represented as

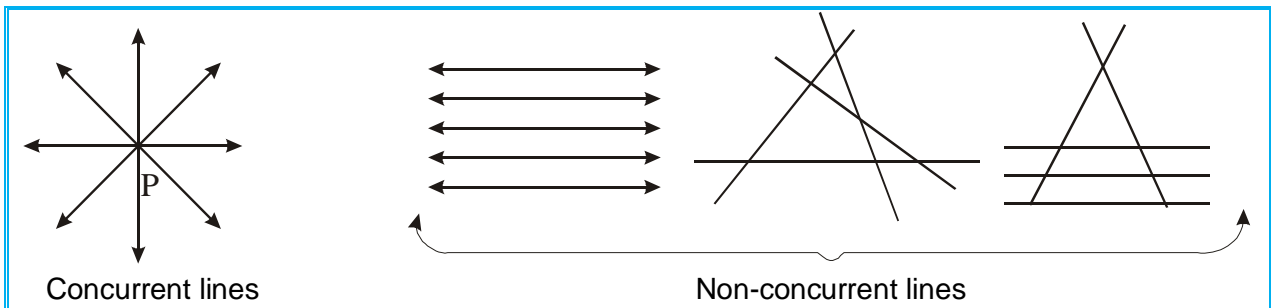


Here B is not the end point

We can extend the ray towards B from A infinitely.

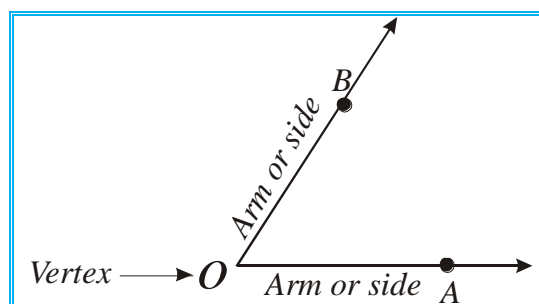
## Concurrent lines

Three or more distinct lines are said to be concurrent if each of them passes through the same point.



## 3. Angles and Their Properties

**Angle :** An **angle** is figure formed by two rays with a common initial point. The common initial point is called the **vertex** of the angle, and the rays forming the angle are called **arms** or **sides** of the angle. In fig. O, is the vertex and OA and OB are sides of the angle AOB or BOA.

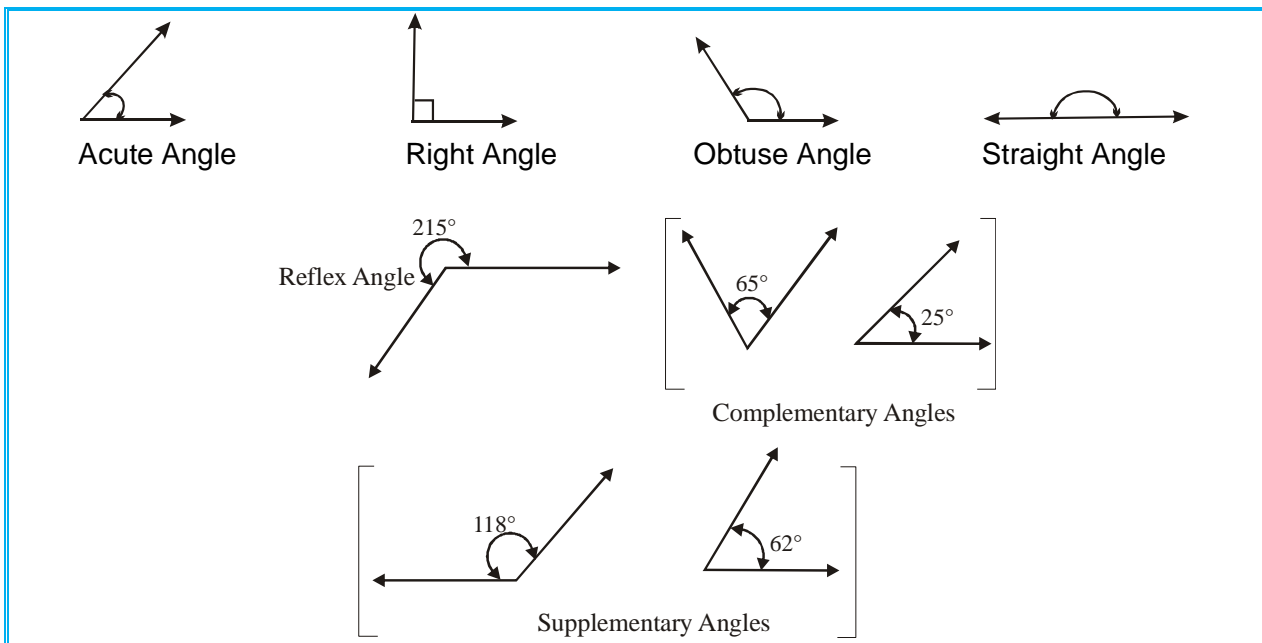


We also use the symbol ' $\angle$ ' to denote the measure of the angle.

**Angular Region :** It consists of the angle AOB and its interior.

**Different types of Angles :**

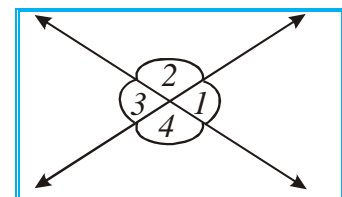
- (i) **Acute angle :** An acute angle is an angle whose measure lies between  $0^\circ$  and  $90^\circ$ .
- (ii) **Right angle :** A right angle which is exactly  $90^\circ$ . The symbol " $\perp$ " is used to indicate a right angle.
- (iii) **Obtuse angle :** A obtuse angle is an angle measuring greater than  $90^\circ$  but less than  $180^\circ$ .
- (iv) **Straight Angle :** A straight angle is an angle which is exactly  $180^\circ$ .
- (v) **Reflex angle :** A reflex angle is greater than  $180^\circ$  but less than  $360^\circ$ .
- (vi) **Complementary angles :** Complementary angles are two angles whose sum is  $90^\circ$ . Each is called the complement of the other.
- (vii) **Supplementary Angles :** Supplementary angles are two angles whose sum is  $180^\circ$ . Each is called the supplement of the other.



**(viii) Vertically Opposite Angles :**

In figure two intersecting lines form the angles numbered 1,2,3 and 4.

Angles 1 and 3 are called **vertically opposite angles** as are angles 2 and 4.

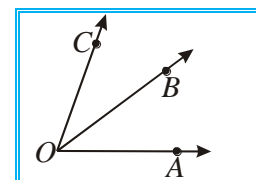


**(ix) Adjacent Angles :**

Two angles AOB and BOC are such that :

- (i) they have a common vertex.
- (ii) have a common arm and
- (iii) their interiors are non-overlapping.

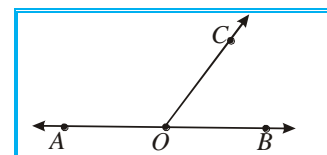
Two angles satisfying the above conditions are called **adjacent angles**.



**(x) Linear Pair :**

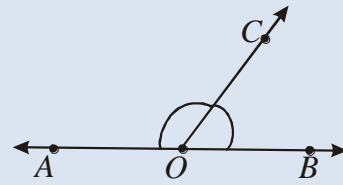
Two adjacent angles whose non common arms are opposite ray are said to form a linear pair.

$\angle AOC$  and  $\angle BOC$  form a linear pair.



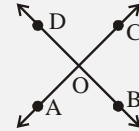
**Axiom (6.1) : (Axiom of linear pair) :** If a ray stands on a line, then the sum of the two adjacent angles so formed is  $180^\circ$ .

$$\angle AOC + \angle BOC = 180^\circ$$



**Axiom 6.2 :** If the sum of the adjacent angles is  $180^\circ$ , then the non common arms of the angles are opposite rays.

**Theorem 6.1 :** If two lines intersect, then the vertically opposite angles are equal. Similarly, it can be proved that  $\angle BOC = \angle DOA$ . Thus, vertically opposite angles are equal.



**Illustration 1 :** In figure, AB is a straight line and x is greater than y by one third of a right angle. Find the values of x and y.

**Solution :**

We are given

$$x = y + \frac{1}{3}(90^\circ) \quad \dots(i)$$

$$\Rightarrow x = y + 30^\circ$$

$$\text{Also, } x + y = 180^\circ \text{ (Linear Pair Axiom).} \quad \dots(ii)$$

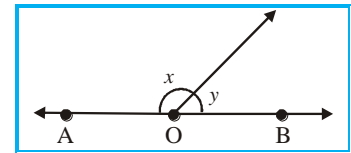
Putting :  $x = y + 30^\circ$  in (ii) we get

$$y + 30^\circ + y = 180^\circ$$

$$2y = 150^\circ$$

$$y = 150/2 = 75^\circ$$

$$\text{From (i) , } x = 75 + 30^\circ = 105^\circ$$



**Illustration 2 :** Find the measure of an angle, if six times its complement is  $12^\circ$  less than twice its supplement.

**Solution :**

Let the measure of the required angle be  $x^\circ$ .

Then, measure of its complement =  $(90 - x)^\circ$ .

Measure of its supplement =  $(180 - x)^\circ$ .

$$\therefore 6(90 - x) = 2(180 - x) - 12$$

$$\Rightarrow 540 - 6x = 360 - 2x - 12$$

$$\Rightarrow 4x = 192$$

$$\Rightarrow x = 48^\circ.$$

Hence, the required angle is  $48^\circ$ .

## 4. Parallel Lines

**Angles made by a transversal on two parallel lines :**

**Transversal :** A transversal is a line that intersects two or more lines at different points.

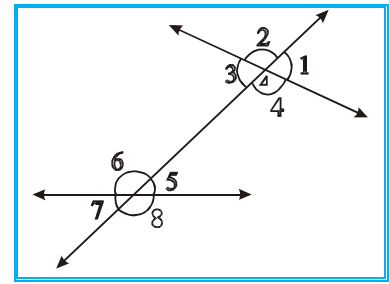
A transversal cutting two lines forms some angles that are given special names.

(i) Interior Angles :  $\angle 3, \angle 4, \angle 5$  and  $\angle 6$

(ii) Exterior Angles :  $\angle 1, \angle 2, \angle 7$  and  $\angle 8$

(iii) Pairs of Corresponding Angles :  $\angle 1$  and  $\angle 5$ ,  
 $\angle 2$  and  $\angle 6$ ,  $\angle 3$  and  $\angle 7$ ,  $\angle 4$  and  $\angle 8$

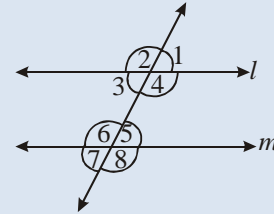
- (iv) Pairs of Alternate Interior Angles :  $\angle 3$  and  $\angle 5$ ,  $\angle 4$  and  $\angle 6$
- (v) Pairs of Alternate Exterior Angles :  $\angle 1$  and  $\angle 7$ ,  $\angle 2$  and  $\angle 8$
- (vi) Consecutive Interior Angles :  $\angle 3$  and  $\angle 6$ ,  $\angle 4$  and  $\angle 5$ .
- (vii) Pair of co-interior angles :  $\angle 4$  &  $\angle 5$ ,  $\angle 3$  &  $\angle 6$ .
- (viii) Pair of co-exterior angles :  $\angle 1$  &  $\angle 8$ ,  $\angle 2$  &  $\angle 7$ .



**Axiom 6.3 :** (Corresponding Angles Axiom)

If a transversal intersects two parallel lines, then each pair of corresponding angles are equal. That is, in Fig.

$$\angle 1 = \angle 5, \angle 2 = \angle 6, \angle 3 = \angle 7 \text{ and } \angle 4 = \angle 8$$



**Axiom 6.4 :** If a transversal intersects two lines such that a pair of corresponding angles is equal, then the two lines are parallel to each other.

In Fig. if  $\angle 1 = \angle 5$  or  $\angle 2 = \angle 6$  or  $\angle 3 = \angle 7$  and  $\angle 4 = \angle 8$ , then lines  $l$  and  $m$  are parallel.

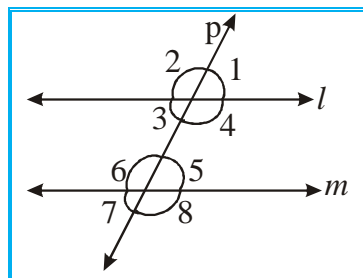
**Theorem 6.2 :** If a transversal intersects two parallel lines, then each pair of alternate interior angles is equal. i.e., if  $l \parallel m$ ,  $\angle 3 = \angle 5$  and  $\angle 4 = \angle 6$ .

**Theorem 6.3 :** If a transversal intersects two lines in such a way that a pair of alternate exterior angles is equal, then the lines are parallel. i.e., if  $\angle 1 = \angle 7$  and  $\angle 2 = \angle 8 \Rightarrow l \parallel m$ .

**Theorem 6.4 :** If a transversal intersects two parallel lines, then each pair of interior angles on the same side of the transversal is supplementary. i.e., if  $\angle 4 + \angle 5 = 180^\circ$  and  $\angle 3 + \angle 6 = 180^\circ \Rightarrow l \parallel m$ .

**Theorem 6.5 :** If a transversal intersects two lines in such a way that a pair of exterior angles on the same side of the transversal is supplementary, then the lines are parallel. i.e., if  $\angle 1 + \angle 8 = 180^\circ$  and  $\angle 2 + \angle 7 = 180^\circ \Rightarrow l \parallel m$ .

**Illustration 3 :** In fig.,  $l \parallel m$  and  $p$  is a transversal to the lines  $l$  and  $m$ .



- (i) If  $\angle 1 = 35^\circ$ , find the remaining angles.
- (ii) If  $\angle 2 + \angle 4 = 210^\circ$ , Find  $\angle 1, \angle 2, \dots, \angle 8$

**Solution :**

(i)  $\angle 1 + \angle 2 = 180^\circ$  [Linear pair axiom]  
 $= \angle 2 = 180^\circ - \angle 1 = 180^\circ - 35^\circ = 145^\circ$

Now :  $\angle 3 = \angle 1 = 35^\circ$  [Vertically opposite angles]

and  $\angle 4 = \angle 2 = 145^\circ$

By the corresponding angles axiom :

$$\angle 5 = \angle 1 = 35^\circ$$

$$\angle 6 = \angle 2 = 145^\circ$$

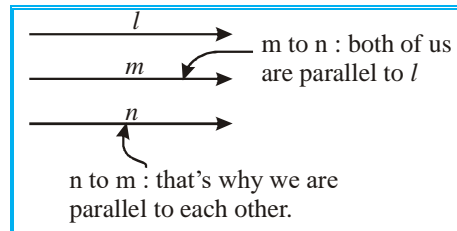
$\angle 7 = \angle 3 = 35^\circ$   
 and  $\angle 8 = \angle 4 = 145^\circ$   
 (ii) Since :  $\angle 2 = \angle 4$  [Vertically opposite angles]  
 and  $\angle 2 + \angle 4 = 210^\circ$   
 We get  $\angle 2 + \angle 2 = 210^\circ$  [  $2\angle 2 = 210^\circ$  ]  
 $\Rightarrow \angle 2 = 105^\circ$   
 $\Rightarrow \angle 4 = \angle 2 = 105^\circ$   
 $\Rightarrow \angle 1 = 180^\circ - \angle 2$   
 $\angle 1 = 180^\circ - \angle 2 = 180^\circ - 105^\circ = 75^\circ$   
 $\angle 3 = \angle 1 = 75^\circ$  [Vertically opposite angles]

By the corresponding angles axiom.

$\angle 5 = \angle 1 = 75^\circ$ ,  $\angle 6 = \angle 2 = 105^\circ$   
 $\angle 7 = \angle 3 = 75^\circ$ , and  $\angle 8 = \angle 4 = 105^\circ$

**Line parallel to the same line :**

We now prove a result which shows that if two lines are parallel to the same line. They are parallel to each other.

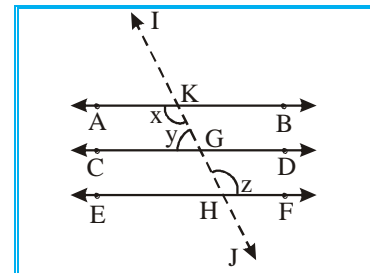


**Theorem 6.6 :** Lines which are parallel to the same line are parallel to each other.

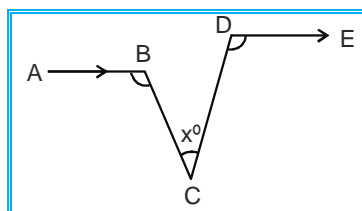
**Illustration 4 :**  $AB \parallel CD$ ,  $CD \parallel EF$  and  $y : z = 3 : 7$ , find  $x$ .

**Solution :**

$\angle CGH = \angle GHF = z$  [Alternate angles]  
 $\angle AKG = \angle CGH$  (Corresponding angles)  
 or  $x = z$   
 Also,  $\angle CGK + \angle CGH = 180^\circ$  [linear Pair]  
 $y + z = 180^\circ$   
 Let,  $y = 3m$ ,  $z = 7m$   
 $3m + 7m = 180^\circ \Rightarrow 10m = 180^\circ$   
 $\Rightarrow m = 18^\circ$   
 $y = 3 \times 18^\circ = 54^\circ$   
 $z = 7 \times 18^\circ = 126^\circ$   
 $\Rightarrow x = z = 126^\circ$

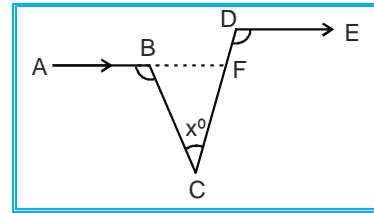


**Illustration 5 :** In the adjoining figure,  $\angle ABC = 100^\circ$ ,  $\angle EDC = 120^\circ$  and  $AB \parallel DE$ . Then, find  $\angle BCD$



**Solution :** Produce AB to meet CD at F.

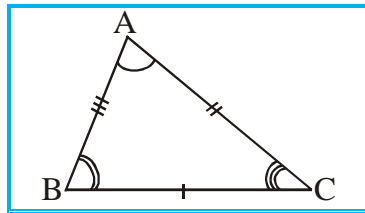
$$\begin{aligned} \Rightarrow \quad \angle BFD &= \angle EDF = 120^\circ && [\text{alternate interior } \angle \text{s}] \\ \Rightarrow \quad \angle BFC &= (180^\circ - 120^\circ) = 60^\circ \\ \Rightarrow \quad \angle CBF &= (180^\circ - 100^\circ) = 80^\circ \\ \therefore \quad \angle BCF &= 180^\circ - (60^\circ + 80^\circ) = 40^\circ. \end{aligned}$$



## 5. Triangle

Triangle is a three sided closed polygon.

**Six Elements of a Triangle :** Three sides BC, CA and AB. Three Angles  $\angle A$ ,  $\angle B$  and  $\angle C$ .



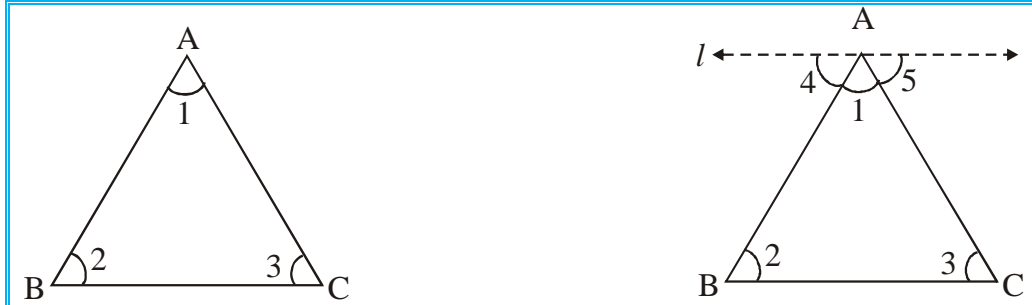
### 5.1 Classification of Triangles

On the Basis of Sides	On the Basis of Angles
<p><b>(i) Scalene :</b> No two sides equal, all angles different.  <math>BC \neq CA</math>  <math>CA \neq AB</math>  <math>AB \neq BC</math>  <math>\angle A \neq \angle B \neq \angle C</math></p>	<p><b>(i) Acute Triangle :</b> A triangle each of whose angles is acute is an acute-angled triangle or acute triangle.  <math>\angle A, \angle B, \angle C &lt; 90^\circ</math></p>
<p><b>(ii) Isosceles Triangle:</b> Two sides equal, angles opposite to equal sides equal.</p>	<p><b>(ii) Right Triangle:</b> A triangle with one angle as a right angle is a right angle triangle or right triangle.</p>
<p><b>(iii) Equilateral Triangle :</b> All the three sides equal. Triangle is equiangular.</p>	<p><b>(iii) Obtuse Triangle :</b> A triangle with one angle as an obtuse angle is termed as an obtuse angled triangle or simply an obtuse triangle.</p>

**5.2 Relation Between the Angles of a Triangle**

**Theorem 6.7 :** The sum of the three angles of a triangles is  $180^\circ$ . This is called the angle sum property of triangle.

Given : A triangle ABC



To Prove :  $\angle A + \angle B + \angle C = 180^\circ$  i.e.  $\angle 1 + \angle 2 + \angle 3 = 180^\circ$

Construction : Through A, draw a line l parallel to BC.

Proof : Since  $l \parallel BC$

$\angle 2 = \angle 4$  .....(i) [Alternate interior angles]

and  $\angle 3 = \angle 5$  .....(ii) [Alternate interior angles]

Adding (i) and (ii) we get :

$\angle 2 + \angle 3 = \angle 4 + \angle 5$

$\Rightarrow \angle 1 + \angle 2 + \angle 3 = \angle 1 + \angle 4 + \angle 5$  [Adding  $\angle 1$  to both the sides]

$\Rightarrow \angle 1 + \angle 2 + \angle 3 = \angle 4 + \angle 1 + \angle 5$

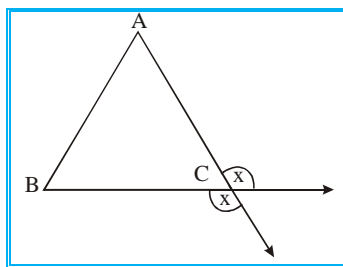
$\Rightarrow \angle 1 + \angle 2 + \angle 3 = 180^\circ$  [ sum of angles at a point on a line is  $180^\circ$ ]

That is  $\angle A + \angle B + \angle C = 180^\circ$

Thus, the sum of the three angles of a triangle is  $180^\circ$ .

**Exterior Angle of a Triangle :**

In fig.  $\angle ACB$  is called the **interior angle** C. Either of the angles marked x (they are equal, vertically opposite) is called the corresponding exterior angle.

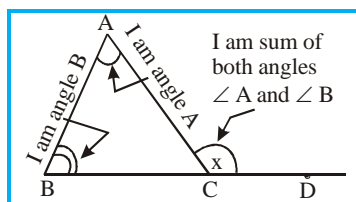


Angles A and B are called the remote interior angles or interior opposite angles of the angle x.

**Theorem 6.8 :** (Exterior Angle Theorem) : If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.

**Corollary :**  $\angle ACD > \angle A$  and  $\angle ACD > \angle B$

Thus, an exterior angle of a triangle is greater than either of the interior opposite angles.



**Illustration 6 :** One of the angles of a triangle is  $65^\circ$ . Find the remaining two angles, if their difference is  $25^\circ$ .

**Solution :** Let  $\angle A = 65^\circ$  and two other angles be  $x$  and  $y$ .  
Then we are given that  $x - y = 25^\circ$  .....(1)

we know that :

$$\angle A + \angle B + \angle C = 180^\circ$$

$$\text{or } 65^\circ + x + y = 180^\circ$$

$$x + y = 115^\circ \quad \text{.....(2)}$$

Adding (1) and (2), we get :

$$2x = 140^\circ \Rightarrow x = 70^\circ$$

From (2), we get,  $y = 115^\circ - x = 115^\circ - 70^\circ = 45^\circ$

Thus the remaining two angles of the triangle are  $70^\circ$  and  $45^\circ$ .

**Illustration 7 :** In  $\triangle ABC$ ,  $AD$  is the bisector of  $\angle BAC$  and  $AD = DC$ . If  $\angle BDA = 70^\circ$ , find  $\angle A$ ,  $\angle B$  and  $\angle C$ .

**Solution :** In  $\triangle DAC$   
 $DA = DC \Rightarrow \triangle DAC$  is an isosceles triangle.

$$\therefore \angle DAC = \angle DCA = x \text{ (say)}$$

$$\text{Also, } \angle ADB = \angle DAC + \angle DCA = x + x = 2x$$

[Exterior angle is equal to sum of the two opposite interior angles]

$$\Rightarrow 70^\circ = 2x$$

$$\Rightarrow x = 35^\circ$$

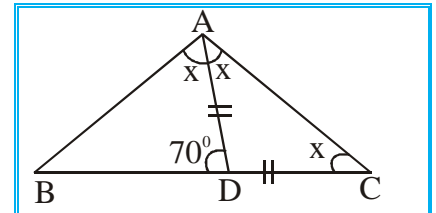
Next, as  $AD$  is the bisector of  $\angle BAC$ ,

$$\angle BAD = \angle DAC = x = 35^\circ$$

$$\text{Thus, } \angle A = \angle BAD + \angle DAC \Rightarrow 35^\circ + 35^\circ = 70^\circ$$

$$\therefore \angle A = 70^\circ, \angle C = 35^\circ$$

$$\text{and } \angle B = 180^\circ - \angle A - \angle C \Rightarrow 180^\circ - 70^\circ - 35^\circ = 75^\circ$$



**Illustration 8 :** In figure,  $TQ$  and  $TR$  are the bisectors of  $\angle Q$  and  $\angle R$  respectively. If  $\angle QPR = 80^\circ$  and  $\angle PRT = 30^\circ$ , determine  $\angle TQR$  and  $\angle QTR$ .

**Solution :** Since the bisectors of  $\angle Q$  and  $\angle R$  meet at  $T$ .

$$\therefore \angle QTR = 90^\circ + \frac{1}{2} \angle QPR$$

$$\Rightarrow \angle QTR = 90^\circ + \frac{1}{2} (80^\circ)$$

$$\Rightarrow \angle QTR = 90^\circ + 40^\circ = 130^\circ$$

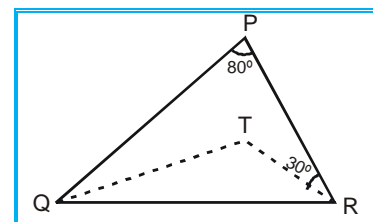
In  $\triangle QTR$ , we have

$$\angle TQR + \angle QTR + \angle TRQ = 180^\circ$$

$$\Rightarrow \angle TQR + 130^\circ + 30^\circ = 180^\circ \quad [\angle TRQ = \angle PRT = 30^\circ]$$

$$\Rightarrow \angle TQR = 20^\circ$$

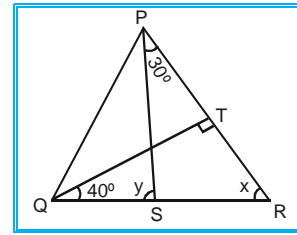
Thus,  $\angle TQR = 20^\circ$  and  $\angle QTR = 130^\circ$ .



**Illustration 9 :** In figure , If  $QT \perp PR$ ,  $\angle TQR = 40^\circ$  and  $\angle SPR = 30^\circ$ , find  $x$  and  $y$ .

**Solution :**

In  $\triangle TQR$   
 $\angle TQR + \angle QTR + \angle TRQ = 180^\circ$   
 $\Rightarrow 40^\circ + 90^\circ + \angle TRQ = 180^\circ$   
 $\Rightarrow \angle TRQ = 180^\circ - 130^\circ = 50^\circ$   
 $\Rightarrow x = 50^\circ$   
 In  $\triangle PSR$ , using exterior angle property, we have  
 $\angle PSQ = \angle PRS + \angle RPS$   
 $\Rightarrow y = x + 30^\circ$   
 $\Rightarrow y = 50^\circ + 30^\circ = 80^\circ$ .



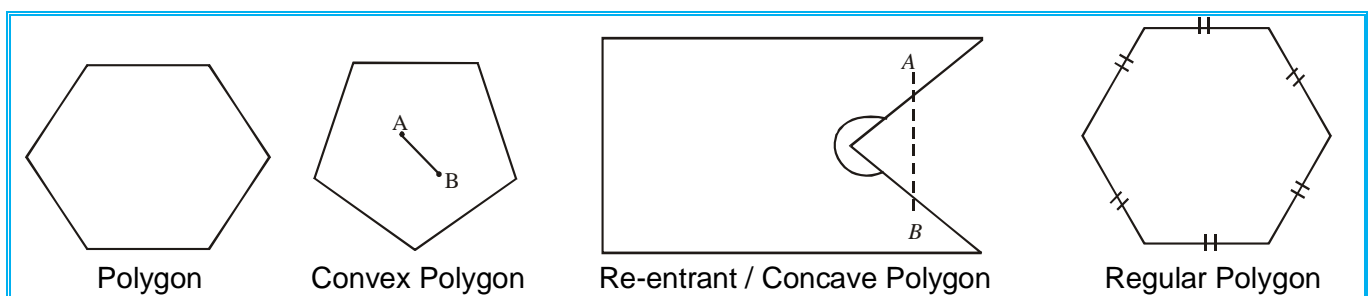
**Illustration 10 :** The side BC of a  $\triangle ABC$  is produced, such that D is on ray BC. The bisector of  $\angle A$  meets BC in L as shown in figure. Prove that  $\angle ABC + \angle ACD = 2\angle ALC$ .

**Solution :**

In  $\triangle ABC$ , we have  
 ext.  $\angle ACD = \angle B + \angle A$   
 $\Rightarrow$  ext.  $\angle ACD = \angle B + 2\angle 1$  ... (i)  
 [ $\because$  AL is the bisector of  $\angle A \therefore \angle A = 2\angle 1$ ]  
 $\Rightarrow \angle ACD = \angle B + 2\angle 1$   
 In  $\triangle ABL$ , we have  
 ext.  $\angle ALC = \angle B + \angle BAL$   
 $\Rightarrow$  ext.  $\angle ALC = \angle B + \angle 1$   
 $\Rightarrow 2\angle ALC = 2\angle B + 2\angle 1$  ... (ii) [Multiplying both sides by 2]  
 Subtracting (i) from (ii), we get  
 $2\angle ALC - \angle ACD = \angle B$   
 $\Rightarrow \angle ACD + \angle B = 2\angle ALC$   
 $\Rightarrow \angle ACD + \angle ABC = 2\angle ALC$ .

## 6. The Polygon

Any plane closed figure bounded by straight lines is called a **polygon**.



A **convex polygon** is one in which no interior angle is greater than  $180^\circ$ .

If we take any two points in the interior of a convex polygon, the segment joining these two points lies completely in the interior.

A **re-entrant / concave polygon** is one in which at least one angle is greater than  $180^\circ$ . If we take two points in the interior of a re-entrant polygon, the segment joining these points may not lie completely in the region.

A **regular polygon** has all its sides equal and all its angles equal.

A **quadrilateral** is a polygon of 4 sides.

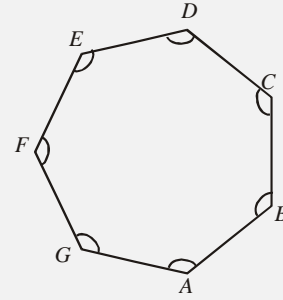
A **pentagon** is a polygon of 5 sides.

A **hexagon** is a polygon of 6 sides.

An **octagon** is a polygon of 8 sides.

**Theorem 6.9 :** In a convex polygon of  $n$  sides, the sum of the interior angles is  $(2n-4)$  right angles.

That is  $\angle A + \angle B + \angle C + \dots$   
 $= (2n - 4) \times 90^\circ$ .



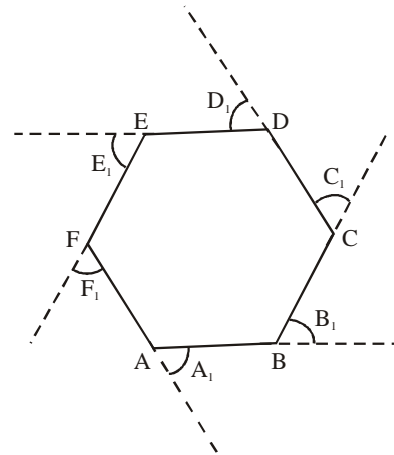
**Corollary 1 :** Each interior angle of a regular polygon of  $n$  sides  $= \left(\frac{2n-4}{n}\right)$  right angles.

For example, Each angle of a regular pentagon is  $\left(\frac{2 \times 5 - 4}{5}\right) \times 90^\circ = 108^\circ$  and

Each angle of a regular hexagon is :  
 $\left(\frac{2 \times 6 - 4}{6}\right) \times 90^\circ = 120^\circ$

**Corollary 2 :** If the sides of a convex polygon are produced in order (clockwise or anticlockwise) the sum of the exterior angles is 4 right angles. That is :

$$\angle A_1 + \angle B_1 + \angle C_1 + \dots = 4 \times 90^\circ = 360^\circ$$



**Corollary 3 :** Each exterior angle of a regular polygon of  $n$  side is  $\left(\frac{360^\circ}{n}\right)$ .

**Corollary 4 :** If each exterior angle of a regular polygon is  $x^\circ$ , then the number of sides of the polygon  $= \frac{360^\circ}{x^\circ}$ .

**Corollary 5 :** If each interior angle of a regular polygon is  $y^\circ$ , then the number of sides of the polygon is  $\frac{360}{180 - y}$ .

For example, if each interior angle of a regular polygon is  $170^\circ$ , then the number of sides of the polygon is  $\frac{360}{180 - 170} = \frac{360}{10} = 36$

**Illustration 11 :** Two regular polygons are such that the ratio of the measures their interior angles is 4 : 3 and the ratio between their number of sides is 2 : 1. Find the number of sides of each polygon.

**Solution :** Let  $2n$  and  $n$  be the number of sides of the regular polygons.

$\therefore$  Their interior angles are  $\left[\frac{2(2n)-4}{2n} \times 90\right]^\circ$  and  $\left[\frac{2n-4}{n} \times 90\right]^\circ$

Since the ratio of the interior angles is 4 : 3

$$\begin{aligned} \therefore \frac{\left[ \frac{2(2n)-4}{2n} \times 90 \right]}{\left[ \frac{(2n-4)}{n} \times 90 \right]} &= \frac{4}{3} \Rightarrow \frac{n}{2n} \times \frac{[2(2n)-4]}{[2n-4]} = \frac{4}{3} \\ \Rightarrow \frac{n-1}{n-2} &= \frac{4}{3} \Rightarrow \frac{1}{2} \times \frac{4(n-1)}{2(n-2)} = \frac{4}{3} \\ \Rightarrow \frac{n-1}{n-2} &= \frac{4}{3} \Rightarrow 3(n-1) = 4(n-2) \\ \Rightarrow 3n-3 &= 4n-8 \Rightarrow 3n-4n = -8+3 \\ \Rightarrow -n &= -5 \Rightarrow n = 5 \\ \therefore 2n &= 2 \times 5 = 10 \end{aligned}$$

Thus the number of sides of the polygons are 10 and 5 respectively.

**Illustration 12 :** The exterior angle of a regular polygon is one-fifth of its interior angle. How many sides has the polygon?

**Solution :** Let the angle of the polygon 'n'.

$$\therefore \text{Exterior angle of the polygon} = \left[ \frac{360}{n} \right]^\circ$$

$$\text{And interior angle of the polygon} = \left[ \frac{2n-4}{n} \times 90^\circ \right]$$

$$\text{Since, Exterior angle} = \frac{1}{5} [\text{Interior angle}]$$

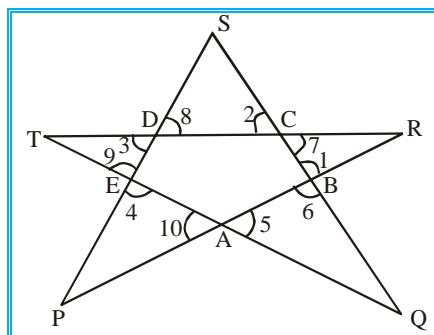
$$\Rightarrow \frac{360}{n} = \frac{1}{5} \left[ \frac{2n-4}{n} \times 90^\circ \right] \Rightarrow \frac{360}{n} = \frac{2n-4}{n} \times 18$$

$$\Rightarrow \frac{1}{n} \times \frac{n}{2n-4} = \frac{18}{360} \Rightarrow 2n-4 = 20$$

$$\Rightarrow 2n = 20 + 4 = 24 \Rightarrow n = \frac{24}{2} = 12$$

Thus, the polygon is having 12 sides.

**Illustration 13 :** In fig. find the value of  $\angle P + \angle Q + \angle R + \angle S + \angle T$ .



**Solution :** As ABCDE is a pentagon, sum of the exterior angles =  $360^\circ$ .

$$\text{i.e. } \angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 = 360^\circ \quad \dots(i)$$

$$\text{But } \angle 1 = \angle 6, \angle 2 = \angle 7, \angle 3 = \angle 8, \angle 4 = \angle 9$$

and  $\angle 5 = \angle 10$  [Vertically opposite angles]

Thus  $\angle 6 + \angle 7 + \angle 8 + \angle 9 + \angle 10 = 360^\circ$  .....(ii)

[ $\because$  Sum of the exterior angles of a polygon is  $360^\circ$ ]

From  $\triangle PAE$ ,  $\triangle QAB$ ,  $\triangle RBC$ ,  $\triangle SDC$  and  $\triangle TDE$

$(\angle P + \angle 4 + \angle 10) + (\angle Q + \angle 5 + \angle 6) + (\angle R + \angle 1 + \angle 7) + (\angle S + \angle 2 + \angle 8) + (\angle T + \angle 9 + \angle 3)$

$= 5 \times 180^\circ$

$= 900^\circ$  .....(iii)

$(\angle P + \angle Q + \angle R + \angle S + \angle T) + (\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5) + (\angle 6 + \angle 7 + \angle 8 + \angle 9 + \angle 10)$

$= 900^\circ$  [Rearranging the terms]

or  $(\angle P + \angle Q + \angle R + \angle S + \angle T) + 360^\circ + 360^\circ = 900^\circ$  [From (i), (ii) & (iii)]

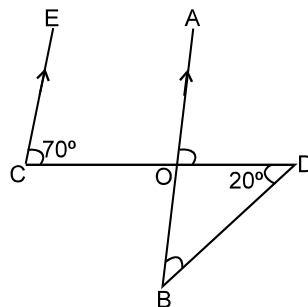
or  $\angle P + \angle Q + \angle R + \angle S + \angle T = 900^\circ - 2 \times 360^\circ$

or  $\angle P + \angle Q + \angle R + \angle S + \angle T = 900^\circ - 720^\circ$

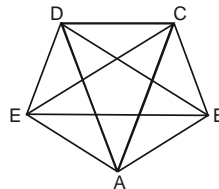
or  $\angle P + \angle Q + \angle R + \angle S + \angle T = 180^\circ$

## DPP-1

1. Two complementary angles are such that two times the measure of one is equal to three times measure of the other. Then the measure of the larger angle is :  
(a)  $36^\circ$                       (b)  $45^\circ$                       (c)  $40^\circ$                       (d)  $54^\circ$
2. In the given figure, if  $EC \parallel AB$ ,  $\angle ECD = 70^\circ$  and  $\angle BDO = 20^\circ$ , then find  $\angle OBD$ .



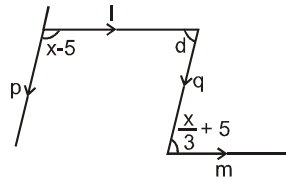
- (a)  $20^\circ$                       (b)  $50^\circ$                       (c)  $60^\circ$                       (d)  $70^\circ$
3. ABCDE is a regular pentagon. A star of five points ACEBDA is formed to join their alternate vertices. The sum of all five vertex angles of this star is :



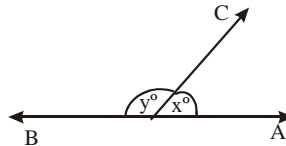
- (a) Two right angle                      (b) Three right angle  
(c) Four right angle                      (d) Five right angle
4. All linear pairs are :  
(a) Supplementary                      (b) Vertically opposite  
(c) Right angles                      (d) None of these
  5. At 3 O' clock, the angle formed between the hands of a clock is :  
(a) Reflex angle                      (b) Straight angle  
(c) Acute angle                      (d) Right angle

**DPP-2**

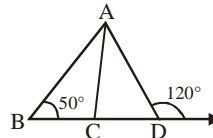
1. In the given figure lines p and q are parallel. Find value of x so that lines l and m be parallel.



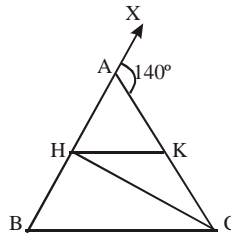
- (a)  $45^\circ$                       (b)  $100^\circ$                       (c)  $135^\circ$                       (d)  $60^\circ$
2. In the given figure,  $\angle x$  is greater than one fifth of a right angle, then:



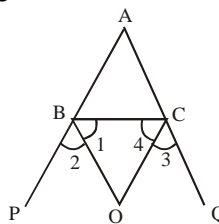
- (a)  $y > 162^\circ$                       (b)  $y \geq 162^\circ$                       (c)  $y \leq 162^\circ$                       (d)  $y < 162^\circ$
3. In figure AC bisects  $\angle BAD$ . What type of triangle is  $\triangle ACB$ ?



- (a) Acute angle triangle                      (b) Right angled triangle  
(c) Obtuse angled triangle                      (d) Reflex Triangle
4. In the figure  $AB = AC$ ,  $CH = CB$  and  $HK \parallel BC$ . If the exterior angle  $CAX$  is  $140^\circ$  then the angle  $HCK$  is



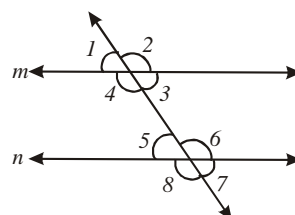
- (a)  $45^\circ$                       (b)  $30^\circ$                       (c)  $50^\circ$                       (d)  $40^\circ$
5. In the adjoining figure BO, CO are angle bisectors of external angles of  $\triangle ABC$ . Then  $\angle BOC$  is :



- (a)  $90 - \frac{1}{2} \angle A$                       (b)  $90 + \frac{1}{2} \angle A$                       (c)  $180 - \frac{1}{2} \angle A$                       (d)  $180 + \frac{1}{2} \angle A$

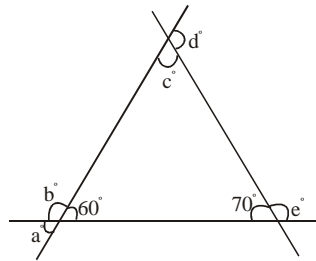
**DPP-3**

1. From the adjoining figure, if  $\angle 2 = 55^\circ$  and  $\angle 5 = 60^\circ$  then the lines m and n are.

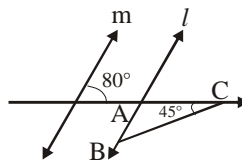


- (a) parallel                      (b) not parallel                      (c) cannot say                      (d) none of these

2. If X is a point on the line AB and Y, Z are points outside such that  $\angle AXY = 45^\circ$  and  $\angle YXZ = 60^\circ$  then  $\angle AXZ$  is equal to :  
 (a)  $120^\circ$  (b)  $135^\circ$  (c)  $150^\circ$  (d)  $105^\circ$
3. In the figure given below, which of the following is the correct inequality?



- (a)  $c^\circ < a^\circ < e^\circ < b^\circ < d^\circ$  (b)  $c^\circ < a^\circ < b^\circ < d^\circ < e^\circ$   
 (c)  $a^\circ < c^\circ < e^\circ < b^\circ < d^\circ$  (d)  $c^\circ < a^\circ < d^\circ < b^\circ < e^\circ$
4. In figure  $l \parallel m$ , then  $\angle ABC$  will be

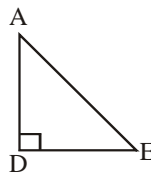


- (a)  $45^\circ$  (b)  $30^\circ$  (c)  $35^\circ$  (d)  $125^\circ$
5. What is the measure of each angle of a regular hexagon?  
 (a)  $120^\circ$  (b)  $60^\circ$  (c)  $80^\circ$  (d)  $160^\circ$

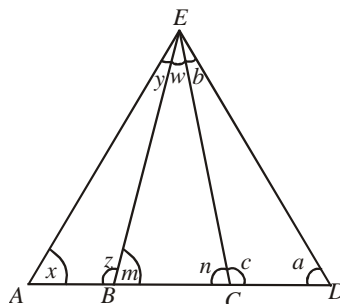
## DPP-4

**Multiple choice question with one or more than one correct answers :**

1. For triangle ADE as shown in figure, which of the following angle relation is/are correct:

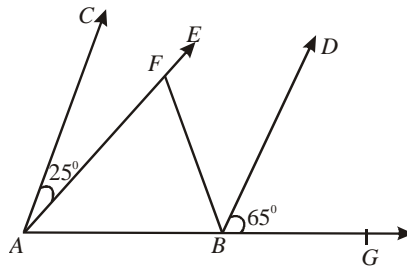


- (a) Of the twelve angle formed at the three vertices by adjoining lines, four are acute, four obtuse and four right angles.  
 (b) The mean measure of the above twelve angles is  $90^\circ$ .  
 (c) The measure of the above twelve angles will generally have three or five distinct value.  
 (d) Of the twelve angles formed, the greatest angle formed is right angle.
2. For triangle ADE as shown in figure, which of the following angle relation is/are correct?

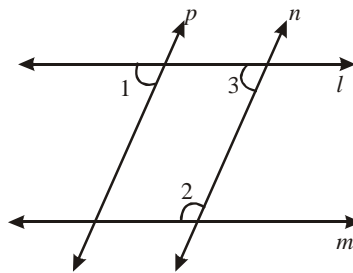


- (a)  $x + y + n = a + b + m$  (b)  $x + z + n = w + c + m$   
 (c)  $x + y = m$  (d)  $y + z = a + b$

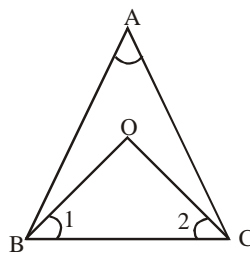
3. Which of the following statements relating to 3 lines  $L_1$ ,  $L_2$  and  $L_3$  in the same plane is correct.
- (a) If  $L_2$  and  $L_3$  are both parallel to  $L_1$ , then they are parallel to each other.  
 (b) If acute angle between  $L_1$  and  $L_2$  is equal to the acute angle between  $L_1$  &  $L_3$ , then  $L_2$  is parallel to  $L_3$   
 (c) If  $L_2$  and  $L_3$  are both perpendicular to  $L_1$  then they are parallel to each other.  
 (d) If perpendicular distance between  $L_1$  and  $L_3$  is equal to perpendicular distance between  $L_1$  and  $L_2$ , then  $L_1$ ,  $L_2$  and  $L_3$  are parallel to each other.
4. In the given figure,  $AC \parallel BD$ ,  $\angle CAF = 25^\circ$ ,  $\angle DBG = 65^\circ$  and  $BF = BA$ . Then which of the following statements is correct :



- (a)  $\angle FBD = 15^\circ$  (b)  $\angle FAB = \angle BCA$   
 (c)  $\angle BFE = 140^\circ$  (d)  $\angle FBG = 80^\circ$
5. In the given figure,  $\ell \parallel m$  and  $p \parallel n$ , if  $\angle 1 = 75^\circ$ , then.



- (a)  $\angle 2 = \angle 1 + 1/3$  (of a right angle)  
 (b)  $\angle 1$  and  $\angle 3$  form a pair of corresponding angles.  
 (c)  $\angle 2$  and  $\angle 3$  form a pair of alternate angle.  
 (d)  $\angle 2$  and  $\angle 3$  form a pair of cointerior angles.
6. In the given figure,  $BO$  and  $CO$  are respectively the bisectors of  $\angle ABC$  and  $\angle ACB$ , then  $\angle BOC$  is equal to



- (a)  $90 - \frac{1}{2} \angle A$  (b)  $180 - \angle 1 + \angle 2$  (c)  $90 + \frac{1}{2} \angle A$  (d)  $180 - (\angle 1 + \angle 2)$
7. A triangle can have at most \_\_\_\_\_ obtuse angles.  
 (a) one (b) two (c) three (d) none
8. If the angles of a triangle are  $(x - 40)^\circ$ ,  $(x - 20)^\circ$  and  $\left(\frac{1}{2}x - 10\right)^\circ$ , then the smallest angle is  
 (a)  $(x - 40)^\circ$  (b)  $\left(\frac{1}{2}x - 10^\circ\right)$  (c)  $(x - 40)^\circ$  (d)  $(180 - x)^\circ$

**NCERT Basics**

**Exercise-1**

**Exercise 6.1**

1. In Fig. 6.13, lines AB and CD intersect at O. If  $\angle AOC + \angle BOE = 70^\circ$  and  $\angle BOD = 40^\circ$ , find  $\angle BOE$  and reflex  $\angle COE$ .

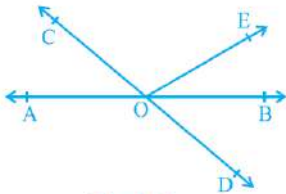


Fig. 6.13

2. In Fig. 6.14, lines XY and MN intersect at O. If  $\angle POY = 90^\circ$  and  $a : b = 2 : 3$ , find c.

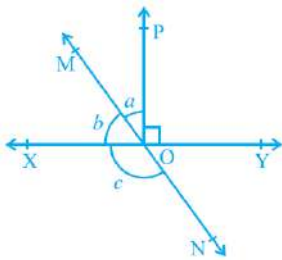


Fig. 6.14

3. In Fig. 6.15,  $\angle PQR = \angle PRQ$ , then prove that  $\angle PQS = \angle PRT$ .

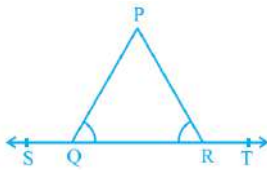


Fig. 6.15

4. In Fig. 6.16, if  $x + y = w + z$ , then prove that AOB is a line.

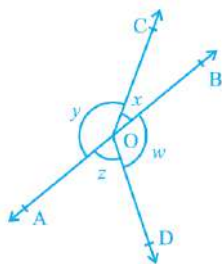


Fig. 6.16

5. In Fig. 6.17, POQ is a line. Ray OR is perpendicular to line PQ. OS is another ray lying between rays OP and OR. Prove that  $\angle ROS = \frac{1}{2} (\angle QOS - \angle POS)$ .

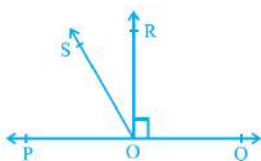


Fig. 6.17

6. It is given that  $\angle XYZ = 64^\circ$  and XY is produced to point P. Draw a figure from the given information. If ray YQ bisects  $\angle ZYP$ , find  $\angle XYQ$  and reflex  $\angle QYP$ .

**Exercise 6.2**

1. In Fig. 6.23, if  $AB \parallel CD$ ,  $CD \parallel EF$  and  $y : z = 3 : 7$ , find  $x$ .

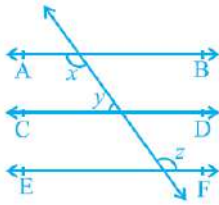


Fig. 6.23

2. In Fig. 6.24, if  $AB \parallel CD$ ,  $EF \perp CD$  and  $\angle GED = 126^\circ$ , find  $\angle AGE$ ,  $\angle GEF$  and  $\angle FGE$ .

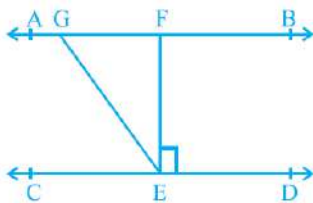


Fig. 6.24

3. In Fig. 6.25, if  $PQ \parallel ST$ ,  $\angle PQR = 110^\circ$  and  $\angle RST = 130^\circ$ , find  $\angle QRS$ .  
[Hint : Draw a line parallel to  $ST$  through point  $R$ .]

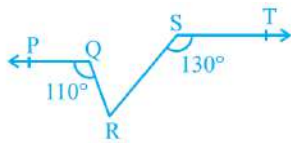


Fig. 6.25

4. In Fig. 6.26, if  $AB \parallel CD$ ,  $\angle APQ = 50^\circ$  and  $\angle PRD = 127^\circ$ , find  $x$  and  $y$ .

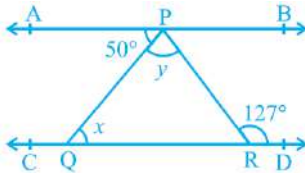


Fig. 6.26

5. In Fig. 6.27,  $PQ$  and  $RS$  are two mirrors placed parallel to each other. An incident ray  $AB$  strikes the mirror  $PQ$  at  $B$ , the reflected ray moves along the path  $BC$  and strikes the mirror  $RS$  at  $C$  and again reflects back along  $CD$ . Prove that  $AB \parallel CD$ .

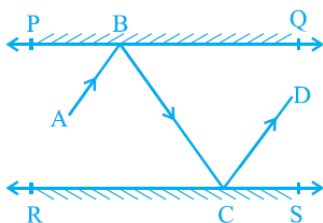


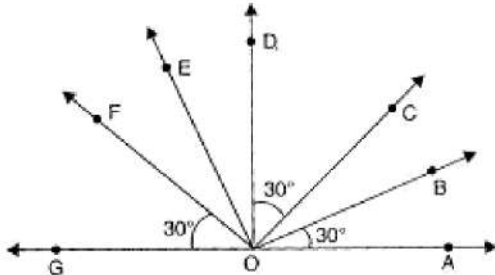
Fig. 6.27

## Concept Mastery

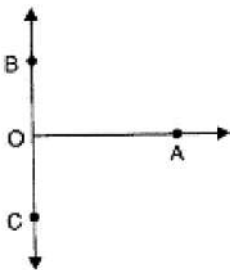
## Exercise-2

### A. Very Short Answer Type Questions

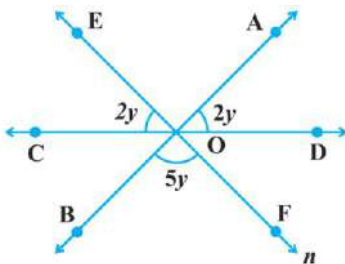
- An angle is  $14^\circ$  more than its complementary angle. What is its measure?
- Two supplementary angles are in the ratio 3 : 2. Find the angles.
- Find the measure of the complementary angle of  $72^\circ$ .
- Find the measure of the supplementary angle of  $125^\circ$ .
- In figure,  $\angle AOF$  and  $\angle FOG$  form a linear pair,  $\angle EOB = \angle FOC = 90^\circ$  and  $\angle DOC = \angle FOG = \angle AOB = 30^\circ$ . Name three pairs of adjacent supplementary angles.



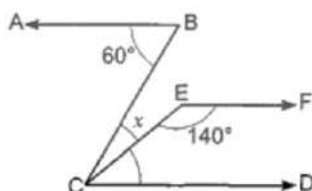
- $\angle AOC$  and  $\angle AOB$  are right angles, show that BOC is a line.



- Two supplementary angles differ by  $48^\circ$ . Find the angles.
- Find the angle which is five times its supplement.
- In the figure, AB, CD and EF are three lines concurrent at O. Find the value of y.



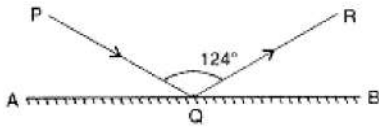
- In Fig., find x if  $AB \parallel CD \parallel EF$ .



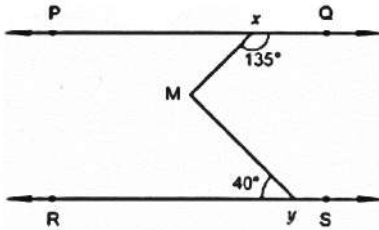
### B. Short Answer Type Questions

- It is given that  $\angle XYZ = 64^\circ$  and XY is produced to point P. Draw a figure from the given information. If ray YQ bisects  $\angle ZYP$ , find  $\angle XYQ$  and reflex  $\angle QYP$ .
- If two straight lines intersect each other in such a way that one of the angles formed measures  $90^\circ$ , show that each of the remaining angles measures  $90^\circ$ .

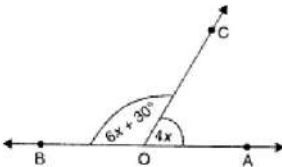
13. In the following figure, PQ is an incident ray and QR is the reflected ray. If  $\angle PQR = 124^\circ$ , then find  $\angle RQB$ .



14. AB, CD and EF are three concurrent lines passing through the point O such that OF bisects  $\angle BOD$ . If  $\angle BOF = 35^\circ$ . Find  $\angle BOC$  and  $\angle AOD$ .
15. In Fig., if  $PQ \parallel RS$ ,  $\angle MXQ = 135^\circ$  and  $\angle MYR = 40^\circ$ , find  $\angle XMY$ .



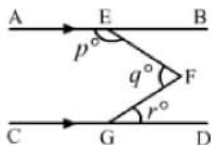
16. What value of  $x$  would make AOB a line in figure, If  $\angle AOC = 4x$  and  $\angle BOC = 6x + 30^\circ$ ?



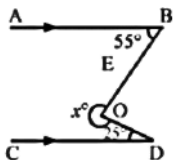
17. Write the supplement of the angle:  $132^\circ$ .
18. If an angle is  $30^\circ$  more than one half of its complement, find the measure of the angle.
19. Find the angle whose complement is one third of its supplement.

### C. Long Answer Type Questions

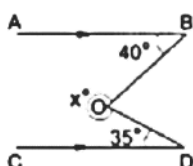
20. In the given figure,  $AB \parallel CD$ . Prove that  $p + q - r = 180$ .



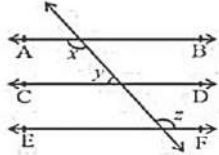
21. Prove that if the arms of an angle are respectively perpendicular to the arms of another angle, then the angles are either equal or supplementary.
22. In each of the figures given below,  $AB \parallel CD$ . Find the value of  $x$ .



23. In the given figure,  $AB \parallel CD$ ,  $\angle ABO = 40^\circ$ ,  $\angle CDO = 35^\circ$ . Find the value of the reflex  $\angle BOD$  and hence the value of  $x$ .



24. In the given figure, if  $AB \parallel CD$ ,  $CD \parallel EF$  and  $y : z = 3 : 7$ , find  $x$ .



**D. True & False**

25. (a) Acute angle is the angle whose measure is more than  $180^\circ$  but less than  $360^\circ$ .  
 (b) The measure of the angle which is the complement of itself is  $45^\circ$ .  
 (c) If two supplementary angles are in the ratio  $13 : 5$ , then the angles are  $120^\circ$  and  $50^\circ$ .  
 (d) Adjacent angles have a common vertex.  
 (e) Two lines perpendicular to the same line are perpendicular to each other.  
 (f) If two lines intersect each other, then the vertically opposite angles are not equal.  
 (g) An angle whose measure is more than  $180^\circ$  but less than  $360^\circ$  is an acute angle.  
 (h) Lines which are parallel to the same line, are not parallel to each other.

**E. Fill in the Blanks**

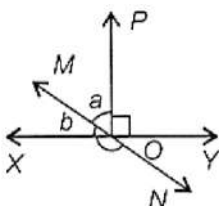
26. (a) If an angle is such that six times its complement is  $12^\circ$  less than twice its supplement, then the value of the angle is \_\_\_\_\_ degrees.  
 (b) A ray has only \_\_\_\_\_ end point.  
 (c) A line segment has \_\_\_\_\_ end points.  
 (d) If the ratio between two complementary angles are  $2 : 3$ , then the angles are \_\_\_\_\_ degrees and \_\_\_\_\_ degrees.  
 (e) An equation of the type \_\_\_\_\_ represents a straight line passing through the origin.  
 (f) The figure formed by two rays with the same initial point, is called an \_\_\_\_\_.  
 (g) The supplement of a right angle is \_\_\_\_\_ degree.  
 (h) A line has \_\_\_\_\_ end point.

**Accuracy Booster**

**Exercise-3**

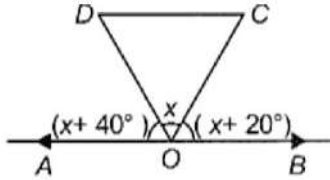
**A. Multiple Choice Questions**

1. If two angles are complements of each other then each angle is  
 (a) a reflex angle (b) an acute angle  
 (c) a straight angle (d) an obtuse angle
2. In the given figure (not drawn to scale), lines  $XY$  and  $MN$  intersect at  $O$ . If  $\angle POY = 90^\circ$  and  $a : b = 2 : 3$ , then  $\angle XON$  is equal to \_\_\_\_\_.

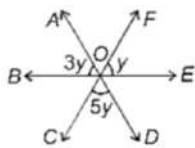


- (a)  $180^\circ$  (b)  $126^\circ$   
 (c)  $130^\circ$  (d)  $90^\circ$

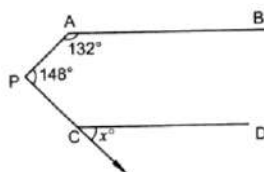
3. If one angle of a triangle is equal to the sum of the other two angles, then the triangle is  
 (a) an isosceles triangle (b) an equilateral triangle  
 (c) a right triangle (d) an obtuse angled triangle
4. In the given figure (not drawn to scale), if  $\triangle OCD$  is an isosceles triangle in which  $OD$  and  $OC$  are equal, then what will be the value of  $\angle OCD$ ?



- (a)  $50^\circ$  (b)  $65^\circ$   
 (c)  $45^\circ$  (d)  $70^\circ$
5. Two planes intersect each other to form a :  
 (a) point (b) plane  
 (c) angle (d) Straight line
6. If one of the angles of a triangle is  $130^\circ$ , then the angle between the bisectors of the other two angles can be  
 (a)  $50^\circ$  (b)  $155^\circ$   
 (c)  $145^\circ$  (d)  $65^\circ$
7. Two straight lines  $AB$  and  $CD$  intersect one another at the point  $O$ . If  $\angle AOC + \angle COB + \angle BOD = 274^\circ$ , then  $\angle AOD =$   
 (a)  $86^\circ$  (b)  $137^\circ$   
 (c)  $94^\circ$  (d)  $90^\circ$
8. The measure of an angle is five times its complement. The angle measures  
 (a)  $75^\circ$  (b)  $65^\circ$   
 (c)  $25^\circ$  (d)  $35^\circ$
9. Two complementary angles are such that two times the measure of one is equal to three times the measure of the other. The measure of the smaller angle is  
 (a)  $30^\circ$  (b) None of these  
 (c)  $36^\circ$  (d)  $45^\circ$
10. In the given figure (not drawn to scale), the value of  $y$  is \_\_\_\_\_.

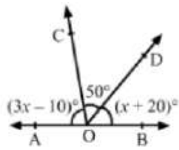


- (a)  $22^\circ$  (b)  $24^\circ$   
 (c)  $10^\circ$  (d)  $20^\circ$
11. In Fig. if  $AB \parallel CD$ , then  $x =$

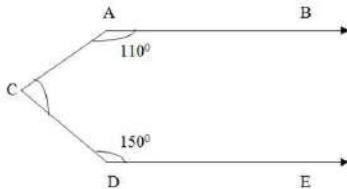


- (a)  $100^\circ$  (b)  $110^\circ$   
 (c)  $105^\circ$  (d)  $115^\circ$

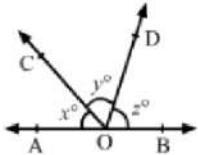
12. In the given figure, AOB is a straight line. If  $\angle AOC = (3x-10)^\circ$ ,  $\angle COD = 50^\circ$  and  $\angle BOD = (x+20)^\circ$  then  $\angle AOC = ?$



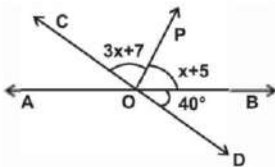
- (a)  $60^\circ$  (b)  $80^\circ$   
(c)  $40^\circ$  (d)  $50^\circ$
13. In the adjoining figure, if  $AB \parallel DE$ , then the measure of  $\angle ACD$  is :-



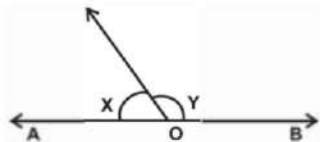
- (a)  $90^\circ$  (b)  $100$   
(c)  $80^\circ$  (d)  $70^\circ$
14. In the adjoining figure, AOB is a straight line. If  $x : y : z = 4 : 5 : 6$ , then  $y = ?$



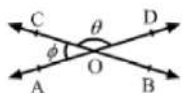
- (a)  $72^\circ$  (b)  $48^\circ$   
(c)  $60^\circ$  (d)  $80^\circ$
15. In the figure AB & CD are two straight lines intersecting at O, OP is a ray. What is the measure of  $\angle AOD$ .



- (a)  $128^\circ$  (b)  $40^\circ$   
(c)  $140^\circ$  (d)  $100^\circ$
16. In the figure, twice of  $x$  is  $30^\circ$  less than  $y$ , then the values of  $x$  &  $y$  respectively are? Given OB & OA are opposite rays.

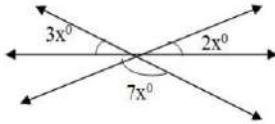


- (a)  $130^\circ, 50^\circ$  (b)  $100^\circ, 80^\circ$   
(c)  $50^\circ, 130^\circ$  (d)  $75^\circ, 105^\circ$
17. In the given figure, straight lines AB and CD intersect at O. If  $\angle AOC = \phi$ ,  $\angle BOC = \theta$  and  $\theta = 3\phi$ , then  $\phi = ?$



- (a)  $40^\circ$  (b)  $30^\circ$   
(c)  $45^\circ$  (d)  $60^\circ$

18. In the adjoining figure, the value of  $x$  is:



- (a)  $15^\circ$  (b)  $10^\circ$   
(c)  $12^\circ$  (d)  $18^\circ$

### B. Assertion & Reason Questions

19. **Assertion (A):** Two adjacent angles always form a linear pair.  
**Reason (R):** In a linear pair of angles two non-common arms are opposite rays.  
(a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.
20. **Assertion (A):** The bisectors of the angles of a linear pair at right angles.  
**Reason (R):** If the sum of two adjacent angles is  $180^\circ$ , then the non-common arms of the angles are in a straight line.  
(a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.
21. **Assertion (A):** If an angle formed by two intersecting lines is  $60^\circ$ , then its vertically opposite angle is  $60^\circ$ .  
**Reason (R):** If two lines intersect each other, then the vertically opposite angle is  $60^\circ$ .  
(a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.
22. **Assertion (A):** Sum of the pair of angles (like  $120^\circ$ ,  $60^\circ$ ) is supplementary.  
**Reason (R):** Two angles, the sum of whose measures is  $180^\circ$ , are called supplementary angles.  
(a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.
23. **Assertion (A):** If angles  $a$  and  $b$  form a linear pair of angles and  $a = 40^\circ$ , then  $b = 150^\circ$ .  
**Reason (R):** Sum of linear pair of angles is always  $180^\circ$ .  
(a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.

**C. Statement Type Questions**

24. Which of the following options is correct:

A pair of adjacent angles have.

- i. Common vertex
- ii. Common Arm.
- iii. Non Common arms are on opposite sides of common arms
- iv. Non Common arms are on the same side of common arms.

- (a) (i) & (ii) are sufficient
- (b) (i), (ii) & (iii) are sufficient
- (c) (i), (ii) & (iv) are sufficient
- (d) (i), (iii) & (iv) are sufficient

25. The incorrect statement is:

- A. Two lines drawn in a plane always intersect at a point.
- B. A line segment has definite length.
- C. Three lines are concurrent if and only if they have a common point.
- D. One and only one line can be drawn passing through a given point and parallel to a given line.

- (a) A
- (b) D
- (c) C
- (d) B

26. Which of the following statements is false?

- (a) Through a given point, only one straight line can be drawn.
- (b) Through two given points, it is possible to draw one and only one straight line.
- (c) Two straight lines can intersect only at one point.
- (d) A line segment can be produced to any desired length.

**D. Match the Column**

27. Match the following:

Column 1	Column 2
(a) Supplementary angles	(i) $30^\circ$ and $60^\circ$
(b) Complete angle	(ii) $90^\circ$
(c) Complementary angles	(iii) $85^\circ$ and $95^\circ$
(d) Right angle	(iv) $360^\circ$

28. Match the following:

Column 1	Column 2
(a) The measure of angle which is 52 less than its supplement is _____	(i) $30^\circ$
(b) Two supplementary angles are in the ratio of 1:5 the smaller angle is_____.	(ii) $135^\circ$
(c) Two supplementary angles are in the ratio of 1:5 the larger angle is_____.	(iii) $64^\circ$
(d) The supplementary of an angle is one-third of the given angle. Find the measure of the given angle	(iv) $150^\circ$

29. Match the following:

Column 1	Column 2
(a) If two lines lie in the same plane and do not intersect when produced on either side then such lines are called	(i) intersecting lines
(b) A straight line which cuts two or more straight lines at distinct points is called a	(ii) overlapping lines
(c) If two lines lie in the same plane and they intersect at unique point when produced on either side then such lines are called	(iii) parallel lines
(d) If two lines lie in the same plane and they intersect at infinite points when produced on either side then such lines are called	(iv) transversal

30. Match the following:

Column 1	Column 2
(a) Two angles are called adjacent angles, if	(i) adjacent angles
(b) Two adjacent angles are said to form a linear pair of angles, if their non-common arms are two	(ii) they have a common arm
(c) If a ray stands on a line then the sum of the adjacent angles so formed is	(iii) opposite rays
(d) The non-common arms are on either side of the common arms in case of	(iv) $2(90^\circ)$

31. Match the following:

Column 1	Column 2
(a) An angle which is greater than $90^\circ$ but less than $180^\circ$	(i) Right angle
(b) An angle which is greater than $180^\circ$ but less than $270^\circ$	(ii) Acute angle
(c) An angle which is greater than 0 but less than $90^\circ$	(iii) Obtuse angle
(d) An angle which is equal to $90^\circ$	(iv) Reflex angle

32. Match the following:

Column 1	Column 2
(a) An angle is one-fifth of its supplement, the angle is	(i) $55^\circ$
(b) An exterior angle of a triangle is 110 and its two interior angles are equal, each of these is	(ii) $30^\circ$
(c) The measure of an angle is five times its complement, the angle is	(iii) $20^\circ$
(d) Four angle are formed on a straight line, if three of them are $90^\circ$ , $30^\circ$ and $40^\circ$ , then fourth angle measure is	(iv) $75^\circ$

33. Match the following:

Column 1	Column 2
(a) The measure of angle which is $52^\circ$ less than its complement is _____	(i) $72^\circ$
(b) Two complementary angles are in the ratio of 1 : 2 the smaller angle is_____.	(ii) $60^\circ$
(c) Two complementary angles are in the ratio of 1 : 2 the larger angle is_____.	(iii) $30^\circ$
(d) The complementary of an angle is one-third of the given angle. Find the measure of the given angle	(iv) $19^\circ$

34. Match the following:

Column 1	Column 2
(a) Acute angle; $\angle A$	(i) $\angle A = 180^\circ$
(b) Obtuse angle; $\angle A$	(ii) $180^\circ < \angle A < 270^\circ$
(c) Reflex angle, $\angle A$	(iii) $0 < \angle A < 90^\circ$
(d) Straight angle, $\angle A$	(iv) $90^\circ < \angle A < 180^\circ$

## Answer Key

### DPP-1

1. (d)    2. (b)    3. (a)    4. (a)    5. (d)

### DPP-2

1. (c)    2. (d)    3. (c)    4. (b)    5. (a)

### DPP-3

1. (b)    2. (d)    3. (a)    4. (c)    5. (a)

### DPP-4

1. (a), (b), (c)    2. (a), (c)    3. (a), (c), (d)    4. (a), (c), (d)  
5. (a), (b), (d)    6. (c), (d)    7. (a)    8. (b)

## NCERT Basics

## Exercise-1

### Exercise 6.1

1.  $30^\circ, 250^\circ$   
2.  $126^\circ$   
4. Sum of all the angles at a point =  $360^\circ$   
5.  $\angle QOS = \angle SOR + \angle ROQ$  and  $\angle POS = \angle POR - \angle SOR$ .  
6.  $122^\circ, 302^\circ$

### Exercise 6.2

1.  $126^\circ$   
2.  $126^\circ, 36^\circ, 54^\circ$   
3.  $60^\circ$   
4.  $50^\circ, 77^\circ$   
5. Angle of incidence = Angle of reflection. At point B, draw  $BE \perp PQ$  and at point C, draw  $CF \perp RS$ .

## Concept Mastery

## Exercise-2

1. Sum of any two angles equals to 90 degrees then they are called complementary angles  
Let one angle =  $x$   
It's complementary angle =  $x + 14$   
 $x + x + 14 = 90$   
 $2x = 90 - 14$   
 $2x = 76$

$$x = \frac{76}{2}$$

$$x = 38$$

One angle =  $x = 38$

Second angle =  $x + 14 = 38 + 14 = 52$ .

2. Let the measures of the given angles be  $(3x)^\circ$  and  $(2x)^\circ$  respectively.

Since the given angles are supplementary, we have

$$3x^\circ + 2x^\circ = 180^\circ$$

$$5x^\circ = 180^\circ$$

$$\Rightarrow x^\circ = 36^\circ$$

$\therefore$  the measures of the given angles are  $(3 \times 36)^\circ$  and , i.e.,  $108^\circ$  and  $72^\circ$  respectively.

Required angles are  $108^\circ$  and  $72^\circ$  respectively.

3. The measure of the complementary angle  $x = (90^\circ - r^\circ)$

Where  $r^\circ =$  given measurement

$$\therefore x = (90^\circ - 72^\circ) = 18^\circ$$

hence, measure of the complementary angle of  $72^\circ = 18^\circ$

4. The measure of the supplementary angle  $x = (180^\circ - r^\circ)$

Where  $r^\circ =$  given measurement

$$\therefore x = (180^\circ - 125) = 55^\circ$$

5.  $\angle GOF, \angle FOA, \angle GOE, \angle EOA, \angle GOD, \angle DOA$ .

6.  $\angle BOC = \angle AOB + \angle AOC$

$$= 90^\circ + 90^\circ = 180^\circ \dots [\text{Given : } \angle AOB \text{ and } \angle AOC = 90^\circ]$$

$\therefore BOD$  is a line  $\dots$  [Linear pair axiom]

7. Given that,

Two supplementary angles are differed by 48o Let, the angle measured be  $x^\circ$

Therefore, its supplementary angle will be  $(180^\circ - x)$

It is given that,

$$(180^\circ - x) - x = 48^\circ$$

$$2x = 180^\circ - 48^\circ$$

$$x = 66^\circ$$

Hence,  $180^\circ - x = 114^\circ$

Therefore, the angles are  $66^\circ$  and  $114^\circ$ .

8. Let the measure of the required angle to  $x$

Then, measure of its supplement =  $(180^\circ - x)$

Given that,

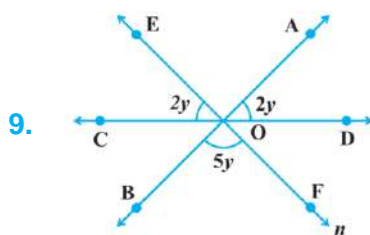
$$x^\circ = 5(180^\circ - x^\circ)$$

$$\Rightarrow x^\circ = 900^\circ - 5x^\circ$$

$$\Rightarrow 6x^\circ = 900^\circ$$

$$\Rightarrow x^\circ = 150^\circ$$

Hence, the measure of the required angle is  $150^\circ$ .



From the given figure:

$\angle AOE = \angle BOF = 5y$  (Vertically opposite angles)

Also,

$$\angle COE + \angle AOE + \angle AOD = 180^\circ$$

$$\text{So, } 2y + 5y + 2y = 180^\circ$$

$$\text{or, } 9y = 180^\circ, \text{ which gives } y = 20^\circ.$$

10. As  $EF \parallel CD$  and  $EC$  is the transversal ;

$$\angle DCE + \angle FEC = 180^\circ \text{ (Co-interior angles are supplementary)}$$

$$\angle DCE + 140^\circ = 180^\circ$$

$$\angle DCE = 180^\circ - 140^\circ = 40^\circ$$

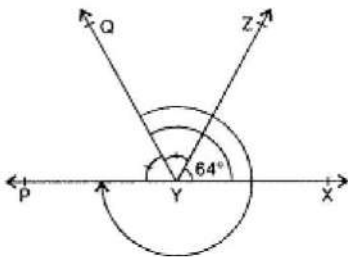
Also,  $AB \parallel CD$  and  $BC$  is transversal.

Hence,  $\angle BCD = \angle ABC$  (Alternate interior angles)

$$\therefore x + \angle DCE = 60^\circ$$

$$\Rightarrow x = 60^\circ - 40^\circ = 20^\circ$$

11.



Ray  $YZ$  stands on line  $PX$

$$\therefore \angle XYZ + \angle ZYP = 180^\circ \dots \text{ [Linear Pair Axiom]}$$

$$\therefore 64^\circ + \angle ZYP = 180^\circ \dots \text{ [Given : } \angle XYZ = 64^\circ]$$

$$\therefore \angle ZYP = 180^\circ - 64^\circ$$

$$\therefore \angle ZYP = 116^\circ \dots (1)$$

$\therefore$  Ray  $YQ$  bisects  $\angle ZYP$

$$\therefore \angle PYQ = \angle ZYQ = \frac{1}{2} \angle ZYP = \frac{1}{2} (116^\circ) = 58^\circ \dots \text{ [Using (1)]}$$

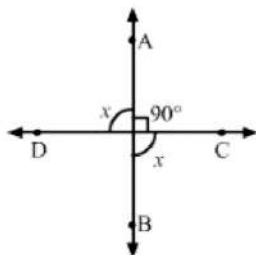
$$\therefore \text{Reflex } \angle QYP = 360^\circ - 58^\circ = 302^\circ \dots \text{ [The sum of all angles} = 360^\circ]$$

Again,  $\angle XYQ = \angle XYZ + \angle ZYQ$

$$= 64^\circ + 58^\circ = 122^\circ \dots \text{ [Given : } \angle XYZ = 64^\circ] \text{ and [ } \angle ZYQ = 58^\circ \text{ from (2)]}$$

hence,  $\angle XYQ = 122^\circ$

12. We know that if two lines intersect, then the vertically-opposite angles are equal.



$$\angle AOC = 90^\circ \quad \angle AOC = \angle BOD = 90^\circ$$

And let  $\angle BOC = \angle AOD = x^\circ$

Also, we know that the sum of all angles around a point is  $360^\circ$

$$\Rightarrow 90^\circ + 90^\circ + x^\circ + x^\circ = 360^\circ$$

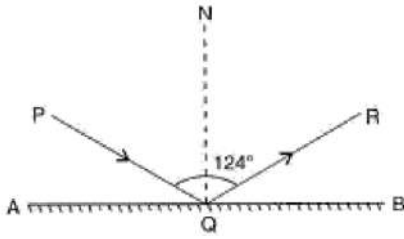
$$\Rightarrow 2x^\circ = 180^\circ \Rightarrow x^\circ = 90^\circ$$

Hence,  $\angle BOC = \angle AOD = x^\circ = 90^\circ$

$$\therefore \angle AOC = \angle BOD = \angle BOC = \angle AOD = 90^\circ$$

Hence, the measure of each of the remaining angles is  $90^\circ$ .

13.



Draw  $QN \perp AB$

Angle of incident = Angle of reflection . . . [by law of reflection]

$$\therefore \angle PQN = \angle NQR$$

$$\angle PQR = 124^\circ \dots \text{[Given]}$$

$$\therefore \angle PQN + \angle NQR = 124^\circ$$

$$\therefore \angle NQR + \angle NQR = 124^\circ \dots \text{[As } \angle PQN = \angle NQR]$$

$$\therefore 2 \angle NQR = 124^\circ$$

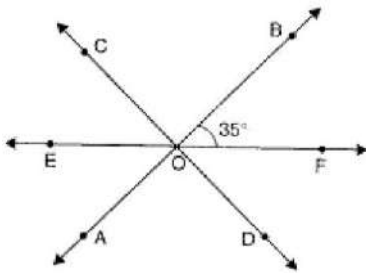
$$\therefore \angle NQR = \frac{124^\circ}{2} = 62^\circ$$

$$\therefore \angle NQB - \angle RQB = 62^\circ$$

$$\therefore 90^\circ - \angle RQB = 62^\circ$$

$$\therefore \angle RQB = 90^\circ - 62^\circ = 28^\circ$$

14.



OF bisects  $\angle BOD$  . . . [Given]

$$\angle BOF = \angle DOF = 35^\circ$$

$$\angle COE = \angle DOF = 35^\circ$$

$$\angle EOF = 180^\circ \dots \text{[A straight angle = } 180^\circ]$$

$$\therefore \angle EOC + \angle BOC + \angle BOF = 180^\circ$$

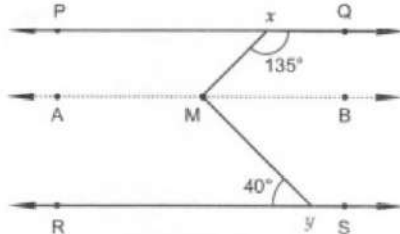
$$\therefore 35^\circ + \angle BOC + 35^\circ = 180^\circ$$

$$\therefore \angle BOC = 180^\circ - 70^\circ = 110^\circ$$

$$\angle AOD = \angle BOC \dots \text{[Vertically opposite angles]}$$

$$= 110^\circ$$

15. Through point M draw a line AB parallel to the line PQ as shown in Fig. Thus, we have



$AB \parallel PQ$  and  $PQ \parallel RS$

$$\Rightarrow AB \parallel RS$$

Now,  $AB \parallel PQ$  and  $\angle QXM$  and  $\angle XMB$  are interior angles on the same side of the transversal XM.

$$\therefore \angle QXM + \angle XMB = 180^\circ$$

$$\Rightarrow 135^\circ + \angle XMB = 180^\circ$$

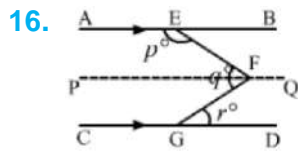
$$\Rightarrow \angle XMB = 180^\circ - 135^\circ = 45^\circ$$

Now,  $AB \parallel RS$  and  $\angle BMY$  and  $\angle MYR$  are alternate angles.

$$\therefore \angle BMY = \angle MYR$$

$$\Rightarrow \angle BMY = 40^\circ$$

$$\text{Hence, } \angle XMY = \angle XMB + \angle BMY = 45^\circ + 40^\circ = 85^\circ$$



Draw  $PFQ \parallel AB \parallel CD$

Now,  $PFQ \parallel AB$  and  $EF$  is the transversal.

Then,

$$\angle AEF + \angle EFP = 180^\circ \dots(i)$$

[Angles on the same side of a transversal line are supplementary]

Also,  $PFQ \parallel CD$ .

$$\angle PFG = \angle FGD = r^\circ \text{ [Alternate Angles]}$$

$$\text{and } \angle EFP = \angle EFG - \angle PFG = q^\circ - r^\circ$$

putting the value of  $\angle EFP$  in equation (i)

we get,

$$p^\circ + q^\circ - r^\circ = 180^\circ \text{ [}\angle AEF = p^\circ\text{]}$$

17. i. In  $\triangle BOD$ ,

$$\angle OBD + \angle BOD + \angle ODB = 180^\circ$$

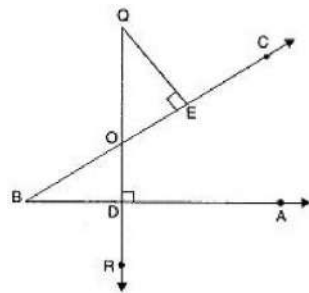
(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle OBD + \angle BOD + 90^\circ = 180^\circ$$

$$\Rightarrow \angle OBD + \angle BOD = 90^\circ \dots\dots\dots (1)$$

In  $\triangle OEQ$ ,

$$\angle EQO + \angle QOE + \angle OEQ = 180^\circ \dots\dots\dots (2)$$



(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle EQO + \angle QOE + 90^\circ = 180^\circ$$

$$\Rightarrow \angle EQO + \angle QOE = 90^\circ \dots\dots\dots (2)$$

From (1) and (2), we get

$$\angle OBD + \angle BOD = \angle EQO + \angle QOE$$

But  $\angle BOD = \angle QOE$  (Vertically Opposite Angles)

$$\therefore \angle OBD = \angle EQO$$

ii. Join  $BQ$

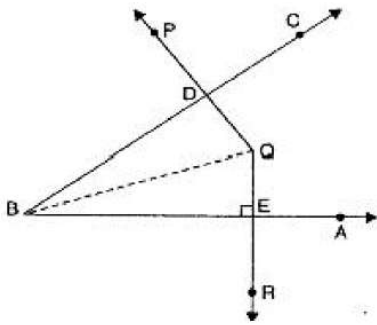
In  $\triangle BDQ$ ,

$$\angle DBQ + \angle BQD + \angle QDB = 180^\circ$$

(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle DBQ + \angle BQD + 90^\circ = 180^\circ$$

$$\Rightarrow \angle DBQ + \angle BQD = 90^\circ \dots\dots\dots (1)$$



In  $\triangle BQE$ ,

$$\angle EBQ + \angle BQE + \angle BEQ = 180^\circ$$

(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle EBQ + \angle BQE + 90^\circ = 180^\circ$$

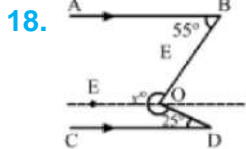
$$\Rightarrow \angle EBQ + \angle BQE = 90^\circ$$

Adding (1) and (2), we get

$$(\angle DBQ + \angle EBQ) + (\angle BQD + \angle BQE) = 90^\circ + 90^\circ = 180^\circ$$

$$\Rightarrow \angle DBE + \angle EQD = 180^\circ$$

$\Rightarrow \angle DBE$  and  $\angle EQD$  are supplementary.



Draw EO  $AB \parallel CD$

Then,  $\angle EOB + \angle EOD = x^\circ$

Now,  $EO \parallel AB$  and  $BO$  is the transversal.

$$\therefore \angle EOB + \angle ABO = 180^\circ \text{ [Consecutive Interior Angles]}$$

$$\Rightarrow \angle EOB + 55^\circ = 180^\circ$$

$$\Rightarrow \angle EOB = 125^\circ$$

Again,  $EO \parallel CD$  and  $DO$  is the transversal.

$$\therefore \angle EOD + \angle CDO = 180^\circ \text{ [Consecutive Interior Angles]}$$

$$\Rightarrow \angle EOD + 25^\circ = 180^\circ$$

$$\Rightarrow \angle EOD = 155^\circ$$

Therefore,

$$x^\circ = \angle EOB + \angle EOD$$

$$x^\circ = (125 + 155)^\circ$$

$$x^\circ = 280^\circ$$

19. Through O, draw  $EO \parallel AB \parallel CD$

Then,  $\angle EOB + \angle EOD = x^\circ$ ,

Now,  $AB \parallel EO$  and  $BO$  is the transversal

$$\therefore \angle ABO + \angle BOE = 180^\circ \text{ [consecutive interior angles]}$$

$$\Rightarrow 40^\circ + \angle BOE = 180^\circ$$

$$\Rightarrow \angle BOE = (180^\circ - 40^\circ) = 140^\circ$$

$$\Rightarrow \angle BOE = 140^\circ$$

Again  $CD \parallel EO$  and  $OD$  is the transversal.

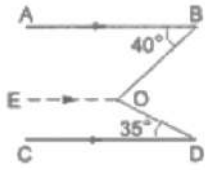
$$\therefore \angle EOD + \angle ODC = 180^\circ$$

$$\Rightarrow \angle EOD + 35^\circ = 180^\circ$$

$$\Rightarrow \angle EOD = (180^\circ - 35^\circ) = 145^\circ$$

$$\Rightarrow \angle EOD = 145$$

$\therefore$  reflex  $\angle BOD = x^\circ = (\angle BOE + \angle EOD)$   
 $= (140^\circ + 145^\circ) = 285^\circ$   
Hence,  $x = 285^\circ$   
 $\Rightarrow \angle BOD = x = 285^\circ$



- 20.** We are given that  $AB \parallel CD$ ,  $CD \parallel EF$  and  $y : z = 3 : 7$   
We need to find the value of  $x$  in the figure given below.  
We know that lines parallel to the same line are also parallel to each other.  
We can conclude that  $AB \parallel EF$   
Let  $y = 3a$  and  $z = 7a$   
We know that angles on the same side of a transversal are supplementary.  
 $\therefore x + y = 180^\circ$   
 $x = z$  Alternate interior angles  
 $z + y = 180^\circ$   
or  $7a + 3a = 180^\circ$   
 $\Rightarrow 10a = 180^\circ$   
 $a = 18^\circ$ .  
 $z = 7a = 126^\circ$   
 $y = 3a = 54^\circ$ .  
Now, as  $x = z$   
 $\Rightarrow x = 126^\circ$ .  
Therefore, we can conclude that  $x = 126^\circ$

- 21.** 15  
Explanation:  
If  $\angle AOB$  is a line, then  
 $\angle AOB = 180^\circ$  . . . [A straight line =  $180^\circ$ ]  
 $\angle AOC + \angle BOC = 180^\circ$   
 $\therefore 4x + (6x + 30^\circ) = 180^\circ$   
 $\therefore 10x + 30^\circ = 180^\circ$   
 $\therefore 10x = 180^\circ - 30^\circ$   
 $\therefore 10x = 150^\circ$   
 $\therefore x = \frac{150^\circ}{10} = 15^\circ$

- 22.** 48  
Explanation:  
Given angle is  $132^\circ$   
Since the sum of an angle and its supplement is  $180^\circ$   
Therefore, its complement will be:  
 $180^\circ - 132^\circ = 48^\circ$

- 23.** 50  
Explanation:  
Let the angle be " $x$ "  
The, its complement will be  $(90^\circ - x)$   
Now, according to question,

$$\text{angle} = 30^\circ + \frac{1}{2} \text{ Complement}$$

$$x = 30^\circ + \frac{1}{2} (90^\circ - x)$$

$$x = 30^\circ + 45^\circ - \frac{x}{2}$$

$$x + = 30^\circ + 45^\circ$$

$$\frac{3x}{2} = 75^\circ$$

$$3x = 150^\circ$$

$$x = 50^\circ$$

Thus, the angle is  $50^\circ$

**24.** 45

Explanation:

Let the measure of the required angle be  $x^\circ$

Then, the measure of its complement =  $(90^\circ - x^\circ)$

And then measure of its supplement =  $(180 - x)^\circ$

given that,

$$(90^\circ - x^\circ) = \frac{1}{3} (180^\circ - x^\circ)$$

$$3(90^\circ - x^\circ) = (180^\circ - x^\circ)$$

$$270^\circ - 3x^\circ = 180^\circ - x^\circ$$

$$2x^\circ = 90^\circ$$

$$x^\circ = 45^\circ$$

Hence, the measure of the required angle is  $45^\circ$ .

**25.** State True or False:

(i) (b) False

(ii) (a) True

(iii) (b) False

(iv) (a) True

(v) (b) False

(vi) (a) True

(vii) (b) False

(viii) (b) False

**26.** Fill in the blanks:

(i) 1. 48

(ii) 1. One

(iii) 1. Two

(iv) 1. 36, 54

(v) 1.  $y = mx$

(vi) 1. Angle

(vii) 1. 90

(viii) 1. no

## Accuracy Booster

## Exercise-3

- |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (b)  | 2. (b)  | 3. (c)  | 4. (d)  | 5. (d)  | 6. (b)  | 7. (a)  |
| 8. (a)  | 9. (c)  | 10. (d) | 11. (a) | 12. (b) | 13. (b) | 14. (c) |
| 15. (c) | 16. (c) | 17. (c) | 18. (a) | 19. (d) | 20. (b) | 21. (a) |
| 22. (a) | 23. (d) | 24. (b) | 25. (a) | 26. (a) |         |         |
27. (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)  
 28. (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)  
 29. (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)  
 30. (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)  
 31. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)  
 32. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)  
 33. (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)  
 34. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

CLASS 9 - MATHEMATICS

Chapter-6 Lines and Angles

**Solutions**

**Concept Mastery**

**Exercise-2**

1. Sum of any two angles equals to 90 degrees then they are called complementary angles

Let one angle =  $x$

It's complementary angle =  $x + 14$

$$x + x + 14 = 90$$

$$2x = 90 - 14$$

$$2x = 76$$

$$x = \frac{76}{2}$$

$$x = 38$$

One angle =  $x = 38$

Second angle =  $x + 14 = 38 + 14 = 52$ .

2. Let the measures of the given angles be  $(3x)^\circ$  and  $(2x)^\circ$  respectively.

Since the given angles are supplementary, we have

$$3x^\circ + 2x^\circ = 180^\circ$$

$$5x^\circ = 180^\circ$$

$$\Rightarrow x^\circ = 36^\circ$$

$\therefore$  the measures of the given angles are  $(3 \times 36)^\circ$  and , i.e.,  $108^\circ$  and  $72^\circ$  respectively.

Required angles are  $108^\circ$  and  $72^\circ$  respectively.

3. The measure of the complementary angle  $x = (90^\circ - r^\circ)$

Where  $r^\circ =$  given measurement

$$\therefore x = (90^\circ - 72^\circ) = 18^\circ$$

hence, measure of the complementary angle of  $72^\circ = 18^\circ$

4. The measure of the supplementary angle  $x = (180^\circ - r^\circ)$

Where  $r^\circ =$  given measurement

$$\therefore x = (180^\circ - 125) = 55^\circ$$

5.  $\angle GOF, \angle FOA, \angle GOE, \angle EOA, \angle GOD, \angle DOA$ .

6.  $\angle BOC = \angle AOB + \angle AOC$

$$= 90^\circ + 90^\circ = 180^\circ \dots [\text{Given : } \angle AOB \text{ and } \angle AOC = 90^\circ]$$

$\therefore BOD$  is a line  $\dots$  [Linear pair axiom]

7. Given that,

Two supplementary angles are differed by 48o Let, the angle measured be  $x^\circ$

Therefore, its supplementary angle will be  $(180^\circ - x)$

It is given that,

$$(180^\circ - x) - x = 48^\circ$$

$$2x = 180^\circ - 48^\circ$$

$$x = 66^\circ$$

$$\text{Hence, } 180^\circ - x = 114^\circ$$

Therefore, the angles are  $66^\circ$  and  $114^\circ$ .

8. Let the measure of the required angle to  $x$

Then, measure of its supplement =  $(180^\circ - x)$

Given that,

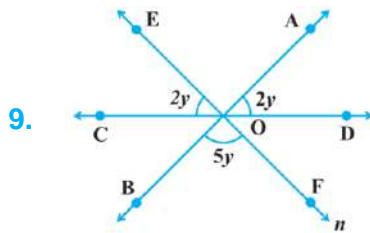
$$x^\circ = 5(180^\circ - x^\circ)$$

$$\Rightarrow x^\circ = 900^\circ - 5x^\circ$$

$$\Rightarrow 6x^\circ = 900^\circ$$

$$\Rightarrow x^\circ = 150^\circ$$

Hence, the measure of the required angle is  $150^\circ$ .



From the given figure:

$$\angle AOE = \angle BOF = 5y \text{ (Vertically opposite angles)}$$

Also,

$$\angle COE + \angle AOE + \angle AOD = 180^\circ$$

$$\text{So, } 2y + 5y + 2y = 180^\circ$$

$$\text{or, } 9y = 180^\circ, \text{ which gives } y = 20^\circ.$$

10. As  $EF \parallel CD$  and  $EC$  is the transversal ;

$$\angle DCE + \angle FEC = 180^\circ \text{ (Co-interior angles are supplementary)}$$

$$\angle DCE + 140^\circ = 180^\circ$$

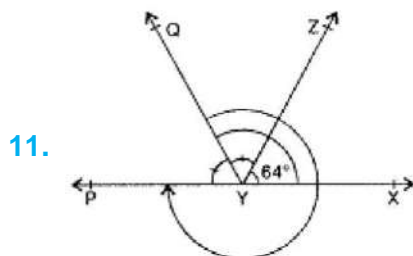
$$\angle DCE = 180^\circ - 140^\circ = 40^\circ$$

Also,  $AB \parallel CD$  and  $BC$  is transversal.

Hence,  $\angle BCD = \angle ABC$  (Alternate interior angles)

$$\therefore x + \angle DCE = 60^\circ$$

$$\Rightarrow x = 60^\circ - 40^\circ = 20^\circ$$



Ray  $YZ$  stands on line  $PX$

$$\therefore \angle XYZ + \angle ZYP = 180^\circ \dots \text{ [Linear Pair Axiom]}$$

$$\therefore 64^\circ + \angle ZYP = 180^\circ \dots \text{ [Given : } \angle XYZ = 64^\circ \text{]}$$

$$\therefore \angle ZYP = 180^\circ - 64^\circ$$

$$\therefore \angle ZYP = 116^\circ \dots \text{ (1)}$$

$\therefore$  Ray  $YQ$  bisects  $\angle ZYP$

$$\therefore \angle PYQ = \angle ZYQ = \frac{1}{2} \angle ZYP = \frac{1}{2} (116^\circ) = 58^\circ \dots \text{ [Using (1)]}$$

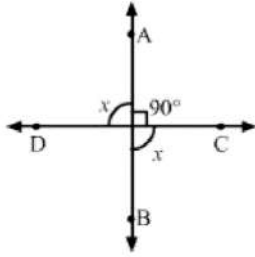
$$\therefore \text{Reflex } \angle QYP = 360^\circ - 58^\circ = 302^\circ \dots \text{ [The sum of all angles} = 360^\circ \text{]}$$

Again,  $\angle XYQ = \angle XYZ + \angle ZYQ$

$$= 64^\circ + 58^\circ = 122^\circ \dots \text{ [Given : } \angle XYZ = 64^\circ \text{] and [ } \angle ZYQ = 58^\circ \text{ from (2)]}$$

hence,  $\angle XYQ = 122^\circ$

12. We know that if two lines intersect, then the vertically-opposite angles are equal.



$$\angle AOC = 90^\circ \quad \angle AOC = \angle BOD = 90^\circ$$

$$\text{And let } \angle BOC = \angle AOD = x^\circ$$

Also, we know that the sum of all angles around a point is  $360^\circ$

$$\Rightarrow 90^\circ + 90^\circ + x^\circ + x^\circ = 360^\circ$$

$$\Rightarrow 2x^\circ = 180^\circ$$

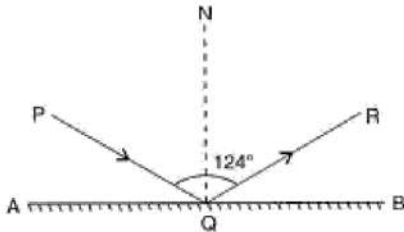
$$\Rightarrow x^\circ = 90^\circ$$

$$\text{Hence, } \angle BOC = \angle AOD = x^\circ = 90^\circ$$

$$\therefore \angle AOC = \angle BOD = \angle BOC = \angle AOD = 90^\circ$$

Hence, the measure of each of the remaining angles is  $90^\circ$ .

13.



Draw  $QN \perp AB$

Angle of incident = Angle of reflection . . . [by law of reflection]

$$\therefore \angle PQN = \angle NQR$$

$$\angle PQR = 124^\circ \dots \dots \text{[Given]}$$

$$\therefore \angle PQN + \angle NQR = 124^\circ$$

$$\therefore \angle NQR + \angle NQR = 124^\circ \dots \dots \text{[As } \angle PQN = \angle NQR]$$

$$\therefore 2 \angle NQR = 124^\circ$$

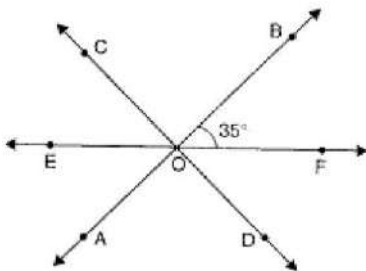
$$\therefore \angle NQR = \frac{124^\circ}{2} = 62^\circ$$

$$\therefore \angle NQB - \angle RQB = 62^\circ$$

$$\therefore 90^\circ - \angle RQB = 62^\circ$$

$$\therefore \angle RQB = 90^\circ - 62^\circ = 28^\circ$$

14.



OF bisects  $\angle BOD$  . . . [Given]

$$\angle BOF = \angle DOF = 35^\circ$$

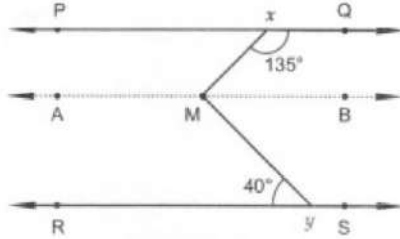
$$\angle COE = \angle DOF = 35^\circ$$

$$\angle EOF = 180^\circ \dots \dots \text{[A straight angle = } 180^\circ]$$

$$\therefore \angle EOC + \angle BOC + \angle BOF = 180^\circ$$

$$\begin{aligned} \therefore 35^\circ + \angle BOC + 35^\circ &= 180^\circ \\ \therefore \angle BOC &= 180^\circ - 70^\circ = 110^\circ \\ \angle AOD &= \angle BOC \dots [\text{Vertically opposite angles}] \\ &= 110^\circ \end{aligned}$$

15. Through point M draw a line AB parallel to the line PQ as shown in Fig. Thus, we have



$AB \parallel PQ$  and  $PQ \parallel RS$

$\Rightarrow AB \parallel RS$

Now,  $AB \parallel PQ$  and  $\angle QXM$  and  $\angle XMB$  are interior angles on the same side of the transversal  $XM$ .

$$\therefore \angle QXM + \angle XMB = 180^\circ$$

$$\Rightarrow 135^\circ + \angle XMB = 180^\circ$$

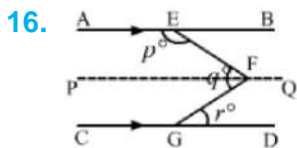
$$\Rightarrow \angle XMB = 180^\circ - 135^\circ = 45^\circ$$

Now,  $AB \parallel RS$  and  $\angle BMY$  and  $\angle MYR$  are alternate angles.

$$\therefore \angle BMY = \angle MYR$$

$$\Rightarrow \angle BMY = 40^\circ$$

Hence,  $\angle XMY = \angle XMB + \angle BMY = 45^\circ + 40^\circ = 85^\circ$



Draw  $PFQ \parallel AB \parallel CD$

Now,  $PFQ \parallel AB$  and  $EF$  is the transversal.

Then,

$$\angle AEF + \angle EFP = 180^\circ \dots(i)$$

[Angles on the same side of a transversal line are supplementary]

Also,  $PFQ \parallel CD$ .

$$\angle PFG = \angle FGD = r^\circ [\text{Alternate Angles}]$$

$$\text{and } \angle EFP = \angle EFG - \angle PFG = q^\circ - r^\circ$$

putting the value of  $\angle EFP$  in equation (i)

we get,

$$p^\circ + q^\circ - r^\circ = 180^\circ [\angle AEF = p^\circ]$$

17. i. In  $\triangle BOD$ ,

$$\angle OBD + \angle BOD + \angle ODB = 180^\circ$$

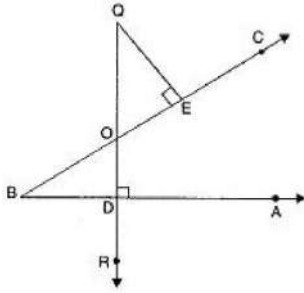
(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle OBD + \angle BOD + 90^\circ = 180^\circ$$

$$\Rightarrow \angle OBD + \angle BOD = 90^\circ \dots\dots\dots (1)$$

In  $\triangle OEQ$ ,

$$\angle EQO + \angle QOE + \angle OEQ = 180^\circ \dots\dots\dots (2)$$



(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle EQO + \angle QOE + 90^\circ = 180^\circ$$

$$\Rightarrow \angle EQO + \angle QOE = 90^\circ \dots\dots (2)$$

From (1) and (2), we get

$$\angle OBD + \angle BOD = \angle EQO + \angle QOE$$

But  $\angle BOD = \angle QOE$  (Vertically Opposite Angles)

$$\therefore \angle OBD = \angle EQO$$

ii. Join BQ

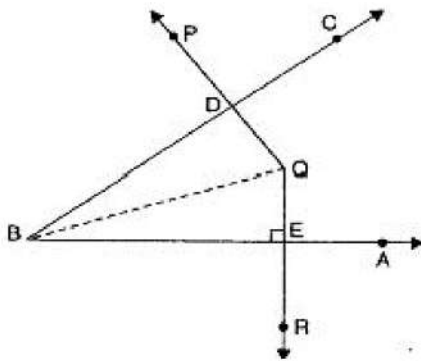
In  $\triangle BDQ$ ,

$$\angle DBQ + \angle BQD + \angle QDB = 180^\circ$$

(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle DBQ + \angle BQD + 90^\circ = 180^\circ$$

$$\Rightarrow \angle DBQ + \angle BQD = 90^\circ \dots\dots (1)$$



In  $\triangle BQE$ ,

$$\angle EBQ + \angle BQE + \angle BEQ = 180^\circ$$

(The sum of the three angles of a triangle is  $180^\circ$ )

$$\Rightarrow \angle EBQ + \angle BQE + 90^\circ = 180^\circ$$

$$\Rightarrow \angle EBQ + \angle BQE = 90^\circ$$

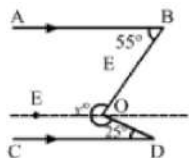
Adding (1) and (2), we get

$$(\angle DBQ + \angle EBQ) + (\angle BQD + \angle BQE) = 90^\circ + 90^\circ = 180^\circ$$

$$\Rightarrow \angle DBE + \angle EQD = 180^\circ$$

$\Rightarrow \angle DBE$  and  $\angle EQD$  are supplementary.

18.



Draw EO  $AB \parallel CD$

Then,  $\angle EOB + \angle EOD = x^\circ$

Now,  $EO \parallel AB$  and  $BO$  is the transversal.

$\therefore \angle EOB + \angle ABO = 180^\circ$  [Consecutive Interior Angles]

$$\Rightarrow \angle EOB + 55^\circ = 180^\circ$$

$$\Rightarrow \angle EOB = 125^\circ$$

Again, EO CD and DO is the transversal.

$$\therefore \angle EOD + \angle CDO = 180^\circ \text{ [Consecutive Interior Angles]}$$

$$\Rightarrow \angle EOD + 25^\circ = 180^\circ$$

$$\Rightarrow \angle EOD = 155^\circ$$

Therefore,

$$x^\circ = \angle EOB + \angle EOD$$

$$x^\circ = (125 + 155)^\circ$$

$$x^\circ = 280^\circ$$

**19.** Through O, draw EO AB || CD

$$\text{Then, } \angle EOB + \angle EOD = x^\circ,$$

Now, AB || EO and BO is the transversal

$$\therefore \angle ABO + \angle BOE = 180^\circ \text{ [consecutive interior angles]}$$

$$\Rightarrow 40^\circ + \angle BOE = 180^\circ$$

$$\Rightarrow \angle BOE = (180^\circ - 40^\circ) = 140^\circ$$

$$\Rightarrow \angle BOE = 140^\circ$$

Again CD || EO and OD is the transversal.

$$\therefore \angle EOD + \angle ODC = 180^\circ$$

$$\Rightarrow \angle EOD + 35^\circ = 180^\circ$$

$$\Rightarrow \angle EOD = (180^\circ - 35^\circ) = 145^\circ$$

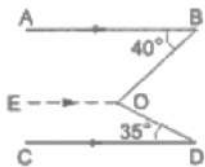
$$\Rightarrow \angle EOD = 145^\circ$$

$$\therefore \text{reflex } \angle BOD = x^\circ = (\angle BOE + \angle EOD)$$

$$= (140^\circ + 145^\circ) = 285^\circ$$

Hence,  $x = 285^\circ$

$$\Rightarrow \angle BOD = x = 285^\circ$$



**20.** We are given that AB || CD, CD || EF and  $y : z = 3 : 7$

We need to find the value of  $x$  in the figure given below.

We know that lines parallel to the same line are also parallel to each other.

We can conclude that AB || EF

$$\text{Let } y = 3a \text{ and } z = 7a$$

We know that angles on the same side of a transversal are supplementary.

$$\therefore x + y = 180^\circ$$

$$x = z \text{ Alternate interior angles}$$

$$z + y = 180^\circ$$

$$\text{or } 7a + 3a = 180^\circ$$

$$\Rightarrow 10a = 180^\circ$$

$$a = 18^\circ.$$

$$z = 7a = 126^\circ$$

$$y = 3a = 54^\circ.$$

Now, as  $x = z$

$$\Rightarrow x = 126^\circ.$$

Therefore, we can conclude that  $x = 126^\circ$

21. 15

Explanation:

If  $\angle AOB$  is a line, then

$$\angle AOB = 180^\circ \dots [\text{A straight line} = 180^\circ]$$

$$\angle AOC + \angle BOC = 180^\circ$$

$$\therefore 4x + (6x + 30^\circ) = 180^\circ$$

$$\therefore 10x + 30^\circ = 180^\circ$$

$$\therefore 10x = 180^\circ - 30^\circ$$

$$\therefore 10x = 150^\circ$$

$$\therefore x = \frac{150^\circ}{10} = 15^\circ$$

22. 48

Explanation:

Given angle is  $132^\circ$

Since the sum of an angle and its supplement is  $180^\circ$

Therefore, its complement will be:

$$180^\circ - 132^\circ = 48^\circ$$

23. 50

Explanation:

Let the angle be "x"

The, its complement will be  $(90^\circ - x)$

Now, according to question,

$$\text{angle} = 30^\circ + \frac{1}{2} \text{ Complement}$$

$$x = 30^\circ + \frac{1}{2} (90^\circ - x)$$

$$x = 30^\circ + 45^\circ - \frac{x}{2}$$

$$x + \frac{x}{2} = 30^\circ + 45^\circ$$

$$\frac{3x}{2} = 75^\circ$$

$$3x = 150^\circ$$

$$x = 50^\circ$$

Thus, the angle is  $50^\circ$

24. 45

Explanation:

Let the measure of the required angle be  $x^\circ$

Then, the measure of its complement =  $(90^\circ - x^\circ)$

And then measure of its supplement =  $(180^\circ - x^\circ)$

given that,

$$(90^\circ - x^\circ) = \frac{1}{3} (180^\circ - x^\circ)$$

$$3(90^\circ - x^\circ) = (180^\circ - x^\circ)$$

$$270^\circ - 3x^\circ = 180^\circ - x^\circ$$

$$2x^\circ = 90^\circ$$

$$x^\circ = 45^\circ$$

Hence, the measure of the required angle is  $45^\circ$ .

25. (i) (b) False  
Explanation: False  
(ii) (a) True  
Explanation: True  
(iii) (b) False  
Explanation: False  
(iv) (a) True  
Explanation: True  
(v) (b) False  
Explanation: False: Two lines perpendicular to the same line are parallel to each other.  
(vi) (a) True  
Explanation: True  
(vii) (b) False  
Explanation: False  
(viii) (b) False  
Explanation: False
26. Fill in the blanks:  
(i) 1. 48  
(ii) 1. one  
(iii) 1. Two  
(iv) 1. 36, 54  
(v) 1.  $y = mx$   
(vi) 1. angle  
(vii) 1. 90  
(viii) 1. no

## Accuracy Booster

## Exercise-3

1. (b) an acute angle  
Explanation: an acute angle  
If two angles are complements of each other, that is, the sum of their measures is  $90^\circ$ , then each angle is an acute angle.
2. (b)  $126^\circ$   
Explanation: Let  $a = 2x$  and  $b = 3x$   
Now, XOY is a straight line.  
 $\therefore 2x + 3x + 90^\circ = 180^\circ \Rightarrow 5x = 90^\circ \Rightarrow x = 18^\circ$   
 $\therefore \angle XON = \angle MOY = \angle MOP + \angle POY$  (vertically opposite angles)  
 $= 36^\circ + 90^\circ = 126^\circ$ .
3. (c) a right triangle  
Explanation: The sum of the angles of triangle is  $180^\circ$ .  
let the angles of triangle be  $a, b, c$   
We have given that one angle of a triangle is equal to the sum of the other two angles  
so we have  
 $c = a + b$   
 $a + b + c = 180^\circ$   
Substitute  $c$  for  $a + b$

$$c + c = 180^\circ$$

$$2c = 180^\circ$$

$$c = 90^\circ$$

Therefore the triangle is a right triangle.

4. (d)  $70^\circ$

Explanation:  $x + 40^\circ + x + x + 20^\circ = 180^\circ$  (Linear pair)

$$\Rightarrow 3x + 60^\circ = 180^\circ \Rightarrow 3x = 120^\circ \Rightarrow x = 40^\circ$$

Now,  $\angle OCD = \angle ODC$  [ $\because OD = OC$ ]

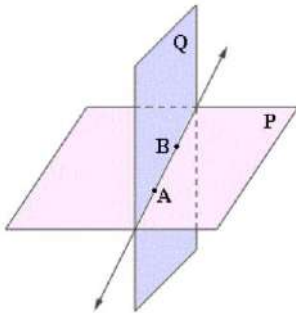
Now,  $C + \angle D + x = 180^\circ$

$$\Rightarrow \angle OCD + \angle ODC + 40^\circ = 180^\circ$$

$$\Rightarrow 2\angle OCD = 140^\circ \Rightarrow \angle OCD = 70^\circ$$

5. (d) Straight line

Explanation:



As can be seen from the above diagram, the two planes "P" and "Q" are intersecting in a line, which is AB.

6. (b)  $155^\circ$

Explanation:

Let angles of a triangle be  $\angle A$ ,  $\angle B$  and  $\angle C$ .

In  $\triangle ABC$ ,

$$\angle A + \angle B + \angle C = 180^\circ \text{ [sum of all interior angles of a triangle is } 180^\circ\text{]}$$

$$\Rightarrow \frac{1}{2}\angle A + \frac{1}{2}\angle B + \frac{1}{2}\angle C = \frac{180^\circ}{2} = 90^\circ \text{ [dividing both sides by 2]}$$

$$\Rightarrow \frac{1}{2}\angle B + \frac{1}{2}\angle C = 90^\circ - \frac{1}{2}\angle A \text{ [}\because \text{ In } \triangle OBC, \angle OBC + \angle BCO + \angle COB = 180^\circ\text{]}$$

$\Rightarrow$  Since,  $\frac{\angle B}{2} + \frac{\angle C}{2} + \angle BOC = 180^\circ$  as BO and OC are the angle bisectors of  $\angle ABC$  and  $\angle BCA$ , respectively

$$\Rightarrow 180^\circ - \angle BOC = 90^\circ - \frac{1}{2}\angle A$$

$$\Rightarrow \angle BOC = 180^\circ - 90^\circ + \frac{1}{2}\angle A$$

$$= 90^\circ + \frac{1}{2} \times 130^\circ = 90^\circ + 65^\circ \text{ [}\because \angle A = 130^\circ \text{ (given)]}$$

$$= 155^\circ$$

Hence, the required angle is  $155^\circ$ .

7. (a)  $86^\circ$

Explanation: Given,

$$\angle AOC + \angle COB + \angle BOD = 274^\circ \text{ .....(i)}$$

$$\angle AOD + \angle AOC + \angle COB + \angle BOD = 360^\circ \text{ (Angles at a point)}$$

$$\angle AOD + 274^\circ = 360^\circ$$

$$AOD = 86^\circ$$

8. (a)  $75^\circ$

Explanation: Let the measure of the required angle be  $x^\circ$

Then, the measure of its complement will be  $(90 - x)^\circ$

$$\therefore x = 5(90 - x)$$

$$\Rightarrow x = 450 - 5x$$

$$\Rightarrow 6x = 450$$

$$\Rightarrow x = 75^\circ$$

9. (c)  $36^\circ$

Explanation: Let  $x$  and  $(90^\circ - x)$  be two complimentary angles

According to question,

$$2x = 3(90^\circ - x)$$

$$2x = 270^\circ - 3x$$

$$x = 54^\circ$$

The angles are:

$$54^\circ \text{ and } 90^\circ - 54^\circ = 36^\circ$$

Thus, smallest angle is  $36^\circ$

10. (d)  $20^\circ$

Explanation: We have,

$$\angle AOF = \angle COD = 5y \text{ (vertically opposite angles)}$$

Now, BOE is a straight line.

$$\therefore 3y + 5y + y = 180^\circ \Rightarrow 9y = 180^\circ \Rightarrow y = 20^\circ$$

11. (a)  $100^\circ$

Explanation: Given that,

$AB \parallel CD$

Produce P to Q so that  $PQ \parallel AB \parallel CD$

$$\angle BAP + \angle APQ = 180^\circ \text{ (Interior angle)}$$

$$132^\circ + \angle APQ = 180^\circ$$

$$\angle APQ = 48^\circ \text{ (i)}$$

$$\angle APC = \angle APQ + \angle QPC$$

$$148^\circ = 48^\circ + \angle QPC \text{ [From (i)]}$$

$$\angle QPC = 100^\circ$$

$$\angle QPC + \angle PCD = 180^\circ \text{ (Interior angles)}$$

$$100^\circ + \angle PCD = 180^\circ$$

$$\angle PCD = 80^\circ$$

$$\angle PCD + x = 180^\circ \text{ (Linear pair)}$$

$$80^\circ + x = 180^\circ$$

$$x = 100^\circ$$

12. (b)  $80^\circ$

Explanation: We have:

$$\angle AOC + \angle COD + \angle BOD = 180^\circ$$

[Since AOB is a straight line]

$$\Rightarrow 3x - 10 + 50 + x + 20 = 180$$

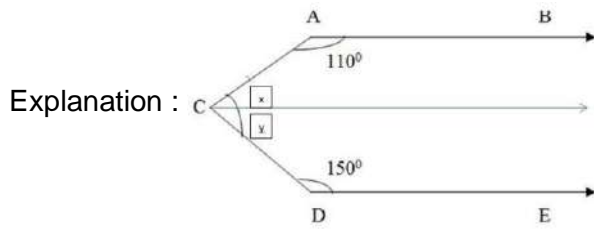
$$\Rightarrow 4x = 120$$

$$\Rightarrow x = 30$$

$$\therefore \angle AOC = [3 \times 30 - 10]^\circ$$

$$\Rightarrow \angle AOC = 80^\circ$$

13. (b)  $100^\circ$



$$x + 110^\circ = 180^\circ \text{ (Supplementary angles)}$$

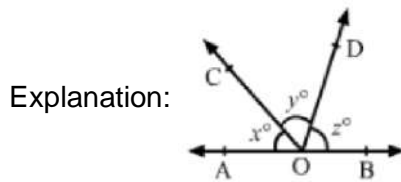
$$x = 70^\circ$$

$$y + 150^\circ = 180^\circ \text{ (Supplementary angles)}$$

$$y = 30^\circ$$

$$\angle ACD = 70^\circ + 30^\circ = 100^\circ$$

14. (c)  $60^\circ$



$$\text{Let } \angle AOC = x^\circ = (4a)^\circ \quad \angle COD = y^\circ = (5a)^\circ \quad \angle BOD = z^\circ = (6a)^\circ$$

Then, we have

$$\angle AOC + \angle COD + \angle BOD = 180^\circ$$

[Since AOB is a straight line]

$$\Rightarrow 4a + 5a + 6a = 180^\circ$$

$$\Rightarrow 15a = 180^\circ$$

$$\Rightarrow a = 12^\circ$$

$$\therefore y = 5 \times a = 5 \times 12^\circ = 60^\circ$$

15. (c)  $140^\circ$

Explanation:  $140^\circ$

From the figure it follows that

$$(3x + 7) + (x + 5) + 40 = 180$$

$$\Rightarrow 4x + 52 = 180$$

$$\Rightarrow 4x = 180 - 52 = 128$$

$$\Rightarrow x = 32$$

Now,

$$\angle AOD = \angle COP + \angle POB$$

$$\Rightarrow \angle AOD = (3x + 7) + (x + 5)$$

$$\Rightarrow \angle AOD = 4x + 12$$

$$\Rightarrow \angle AOD = 4 \times 32 + 12$$

$$\Rightarrow \angle AOD = 128 + 12$$

$$\Rightarrow \angle AOD = 140$$

16. (c)  $50^\circ, 130^\circ$

Explanation:  $50^\circ, 130^\circ$

Given that  $2x = y - 30$

$$\Rightarrow 2x - y = -30 \dots(i)$$

Also,  $x + y = 180 \dots(ii)$

Adding (i) and (ii), we get

$$3x = 150$$

$$\Rightarrow x = 50$$

$$\text{So, } y = 180 - 50 = 130$$

Hence  $x = 50$  and  $y = 130$

17. (c)  $45^\circ$

Explanation: We have:

$$\theta + \phi = 180^\circ [\because \text{AOD is a straight line}]$$

$$\Rightarrow 3\phi + \phi = 180^\circ [\because \theta = 3\phi]$$

$$\Rightarrow 4\phi = 180^\circ$$

$$\Rightarrow \phi = 45^\circ$$

18. (a)  $15^\circ$

Explanation:  $7x + 2x + 3x = 180^\circ$

$$12x = 180^\circ$$

$$x = 15^\circ$$

19. (d) A is false but R is true.

Explanation: Two adjacent angles do not always form a linear pair. In a linear pair of angles, two non-common arms are opposite rays.

20. (b) Both A and R are true but R is not the correct explanation of A.

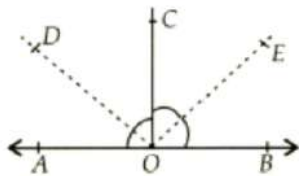
Explanation:  $\angle AOC + \angle BOC = 180^\circ$  [Linear Pair]

$$\frac{1}{2} (\angle AOC + \angle BOC) = \frac{180^\circ}{2}$$

$$\frac{1}{2} \angle AOC + \frac{1}{2} \angle BOC = 90^\circ$$

$$\angle DOC + \angle EOC = 90^\circ$$

The bisectors of the angles of a linear pair are at right angles.



21. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

22. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

23. (d) A is false but R is true.

Explanation: A is false but R is true.

24. (b) (i), (ii) & (iii) are sufficient

Explanation: (i), (ii) & (iii) are sufficient

25. (a) A

Explanation: If two lines intersect then they must lie in one plane but its converse is not necessarily true.

26. (a) Through a given point, only one straight line can be drawn.

Explanation: This statement is false because we can draw infinitely many straight lines through a given point.

27. (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

28. (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

29. (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

30. (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

31. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

32. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

33. (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

34. (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

# PRE-FOUNDATION

CLASS IX

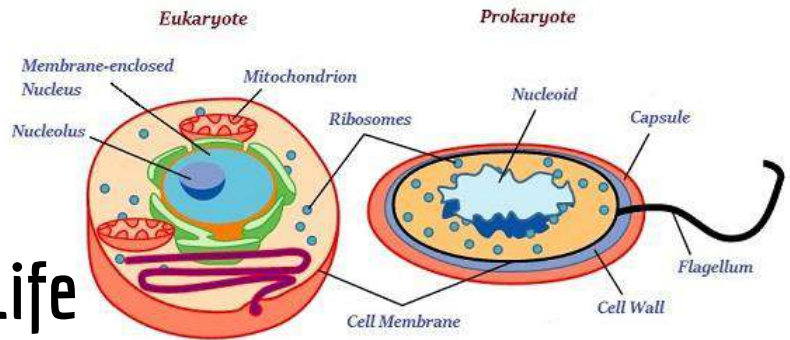
SAMPLE

# BIOLOGY



# CHAPTER-5

## Fundamental Unit of Life



### Chapter Flow

1. Introduction
2. History
3. Cell Theory
4. Types Of Cell & Organism
5. Cell Structure, Shape, Size and Number
  1. Structure of Cell
  2. Shape of Cell
  3. Size of Cells
  4. Number of Cells
6. Microscope
7. Parts of A Cell
  1. Plasma Membrane or Cell Membrane
  2. Nucleus
  3. Cytoplasm
8. Cell Organelles Found In Eukaryotic Cells
9. Cell and Their Types
10. Cell Division

DPP-1

DPP-2

DPP-3

DPP-4

Exercise-1 NCERT Basics

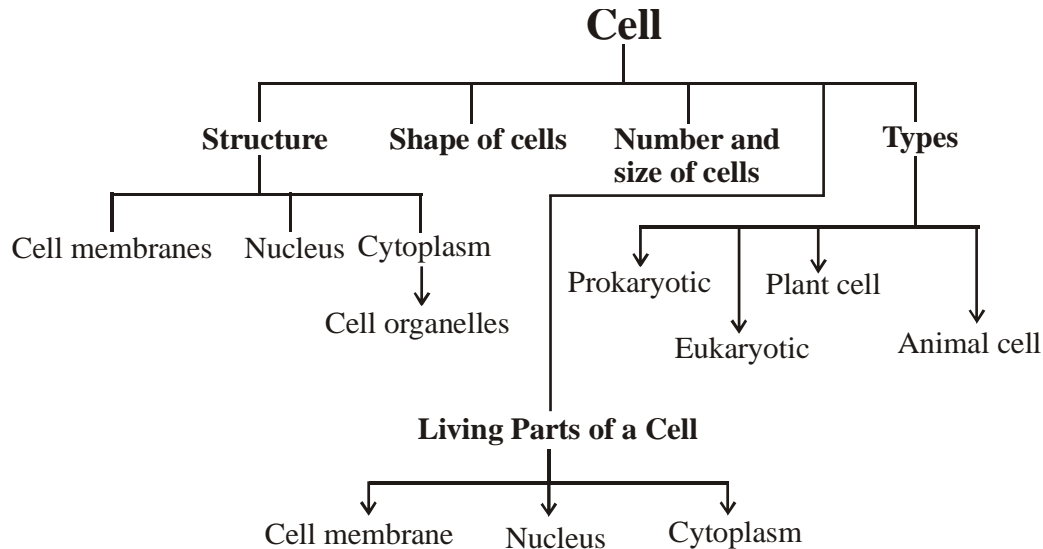
Exercise-2 Concept Mastery

Exercise-3 Accuracy Booster

 Quick Exam Revision

# Fundamental Unit of Life

## 1. Introduction



- **Cell is the structural and functional unit of all life forms.**
- A single cell organism such as **bacteria, Amoeba and Chlamydomonas** are also a type of life forms.
- **The microscopic study of cell is called Cytology.**
- **A cell may be defined as a unit of protoplasm surrounded by a membrane.**

## 2. History

- **A.V. Leeuwenhoek (1632 – 1723)**, a first person to construct a microscope. He discovered the minute forms of life such as bacteria and single-celled animals like **Infusoria** in a drop of water.
- Cells were first discovered by **Robert Hooke (1665)**, in a cork slice. He gave details about cell in his book "**Micrographia**" and described cell as honey comb lattice.
- **Leeuwenhoek (1674)** with the improved microscope, discovered the free cells of bacteria for the first time.
- **Robert Brown** in **1831**, discovered the **nucleus** in the cell.
- **J.E. Purkinje** in **1839** gave the term '**protoplasm**' for the **living fluid substance of the cell**.
- The cell theory was presented by two German biologists, **M.Schleiden (1838)** and **T. Schwann (1839)**.
- In 1855, **Rudolf Virchow** said, "Omnis cellulae cellula", (cells arise from pre-existing cells).

## 3. Cell Theory

- Two biologists, "**Schleiden and Schwann**" gave the "**Cell theory**" which was later on expanded by "**Rudolf Virchow**". Cell theory states that
  - (i) All plants and animals are composed of cells.

- (ii) Cell is the basic unit of life.
- (iii) All cells arise from pre-existing cells.



**Do you know**

Viruses are the exceptions of cell theory.

#### 4. Types of Cell & Organism

**(a) On the Basis of Number of Cells Organisms can be categorized as :**

- (i) **Unicellular organisms** : These are organisms which made up of single cell only. This single cell Performs all the vital body functions of an organism. e.g. Amoeba.
- (ii) **Multicellular organisms** : These are the organisms which made up of numerous cells. These cells then combine to form an organ and group of organs performing different functions forms an organ system which further forms an organism. e.g. plants and animals.

**(b) On the basis of type of organization, cells are of two types :**

- (i) **Prokaryotic cells** : These are primitive and incomplete cells. They have less developed nucleus without nuclear membrane & nucleolus. e.g. Bacteria.
- (ii) **Eukaryotic cells** : These are well developed cells. They have advanced nucleus with unclear membrane and nucleolus. e.g. Plants & animals.

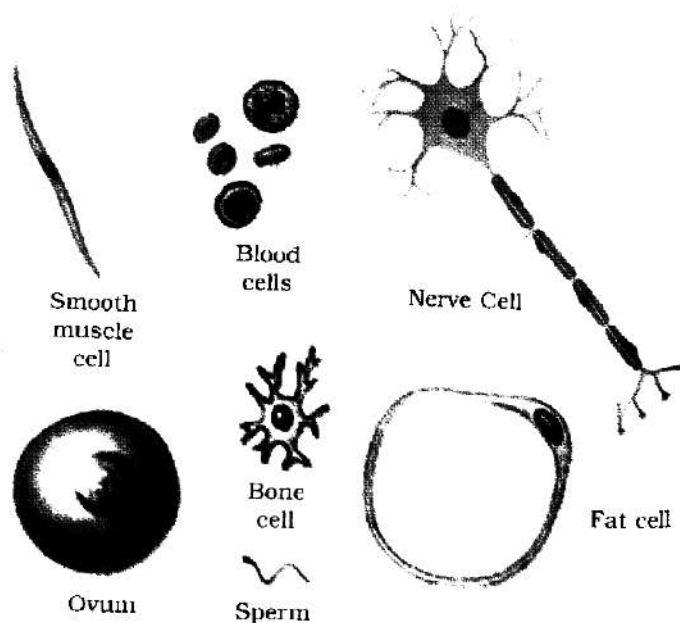
#### 5. Cell Structure, Shape, Size and Number

##### 1. Structure of Cell

- All cells have three major functional regions, viz. plasma membrane, nucleus and cytoplasm.
- The **cytologists** divide the cell into two major components – the nucleus and the cytoplasm, with the development of electron microscope, whose magnifying power is of the order  $16 \times 10^5$ .

##### 2. Shape of Cell

- There is a great variation in the shape of cells. The shape of cell is usually related to its function.



### 3. Size of Cells

- The smallest cells (0.1 – 0.2  $\mu\text{m}$ ) are found as bacteria and **pleuropneumonia-like organisms (PPLO)**, eg. **Mycoplasma galliseptum**.
- The largest cell is the egg of an Ostrich which measures about 180  $\mu\text{m}$  in diameter.
- The largest human cell is the female ovum (0.01 mm in diameter).
- The smallest human cell is the red blood cell (0.0075 mm or 7.5  $\mu\text{m}$ ).



#### Do you know

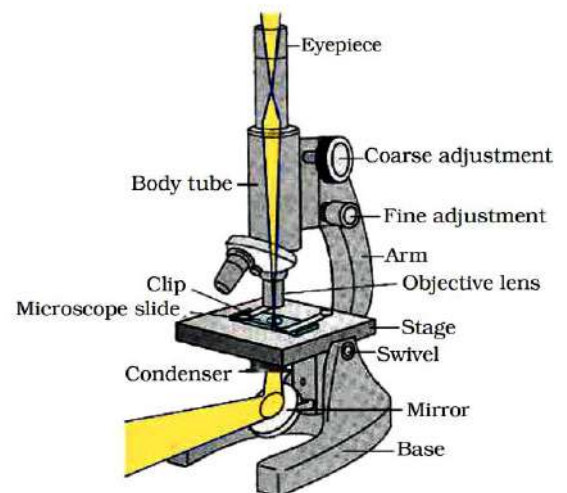
**Cells are measured in micrometres. A micrometer is one thousandth of a millimetre.**

### 4. Number of Cells

- The number of cells in living organisms also varies greatly. In unicellular organisms, a single cell constitutes its body eg. **Chlamydomonas, Amoeba and Paramecium (Protist Organisms)**.
- On the other hand, in human body, the estimated number of cells is about 26 trillion.

### 6. Microscope

- **A Microscope is an instrument which magnifies the object seen through it.**
- **Resolving Power of a Microscope :** In addition to magnifying a specimen, microscope must produce a clear image of the closely spaced parts. The ability to provide such an image is called the resolving power of a microscope.



### 7. Parts of A Cell

#### 1. Plasma membrane or Cell membrane

#### 2. Nucleus

- |                      |                        |
|----------------------|------------------------|
| (a) Nuclear membrane | (b) Nucleolus          |
| (c) Nucleoplasm      | (d) Chromatin material |

#### 3. Cytoplasm : Contain various cell organelles

- |                               |                   |
|-------------------------------|-------------------|
| (a) Endoplasmic Reticulum     | (b) Golgi Complex |
| (c) Lysosome                  | (d) Mitochondria  |
| (e) Plastid (plants only)     | (f) Ribosome      |
| (g) Centrosome (animals only) |                   |

#### 1. Plasma Membrane or Cell Membrane

- Every living cell is externally covered by a thin, transparent, elastic, selectively-permeable membrane called- **plasma membrane** or **cell membrane**.
- Present on both prokaryotic and eukaryotic cells.
- Made up of protein and phospholipids.

- Fluid-Mosaic model of plasma membrane is most acceptable. It was proposed by **Singer** and **Nicholson**.
- It helps in exchange of gases i.e. CO<sub>2</sub>, O<sub>2</sub> by the process of **diffusion**.
- “It the movement of molecules from the region of high concentration to the region of low concentration”.

**Example - 1**

- If the perfume bottle is opened in one corner of the room, then the fragrance of the perfume can be smelled on the other corner soon.
- It happens because the fragrance molecules are more concentrated in the perfume bottle.
- The fragrance molecules are nil in the air present in the room.
- The fragrance molecules spread in the air present in the room from the opened perfume bottle just by diffusion.

**Example - 2**

- If a drop of ink is added to the breaker containing water, then the ink slowly spreads in the water.
- It occurs because of diffusion.
- Movement of water takes place by the process of osmosis through it.

**Osmosis**

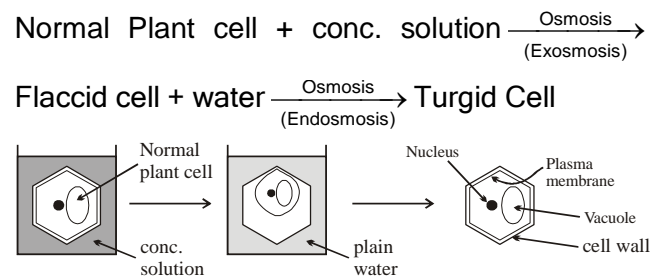
- Is the process of movement of solvent molecules from the region of low concentration to the region of high concentration through semi-permeable membrane.

**Example - 1**

- If the plant cell is placed in a concentrated solution, then the cytoplasm of the cell shrinks.
- The cytoplasm shrinks, since the water (universal solvent) from the cytoplasm moves into the surrounding solution through semi-permeable membrane (plasma-membrane).
- The phenomenon is called “Osmosis”.
- The cell that has lost the water from the cytoplasm is called ‘flaccid cell’.

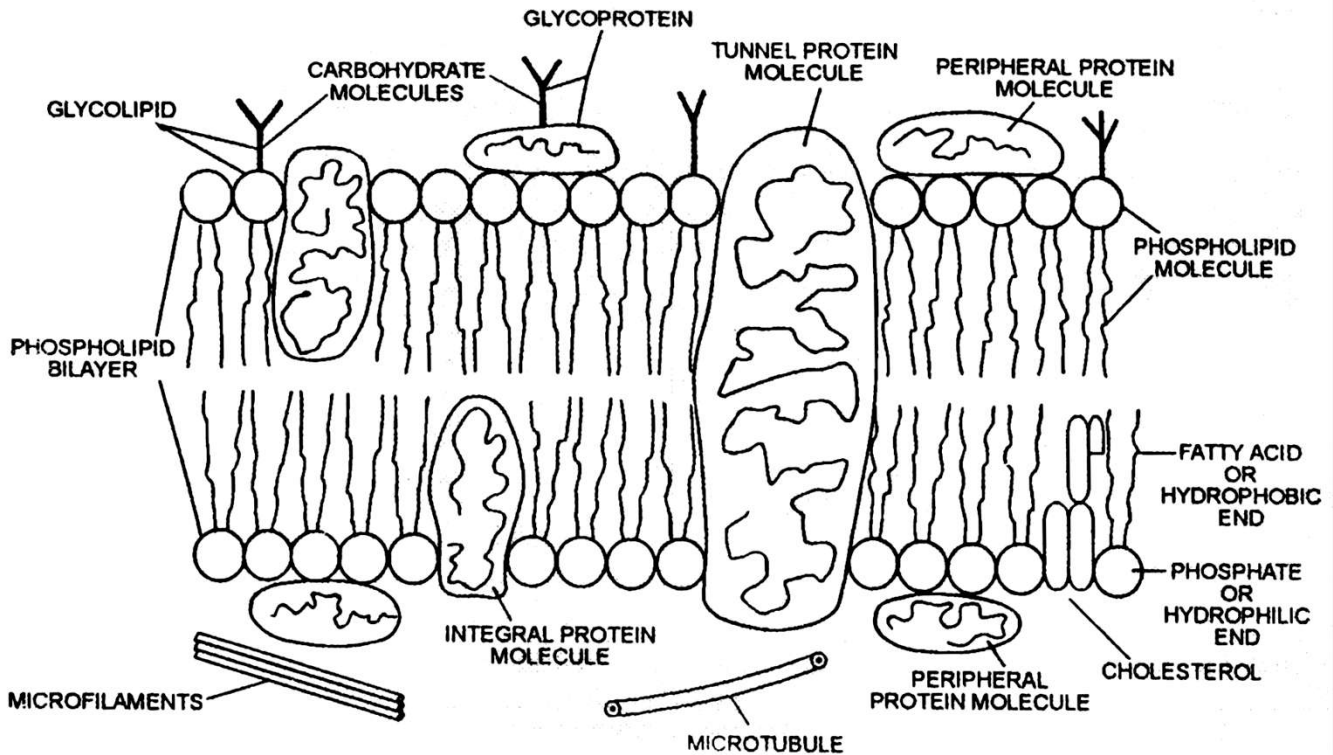
**Example - 2**

- If the flaccid cell is placed in plain water, then the water starts moving into the cell through plasma-membrane.
- The cytoplasm swells and starts exerting the pressure on the cell wall.
- Now the cell is called “turgid cell”.



**Example - 3**

- If the plant cell is kept in the solution that has same concentration (Isotonic) to that of cytoplasm, then there is no much change in the amount and concentration of cytoplasm.
- This occurs because there is no net movement of solvent molecules across the plasma membrane.
- The flexibility of the cell membrane helps the cell to engulf food and other materials from the surrounding. This process is called **endocytosis**. In take of solid food by cells is called **phagocytosis** (cell eating) where as in take of liquid by cells is called **pinocytosis** (cell drinking).



### Functions of Cell Membrane

- It regulates the movement of molecules in and out of the cells.
- It allows selective molecules to pass through it, so called selectively permeable.
- Selective permeability allows the passage of solvent molecules i.e. water. On the basis of this property, cell shows change in its shape according to concentration of surrounding solutions, which are :
  - (i) In isotonic solution, has the same concentration of water and solutes as inside a cell. Cell shows no change in its shape.
  - (ii) In hypotonic solution, has lower solute concentration than inside the cell. Cell becomes turgid.
  - (iii) In hypertonic solution, has higher solute concentration than inside the cell. Cell becomes flaccid.

### Cell wall :

- Outer most, rigid, dead, protective and supportive layer found on all plant cells, bacteria, cyanobacteria and some protists but not found on animal cells.
- Discovered by **Robert Hooke (1666)**.

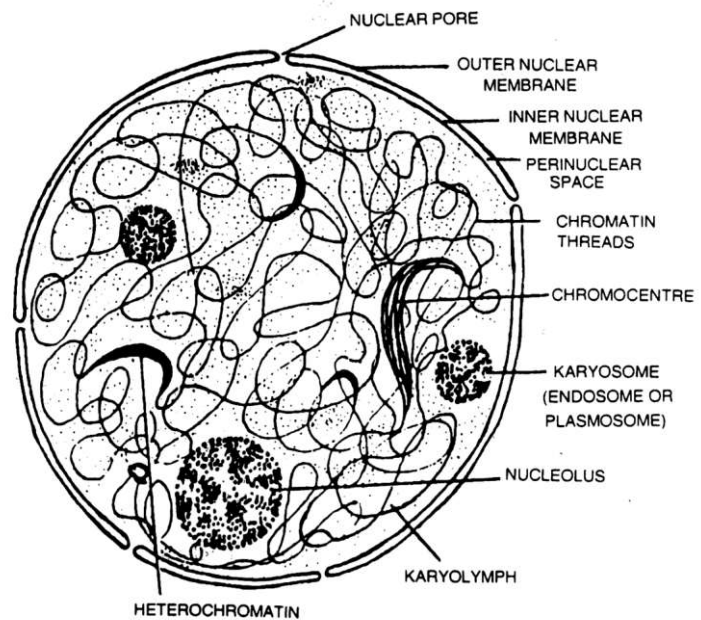
### Function of Cell wall :

- It lies outside the plasma membrane.
- Provide shape and rigidity to cell.
- In plants, it is made up of cellulose, a polymer of glucose.
- In Fungi, it is made up of chitin, a polymer of acetylglucosamine.
- In prokaryotes, it is made up of peptidoglycan, a combination of non-cellulose polysaccharides and amino acids.

- Helps in withstanding hypotonic external media without bursting the cell. In such condition cell absorb water by osmosis, swells up and exerts a pressure on cell wall. It is called turgor pressure (TP). At the same time cell wall exert an equal pressure on Plasma membrane, called wall pressure (WP). In fully turgid cell WP is always equal to TP. Thus, due to cell wall, cell can withstand greater changes in surrounding medium.

## 2. Nucleus

- Important and essential part of the cell is present in cytoplasm and is called 'nucleus'.
- It shows variation in shape and number.
- Most cells are monokaryotic with (single nucleus) but RBCs of mammals are enucleate, **Paramecium** is binucleate, **Opalina** is multinucleate.
- **Robert Brown (1831)** described it for the first time.
- In prokaryotic cells well defined nucleus is absent due to the absence of nuclear membrane. Such undefined nuclear region is called **nucleoid** or **genophore**.



### Do you know

**Nucleus was discovered by an English biologist, Robert Brown in 1831.**

### Structure :

- It is generally spherical or oval in shape.
- It is formed of four components.

#### (a) Nuclear Membrane :

- It is bilayered, also called nuclear envelope or nucleolemma.
- Has nuclear pores that allow exchange of substances between nucleus and cytoplasm.

#### (b) Nucleolus :

- 1<sup>st</sup> observed by **Fontana** (1781).
- It is most prominent in non dividing cell.
- It is a store house of RNA. Helps in synthesis of ribosomes.



### Do you know

**Nucleolus is known as the factory of ribosome.**

**(c) Nucleoplasm :**

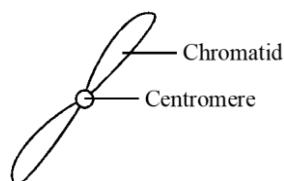
- Transparent, homogenous, semifluid substance, has chromatin material and nucleolus.
- Has water, sugar, minerals and various enzymes.

**(d) Chromatin material :**






- First reported by **W. Flemming (1882)**.
- Made up of DNA with genes.
- Genes are linearly arranged on DNA.
- Change in DNA produce variations.
- Since DNA can be coloured (stained) and is in the form of net-work, it is also called chromatin network.
- By coiling (or condensation), chromatin material can form chromosomes.

**Chromosome :**

- Appear only at the time of cell division inside the nucleus.
- Appear by coiling and condensation of DNA.
- DNA coil around the histone proteins, so chromosomes are said to be made of nucleo-proteins (since DNA is a nucleic acid).
- Chroma means colour or stain or dye and soma means body.
- Since chromosomes can be coloured or stained, these are given the name 'chromosomes'.
- The term chromosome was used for the first time by Waldeyer.
- Chromosomes appear as rod or thread shaped structures.
- Since DNA has genes on it, DNA is called 'genetic material'.
- Since chromosome are made of DNA, that in turn has genes, chromosomes carry genetic information from one generation to the next generation.
- Thus the chromosomes are called 'the vehicles of heredity'.
- Structure of a typical chromosome :



- On the basis of the position of centromere on the chromosome, chromosomes are of following types.

- |                                |   |   |
|--------------------------------|---|---|
| 1. Metacentric or V-shaped     | → |  |
| 2. Sub-metacentric or L-shaped | → |  |
| 3. Acrocentric or j-shaped     | → |  |
| 4. Telocentric or i-shaped     | → |  |
| 5. Acentric                    | → |  |

### Functions :

- Controls all cellular activities.
- Chromosome contains hereditary informations of the cell and transfer the genetic information from one generation to another.
- Plays central role in cellular reproduction. It determines the way in which cell will develop.

### 3. Cytoplasm

- Part of cell present outside the nucleus and inside the cell membrane is called cytoplasm. Has various organelles to perform various activities of cell like digestion, synthesis, release of energy etc.
- Cytoplasm is an aqueous jelly with H<sub>2</sub>O, Oxygen, Carbohydrates, lipids, proteins, amino acids etc.
- Organelles are primitive in Prokaryotic cells.

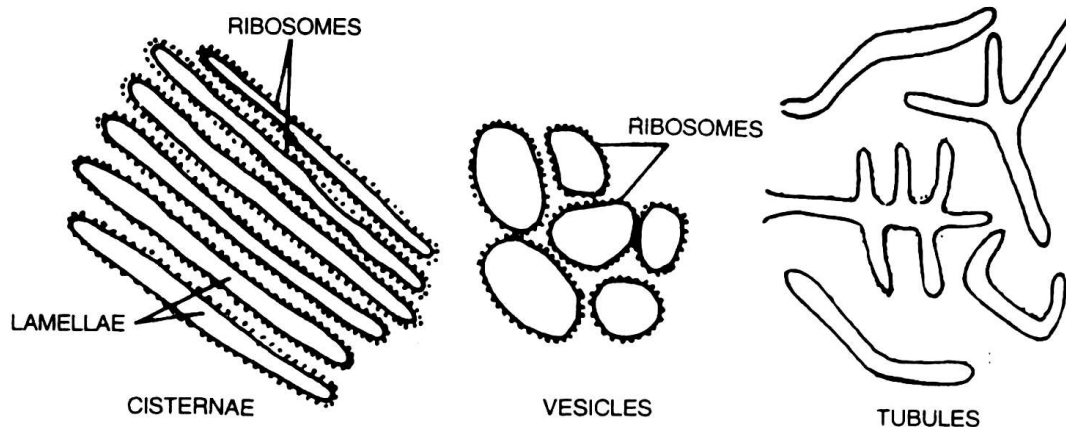
#### **Knowledge Enhancer**

On the basis of membranous covering, cell organelles are divided into three types :

- Membrane less organelles** – Example : Ribosomes.
- Single membrane bound organelles** – Example : Endoplasmic reticulum, Golgi bodies, Lysosomes, Vacuoles.
- Double membrane bound organelles** – Example : Mitochondria and plastids.

### 8. Cell Organelles Found In Eukaryotic Cells

#### (a) Endoplasmic Reticulum (ER)



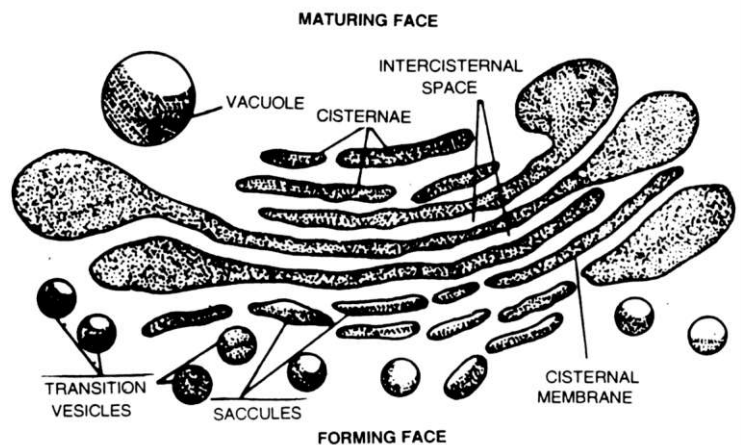
- First observed by **Garnier (1897)**, then ER the term was given by **Porter (1952)**.
- Membranous network, enclosing a fluid-filled lumen present through out the cytoplasm.
- Absent in prokaryotes.
- Made up of three types of elements i.e. Cisternae, Vesicles and Tubules.
- On the basis of presence or absence of ribosomes, ER is of two types
  - (a) Smooth or agranular endoplasmic reticulum (SER)
  - (b) Rough or granular endoplasmic reticulum (RER).

**Functions :**

- Helps in transportation of materials between various regions of the cytoplasm or between the cytoplasm and the nucleus.
- Act as cytoskeleton and provide mechanical support and shape to cell.
- RER helps in synthesis of proteins which are sent to various places in the cell depending on need. SER helps in lipid synthesis.
- Some proteins and lipids synthesized in ER are used for producing cell membrane the process is called **membrane biogenesis**.
- Some proteins and lipids synthesized by ER also work as hormones and enzymes.
- ER forms cytoplasmic frame work and provide surface for biochemical activities.
- In liver cells of vertebrates, SER helps in detoxifying many poisons and drugs.

**(b) Golgi Apparatus :**

- First described by **Camilo Golgi (1898)**, by using black reaction staining technique.
- In animal cells it lies above the nucleus. In plant cells, it is scattered in the cytoplasm and is called **dictyosomes**.
- Shape varies and depends on functional state of the cell called **pleomorphic** organelles.
- It consist of set of smooth, flattened cisternae, vacuoles, vesicles.
- Its membrane is connected with membrane of ER and make another cellular membrane system.



**Function :**

- Golgi apparatus helps in packing and dispatching various materials synthesized near ER to inside and outside the cell.
- It helps in storage, modification and packaging of products in vesicles.
- Some time it may form complex sugar from simple sugar.
- Also forms lysosomes, by converting proteins into enzymes.



**Do you know**

**Golgi body is a single complex in animal cells while in plant cells, it is formed of separate units called dictyosomes.**

**(c) Lysosomes :**

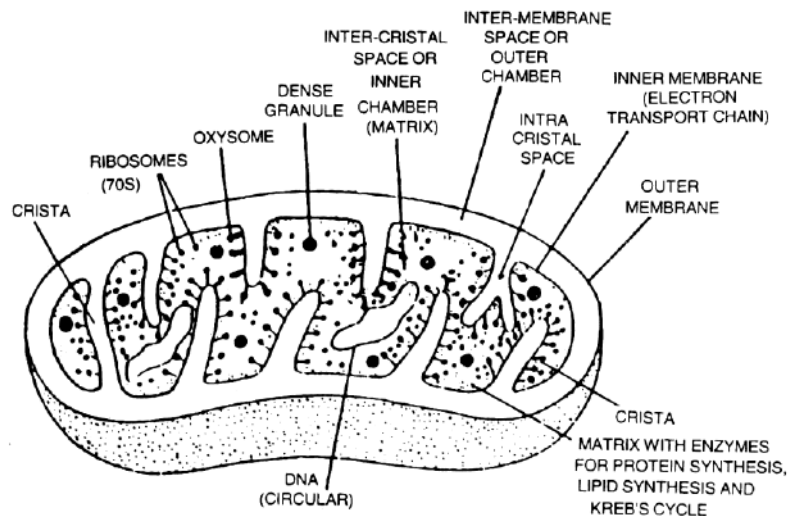
- Discovered by **de Duve (1955)**.
- Membrane-bound vesicles formed by SER or golgi apparatus.
- Contain strong hydrolytic enzyme capable of digesting or breaking down all organic materials, these enzymes are synthesized by RER.

**Function :**

- Helps in intracellular digestion, so called digestive bags.
- Destroy any foreign material inside cell such as bacteria etc.
- Also remove the worn-out and poorly working cell organelles by digesting them. Hence, make a waste disposal system of the cell and keep the cell clean.
- During disturbance in cellular metabolism, Lysosomes get burst and its enzyme digest their own cell. Thus, Lysosomes are also called **suicidal bags** of cell.

**(d) Mitochondria :**

- It was first observed by Altman and was later explained by Kollikar.
- Name mitochondria was given by **Benda (1897-98)**.
- Rod-shaped, double membranous cell organelles, called **power-house of cell**.
- Outer membrane is smooth and porous but inner one is folded into finger like cristae, for ATP generating reactions.
- On cristae oxysomes are present, which are the main site of ATP generation.



**Function :**

- Main cell organelles that help in aerobic respiration.
- Release energy required in the form of ATP (Adenosine triphosphate). ATP is called **energy currency**.
- ATP is used for making new chemical compounds and for mechanical works.
- Mitochondria have their own circular DNA and ribosomes. So, regarded as **semi-autonomous** and **self-replicating cell organelles**.

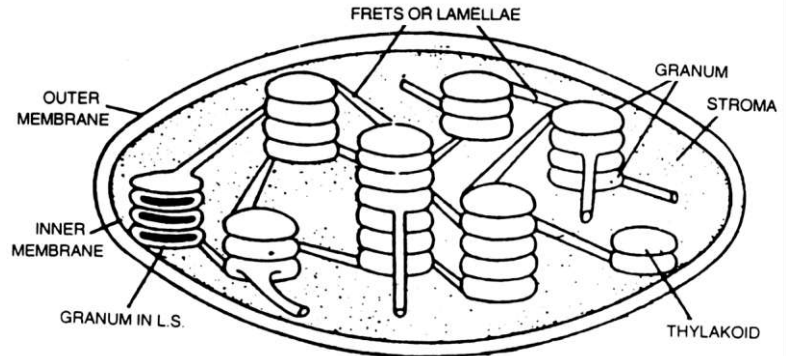


**Do you know**

**ATP = Adenosine Triphosphate. ATP is known as energy currency of the cell. It is a common cellular fuel that drives many energy-requiring processes of the cell.**

**(e) Plastids :**

- Term plastid was given by **Haeckel (1866)**.
- Found in all plant cells and some protists.
- These are double-membranous and have their own DNA. Thus, called **semi-autonomous and self-replicating** cell organelles.
- In photosynthetic prokaryotic bacteria chlorophyll is associated with membranous vesicles (but not with plastids).
- Schimper used the term plastid for the first time in 1885 and classified plastids as :



**(i) Leucoplasts :** Colourless plastids that store starch, oil and proteins.

**(ii) Chromoplasts :** Coloured plastids other than green. Contain several pigments and provide colour to petals, fruits etc.

**(iii) Chloroplast :** Green coloured plastids, found in leaf and other green parts of plants. Help in photosynthesis to prepare carbohydrates. So, are called **kitchen of the cell**.

- Two membranes of chloroplast surround colourless, proteinaceous matrix called **stroma**, containing DNA, ribosomes and enzymes etc. In stroma dark reaction of photosynthesis takes place.
- Stroma contain flat, membranous disc like structures called **thylakoids**, and their group forms granum.
- Grana are connected by stroma lamellae.
- In side grana chlorophyll molecules are present. So, in grana light reaction of photosynthesis occurs.



**Do you know**

**Granum is the site of light reaction during photosynthesis while stroma is the site of dark reaction during photosynthesis.**

**(f) Ribosome**

- First observed by **Claude (1941)** through electron microscope and called **microsome**.
- Name ribosome was given by **Palade (1955)**.
- Smallest cell organelle found in both prokaryotic and eukaryotic cells.
- Not surrounded by membrane.
- Are of two types on the basis of size and Swedberg unit or sedimentation coefficient i.e.
  - (a) 70S ribosomes :** Found in prokaryotes and have two sub units (i.e. 50S and 30S).
  - (b) 80S ribosomes :** Found in eukaryotes and have two sub units (that is 60S and 40S).

**Function :**

- Main site of protein synthesis.

### (g) Centrosome

- Formed by two granules called **centrioles**, surrounded by transparent area called **centrosphere**.
- Found in all animal cells except mature RBC and nerve cell. Also found in most of protists, motile plant cells.

#### Function :

- Forms asters during cell division of animal cells.
- Forms basal-bodies of cilia and flagella.

### (h) Peroxisomes

- Small, membrane bound sacs and contain powerful oxidative enzymes.
- Mostly found in kidney and liver cells.

#### Function :

- In plants, help in photorespiration.
- Carrying out some oxidative reactions and help in removal of toxic substances.

### (i) Vacuoles

- These are uni-membranous sacs for storage of solid or liquid, nutrients
- Outer membrane is called **tonoplast**.
- Small and few in animal cells but large and well developed in plant cells.
- Centrally placed in plant cells and may occupy 50-90% of the cell volume.

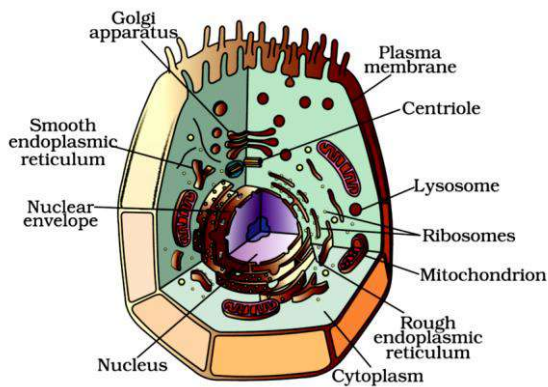
#### Function :

- Store some proteins, amino acids, sugars, various organic acids etc., that are essential for plant cells.
- In amoeba, store food called and so are called food vacuoles.
- In some unicellular, aquatic organisms vacuole helps in expelling excess water and some wastes from the cell and are called **contractile vacuole (CV)**.

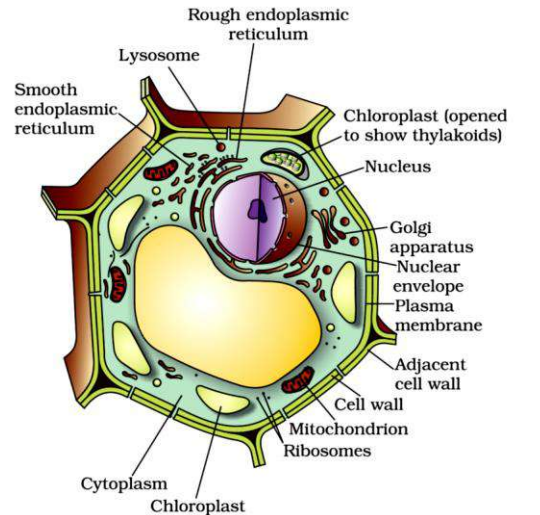
### (j) Cell Inclusions

- On the basis of nature, cell inclusions are classified as :
  1. Reserve product: Carbohydrates, fats and oils, yolk (in animals), proteins.
  2. Secretory Products: Enzymes, pigments, nectar (in plants).
  3. Waste products (in plants): Mineral crystals, gums and resins, latex, alkaloids (e.g. nicotine, morphine, quinine), tannin and essential oils.

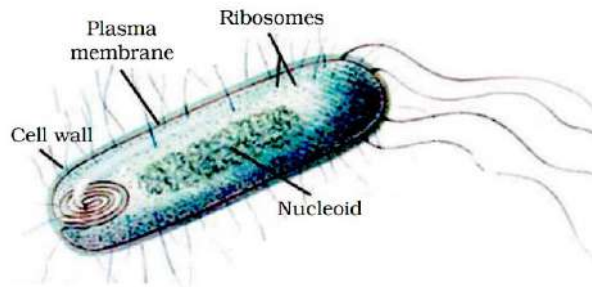
**9. Cell and Their Types**



**Animal Cell**



**Plant cell**



**Bacterial Cell**

**Differences between prokaryotic and eukaryotic cell**

Prokaryotic Cell	Eukaryotic Cell
1. Size is generally small (1 – 10 μm)	1. Size is generally large (5 – 100 μm)
2. Protoplasm is relatively rigid, usually non-vacuolate.	2. Protoplasm is typically more fluid like, generally vacuolate.
<b>3. True nucleus absent, i.e. nuclear membrane and nucleolus are absent.</b>	<b>3. True nucleus present, i.e. nuclear membrane and nucleolus are present.</b>
4. DNA scattered in the protoplasm and without histone proteins.	4. DNA organized with histone proteins to form chromosomes.
5. Membrane-bound cell organelles like plastids, mitochondria, Golgi bodies, E.R. are absent.	5. Membrane-bound cell organelles like plastids mitochondria, Golgi bodies, E.R. are present.
<b>6. Ribosomes are of 70S type.</b>	<b>6. Ribosomes are of 80S type.</b>
7. <b>Examples :</b> Bacteria, blue-green algae, mycoplasma.	7. <b>Examples:</b> Cells of all higher organisms

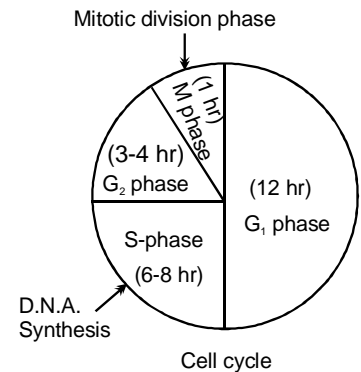
**Differences between plant and animal cells**

Plant cell	Animal cell
1. Plant cells are usually larger than animal cells.	Animal cells are generally small in size.
2. The plasma membrane of a plant cell is surrounded by a rigid cell wall.	Cell wall is absent.
3. Plastids (leucoplasts, chloroplasts, chromoplasts) are present in plant cells.	Plastids are absent.
4. Vacuoles are present in abundance. They are larger in size.	Vacuoles are less in number and smaller in size.
5. Plant cells have many simpler units of Golgi complex, called dictyosomes.	Animal cells have a single highly elaborate Golgi complex.
6. Centrioles have not been found in plant cells (except in a few lower plants).	Animal cells possess centrioles.
7. Cytokinesis takes place by cell-plate formation.	Cytokinesis takes place by constriction during cell division.
8. Plant cells usually have a regular shape.	Animal cells are usually irregular in shape.

**10. Cell Division**

Cell division was first observed by Nageli in plant cell (1842) and it was first studied by Prevost and Dumas in the fertilized egg of frog.

- **Cell Cycle** : It is a series of programmed cyclic changes by which the cell duplicates its contents and divides into two daughter cells. Cell cycle was discovered by Howard and Pelc. It is divided into two phases :
  1. Long non dividing (I – phase) or interphase.
  2. Short dividing M – phase or mitotic phase



1. **Long non dividing (I – phase) or interphase or preparatory phase** : Interphase divided in the following steps.
  - **G<sub>1</sub>** (First growth phase),
  - **S** (Synthesis phase),
  - **G<sub>2</sub>** (Second growth phase)
2. **Short dividing M – phase** : It is the phase of cell division. It consists of karyokinesis (nuclear division) and cytokinesis (cytoplasmic division). It is of three types:

**1. Mitosis**

- Term mitosis was given by Flemming.
- It is also called as somatic division as it occurs during formation of body cells.
- It is an equational division in which a parent cell divides into two identical daughter cells, each of them contains the same number of chromosomes as are present in parent cell.
- **It occurs in two steps :**
  - (i) **Karyokinesis**
  - (ii) **Cytokinesis**

(i) **Karyokinesis** : Division of nucleus. It is divided in four steps :

(a) **Prophase** : Longest phase of cell division. In this chromatin condensed into chromosomes and nuclear membrane disappears.

(b) **Metaphase** : Chromosomes are arranged at the equator & forming a metaphase plate. Chromosomes are shortest and thickest in this stage. This phase is most suitable for study of chromosomes.

(c) **Anaphase** : Shortest phase of cell division.

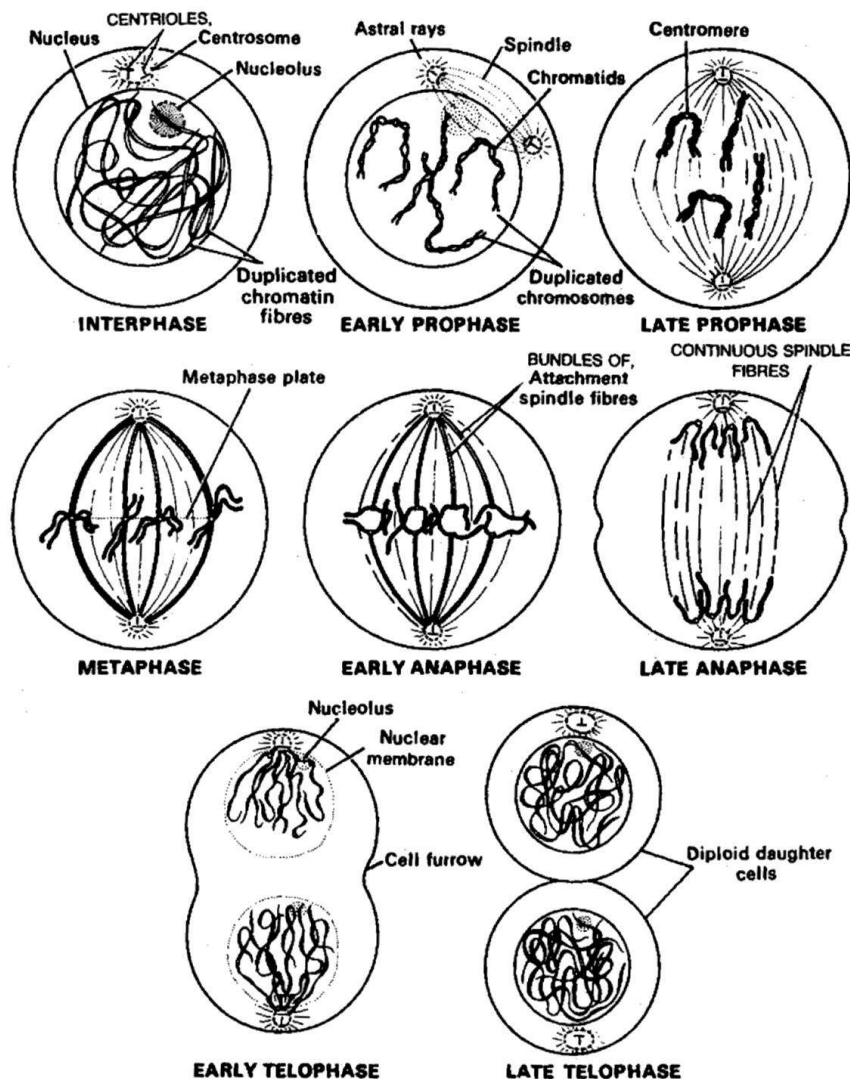
- Chromosomes are appeared in different shapes.
- V – Shaped (Metacentric)
- L – Shaped (Submetacentric)
- J – Shaped (Acrocentric)
- I – Shaped (Telocentric)

(d) **Telophase** : It is reverse of prophase

(ii) **Cytokinesis** : It is referred to the division of cytoplasm.

**In animals it occurs by formation of cleavage furrow in the middle by constriction in plasma membrane. In plants it occurs by cell plate formation.**

**Note** : Colchicine is a mitotic poison. It blocks the completion of metaphase.



Various stages of mitosis.

## 2. Meiosis

- It occurs only once in the life cycle of organism.
- It is a double division in which a diploid cell divides twice to form four haploid cells.
- It can be studied in anthers of unopened flowers in plants and in testis of grasshopper in animals. It consists of two phases :

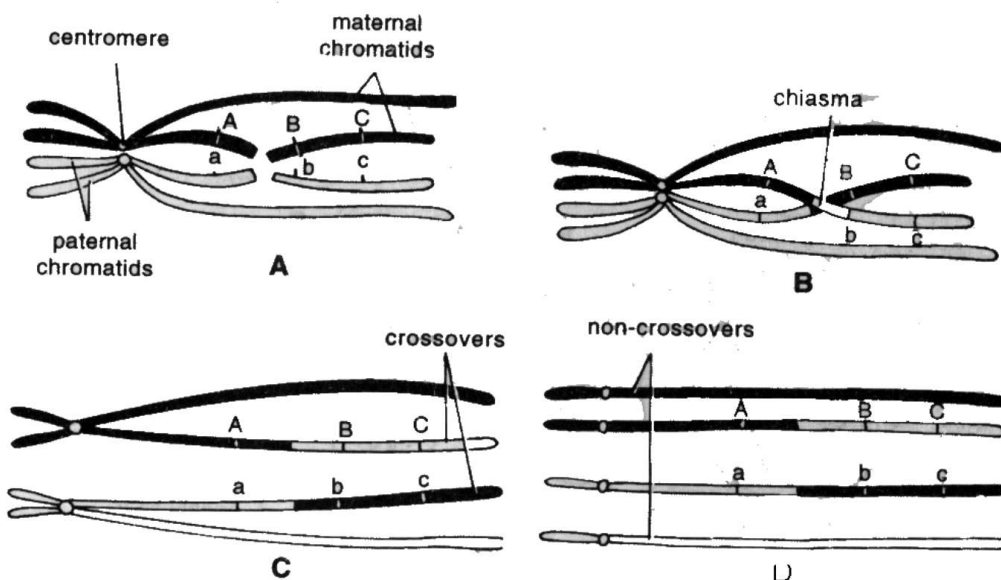
(i) **Interphase** : Size of nucleus increases to three times. It also involves  $G_1 - S -$  phase in meiosis-I and  $G_1 - G_2$  in meiosis-II.

(ii) **M – phase** : It occurs in two steps

(a) Meiosis – I, (b) Meiosis – II

(a) **Meiosis – I** : Also called as reduction division. Diploid stage changes to haploid stage. It occurs in four steps.

- **Prophase – I** : It is the longest phase of meiosis. It has following stages :
- **Leptotene** : Chromatin fibers condense to form chromosomes. There are two chromosomes of each type which are diploid and are called as “homologous chromosomes”.
- **Zygotene** : Synaptonemal complex is formed between two homologous chromosomes.
- **Pachytene** : The exchange of segments between non sister chromatids of chromosome is called as crossing over.
- **Diplotene** : Synaptonemal complex is dissolved, tetrads are cleared. At some places nonsister chromatids of two homologous chromosomes remain attached to form a chiasmata.



Genes or chromatid exchange between homologous chromosomes during meiosis

- **Diakinesis** : Chiasmata shifts towards ends, nucleolus degenerates.
- **Metaphase – I** : Spindles are formed and bivalents form a double whorl or double metaphase plate.
- **Anaphase – I** : Chiasmata disappears, homologous chromosomes separate by disjunction forming dyads. They move towards poles and form two groups of haploid chromosomes.
- **Telophase – I** : Chromosomes elongate, nucleoplasm & nuclear envelope reappears.

**(b) Meiosis – II** : It is also called as equational division and maintains the haploid number of chromosomes. No replication of DNA occurs in this stage (It is similar to mitosis)

- Prophase – II
- Metaphase – II
- Anaphase – II
- Telophase – II

**Differences between mitotic and meiotic cell division**

Mitosis	Meiosis
It occurs in all somatic cells.	It occurs in reproductive cells (germ cells)
In the resultant daughter cells, the number of chromosomes remains the same (i.e., diploid), hence, called equational division.	In resultant daughter cells, the number of chromosomes reduces to half (i.e., haploid), hence, called reductional division.
By mitosis two daughter cells are produced	By meiosis four daughter cells are produced.
During mitosis no crossing over takes place	During meiosis crossing over takes place.
Daughter cells have identical chromosomes which are also identical to that of parent cell (i.e. remains constant)	Chromosomes of the daughter cells are with combined components (genes) of both parents (i.e., genetic variability occurs)

- **Significance of mitosis** : It is essential for growth, repair, differentiation, maintenance of chromosome number etc.
- **Significance of meiosis** : It produces variations and essential for sexual reproduction. It maintains the chromosome number in each generation of living organisms.

**(c) Amitosis** : It was discovered by Remak. In this division, cells are divided into two cells without any particular pattern. e.g. prokaryotic cells.

**DPP-1**

1. "Cell is a unit of life" (OR the term cell was proposed by) :  
 (a) Malpighi                      (b) Leeuwenhoek                      (c) Schleiden                      (d) Hooke
2. Plant cell is characterized by :  
 (a) Presence of wall, absence of vacuole  
 (b) Presence of wall, vacuole starch and the absence of centriole or centrosome.  
 (c) Presence of vacuole and absence of plastids  
 (d) Presence of centriole and lysosomes and absence of plastids.
3. The main difference between an animal and a plant cell is :  
 (a) Plant cells lack rigid cell wall                      (b) Animal cells lack rigid cell wall  
 (c) Plant cells possess small vacuoles                      (d) Animal cells possess large vacuoles
4. Example of unicellular animal is/are :  
 (a) Amoeba                      (b) Paramecium  
 (c) Plasmodium                      (d) All of these
5. Who applied cell theory to plants?  
 (a) Schwann                      (b) Schleiden  
 (c) Swanson                      (d) Jensen

6. Cell theory states that :
- (a) All living cells do mitosis and meiosis (b) All cells are living  
(c) All cells have nucleus (d) Cell is structural unit of all living organisms
7. Selective permeability is the property of :
- (a) Cell membrane (b) Cell wall  
(c) ER & Nuclear membrane (d) All of these
8. Major component of cell membrane is
- (a) Lipid (b) Protein (c) Carbohydrate (d) Nucleic acid

## DPP-2

1. Plasma membrane
- (a) Controls the passage of water and soluble substances in and out of the cell  
(b) Helps in protein synthesis  
(c) Serves as a selective permeable membrane  
(d) (a) and (c)
2. Outermost membrane enclosing the contents of a plant cell is called
- (a) Tonoplast (b) ER (c) Plasmalemma (d) Cell wall
3. Plasma membrane or unit membrane is made up of
- (a) Phosphoprotein and carbohydrate (b) Protein and fat/phospholipid  
(c) Phospholipid/fat and carbohydrate (d) Carbohydrate and fat/phospholipid
4. What is the latest model for the structure of plasmalemma
- (a) Unit membrane model (b) Fluid mosaic model  
(c) Molecular sieve model (d) Sandwich model
5. Controlling centre of a cell is :
- (a) Nucleus (b) Nucleolus (c) Chloroplast (d) Ribosome
6. What happens to a cell, if its nucleus is removed :
- (a) Cell dies (b) Its catabolism increases  
(c) Its metabolism decreases (d) It becomes non-osmotic
7. An enucleated living plant cell is :
- (a) Vessel (b) Tracheid (c) Sieve cell (d) All of the above
8. A Prokaryotic cell does not possess :
- (a) Nuclear membrane (b) Plasma membrane (c) Cell wall (d) Cytoplasm

## DPP-3

1. Main difference between living and non living is the presence of :
- (a) Nucleus and growth (b) Protoplasm  
(c) Mitochondria and cytoplasm (d) Movements
2. Who coined the term protoplasm?
- (a) Dujardin (b) Purkinje (c) Nirenberg (d) Francis P. Roux
3. Protoplasm includes :
- (a) only cytoplasm (b) only nucleus and centrosome  
(c) Both cytoplasm and nucleus (d) None of these

4. The compound present in the largest quantity in an active protoplasm is :  
(a) Glucose                      (b) Fat                              (c) Protein                        (d) Water
5. pH of cytoplasm is :  
(a) Acidic                        (b) Alkaline                        (c) Slightly acidic                (d) Strongly basic
6. The endoskeleton of a cell is made up of :  
(a) Cell wall                      (b) ER                                (c) Cytoplasm                      (d) Mitochondria
7. Which of the cell organelle exhibits maximum polymorphism?  
(a) Lysosome                      (b) Spherosome                      (c) Ribosome                        (d) Dictyosome
8. Which one is not the function of Golgi complex?  
(a) Carbohydrate synthesis                      (b) Formation of Lysosome  
(c) Formation of secretory vesicles                      (d) Digestion of intracellular particles

### **DPP-4**

1. Hydrolytic enzymes are located in :  
(a) Lysosomes                      (b) Ribosomes                      (c) Microsomes                      (d) Mesosomes
2. Maximum Lysosomes occur in :  
(a) Plant cells                      (b) Animal cells                      (c) Both equally                      (d) Bacterial cells
3. Tonoplast is a membrane surrounding the :  
(a) Cytoplasm                      (b) Nucleus                              (c) Vacuole                              (d) Mitochondria
4. What type of protein is synthesized over ribosomes?  
(a) Reserve food protein                              (b) Enzymatic protein  
(c) Flagellar protein                                      (d) All of these
5. Which of the pairs resemble in having the prokaryotic ribosomes :  
(a) Chloroplast and nucleus                              (b) Nucleus and cytoplasm  
(c) Cytoplasm and nucleus                              (d) Mitochondria and chloroplast
6. Within the cell the site of respiration or oxidative phosphorylation is :  
(a) Mitochondria                                      (b) Nucleolus  
(c) Golgi bodies                                      (d) Ribosomes
7. Which cell organelle, transform the light energy into organic material?  
(a) Chromoplast                                      (b) Elioplast and leucoplast  
(c) Chloroplast                                      (d) Mitochondria
8. Plastids contain :  
(a) Microtubules                                      (b) Chromatin network  
(c) Thylakoids                                      (d) Cristae
9. Green tomatoes turn red because :  
(a) Chloroplast turns into chromoplast  
(b) Chloroplast disappears and chromoplast are produced  
(c) Chromoplast overlap the chloroplasts  
(d) Anthocyanins appear in the cell
10. Chloroplasts are called semi-autonomous structures due to the presence of :  
(a) DNA only                                      (b) RNA only  
(c) DNA and RNA                                      (d) Pigments & Proteins

## NCERT Basics

## Exercise-1

1. Make a comparison and write down ways in which plant cells are different from animal cells.
2. How is a prokaryotic cell different from a eukaryotic cell?
3. What would happen if the plasma membrane ruptures or breaks down?
4. What would happen to the life of a cell if there was no Golgi apparatus?
5. Which organelle is known as the powerhouse of the cell? Why?
6. Where do the lipids and proteins constituting the cell membrane get synthesised?
7. How does an Amoeba obtain its food?
8. What is osmosis?
9. Carry out the following osmosis experiment:
  - Take four peeled potato halves and scoops each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,
    - (a) Keep cup A empty
    - (b) Put one teaspoon sugar in cup B
    - (c) Put one teaspoon salt in cup C
    - (d) Put one teaspoon sugar in the boiled potato cup D.Keep these for two hours. Then observe the four potato cups and answer the following:
  - (i) Explain why water gathers in the hollowed portion of B and C.
  - (ii) Why is potato A necessary for this experiment?
  - (iii) Explain why water does not gather in the hollowed out portions of A and D.
10. Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?

## Concept Mastery

## Exercise-2

### A. Very Short Answer Type Questions

1. What is microscope?
2. Name the organelle which show the analogy as packaging and dispatching unit of the cell.
3. Which organelle is associated with ribosome formation?
4. Which organelle serves as a channel for transport of materials between cytoplasm and nucleus?
5. Name the organelle which shows the analogy as transporting channels of the cell.
6. Which organelle is known as the powerhouse of the cell? Why?
7. Why are lysosomes called 'suicidal bags'?
8. Who discovered cells, and how?

### B. Short Answer Type Questions

9. Why is plasma membrane called selectively permeable membrane?
10. A solution of 3% glucose and a solution of 8% glucose are kept in a trough separated by a semipermeable membrane. What will you observe after 1 hour?
11. What are the differences between cell wall and cell membrane?

12. How are the following related to each other?

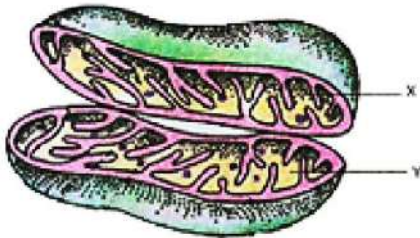
- i. Chromatin network and chromosomes
- ii. Chloroplast and chlorophyll
- iii. Genes and DNA

13. Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	Eukaryotic Cell
1. Size. Generally small (1 – 10 $\mu\text{m}$ ).	1. Size. Generally large (5 – 100 $\mu\text{m}$ ).
2. Nuclear Region _____ and known as _____	2. Nuclear Region. Well defined and surrounded by a nuclear membrane.
3. Chromosomes. Single	3. More than one Chromosome
4. Membrane Bound Cell Organelles. Absent.	4. _____

14. Differentiate between diffusion and osmosis. What is its importance?

15.



- a. Label X and Y
- b. What is the function of X?
- c. What is the composition of Y?
- d. Identify the above diagram and what is its common name?

### C. Long Answer Type Questions

16. Draw a well-labeled diagram of a eukaryotic nucleus. How is it different from the nucleoid?

17. Write the main function of each of the following.

- |                     |                           |
|---------------------|---------------------------|
| (a) Plasma membrane | (b) cell wall             |
| (c) Ribosome        | (d) Lysosome              |
| (e) Nucleolus       | (f) Endoplasmic reticulum |

18. i. State what will happen when human red blood cells are placed in a hypotonic salt/sugar solution.

ii. Why plant cell shrinks when kept in a hypertonic solution.

iii. Why lysosomes are known as suicidal bags?

19. Write the main functions of atleast ten cell components.

20. What are cell organelles? Write the names of different cell organelles.

### D. True & False

21. (a) There is a division of labor in multicellular organisms.

(b) Some substances like carbon dioxide or oxygen can move across the cell membrane by a process called osmosis.

(c) The mitochondria control all the metabolic activities of the cell.

(d) Passive transport is the movement of any substance through the cell membrane that requires energy.

(e) There are some organisms that are single-celled but can live their own.

**E. Fill in the Blanks**


22. (a) \_\_\_\_\_ are fluid-filled sacs bound by a single membrane.  
(b) Nucleoid is an undefined nuclear region of the \_\_\_\_\_ cell, containing the genetic material.  
(c) The inward transport of substances in solid form is called \_\_\_\_\_.  
(d) Organism consisting of more than one cell, wherein the differentiated cells perform specialized functions in the organism is called a \_\_\_\_\_ organism.

**Accuracy Booster**

**Exercise-3**

**A. Multiple Choice Questions**

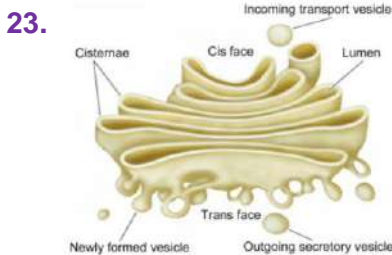
1. The structure/organelle of a cell that functions as a passage for intracellular transport as well as a manufacturing surface is:  
(a) endoplasmic reticulum (b) plastids  
(c) plasma membrane (d) ribosome
2. The basic building units of an onion bulb, are called \_\_\_\_\_.  
(a) scales (b) cells  
(c) roots (d) tissues
3. Cell-wall of plant cell is made up of cellulose. Which of the following is not able to digest cellulose?  
(a) Goat (b) Human beings  
(c) Deer (d) Cow
4. 1  $\mu\text{m}$  is  
(a) 10<sup>-3</sup> m (b) 10<sup>-10</sup> m  
(c) 10<sup>-9</sup> m (d) 10<sup>-6</sup> m
5. Kitchen of the cells  
(a) Golgi apparatus (b) Endoplasmic reticulum  
(c) Chloroplast (d) Mitochondria
6. Robert Brown is a well known scientist as he discovered \_\_\_\_\_.  
(a) Lysosome (b) Cell  
(c) Nucleus (d) Vacuole
7. Lipid molecules in the cell are synthesized by  
(a) Plastids (b) Rough endoplasmic reticulum  
(c) Golgi apparatus (d) Smooth endoplasmic reticulum
8. The membrane of the Golgi apparatus has connections with those of:  
(a) nuclear membrane (b) endoplasmic reticulum  
(c) cell membrane (d) mitochondria
9. Chromosomes are made up of  
(a) RNA (b) DNA  
(c) DNA and protein (d) Protein
10. The site of detoxification in liver cells is:  
(a) SER (b) lysosome  
(c) ribosome (d) RER

11. Organelle without a cell membrane is  
 (a) Ribosome (b) Golgi apparatus  
 (c) Chloroplast (d) Nucleus
12. If a plant cell is kept in a hypotonic solution, it will:  
 (a) increase in its volume (b) the decrease in its volume  
 (c) burst (d) maintain the same volume
13. A cell will swell up if  
 (a) The concentration of water molecules in the surrounding medium is higher than water molecules concentration in the cell.  
 (b) The concentration of water molecules is the same in the cell and in the surrounding medium.  
 (c) The concentration of water molecules does not matter.  
 (d) The concentration of water molecules in the cell is higher than the concentration of water molecules in the surrounding medium.
14. Following are a few definitions of osmosis read carefully and select the correct definition.  
 (a) Movement of solvent molecules from its higher concentration to lower concentration  
 (b) Movement of solvent molecules from higher concentration to lower concentration of solution through a permeable membrane  
 (c) Movement of solute molecules from lower concentration to higher concentration of solution through a semipermeable membrane  
 (d) Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane
15. A cell has 10 chromosomes. After mitotic cell division, the number of chromosomes in the daughter cell will be:  
 (a) 10 (b) 4  
 (c) 20 (d) 5
16. Which of these options are not a function of Ribosomes?  
 i. It helps in manufacture of protein molecules  
 ii. It helps in manufacture of enzymes  
 iii. It helps in manufacture of hormones  
 iv. It helps in manufacture of starch molecules  
 (a) (iii) and (iv) (b) (iv) and (i)  
 (c) (i) and (ii) (d) (ii) and (iii)
17. Which of the following is correct for the given figure?  
 (a) The parts labelled 'a', 'b' and 'c', all possess photosynthetic pigments such as chlorophyll.  
 (b) The part labelled 'a' is the site of dark reaction.  
 (c) The part labelled 'c' is called granum.  
 (d) The part labelled 'b' is called intergranal thylakoid.
- 
18. Analyze the statements and pick up the right one regarding mitochondrial membranes from the following:  
 (a) Mostly mitochondria have a single membrane  
 (b) The inner membrane is longer than the outer membrane  
 (c) The outer membrane is longer than the inner membrane  
 (d) Both the inner and the outer membranes are almost equal in length

19. Where are proteins synthesised inside the cells?  
 (a) Over the Nucleus  
 (b) Over centrosome  
 (c) Over the Ribosomes  
 (d) Over Golgi bodies
20. Select the cell that contains starch: Name it

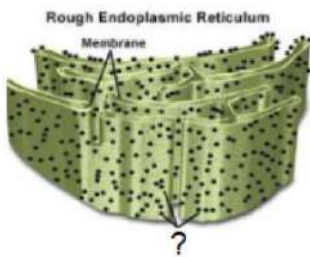


- (a) Onion cell  
 (b) Cheek cell  
 (c) Prokaryotic cell  
 (d) Amyloplast
21. Membrane-bound cell organelles are not found in \_\_\_\_\_ cells.  
 (a) Fungal  
 (b) Eukaryotic  
 (c) Prokaryotic  
 (d) Amoeba
22. In plant cells, \_\_\_\_\_ perform the function of centrioles.  
 (a) Polar cap  
 (b) Leucoplast  
 (c) Stroma  
 (d) Spindle fibres



Identify the above-given cell organelle. Mention its location.

- (a) Golgi apparatus, near nucleus  
 (b) Ribosome, on the endoplasmic reticulum  
 (c) Endoplasmic reticulum, cytoplasm  
 (d) Golgi apparatus, away from nucleus
- 24.



Identify the black dots that are shown in the above figure and mention its function.

- (a) Lysosome, cell digestion  
 (b) Nucleus, controls lipid synthesis  
 (c) Ribosome, helps in protein synthesis  
 (d) Golgi bodies, secretion of enzymes
25. Select the odd one out  
 (a) Molecules soluble in an organic solvent can easily pass through the membrane.  
 (b) The movement of water across a semi-permeable membrane is affected by the number of substances dissolved in it.  
 (c) The plasma membrane contains chitin and sugar in plants.  
 (d) Membranes are made up of organic molecules like proteins and lipids.

**B. Assertion & Reason Questions**

- 26. Assertion(A):** Lysosome is called a suicidal bag.  
**Reason(R):** Lysosomes contain certain digestive enzymes that help to auto digest the cell in case if there is an infection.
- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true and R is not the correct explanation of A.  
(c) A is true and R is false.  
(d) A is false and R is true.
- 27. Assertion (A):** Cell vomiting process occurs in cells to remove undigested substances, secrete hormones, enzymes, and transport various substances.  
**Reason (R):** Cell vomiting is a process in which the waste materials from the cell are extruded through the plasma membrane by diffusing the vesicles containing materials needs to be taken out of the body.
- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true and R is not the correct explanation of A.  
(c) A is true and R is false.  
(d) A is false and R is true.
- 28. Assertion (A):** Plant cells have very large vacuoles.  
**Reason (R):** In plant cells, vacuoles are full of cell sap.
- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true and R is not the correct explanation of A.  
(c) A is true and R is false.  
(d) A is false and R is true.
- 29. Assertion (A):** Mitochondria and chloroplasts are semiautonomous organelles.  
**Reason (R):** They are formed by the division of pre-existing organelles and contain DNA but lack protein-synthesizing machinery.
- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true and R is not the correct explanation of A.  
(c) A is true and R is false.  
(d) A is false and R is true.

**C. Statement Type Questions**

- 30. Statement A:** The secreted proteins are packed inside the secretory vesicles which are pinched off from the Golgi apparatus.  
**Statement B:** ER is absent in the red blood cells of mammals.
- Which of the two statement(s) is/are true?
- (a) Neither statement A nor statement B  
(b) Statement B  
(c) Both the statements - A and B  
(d) Statement A
- 31. Identify the correct statement:**
- A. The double membrane is present in the nucleus.  
B. A liver cell carries about 500-1000 mitochondria.  
C. Wood contains the largest amount of cellulose.  
D. All the statements are correct.
- (a) (A) (b) (D)  
(c) (C) (d) (B)

32. Find the incorrect statement:

- A. Root tips are permanent tissue.
- B. Mycoplasma gallisepticum is the smallest cell among the unicellular organisms.
- C. Acetabularia measures nearly 10 cm in height.
- D. Tonoplast is the membrane surrounding the vacuole.

- (a) (B) (b) (D)
- (c) (A) (d) (C)

33. Select the incorrect statement.

- i. Osmosis is a slow process, occurs down the concentration gradient and does not expend energy.
- ii. Electron microscope uses very high voltage electricity. It uses electromagnets instead of glass lenses and beam of electrons instead of light.
- iii. A semipermeable membrane does not allow both solvent and solute molecules to pass through it.
- iv. Active transport of materials is rapid and usually occurs against the concentration gradient involving carrier proteins and energy in the form of ATP.

- (a) Statement (i) is correct. (b) Statement (iv) is correct.
- (c) Statement (ii) is correct. (d) Statement (iii) is correct.

**D. Match The Column**

34. Match the following Column A with Column B:

Column A	Column B
(a) Mitochondria	(i) Helps in cell division in the animal cell
(b) Golgi apparatus	(ii) Sites of cellular respiration
(c) Centrosome	(iii) Produces vacuoles
(d) Vacuoles	(iv) Helps to maintain the osmotic pressure in a cell

35. Match the following Column A with Column B:

Column A	Column B
(a) Golgi Apparatus	(i) Cell theory
(b) Virchow	(ii) Cell
(c) Robert Brown	(iii) Camillo Golgi
(d) Robert Hooke	(iv) Nucleus

36. Match the following Column A with Column B:

Column A	Column B
(a) Active Transport	(i) Outward transport of substances by means of carrier molecules
(b) Pinocytosis	(ii) Inward transport of substances in solid form
(c) Exocytosis	(iii) Movement of any substance through the cell membrane that requires energy
(d) Phagocytosis	(iv) Inward transport of substances in fluid form

37. Match the following Column A with Column B:

Column A	Column B
(a) Plasma Membrane	(i) Plays a crucial role in detoxifying many poisons and drugs
(b) Nucleus	(ii) Allows or permits the entry and exit of some materials in and out of the cell
(c) Endoplasmic reticulum	(iii) Serve as the intracellular digestive system
(d) Lysosomes	(iv) Controls all the metabolic activities of the cell

38. Match the following with the correct response :

(a) Genes	(i) Gases
(b) Diffusion	(ii) Loss of water by plant cells
(c) Osmosis	(iii) Movement of water molecular
(d) Plasmolysis	(iv) Hereditary units

(a) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

(b) (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)

(c) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

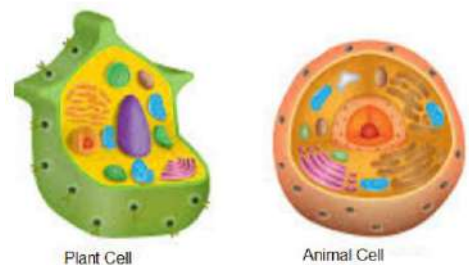
(d) (a) - (iii), (b) - (ii), (c) - (iv), (d) - (i)

### E. Case Study or Paragraph

39. Read the passage and answer any four questions:

The plasma membrane is the outermost covering of the cell that separates the contents of the cell from its external environment. The plasma membrane allows or permits the entry and exit of some materials in and out of the cell through osmosis and diffusion. Osmosis is the passage of water from a region of high water concentration through a selectively permeable membrane to a region of low water concentration till equilibrium is reached. If the medium has exactly the same water concentration as the cell, there will be no net movement of water across the cell membrane. Osmosis is a special case of diffusion through a selectively permeable membrane. Diffusion is important in the exchange of gases and water in the life of a cell. In addition to this, the cell also obtains nutrition from its environment.

#### ANIMAL VS PLANT CELLS



i. In diffusion, there is a spontaneous movement of a substance from a region of \_\_\_\_\_ concentration to a region where its concentration is \_\_\_\_\_.

a. high, low

b. low, high

c. high, high

d. low, low

ii. The plasma membrane is flexible and is made up of

I. protein

II. Lipids

III. fat

IV. carbohydrates

Choose the correct option

a. (I) and (II)

b. (II) and (III)

c. (III) and (IV)

d. (IV) and (I)

iii. Unicellular freshwater organisms and most plant cells tend to gain water through

a. osmosis

b. diffusion

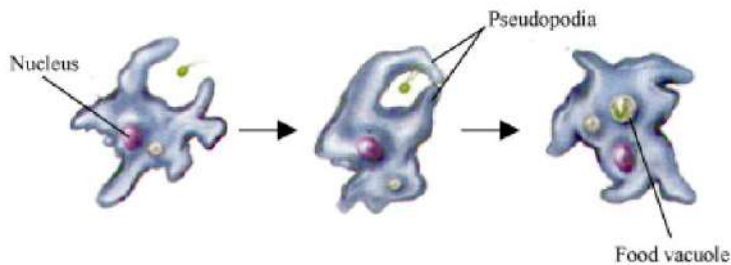
c. absorption

d. none of these

iv. The cell will shrink in which of the following solution?

- a. Hypotonic solution  
b. Hypertonic solution  
c. isotonic solution  
d. none of these

v. Amoeba acquire its food through the process of



- a. endocytosis  
b. exocytosis  
c. both (a) and (b)  
d. none of these

**40. Read the passage and answer any four questions:**

Plant cells, in addition to the plasma membrane, have another rigid outer covering called the cell wall. The cell wall lies outside the plasma membrane. The plant cell wall is mainly composed of cellulose. The nucleus has a double-layered covering called a nuclear membrane. The nuclear membrane has pores that allow the transfer of material from inside the nucleus to its outside, that is, to the cytoplasm. The nucleus contains chromosomes, which are visible as rod-shaped structures only when the cell is about to divide. Chromosomes contain information for the inheritance of characters from parents to the next generation in the form of DNA. The nucleus plays a central role in cellular reproduction, the process by which a single cell divides and forms two new cells.

i. Cellulose is a complex substance which provides:

- a. mechanical support  
b. structural strength to plants  
c. both (a) and (b)  
d. none of these

ii. Chromosomes are made up of:

- a. DNA  
b. Protein  
c. DNA and protein  
d. RNA

iii. Plasmolysis in a plant cell is defined as:

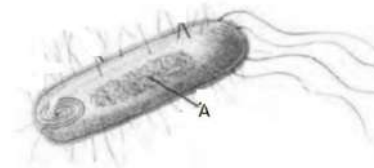
- I. breakdown (lysis) of the plasma membrane in hypotonic medium  
II. shrinkage of cytoplasm in hypertonic medium  
III. shrinkage of nucleoplasm  
IV. swelling of cytoplasm

Choose the correct statement

- a. (I) and (II)  
b. (II) and (III)  
c. Only (II)  
d. (IV) and (I)

iv. Identify ((A) in the given diagram

- a. nucleus  
b. nucleolus  
c. nucleic acid  
d. nucleoid



v. Select the odd one out.

- The movement of water across a semi-permeable membrane is affected by the number of substances dissolved in it.
- Membranes are made of organic molecules like proteins and lipids.
- Molecules soluble in organic solvents can easily pass through the membrane.
- Plasma membranes contain chitin sugar in plants.

41. Read the passage and answer any four questions:

Leeuwenhoek discovered the free-living cells in pond water for the first time. Robert Brown discovered the nucleus in the cell. A single cell may constitute a whole organism as in Amoeba. These organisms are called unicellular organisms. On the other hand, many cells group together in a single body and assume different functions in it to form various body parts in multicellular organisms. The shape and size of cells are related to the specific function they perform. Each living cell has the capacity to perform certain basic functions that are characteristic of all living forms. Each kind of cell organelle performs a special function, such as making new material in the cell, clearing up the waste material from the cell and so on.

i. Cells were first discovered by:

- |                 |                |
|-----------------|----------------|
| a. Robert Hooke | b. Leeuwenhoek |
| c. Schleiden    | d. Virchow     |

ii. Which of the following is a unicellular organism?

- |                  |           |
|------------------|-----------|
| a. Fungi         | b. Plants |
| c. Chlamydomonas | d. Animal |

iii. Who suggested that all cells arise from pre-existing cells?

- |                 |                |
|-----------------|----------------|
| a. Robert Hooke | b. Leeuwenhoek |
| c. Schleiden    | d. Virchow     |

iv. Which of the following is an incorrect statement?

- Each living cell has the capacity to perform certain basic functions
  - There is a division of labour in multicellular organisms
  - Each kind of cell organelle performs a special function
  - All activities inside the cell do not interact with the environment.
- |                   |                   |
|-------------------|-------------------|
| a. (I) and (II)   | b. (II) and (III) |
| c. (III) and (IV) | d. Only (IV)      |

v. Identify the given cell.

- Blood cell
- Nerve cell
- Ovum
- Fat cell



**Question No. 42 to 46 are based on the given text. Read the text carefully and answer the questions:**

Prior to division, chromosomes replicate. Every chromosome becomes double. In common type of cell division, the two replicas of each chromosome separate and pass to different daughter cells. This maintains the chromosome number in the daughter cells similar to mother cell. The division makes all cells of the body similar to one another in genetic composition.

42. When do chromosomes replicate?

- |                                     |                          |
|-------------------------------------|--------------------------|
| (a) Before cell division            | (b) During cell division |
| (c) During sexual reproduction only | (d) After cell division  |

43. All cells of the body of an organism contains the same number of chromosomes. How is it possible?  
(a) Formation of chromosome replicas after each cell division inside the newly formed cells  
(b) Each chromosome multiplies twice and separates twice during every cell division  
(c) Replication and separation of chromosome replicas during every cell division  
(d) A multicellular organism develops due to repeated cell division
44. What is the name of this mode of division?  
(a) Amitosis (b) Meiosis  
(c) Mitosis (d) Brachymeiosis
45. In which type of function does it participate?  
(a) Vegetative reproduction (b) Growth of multicellular organism  
(c) Asexual reproduction (d) All of these
46. Chromosomes are made up of \_\_\_\_\_.  
(a) DNA and proteins (b) Proteins  
(c) DNA (d) Carbohydrate

## Answer Key

### DPP-1

1. (d) 2. (b) 3. (b) 4. (d) 5. (b) 6. (d) 7. (a)  
8. (a)

### DPP-2

1. (d) 2. (d) 3. (b) 4. (b) 5. (a) 6. (a) 7. (c)  
8. (a)

### DPP-3

1. (b) 2. (b) 3. (c) 4. (d) 5. (c) 6. (b) 7. (a)  
8. (d)

### DPP-4

1. (a) 2. (b) 3. (c) 4. (d) 5. (d) 6. (a) 7. (c)  
8. (c) 9. (a) 10. (c)

## Concept Mastery

## Exercise-2

1. Microscope is an optical instrument consisting of a lens or combination of lenses which renders minute objects distinctly visible.
2. The organelle that shows the analogy as the packaging and dispatching unit of the cell is Golgi complex.
3. Nucleolus
4. Endoplasmic reticulum
5. Endoplasmic reticulum
6. It is Mitochondria of the cell also known as the power house of the cell because it synthesizes energy in the form of ATP during respiration which is vital for various life activities.
7. Lysosomes contain digestive enzymes that digest any foreign substance which enters into the cell. If cell is not working properly or become dead, lysosomes burst and digest the cell in which they are present. Hence, they are called 'suicidal bag'.
8. In 1665, an English scientist named Robert Hooke discovered cells. He saw honey comb like structure while observing thin slice of cork under his self-designed microscope.
9. The cell membrane or the plasma membrane is known as a selectively permeable membrane because it regulates the movement of substances in and out of the cell. This means that the plasma membrane allows the entry of only some substances and prevents the movement of some other materials.
10. After 1 hour the solutions on both the sides of the semipermeable membrane will become isotonic because of the process of osmosis.

11.

S.No	Cell Wall	Cell Membrane
1.	Cell wall is found in plant cell	Cell membrane is found in animal cells
2.	Cell wall is completely permeable	Cell membrane is semi-permeable.
3.	The function of the cell membrane is the same as that of the skin.	The function of the cell wall is to provide strength and rigidity to the cell.
4.	It is non – living	It is living
5.	It is made up of cellulose	It is made up of lipids and proteins

12. i. The cell contains nuclear material which can be seen as an entangled mass of thread-like structure when it is not dividing. The chromatin material gets organized into rod-like structures called chromosomes when the cell is about to divide.  
ii. Chloroplasts are green-coloured plastids that contain a green coloured pigment called chlorophyll.  
iii. Genes are the functional segments of DNA (present on DNA) that control a specific trait by making a specific protein.

13.

Prokaryotic Cell	Eukaryotic Cell
1. Size. Generally small (1 – 10 $\mu\text{m}$ ).	1. Size. Generally large (5 – 100 $\mu\text{m}$ ).
2. Nuclear Region Poorly defined due to absence of nuclear envelope and known as Nucleoid	2. Nuclear Region. Well defined and surrounded by a nuclear membrane.
3. Chromosomes. Single	3. More than one Chromosome
4. Membrane Bound Cell Organelles. Absent.	4. Membrane bound cell organelles are present.

14.

<b>OSMOSIS</b>	<b>DIFFUSION</b>
It involves the movement of solvent molecules	It involves the movement of solute molecules
Molecules move from a lower concentration of solute to a higher concentration of solute	Molecules move from higher concentration of solute to a lower concentration of solute
It occurs only across a semi-permeable membrane	It does not require semi-permeable membrane
Example: Shrinking of Potato slice when kept in concentrated sucrose solution	Example: Spreading of ink when a drop of it is put in a glass of water.

Importance – diffusion and osmosis are important for the transport of substances across the cell membrane.

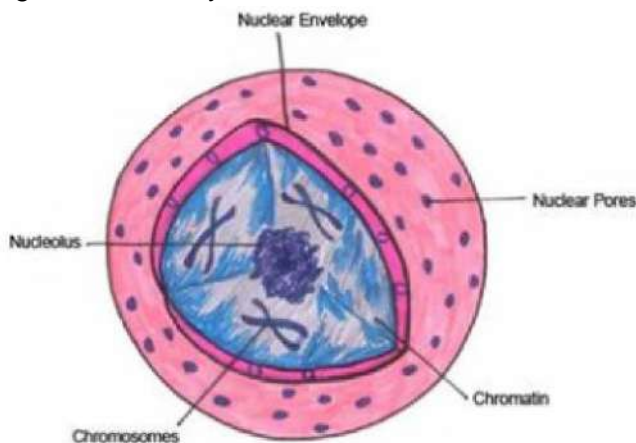
15. a. X- crista Y- matrix.

b. A crista is a fold in the inner membrane of a mitochondrion. Function of X is to increase surface area of inner membrane for ATP Synthesis.

c. Composition of Y. It contains the mitochondrial DNA in a structure called a nucleoid. It contains ribosomes that produce proteins used by the mitochondrion. It contains granules of ions that appear to be involved in the ionic balance of the mitochondrion.

d. Mitochondrion (Cut lengthwise). Common Name. Powerhouse of cell.

16. Figure: An eukaryotic nucleus



<b>Nucleus</b>	<b>Nucleoid</b>
Nuclear membrane is present.	Nuclear membrane absent.
Nucleolus present.	Nucleolus absent.
Genetic materials are enclosed in nucleus.	Genetic materials are not contained in any closed structure.
Found in eukaryotes.	Found in prokaryotes.

17. (a) Plasma membrane – The cell membrane separates the cell from its external environment, and is selectively permeable (controls what gets in and out). It protects the cell and provides stability. Proteins are found embedded within the plasma membrane, with some extending all the way through in order to transport materials.

(b) Cell wall – The cell wall is a rigid organelle composed of cellulose and lying just outside the cell membrane. The cell wall gives the plant cell its box-like shape. It also protects the cell. The cell wall contains pores which allow materials to pass to and from the cell membrane.

(c) Ribosome – Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the rough endoplasmic reticulum. Ribosomes produce protein. They could be thought of as "protein factories" of the cell.

(d) Lysosome – Lysosomes are small sac-like structures surrounded by a single membrane and

containing strong digestive enzymes which when released can break down worn out organelles or food. The lysosome is also known as a suicide sac.

(e) Nucleolus – It synthesizes ribosome

(f) Endoplasmic Reticulum – Produces lipids and proteins and also in intracellular transport of substances.

18. i. When human red blood cells are placed in hypotonic salt/sugar solution they swell due to endosmosis.  
ii. Plant cell shrinks when kept in hypertonic solution because the concentration of the solvent is more inside the cell. It shrinks due to exosmosis.  
iii. Lysosomes are known as suicidal bags because, during the breakdown of cell structure, lysosome bursts and enzymes eat up their own cells.
19. The ten cell components are:  
i. Plasma membrane: It acts as a semipermeable membrane and allows only selective substances to pass through it.  
ii. Chromosomes: To carry hereditary characters of an organism from one generation to another.  
iii. Lysosomes: Breakdown of unwanted macromolecules is the main function of these organelles.  
iv. Ribosomes: These help in protein synthesis.  
  
v. Nucleus: Control centre of the cell. It contains cellular DNA (genetic information) in the form of genes.  
vi. Mitochondria: The main function of mitochondria in aerobic cells is the production of energy by the synthesis of ATP.  
vii. Nucleolus: Biosynthesis of ribosomal RNA (rRNA) and acts as a platform for protein synthesis.  
viii. Cell wall: It provides protection and rigidity to the plant cell.  
ix. Chloroplasts: These are the sites of photosynthesis within plant cells.  
x. Endoplasmic reticulum: Serves as channels for transport of materials.
20. Cell organelles are the intracellular structures present in the cytoplasm. Various cell organelles are –  
1. Mitochondrion – It produces energy  
2. Endoplasmic reticular – synthesize lipids and proteins  
3. Golgi apparatus - Storage, packaging and dispatch various substances.  
4. Lysosomes – Digest intracellular substances  
5. Ribosomes – Synthesize proteins  
6. Vacuoles – Provide turgidity and store house of various organic substances
21. State True or False:  
(i) (a) True Explanation: True  
(ii) (b) False  
Explanation: False. Some substances like carbon dioxide or oxygen can move across the cell membrane by a process called diffusion.  
(iii) (b) False  
Explanation: False. The nucleus controls all the metabolic activities of the cell.  
(iv) (b) False  
Explanation: False. Active transport is the movement of any substance through the cell membrane that requires energy.  
(v) (a) True Explanation: True
22. Fill in the blanks:  
(i) 1. Vacuoles  
(ii) 1. Prokaryotic  
(iii) 1. Phagocytosis  
(iv) 1. Multicellular

## Accuracy Booster

## Exercise-3

1. (a)      2. (b)      3. (b)      4. (d)      5. (c)      6. (c)      7. (d)  
8. (b)      9. (c)      10. (a)      11. (a)      12. (a)      13. (a)      14. (d)  
15. (a)      16. (a)      17. (b)      18. (b)      19. (c)      20. (d)      21. (c)  
22. (a)      23. (a)      24. (c)      25. (c)      26. (a)      27. (a)      28. (a)  
29. (c)      30. (c)      31. (b)      32. (c)      33. (d)
34. (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv).  
35. (a) – (iii), (b) – (i), (c) – (iv), (d) – (ii).  
36. (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii).  
37. (a) – (ii), (b) – (iv), (c) – (i), (d) – (iii).  
38. (a) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)  
39. i. (a) high, low  
ii. (a) both (I) and (II)  
iii. (a) osmosis  
iv. (b) Hypertonic solution  
v. (a) endocytosis
40. i. (b) structural strength to plants  
ii. (c) DNA and protein  
iii. (c) Only (II)  
iv. (d) nucleoid  
v. (d) Plasma membranes contain chitin sugar in plants.
41. i. (a) Robert Hooke  
ii. (c) Chlamydomonas  
iii. (d) Virchow  
iv. (d) Only (IV)  
v. (d) Fat cell
42. (a)      43. (c)      44. (c)      45. (d)      46. (a)



## Quick Exam Revision

1. In 1665, Robert Hooke first discovered and named the cells.
2. Cell is the structural and functional unit of all living organisms.
3. Organisms may be unicellular or multi-cellular. A single cell constitutes the unicellular organism whereas many cells coordinately function in case of multi-cellular organism.
4. The size, shape and volume of the cell are related to the specific function that they perform.
5. A cell generally shows plasma membrane, nucleus and cytoplasm.
6. Plasma membrane is a thin, selectively permeable membrane, covering the cell and is made up of lipids and proteins.
7. Functions of plasma membrane :
  - (i) It separates the contents of a cell from its outside environment.
  - (ii) It regulates the flow of substances to and from the cell through diffusion, facilitated diffusion, active transport and endocytosis.
8. Osmosis is diffusion of water through a selectively permeable membrane.
9. A cell will gain water when placed in hypotonic solution and lose water when placed in hypertonic solution. When placed in isotonic solution, cells will neither lose nor gain water.

Can be written more specifically as :

  - (i) Hypotonic solution : A cell placed in it will gain water.
  - (ii) Hypertonic solution : A cell placed in it will lose water : Also known as plasmolysis.
  - (iii) Isotonic solution: A cell placed in it will neither gain nor lose water.
10. In addition to plasma membrane, the cells of plants, fungi and bacteria have another rigid, non-living, outer covering called cell wall, composed mainly of cellulose.

Can be written more specifically as

Cells of Plants, fungi & bacteria: Contain both plasma membrane & cell wall.  
Cell wall is rigid, non-living & outer most covering, composed mainly of cellulose.
11. When placed in hypertonic solution, a living plant cell shows plasmolysis.
12. Cell wall provides mechanical strength to the cell. It permits the cell to withstand huge changes in the surrounding medium.
13. Nucleus is an important, spherical, usually centrally located constituent of the cell and is bounded by double layered nuclear envelope.
14. The nucleus of a dividing cell shows rod-shaped chromosomes, made up of DNA and proteins. In a non-dividing cell, the chromosomes elongate and take the form of thread-like chromatin.
15. DNA molecules are responsible for transmitting hereditary information from one generation to the next.
16. Nucleus controls all metabolic activities of the cell.
17. Depending on the presence or absence of nucleus, cells may be prokaryotic or eukaryotic.
  - (i) Prokaryotic cells lack a well-defined nucleus and instead show nucleoid, an undefined nuclear region containing the genetic material.
  - (ii) Eukaryotic cells possess a proper nucleus with nuclear membrane.
18. Cytoplasm is the fluid content of the cell, occurring between nucleus and plasma membrane. It stores several vital chemicals and is the site of certain important metabolic pathways.
19. Several specialized cell organelles are present in the cytoplasm. These organelles perform different kinds of metabolic activities and are kept separate from each other.

20. The various cell organelles include endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, plastids, vacuoles and centrosome.
21. Endoplasmic reticulum (ER) is an extensive, interconnected, membrane bound network of tubes and sheets.
22. Ribosomes are attached to the surface of Rough Endoplasmic Reticulum (RER) and are absent in Smooth Endoplasmic Reticulum (SER).
23. Functions of ER :
  - (i) It synthesizes important proteins (RER) and lipids (SER).
  - (ii) It provides a pathway for intracellular transport of materials.
  - (iii) SER of liver cells is important for detoxification.
24. Golgi apparatus is a network of stacked, flattened, membrane bound sacs and vesicles.
25. Golgi apparatus carries out the storage, modification and packaging of substances manufactured in the cell and is also involved in lysosome formation.
26. The spherical, sac-like lysosomes contain powerful digestive enzymes and form the waste disposal system of the cell. They are also known as 'suicide bags'.
27. Mitochondria and plastids are each covered by 2 membranes and possess their own DNA and ribosomes.
28. Mitochondria are the 'power houses of the cell', providing energy for various metabolic activities.
29. Chromoplasts and leucoplasts are the 2 types of plastids present in plant cells.
30. Chloroplasts are chromoplasts containing chlorophyll and carry out photosynthesis in plants.
31. Leucoplasts store starch, oil and protein granules.
32. The large central vacuole of mature plant cells provides turgidity to the cell and also stores important substances.
33. In unicellular organisms, vacuoles play important roles in nutrition and osmoregulation.
34. Ribosomes are sites of protein synthesis.
35. Centrosome is found only in animal cells and consists of 2 centrioles. Centrosome helps in cell division.
36. The membrane-bound cell organelles are absent in prokaryotic cells.
37. Differences between plant cell and animal cell.

Plant cell		Animal cell
1.	Plant cells are generally large in size.	Animal cells are smaller than plant cells.
2.	Plant cells possess plastids.	Animal cells lack plastids.
3.	Cell wall is present	Cell wall is absent.
4.	Mature plant cells possess a large, central and permanent vacuole.	Animal cells possess many small and temporary vacuoles.
5.	Centrosome and centrioles are absent in plant cells.	Centrosome and centrioles are present in animal cells.

38. The basic structural organization of the cell helps it to perform important functions like respiration, nutrition, excretion and protein synthesis.

CLASS 9 - BIOLOGY

Chapter-5 Fundamental Unit of Life

**Solutions**

**Concept Mastery**

**Exercise-2**

1. Microscope is an optical instrument consisting of a lens or combination of lenses which renders minute objects distinctly visible.
2. The organelle that shows the analogy as the packaging and dispatching unit of the cell is Golgi complex.
3. Nucleolus
4. Endoplasmic reticulum
5. Endoplasmic reticulum
6. It is Mitochondria of the cell also known as the power house of the cell because it synthesizes energy in the form of ATP during respiration which is vital for various life activities.
7. Lysosomes contain digestive enzymes that digest any foreign substance which enters into the cell. If cell is not working properly or become dead, lysosomes burst and digest the cell in which they are present. Hence, they are called 'suicidal bag'.
8. In 1665, an English scientist named Robert Hooke discovered cells. He saw honey comb like structure while observing thin slice of cork under his self-designed microscope.
9. The cell membrane or the plasma membrane is known as a selectively permeable membrane because it regulates the movement of substances in and out of the cell. This means that the plasma membrane allows the entry of only some substances and prevents the movement of some other materials.
10. After 1 hour the solutions on both the sides of the semipermeable membrane will become isotonic because of the process of osmosis.

11.

S.No	Cell Wall	Cell Membrane
1.	Cell wall is found in plant cell	Cell membrane is found in animal cells
2.	Cell wall is completely permeable	Cell membrane is semi-permeable.
3.	The function of the cell membrane is the same as that of the skin.	The function of the cell wall is to provide strength and rigidity to the cell.
4.	It is non – living	It is living
5.	It is made up of cellulose	It is made up of lipids and proteins

12. i. The cell contains nuclear material which can be seen as an entangled mass of thread-like structure when it is not dividing. The chromatin material gets organized into rod-like structures called chromosomes when the cell is about to divide.  
ii. Chloroplasts are green-coloured plastids that contain a green coloured pigment called chlorophyll.  
iii. Genes are the functional segments of DNA (present on DNA) that control a specific trait by making a specific protein.

13.

Prokaryotic Cell	Eukaryotic Cell
1. Size. Generally small (1 – 10 $\mu\text{m}$ ).	1. Size. Generally large (5 – 100 $\mu\text{m}$ ).
2. Nuclear Region Poorly defined due to absence of nuclear envelope and known as Nucleoid	2. Nuclear Region. Well defined and surrounded by a nuclear membrane.
3. Chromosomes. Single	3. More than one Chromosome
4. Membrane Bound Cell Organelles. Absent.	4. Membrane bound cell organelles are present.

14.

<b>OSMOSIS</b>	<b>DIFFUSION</b>
It involves the movement of solvent molecules	It involves the movement of solute molecules
Molecules move from a lower concentration of solute to a higher concentration of solute	Molecules move from higher concentration of solute to a lower concentration of solute
It occurs only across a semi-permeable membrane	It does not require semi-permeable membrane
Example: Shrinking of Potato slice when kept in concentrated sucrose solution	Example: Spreading of ink when a drop of it is put in a glass of water.

Importance – diffusion and osmosis are important for the transport of substances across the cell membrane.

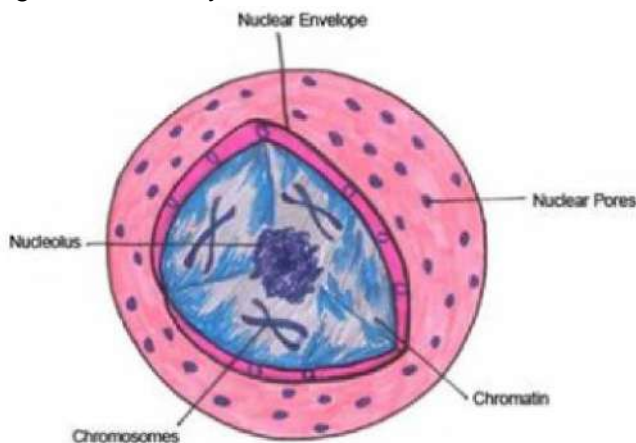
15. a. X- crista Y- matrix.

b. A crista is a fold in the inner membrane of a mitochondrion. Function of X is to increase surface area of inner membrane for ATP Synthesis.

c. Composition of Y. It contains the mitochondrial DNA in a structure called a nucleoid. It contains ribosomes that produce proteins used by the mitochondrion. It contains granules of ions that appear to be involved in the ionic balance of the mitochondrion.

d. Mitochondrion (Cut lengthwise). Common Name. Powerhouse of cell.

16. Figure: An eukaryotic nucleus



<b>Nucleus</b>	<b>Nucleoid</b>
Nuclear membrane is present.	Nuclear membrane absent.
Nucleolus present.	Nucleolus absent.
Genetic materials are enclosed in nucleus.	Genetic materials are not contained in any closed structure.
Found in eukaryotes.	Found in prokaryotes.

17. (a) Plasma membrane – The cell membrane separates the cell from its external environment, and is selectively permeable (controls what gets in and out). It protects the cell and provides stability. Proteins are found embedded within the plasma membrane, with some extending all the way through in order to transport materials.

(b) Cell wall – The cell wall is a rigid organelle composed of cellulose and lying just outside the cell membrane. The cell wall gives the plant cell its box-like shape. It also protects the cell. The cell wall contains pores which allow materials to pass to and from the cell membrane.

(c) Ribosome – Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the rough endoplasmic reticulum. Ribosomes produce protein. They could be thought of as "protein factories" of the cell.

(d) Lysosome – Lysosomes are small sac-like structures surrounded by a single membrane and

containing strong digestive enzymes which when released can break down worn out organelles or food. The lysosome is also known as a suicide sac.

(e) Nucleolus – It synthesizes ribosome

(f) Endoplasmic Reticulum – Produces lipids and proteins and also in intracellular transport of substances.

- 18.** i. When human red blood cells are placed in hypotonic salt/sugar solution they swell due to endosmosis.  
ii. Plant cell shrinks when kept in hypertonic solution because the concentration of the solvent is more inside the cell. It shrinks due to exosmosis.  
iii. Lysosomes are known as suicidal bags because, during the breakdown of cell structure, lysosome bursts and enzymes eat up their own cells.
- 19.** The ten cell components are:  
i. Plasma membrane: It acts as a semipermeable membrane and allows only selective substances to pass through it.  
ii. Chromosomes: To carry hereditary characters of an organism from one generation to another.  
iii. Lysosomes: Breakdown of unwanted macromolecules is the main function of these organelles.  
iv. Ribosomes: These help in protein synthesis.
- v. Nucleus: Control centre of the cell. It contains cellular DNA (genetic information) in the form of genes.  
vi. Mitochondria: The main function of mitochondria in aerobic cells is the production of energy by the synthesis of ATP.  
vii. Nucleolus: Biosynthesis of ribosomal RNA (rRNA) and acts as a platform for protein synthesis.  
viii. Cell wall: It provides protection and rigidity to the plant cell.  
ix. Chloroplasts: These are the sites of photosynthesis within plant cells.  
x. Endoplasmic reticulum: Serves as channels for transport of materials.
- 20.** Cell organelles are the intracellular structures present in the cytoplasm. Various cell organelles are –  
1. Mitochondrion – It produces energy  
2. Endoplasmic reticular – synthesize lipids and proteins  
3. Golgi apparatus - Storage, packaging and dispatch various substances.  
4. Lysosomes – Digest intracellular substances  
5. Ribosomes – Synthesize proteins  
6. Vacuoles – Provide turgidity and store house of various organic substances
- 21.** State True or False:  
(i) (a) True Explanation: True  
(ii) (b) False  
Explanation: False. Some substances like carbon dioxide or oxygen can move across the cell membrane by a process called diffusion.  
(iii) (b) False  
Explanation: False. The nucleus controls all the metabolic activities of the cell.  
(iv) (b) False  
Explanation: False. Active transport is the movement of any substance through the cell membrane that requires energy.  
(v) (a) True Explanation: True
- 22.** Fill in the blanks:  
(i) 1. Vacuoles  
(ii) 1. Prokaryotic  
(iii) 1. Phagocytosis  
(iv) 1. Multicellular

## Accuracy Booster

## Exercise-3

- (a) endoplasmic reticulum  
Explanation: The SER helps in the manufacture of fat molecules, or lipids, important for cell function. One function of the ER is to serve as channels for the transport of materials (especially proteins) between various regions of the cytoplasm or between the cytoplasm and the nucleus.
- (b) cells  
Explanation: Cells are the basic and fundamental unit of life, in both plants and animals.
- (b) Human beings  
Explanation: Cellulose is a complex material which cannot be digested by human beings. Only ruminants can digest it. for ex: cow
- (d)  $10^{-6}$  m  
Explanation: The value of  $1 \mu\text{m}$  is  $10^{-6}$  m.
- (c) Chloroplast  
Explanation: Chloroplasts are special structures present only in plant cells. With the help of this chlorophyll, the plants prepare their food in the presence of water, sunlight and oxygen. Hence, chloroplasts are called the kitchen of a plant cell.
- (c) Nucleus  
Explanation: Nucleus
- (d) Smooth endoplasmic reticulum  
Explanation: The smooth endoplasmic reticulum lacks ribosomes and functions in lipid manufacture and metabolism, the production of steroid hormones, and detoxification.
- (b) endoplasmic reticulum  
Explanation: The Golgi apparatus functions as a factory in which proteins received from the Endoplasmic reticulum are further processed and sorted for transport to their eventual destinations: lysosomes, the plasma membrane, or secretion.
- (c) DNA and protein  
Explanation: Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.
- (a) SER  
Explanation: SER i.e. the smooth endoplasmic reticulum lacks ribosomes and functions in lipid manufacture and metabolism, the production of steroid hormones, and detoxification.
- (a) Ribosome  
Explanation: Ribosomes are non membrane bound organelles that are found freely occurring in the cytoplasm.
- (a) increase in its volume  
Explanation: The cell is said to be turgid when the plant cell wall becomes rigid and stretched by an increase in the volume of vacuoles due to the absorption of water when placed in a hypotonic solution.
- (a) The concentration of water molecules in the surrounding medium is higher than water molecules concentration in the cell.  
Explanation: A cell will swell up if it is placed in the hypotonic solution. This is so because the concentration of water molecules in the surrounding medium is higher than water molecules concentration in the cell So, the water molecules move from external solution into cell sap.
- (d) Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane  
Explanation: Osmosis is the passive movement of water or any other solvent molecules from a region of higher water concentration to a region of lower water concentration through a

semipermeable membrane.

15. (a) 10

Explanation: Mitosis is a part of the cell cycle where replicated chromosomes are separated into two new nuclei. During mitotic division, the number of chromosomes in the daughter cells remains the same. Therefore, a cell having 10 chromosomes will produce daughter cells that have 10 chromosomes each.

16. (a) (iii) and (iv)

Explanation: Ribosomes are involved in protein synthesis. Enzymes are also proteins. Hence, ribosomes also make enzymes.

17. (b) The part labelled 'a' is the site of dark reaction.

Explanation: The given figure is of chloroplast. The part labelled 'a' is stroma. The part labelled 'b' is called grana where light reaction of photosynthesis takes place. The part labelled 'c' is intergranal thylakoid. Photosynthetic pigments such as chlorophyll are present only in thylakoid membranes (grana + intergranal thylakoids) and not in stroma or nongranal thylakoids.

18. (b) The inner membrane is longer than the outer membrane

Explanation: The inner membrane, which has a larger surface area than the outer membrane, contains features referred to as cristae (literally, crests) which have long been represented as simple infoldings of this membrane.

19. (c) Over the Ribosomes

Explanation: The Rough Endoplasmic Reticulum (RER) has ribosomes attached to its surface. Ribosomes are the sites of protein manufacture. They are associated with the synthesis of proteins from amino acids.

20. (d) Amyloplast

Explanation: These cells contain carbohydrate. Starch is a complex carbohydrate.

21. (c) Prokaryotic

Explanation: Prokaryotic cells lack a nuclear envelope and membrane-bound cell organelles.

22. (a) Polar cap

Explanation: Plant cells lack centrosomes or spindle pole bodies which act as the microtubule-organising centers in animal cells. Centrioles are a very important part of centrosomes. The function of chromatid separation in plants is performed by polar cap during cell division.

23. (a) Golgi apparatus, near nucleus

Explanation: Golgi apparatus with cisternae, tubules, and vesicles arranged near the nucleus in cytoplasm acting as a postman of the cell.

24. (c) Ribosome, helps in protein synthesis

Explanation: When ribosomes are present on endoplasmic reticulum it is called the rough endoplasmic reticulum. Ribosomes help in protein synthesis.

25. (c) The plasma membrane contains chitin and sugar in plants.

Explanation:

The odd statement is - Plasma membrane contains chitin and sugar in plants. Other statements describe the movement of molecules across the semi-permeable membrane and the associated phenomena.

26. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Lysosomes help in autodigestion of cells hence they are regarded as a suicidal bag.

27. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Exocytosis or cell vomiting is a process in which the waste materials from the cell are extruded through the plasma membrane by diffusing the vesicles containing materials that need to be taken out of the body. This process occurs in cells to remove undigested substances, secrete hormones, enzymes, and transport various substances.

28. (a) Both A and R are true and R is the correct explanation of A.  
Explanation: Plant cells possess large vacuoles to perform functions like:  
i. Storage of water, mineral etc.  
ii. Provide turgidity and rigidity to the cell, as it is filled with cell sap.
29. (c) A is true but R is false.  
Explanation: Both mitochondria and chloroplasts are double membrane-bound, semi-autonomous cell organelles. Their structure and functions are partially controlled by the nucleus of the cell and partially by themselves. Both possess their own DNA and arise from pre-existing cells. 70S type of ribosome is present in both organelles which can help to translate the coded information contained in mRNA and protein synthesis.
30. (c) Both the statements - A and B  
Explanation: Both statements are correct. Golgi apparatus consists of a system of membrane-bound vesicles. The proteins manufactured by the ribosomes are packed inside the vesicles. Endoplasmic Reticulum (ER) is absent in the red blood cells of mammals. Red Blood Cells in mammals anucleate when mature i.e. they do not contain a nucleus. This is so that the cell has maximum space for haemoglobin.
31. (b) (D)  
Explanation: The nucleus is a double membranous structure. It is surrounded by a double membrane - the inner nuclear membrane and the outer nuclear membrane. A liver cell contains about 500-1000 mitochondria. A large amount of cellulose is present in the wood of a plant.
32. (c) (A)  
Explanation:  
A. Root tips are replaced; they are meristematic tissue; and not permanent tissue.  
B. Mycoplasma gallisepticum is the smallest cell amongst the unicellular organisms.  
C. Acetabularia measures nearly 10 cm in height.  
D. Tonoplast is the membrane that bounds the chief vacuole of a plant cell. It is also known as the 'vacuolar membrane'. It separates the vacuolar contents from the cytoplasm of the cell.  
Hence, statement A is incorrect.
33. (d) Statement (iii) is correct.  
Explanation: A semipermeable membrane allows only solvent molecules to pass through it.
34. The correct order of match is given as (a) – (ii), (b) – (iii), (c) – (i), (d) – (iv).
35. The correct order of match is given as (a) – (iii), (b) – (i), (c) – (iv), (d) – (ii).
36. The correct order of match is given as (a) – (iii), (b) – (iv), (c) – (i), (d) – (ii).
37. The correct order of match is given as (a) – (ii), (b) – (iv), (c) – (i), (d) – (iii).
38. (a) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)  
Explanation:  
Genes are functional units of heredity that determine the characters of organisms.  
Diffusion is the process of passage of fluid from a region of high concentration to a region of low concentration.  
It plays an important role in the gaseous exchange between the cells as well as the cell and its external environment. Water also obeys the law of diffusion.  
The passage of water from a region of higher water concentration to a region of lower water concentration through a semi-permeable membrane is called osmosis. The movement of water across the plasma membrane is affected by the amount of substance dissolved in water.  
Plasmolysis is a plant cell that refers to the contraction of protoplast as a result of the loss of water from the cell. The shrinkage of cytoplasm occurs due to exo-osmosis in a hypertonic medium. A hypertonic solution is one that has a lesser concentration of water as compared to that inside the cell. During the process, there is a higher external osmotic pressure and a net flow of water from the cell.

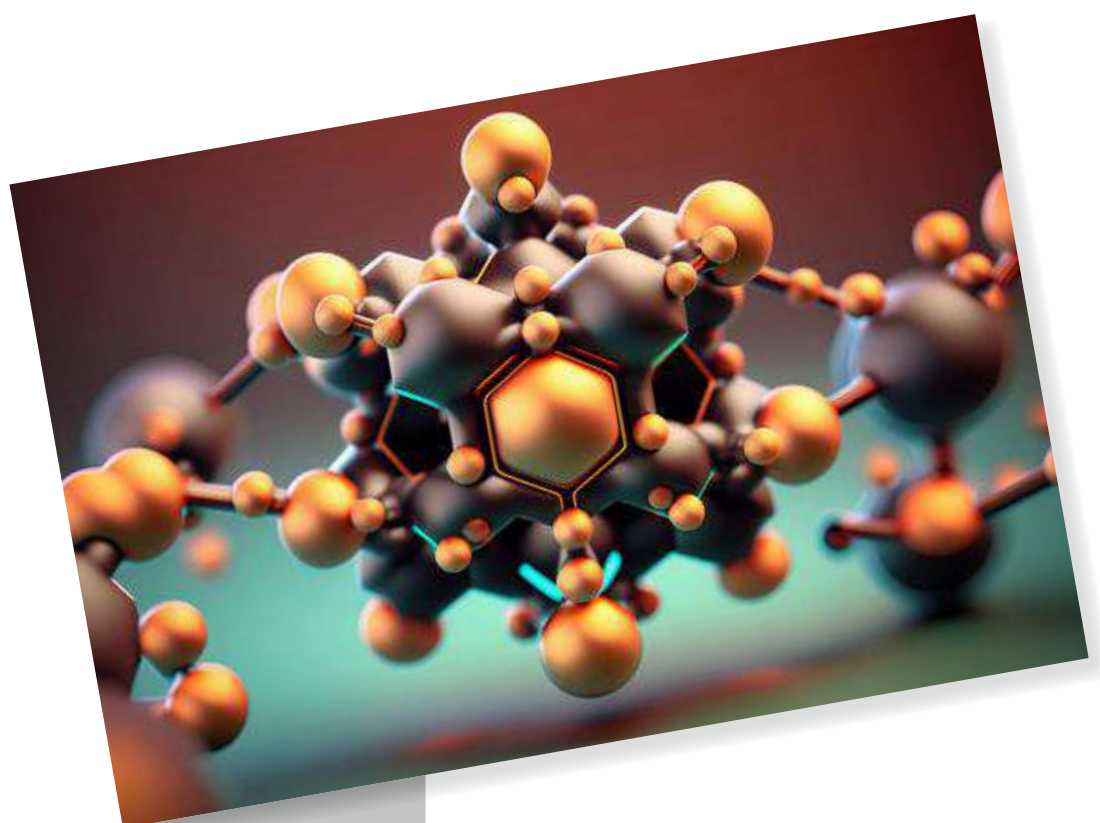
39. i. (a) high, low  
ii. (a) both (I) and (II)  
iii.(a) osmosis  
iv. (b) Hypertonic solution  
v. (a) endocytosis
40. i. (b) structural strength to plants  
ii. (c) DNA and protein  
iii.(c) Only (II)  
iv. (d) nucleoid  
v. (d) Plasma membranes contain chitin sugar in plants.
41. i. (a) Robert Hooke  
ii. (c) Chlamydomonas  
iii.(d) Virchow  
iv. (d) Only (IV)  
v. (d) Fat cell
42. (a) Before cell division  
Explanation: Before cell division
43. (c) Replication and separation of chromosome replicas during every cell division  
Explanation: Replication and separation of chromosome replicas during every cell division
44. (c) Mitosis  
Explanation: Mitosis
45. (d) All of these  
Explanation: All of these
46. (a) DNA and proteins  
Explanation: Chromosomes are made up of DNA and proteins.

# PRE-FOUNDATION

## CLASS X

SAMPLE

# CHEMISTRY




# CHAPTER-2

## Metals & Non-Metals

Group					
13	14	15	16	17	18
				H Hydrogen	He Helium
B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon
Al	Si Silicon	P Phosphorus	S Sulfur	Cl Chlorine	Ar Argon
Ga	Ge Germanium	As Arsenic	Se Selenium	Br Bromine	Kr Krypton
In	Sn	Sb Antimony	Te Tellurium	I Iodine	Xe Xenon
Tl	Pb	Bi	Po	At	Rn Radon

### Chapter Flow

1. Introduction
  2. Elements
  3. Classification
  4. Occurrence of Metals And Non-Metals
  5. Physical Properties of Metals and Non-Metals
    1. Physical State
    2. Hardness
    3. Lustre
    4. Density
    5. Melting and Boiling Points
    6. Malleability
    7. Ductility
    8. Tensile Strength
    9. Thermal Conductivity
    10. Electrical Conductivity
    11. Sonorous
    12. Colour
  6. Chemical Properties of Metals and Non Metals
    1. Reaction with Oxygen
    2. Reaction with Water
    3. Reaction with Cold Water
    4. Reaction with Boiling Water
    5. Reaction with Steam
    6. Corrosion
    7. Reaction with Acids
    8. Reaction with Bases
    9. Displacement Reactions
- DPP-1**
- DPP-2**
- DPP-3**
- DPP-4**
- Exercise-1 NCERT Basics**
- Exercise-2 Concept Mastery**
- Exercise-3 Accuracy Booster**
-  **Quick Exam Revision**

# Metals & Non-Metals

## 1. Introduction

The progress of man towards civilisation is linked up with the discovery of metals and non-metals. Even today, the index of prosperity of a nation depends upon the amount of metals and non-metals it produces and uses. The metallic resources of a nation are of immense value. The discovery of bronze, the alloy of copper, and tin resulted in the bronze age in history. This period was followed by the iron age with the discovery of superior quality of iron.

Every material has a specific use depending upon its physical and chemical properties.

## 2. Elements

A pure substance that consists of only one kind of atoms is called an **element**. The smallest unit of an element is atom. Elements cannot be broken down into smaller units and the building blocks of a variety of substances.

There are about 118 elements known to us today, out of which 92 are found in nature while the remaining elements have been prepared artificially. Of all the naturally occurring elements, 22 are non-metals and 70 are metals.

## 3. Classification

### Classification of Elements

Lavoisier classified all the known elements into three groups: **metals**, **non-metals** and **metalloids**.

#### ➤ Metals

The elements which are hard, lustrous, malleable, ductile, sonorous, and good conductors of heat and electricity are called **metals**.

**Examples:** iron, copper, gold, silver, aluminium etc.

#### ➤ Non-metals

The elements which are brittle, non-lustrous, non-malleable, non-ductile, and poor conductors of heat and electricity are called **non-metals**.

**Examples:** nitrogen, sulphur, phosphorus, carbon, oxygen.

#### ➤ Metalloids

The elements which possess the characteristics of both metals and non-metals are called **metalloids**.

**Examples:** boron, silicon, arsenic, germanium.

## 4. Occurrence of Metals And Non-Metals

Metals can occur in free or elemental state or in the form of compounds in nature inside the earth's crust. Reactive metals generally occur in combined form, and less reactive metals in both free as well as combined form. Highly unreactive elements occur in free state in nature. Examples of metals that occur in nature as compounds include aluminum (bauxite), copper (copper pyrites), iron (as haematite), and silver (as argentite). Of these, silver and copper occur in both free state and combined form. Gold is found in nature only in free state.

Like metals, non-metals also occur in the free (oxygen, nitrogen) as well as in combined state (silicon, phosphorus) in nature.

## 5. Physical Properties of Metals and Non-Metals

Let us now learn about the physical properties of metals and non-metals.

### 5.1 Physical State

**Metals** are generally solid at room temperature except mercury and gallium, francium, caesium, rubidium, which exist in liquid form at room temperature.

**Non-metals** can exist in all three states but generally they are solid or gas at room temperature. Hydrogen, chlorine and oxygen are gases. Iodine, silicon, carbon and phosphorus are solids but bromine is found in liquid state.

### 5.2 Hardness

**Metals** are generally hard. Hardness varies from metal to metal. Metals like sodium and potassium are soft and can be easily cut with a knife.

**Non-metals** are generally soft except diamond which is very hard.



*Sodium can be cut with a knife*

#### Activity - 1



Carefully take out a piece of sodium (Na) and a piece of potassium (K) with the help of a pair of tongs and dry them between the folds of a filter paper. Cut each of them with a sharp knife. What do you observe? They can be cut with a knife, so they are soft metals.

Now try to cut metal pieces such as those of magnesium (Mg), lead (Pb), aluminum (Al), copper (Cu), iron (Fe), etc., and write your observations.

### 5.3 Lustre

**Metals** shine in their pure state. This shining property (Glitter) of metals is called **metallic lustre**. Gold is yellow and copper is reddish brown. Magnesium, aluminium and silver appear white. Because of the ability of metals to shine and reflect light they are used for making jewellery, statues and decorative pieces.

**Non-metals** are non-lustrous or dull except graphite and iodine which are lustrous.



*Lustre of gold*

### Activity - 2



**Metals are Lustrous** : Collect some pieces of pure iron, copper, aluminum, gold, silver and magnesium ribbons. Rub the surface of each sample with sand paper and note their appearance. Do they shine? Yes, their surfaces have a shining appearance.

### 5.4 Density

**Metals** generally have a high density. Some metals like sodium, potassium, calcium, aluminium and magnesium have low densities. Lithium is the lightest metal.

**Non-metals** have low density.

### 5.5 Melting and Boiling Points

**Metals** generally have high melting and boiling points. Tungsten has the highest melting point. Sodium and potassium have low melting points. Mercury has a low boiling point.

**Non-metals** usually have low melting and boiling points except graphite which has a high melting point. Silicon and boron too have high boiling points.

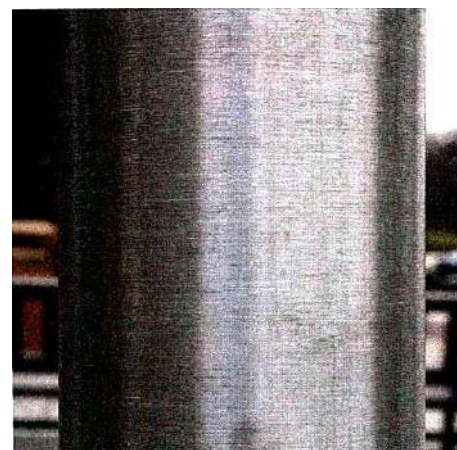
### 5.6 Malleability

**Metals** the property by which metals can be beaten into sheets or foils is called **malleability**.

Gold and silver are among the best malleable metals.

This is what helps jewellery designers create intricately carved bangles, chains and decorative articles in gold and silver. You must have seen that halwais (sweetmakers) use silver papers to decorate barfi and rasgullas. They are actually using **silver foil** for decoration. At home we use aluminium foils for packing chapatis and idlis. This shows that silver and aluminium can be beaten into thin foils.

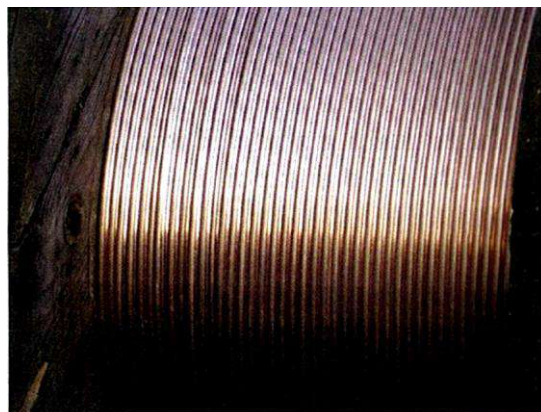
**Non-metals** are non-malleable. They break into pieces when hammered, so they are brittle.



*Malleable metal forming sheets*

### 5.7 Ductility

**Metals** : Most metals can easily be drawn into thin wires, which have a wide range of applications. The property by virtue of which metals can be drawn into thin wire is called **ductility**. Gold and silver are two of the most ductile metals known. Other metals that can be drawn into wires include copper, aluminium and tungsten.



*Ductile metal forming wires*

**Non-metal** : None metals are brittle and cannot be drawn into wires.

**Activity - 3**



Take an incandescent bulb and observe it carefully. What material is used to make the filament of the bulb which glows and gives you light? The bulb does not glow if the filament breaks. The filament is made of very thin wires of tungsten metal which breaks easily when there is an overflow or short-circuit of current. This shows that tungsten metal is highly ductile.



*An incandescent bulb has tungsten filament*

### 5.8 Tensile Strength

**Metals** : Generally metals have a high tensile strength. They can be stretched to some degree without breaking. Zinc and arsenic are exceptions. Metals are very strong. This is the reason that iron is widely used in construction of buildings, bridges and railway lines, etc.

**Non-metals** : Non metals have low tensile strength.

### 5.9 Thermal Conductivity

**Metals** : Metals are good conductors of heat and therefore used for making cooking utensils. Silver is the best conductor of heat followed by copper, gold, aluminium and tungsten.

**Non-metals** : Non- metals are generally poor conductors of heat. Diamond, which is a good conductor of heat, is an exception.

### 5.10 Electrical Conductivity

**Metals** : Metals are good conductors of electricity and are, therefore, used for making electrical wires and cables.

**Non-metals** : Non- metals are generally poor conductors of electricity. Graphite, which is a good conductor of electricity is an exception.

### 5.11 Sonorous

**Metals** : When metal pipes strike each other, they produce a ringing sound. The property by virtue of which metal objects produce a ringing sound when struck with a hard object is called **sonority**. Objects like wind chimes and bells make use of this property of metals.

**Non-metals**: Non-metals produce a dull sound when struck with a hard object.

### 5.12 Colour

**Metals** : Most metals are white or silvery-grey. There are, however, a few exceptions. For example, gold is yellow and copper is reddish-brown.

**Non-metals** : Some non-metals are colourless while some are coloured. For example, chlorine is a greenish-yellow gas, bromine is a brown liquid, iodine is a violet solid and oxygen and nitrogen are colourless gases.

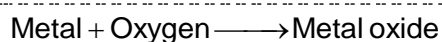
S.N.	Property	Metals	Non-metals
1	Physical state	They are solid at room temperature except mercury (Hg) which is a liquid.	They are either solids or gases except bromine which is a liquid.
2	Metallic lustre	They are lustrous (shiny).	They are non-lustrous or dull, except graphite and iodine.
3	Density	They usually have high density.	They usually have low density.
4	Malleability	They are malleable.	They are non-malleable and brittle.
5	Ductility	They are ductile.	They are non-ductile.
6	Conductivity	They are good conductors of heat and electricity.	They are bad or poor conductors of heat and electricity except graphite.
7	Melting and boiling points	They have high melting and boiling points, except Na and K.	They have low melting and boiling points except graphite, diamond, silicon, boron.
8	Hardness	They are hard except Na and K which are soft metals.	They are soft except diamond which is hard.
9	Sonority	They are sonorous.	They are non-sonorous.
10	Tensile strength	They have high tensile strength.	They have low tensile strength.

## 6. Chemical Properties of Metals and Non Metals

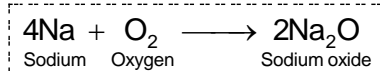
Some typical chemical properties of metals and non-metals are :

### 6.1 Reaction with Oxygen

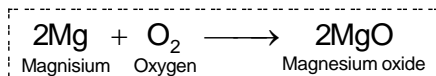
➤ **Metal** : Most metals combine with oxygen to form metal oxides.



- Sodium reacts vigorously with the oxygen present in air to form sodium oxide. As a result it catches fire if left in open. It is, therefore, kept immersed in kerosene.

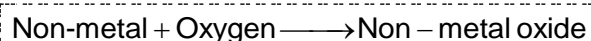


- Magnesium on heating burns in air (oxygen) with a dazzling white light to form magnesium oxide.

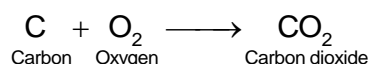


The metallic oxides formed are **basic** in nature and turn **red litmus solution blue**.

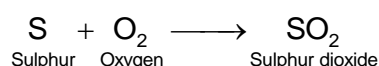
➤ **Non-Metal** : Non-metals like carbon, sulphur, and phosphorus react with oxygen to form non-metallic oxides. These oxides are also called acidic oxides as they form acids when dissolved in water.



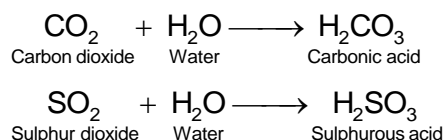
- Carbon burns in air (oxygen) to form carbon dioxide.



- Sulphur burns in air (oxygen) to form a pungent (i.e., having a strong smell), suffocating gas called sulphur dioxide.



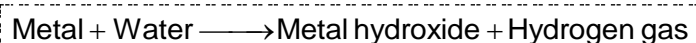
These oxides dissolve in water to form acids.



## 6.2 Reaction with Water

When a metal reacts with water, a metal oxide or metal hydroxide and hydrogen gas are formed. The intensity of reaction of a metal with water depends on its chemical reactivity. Some metals react even with cold water, some react with hot water, some react only with steam whereas some do not react at all with water.

➤ **Metal** : Most metals react with water to produce a metal hydroxide or metal oxide and hydrogen gas.

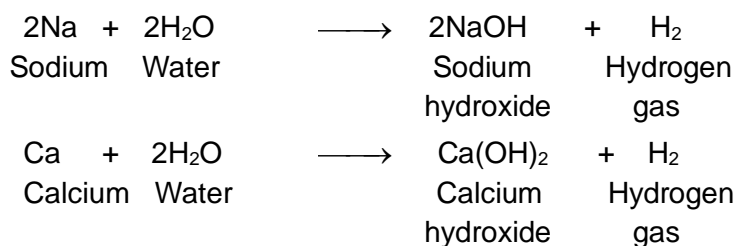


Or



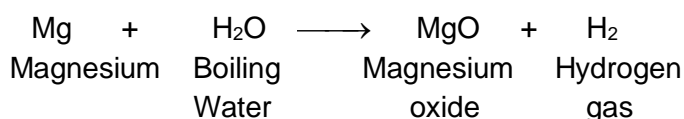
## 6.3 Reaction with Cold Water

Very reactive metals such as sodium, potassium and calcium rapidly displace hydrogen from cold water at room temperature forming their respective hydroxides.



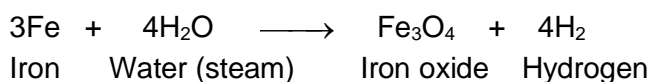
## 6.4 Reaction with Boiling Water

Less reactive metals like magnesium and zinc displace hydrogen gas only from boiling water forming oxides of the metals.



## 6.5 Reaction with Steam

Other less reactive metals like iron and nickel displace hydrogen gas from steam forming only oxides of metals.



**Non-metals** do not react with water or steam to release hydrogen gas.

### Activity – 4

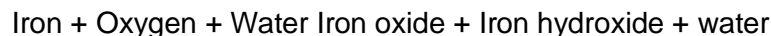


**Sodium Reacts with Water** : Take a beaker half filled with water. Add a small piece of dry sodium into the water. Observe what happens. Sodium reacts vigorously with water and a gas is evolved. Dip a red litmus paper in the beaker and note the change in colour of the litmus. It turns blue. This is due to the formation of sodium hydroxide solution. The gas evolved is hydrogen.

## 6.6 Corrosion

Iron and many other metals react with oxygen and moisture present in the atmosphere. This phenomenon is called corrosion. The process of slow eating away of a metal due to the attack of atmospheric gases and moisture on its surface is called **corrosion**.

- Iron reacts with oxygen and moisture present in the atmosphere to form a brown, flaky substance called rust. Rusting of iron is an undesirable reaction because the layer of rust formed falls off, exposing the metal to further rusting. As a result, iron objects become weak with the passage of time.



- Copper objects get coated with a green substance called basic copper carbonate with the passage of time. This green substance is formed due to the reaction of copper with carbon dioxide and moisture present in the atmosphere.



- Silver objects become blackened and lose their sheen with the passage of time. This happens due to the reaction of silver with hydrogen sulphide gas present in the atmosphere.

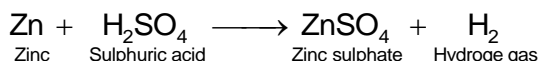
## 6.7 Reaction with Acids

**Metals :** When a metal reacts with an acid, a salt and hydrogen gas are produced.

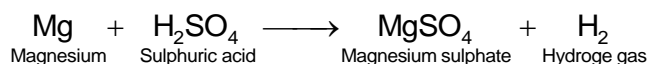


Salts are compounds formed when a metal replaces hydrogen in an acid. Different acids and metals react to form different salts.

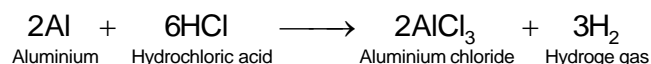
- Zinc reacts with sulphuric acid to form zinc sulphate and hydrogen gas.



- Magnesium reacts with sulphuric acid to form magnesium sulphate and hydrogen gas.



- Aluminium reacts with hydrochloric acid to form aluminium chloride and hydrogen gas.



With some metals, the reaction is very fast and vigorous, while with others it may be slow. Some metals do not react with acids at all.

**Non-metals :** Generally, non-metals do not react with acids.

### Activity – 5



**Aim :** To show that hydrogen is produced when magnesium reacts with dilute sulphuric acid.

**Materials needed :** Magnesium ribbon, dilute sulphuric acid, test tube, dropper, and a matchstick.

**Method :**

- Take a piece of magnesium ribbon in the test tube.
- Using a dropper, carefully add a few drops of dilute sulphuric acid from the sides of the test tube.
- Bring a burning matchstick near the mouth of the test tube.

**Observation :** Bringing a burning matchstick near the mouth of the test tube produces a 'pop' sound.

**Conclusion :** The gas produced in the reaction is hydrogen.

**Note :** Adult supervision required.

## 6.8 Reaction with Bases

**Metals :** Most metals do not react with bases. Only a few, like aluminium, zinc, and lead react with solutions of strong bases like sodium hydroxide to produce a compound of that metal and hydrogen gas.

**Non-metals :** The reactions of non-metals with bases are complex.

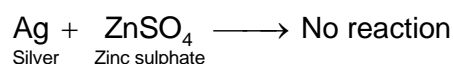
## 6.9 Displacement Reactions

In a displacement reaction, a metal reacts with a salt solution and 'displaces' (or replaces) the metal present in it. Displacement reactions are explained on the basis of the activity series of metals.

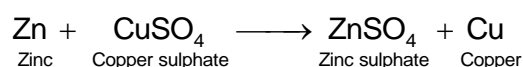
The **activity series of metals** is a list of common metals arranged in the decreasing order of reactivity.

This means that a metal which is placed higher in the activity series is more reactive than those placed below it. The activity series of metals is shown in Figure. You can predict whether or not a displacement reaction will take place by looking at the activity series. A metal will only react with a salt solution if it is placed higher in the activity series than the metal in the salt. For example, iron, which is placed higher in the activity series than copper, reacts with copper sulphate solution. Copper, however, does not react with iron sulphate as it is less reactive than iron. Some more examples are discussed below.

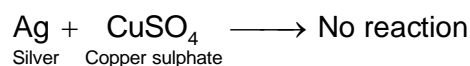
- Silver does not react with zinc sulphate.



- Zinc reacts with copper sulphate to form zinc sulphate and copper.

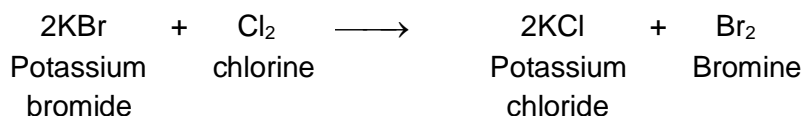


- Silver does not react with copper sulphate



From the above reactions, we can conclude that the order of reactivity of zinc, copper, and silver is : Zn > Cu > Ag (i.e. zinc is the most reactive of the three and silver, the least reactive).

Like metals, a more reactive non-metal displaces a less reactive non-metal from its salt solution. This is observed in the halogens gas family in which F > Cl > Br > I.



Potassium (K)
Sodium (Na)
Calcium (Ca)
Magnesium (Mg)
Aluminium (Al)
Zinc (Zn)
Iron (Fe)
Tin (Sn)
Lead (Pb)
Hydrogen (H)
Copper (Cu)
Mercury (Hg)
Silver (Ag)
Gold (Au)
Platinum (Pt)

↑ Most reactive  
↓ Least reactive

**Activity series of metals**

### Activity – 6



**Aim :** To prove that iron is more reactive than copper  
Materials needed: Iron filings, copper turnings, copper sulphate solution, iron sulphate solution, test tubes, and a dropper

**Method :**

- Take some iron filings in a test tube and add some copper sulphate solution with the help of a dropper (test tube A).
- Take some copper turnings in a test tube and add some iron sulphate solution with the help of a dropper (test tube B).

**Observation :** In test tube A, iron filings turn brown due to the deposition of copper and the solution turns pale green due to the formation of iron sulphate solution. No reaction is observed in test tube B.

**Conclusion:** Iron is more reactive than copper as it displaces copper from copper sulphate solution.

**Differences between Chemical Properties of Metals and Non-metals**

S.N.	Property	Metals	Non-metals
1	Reaction with oxygen	They form basic oxides which turn red litmus blue.	They form acidic oxides which turn blue litmus red. Some nonmetals also form neutral oxides.
2	Reaction with water	They react with water to form metal oxide or metal hydroxide	They do not react with water and produce hydrogel) gas.
3	Reaction with dilute acids	They react with dilute acids to form corresponding salt and hydrogen gas.	They do not react with acids.
4	Displacement reaction	A more reactive metal displaces a less reactive metal from its salt solution.	A more reactive non-metal displaces a less reactive non-metal from its salt solution.

**Alloy**

An **alloy** is a mixture of two or more metals or a metal and a non-metal. Examples of alloys are stainless steel (a mixture of iron, nickel, and chromium) and bronze (a mixture of Copper and Tin). Alloys have more desirable properties than their constituents and are more corrosion resistant.

**Uses of Common metals**

1. Copper and aluminium metals are used to make wires to conduct electric current.
2. Iron, copper and aluminium are used to make household utensils and factory equipments.
3. Iron is used as a catalyst in the preparation of ammonia gas by Haber's process. It is also used in the construction of ships, buildings, automobiles and other machinery.
4. Zinc is used for galvanising iron to protect it from rusting.
5. Chromium and nickel metals are used for electroplating and in the manufacturing of stainless steel.
6. The aluminium foils are used in packaging of medicines, cigarettes and food materials. It is used for making alloys and high voltage transmission wires.
7. Mercury is used for making thermometres.
8. Sodium, titanium and zirconium are used in projects related with atomic energy and space science..
9. Zirconium is also used for making bullet proof alloy steel.
10. Silver and gold are used to make jewelleryes and ornaments.
11. Copper and zinc are constituents of enzymes which act as biological catalysts.
12. Iron is the constituent of haemoglobin and magnesium is a constituent of chlorophyll.
13. Tin is used for tinning, cooking utensils, for making alloys and electrical fuse wire.
14. Magnesium is used in fireworks and for making alloys.
15. Gold and silver amalgam are used in dentistry for filling tooth cavities.
16. Lead is used for making water pipes, bullets and X-ray shields.

**Uses of common Non metals**

1. Phosphorus is used in manufacturing phosphoric acid and superphosphate fertiliser, matchstick, rat poison, alloy, fireworks, smoke screens.
2. Sulphur is used for making sulphuric acid which in turn is used for making plastics, synthetic fibres, dyes, drugs, detergents, explosives, fertilizers, vulcanization of rubber, germicide and in beauty parlours.
3. Powdered graphite is used as a dry lubricant. Graphite is used for making graphite electrodes in dry cells and electric arcs. It is also used for making the core of pencils called pencil leads.
4. Sand is used in making glass and cement.
5. Nitrogen is used for manufacturing ammonia, nitric acid, explosive, etc.
6. Silicon is used for making silicon steel alloy and a polymer called silicone.

7. Hydrogen is used as a fuel and for making ammonia, hydrochloric acid and vegetable ghee.
8. Chlorine is used for bleaching and sterilising water.
9. Iodine is used for making iodine salt and tincture iodine.
10. Oxygen is essential for respiration and combustion.

### Remember

- Did you know exposure to high doses of mercury can lead to blindness and paralysis? In the 1950s, hundreds of people in a small town called Minamata, Japan, were disabled and many others died due to nervous disorder and brain damage. It was later found that the fish they ate from Minamata bay were poisoned with mercury, and it was this exposure to mercury that was responsible for the 'Minamata syndrome'.
- This iron pillar near the Qutub Minar in New Delhi is considered a metallurgical wonder by archaeologists and metallurgists all over the world as it has withstood corrosion for the last 1600 years, despite harsh weather conditions.

### Key Words

- **Atom:** Atom is the smallest particle of matter which cannot be divided further by any physical mean. Atom are the basic units from which molecules and ions are formed.
- **Element :** a pure substance that consists of only one kind of atoms.
- **Metals :** elements which are hard, solid, malleable, ductile, possess lustre and are good conductors of heat and electricity.
- **Non-metals :** elements which are non-lustrous, brittle and are poor conductors of heat and electricity.
- **Metalloids :** elements which share the properties of metal and non-metals
- **Native state :** free state.
- **Malleability :** the ability of a metal to be beaten into sheets.
- **Ductility :** the property by which a metal can be drawn into wires.
- **Brittle :** substance which can be easily broken.
- **Displacement :** a reaction in which a more reactive metal displaces a less reactive metal from its Reaction salt solution.
- **Lustre :** the property of a metal by virtue of which its surface has a shine.
- **Sonorous :** the property of a metal which produces sound when struck with a hammer.
- **Conductivity :** the property due to which a substance conducts heat and electricity.
- **Acidic oxides :** the oxides of non-metals which dissolve in water to form acids.
- **Basic oxides :** the oxides of metals which dissolve in water to form bases.

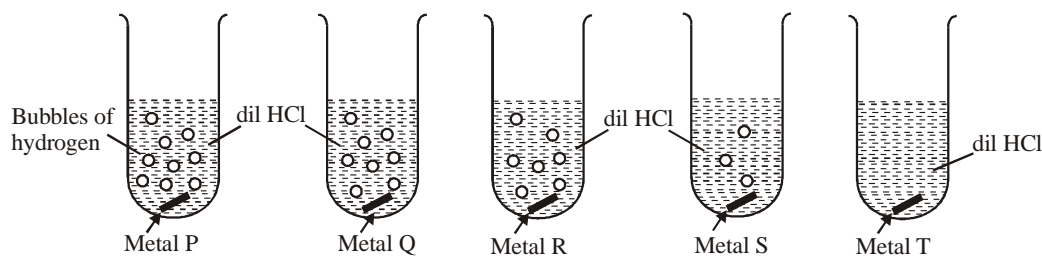
## DPP-1

1. Which of the following is a volatile liquid?  
(a) Chlorine                      (b) Fluorine                      (c) Bromine                      (d) Iodine
2. A monovalent cation which has atomic number 11, makes a compound with a monovalent anion whose atomic number is 17. The popular name of the compound is  
(a) Plaster of Paris      (b) Chilli salt peter      (c) Common salt      (d) TNT
3. All of the following are malleable except  
(a) Graphite                      (b) Iron                      (c) Aluminium                      (d) Silver
4. Purple colour of potassium permanganate solution can be decolourised by :  
(a) Carbonic acid      (b) Hydrochloric acid      (c) Citric acid                      (d) Acetic acid
5. The property of a material to convert it into thin sheets is called  
(a) Ductility                      (b) Malleable                      (c) Tension                      (d) All of the above
6. Which of the following properties is generally not shown by metals?  
(a) Electrical conduction                      (b) Sonorous in nature  
(c) Dullness                      (d) Ductility
7. Which one of the following is not a combination reaction :  
(a)  $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$                       (b)  $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$   
(c)  $\text{Cu} + 2\text{Ag(NO}_3)_2 \rightarrow \text{Cu(NO}_3)_2 + 2\text{Ag}$                       (d)  $2\text{NH}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow (\text{NH}_4)_2\text{CO}_3$
8. Aluminium is used for making cooking utensils. Which of the following properties of aluminium are responsible for the same?  
(i) Good thermal conductivity                      (ii) Good electrical conductivity  
(iii) Ductility                      (iv) High melting point  
(a) (i) and (ii)                      (b) (i) and (iii)                      (c) (ii) and (iii)                      (d) (i) and (iv)

## DPP-2

1. On addition of which metal, copper sulphate solution (blue colour) will be changed to colourless solution  
(a) Fe                      (b) Ag                      (c) Zn                      (d) Hg
2. Which one of the following statements pertaining to the general properties of metals is wrong?  
(a) Most of the metals form basic oxide  
(b) All metals displace hydrogen from acids  
(c) The hydroxides of heavy metals are converted to their oxides upon ignition  
(d) Metals form alloys with other metals
3. 'X' is the product formed when sulphur reacts with oxygen; it dissolves in water to produce 'Y'. Choose the correct option X and Y  
(a)  $\text{SO}_2$ , acid                      (b)  $\text{SO}_3$ , neutral                      (c)  $\text{SO}_2$ , base                      (d)  $\text{SO}_3$ , acid
4. Aqueous solution of which of the following salt is neutral :  
(a)  $\text{NH}_4\text{Cl}$                       (b)  $\text{KCl}$                       (c)  $\text{Na}_2\text{CO}_3$                       (d)  $\text{MgCl}_2$
5. Nitric acid can't be used in place of sulphuric acid labs for the preparation of hydrogen chloride as  
(a) It is more volatile than hydrochloric acid      (b) It is more volatile than sulphuric acid  
(c) It decomposes easily                      (d) It reacts with hydrochloric acid

6. Observe the rate of evolution of hydrogen gas with five metals P, Q, R, S and T at room temperature. What could be the metals P, Q, R, S and T?



- |     | P  | Q  | R  | S  | T  |
|-----|----|----|----|----|----|
| (a) | Zn | Al | Mg | Cu | Fe |
| (b) | Mg | Al | Zn | Fe | Cu |
| (c) | Al | Zn | Mg | Fe | Cu |
| (d) | Fe | Zn | Mg | Al | Cu |
7. A yellow coloured brittle element on burning produces a gas. The solution of this gas in water turns blue litmus red. The oxide is generally responsible for acid rain and for spoiling the buildings made of marble. The element and the oxide are
- (a) Fe,  $\text{Fe}_2\text{O}_3$                       (b) Si,  $\text{SiO}_2$                       (c) S,  $\text{SO}_2$                       (d) Ca, CaO
8. When lead nitrate crystals are heated :
- (a) A greenish yellow gas is evolved and a brown residue is left behind  
 (b) A brown gas is evolved and a yellow residue is left behind  
 (c) A brown gas is evolved and a white residue is left behind  
 (d) A colourless gas is evolved and a white residue is left

### DPP-3

1. Copper is extracted from the ore copper pyrite by smelting in a blast furnace. The flux used and the Slag are -
- (a) flux CaO, slag  $\text{CaSiO}_3$                       (b) flux  $\text{SiO}_2$ , slag  $\text{CaSiO}_3$   
 (c) flux FeO, slag  $\text{FeSiO}_3$                       (d) flux  $\text{SiO}_2$ , slag  $\text{FeSiO}_3$
2. \_\_\_\_\_ is not present in gun metal.
- (a) Cu                      (b) Sn  
 (c) Zn                      (d) Fe
3. The reaction which is exothermic is :
- (a) Corrosion                      (b) Photosynthesis  
 (c) Respiration                      (d) Rancidity
4. The rechargeable battery used in a mobile handset is usually :
- (a) Lead ion battery                      (b) Sodium ion battery  
 (c) Hydrogen ion battery                      (d) Lithium ion battery
5. Match the entries in column - A with appropriate ones in column - B.
- |                            |                                 |
|----------------------------|---------------------------------|
| <b>Column - A</b>          | <b>Column - B</b>               |
| (1) German silver          | (a) for making printing type    |
| (2) Tungsten steel         | (b) soldering                   |
| (3) Alloy of Sn and Pb     | (c) for making high speed tools |
| (4) Alloy of Pb, Sn and Sb | (d) for making jewellery        |

- (a)  $1 \rightarrow b ; 2 \rightarrow c ; 3 \rightarrow d ; 4 \rightarrow a$                       (b)  $1 \rightarrow c ; 2 \rightarrow d ; 3 \rightarrow a ; 4 \rightarrow b$   
 (c)  $1 \rightarrow d ; 2 \rightarrow c ; 3 \rightarrow b ; 4 \rightarrow a$                       (d)  $1 \rightarrow d ; 2 \rightarrow a ; 3 \rightarrow b ; 4 \rightarrow c$
6. 'Alclad' is perfectly resistant to corrosion by sea water. The alloy is  
 (a) magnalium coated with aluminium                      (b) duralumin coated with aluminium  
 (c) r-alloy duralumin                      (d) a mixture of magnalium and duralumin
7. In the extraction of iron, the most preferred ores are  
 (a) hematite and limonite                      (b) copper pyrites and siderite  
 (c) magnetite and iron pyrites                      (d) Limonite and copper pyrites.
8. Solvay process is used for the manufacture of :  
 (a) Washing soda                      (b) Baking soda                      (c) Bleaching powder                      (d) None of these

### DPP-4

1. In the metallurgy of copper, the impure metal got after Bessemerization is called :  
 (a) blister copper                      (b) wrought copper                      (c) brass copper                      (d) pig copper
2. Which of the following is purest form of iron?  
 (a) Wrought iron                      (b) Pig iron                      (c) Steel                      (d) None of these
3.  $Cl_2$  acts as bleaching agent because in presence of moisture it produces:  
 (a)  $O_2$                       (b)  $Cl$                       (c)  $O$                       (d)  $HCl$
4. When copper metal reacts with dil.  $HCl$  :  
 (a) Copper chloride and  $H_{2(g)}$  is formed  
 (b) Copper sulphate and  $SO_{2(g)}$  is formed  
 (c) No reaction takes place  
 (d) Copper sulphate and  $H_2S$  gas is formed.
5. In iron metallurgy, lime stone is used :  
 (a) To obtain heat energy                      (b) to reduce iron oxide into iron  
 (c) as an iron ore                      (d) to remove sand ( $SiO_2$ )
6. The substance which are put into the blast furnace in the manufacture of iron :  
 (a) Iron ore,  $CaO$ ,  $Ca(OH)_2$ , and  $CaSiO_3$   
 (b) Iron ore, coke, limestone and  $CaSiO_3$   
 (c) Iron ore, coke, lime stone and Hot air  
 (d) Iron ore,  $CaO$ , lime stone and Hot air
7. To obtain chromium from chromium oxide. Method used is  
 (a) Aluminothermic process                      (b) Electrolytic reduction process  
 (c) Carbon reduction                      (d) Carbon monoxide reaction
8. A student while heating solid lead nitrate taken in a test-tube would observe :  
 (a) White residue of  $PbO_2$                       (b) Green residue of  $NO_2$   
 (c) Yellow residue of  $PbO_2$                       (d) Brown residue of  $NO$ .

### DPP-5

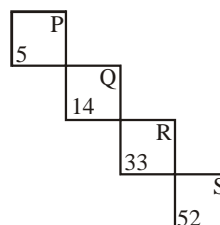
1. The solution of one of the following compound conduct electricity :  
 (a)  $CH_4$                       (b)  $MgCl_2$                       (c)  $CCl_4$                       (d)  $C_2H_4$

2. Four substances have the following electrical properties. What are these four substances?

Substance	Electrical property
W	Does not conduct under any conditions
X	Conducts only in aqueous solution
Y	Conducts in both the molten and solid
Z	Conducts in both the molten and aqueous

- |     |     |      |      |      |
|-----|-----|------|------|------|
|     | W   | X    | Y    | Z    |
| (a) | HCl | S    | NaCl | Pb   |
| (b) | Pb  | HCl  | NaCl | S    |
| (c) | S   | HCl  | Pb   | NaCl |
| (d) | S   | NaCl | HCl  | Pb   |
3. A non-metal X is an important constituent of our food. It forms two oxides Y and Z. Y is toxic and causes suffocation and even death while Z is responsible for global warming. Identify X, Y and Z.
- (a) X = C, Y = CO, Z = CO<sub>2</sub>                      (b) X = S, Y = SO<sub>2</sub>, Z = SO<sub>3</sub>  
(c) X = P, Y = P<sub>2</sub>O<sub>3</sub>, Z = P<sub>2</sub>O<sub>5</sub>                      (d) X = O, Y = O<sub>2</sub>, Z = O<sub>3</sub>

4. Shweta was given four squares P, Q, R and S with atomic numbers written on them. She gave the following four statements.



- (i) Element after square Q is a non-metal.  
(ii) Square R represents a metalloid.  
(iii) Element just before square R is a metalloid.  
(iv) Element Just before square S is a metal.
- The true statements given by her are \_\_\_\_\_ .
- (a) (i), (ii) and (iii)                      (b) (i), (ii) and (iv)  
(c) (ii) and (iii)                      (d) (i), (ii), (iii) and (iv)

5. While performing the experiment to observe action of acetic acid on solution bicarbonate, a student wanted to confirm that the gas evolved is CO<sub>2</sub>. For this he should :

- (a) Pass the through lime water                      (b) Pass it through CuSO<sub>4</sub> solution  
(c) Pass it through ZnSO<sub>4</sub> solution                      (d) Pass it through distilled water.
6. Among the following which pair is found in both native and combined state in nature.
- (a) Cu and Ag                      (b) Na and Hg                      (c) Cu and Ni                      (d) Mg and Pt

7. Match the following

**Column - I**

- (a) NaHCO<sub>3</sub>  
(b) Na<sub>2</sub>CO<sub>3</sub> · 10H<sub>2</sub>O  
(c) NaOH  
(d) CuSO<sub>4</sub> · 5H<sub>2</sub>O

- (a) (a) i ; (b) ii ; (c) iii ; (d) iv  
(c) (a) i ; (b) iv ; (c) ii ; (d) iii

**Column - I**

- (i) Caustic soda  
(ii) Baking soda  
(iii) Blue vitriol  
(iv) Washing soda

- (b) (a) ii ; (b) iv ; (c) i ; (d) iii  
(d) (a) ii ; (b) iv ; (c) iii ; (d) ii

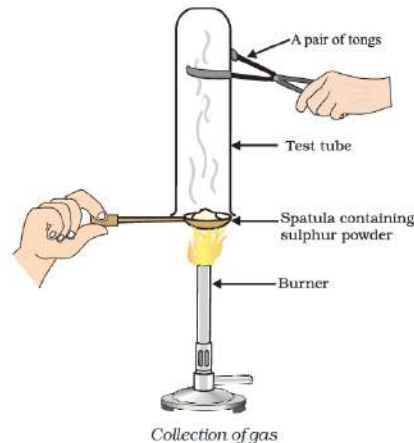
8. In order to study the neutralisation reaction of acid and base, a student took 10 ml of dilute hydrochloric acid in a conical flask and added a few drops of phenolphthalein indicator to it. He than added dilute sodium hydroxide solution to the conical flask dropwise with a dropper while shaking the conical flask will turn:

- (a) Slightly red                      (b) Slightly yellow                      (c) Colourless                      (d) Slightly pink

## NCERT Basics

## Exercise-1

- Which of the following pairs will give displacement reactions?
  - NaCl solution and copper metal
  - MgCl<sub>2</sub> solution and aluminium metal
  - FeSO<sub>4</sub> solution and silver metal
  - AgNO<sub>3</sub> solution and copper metal.
- Which of the following methods is suitable for preventing an iron frying pan from rusting?
  - Applying grease
  - Applying paint
  - Applying a coating of zinc
  - All of the above.
- An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be
  - calcium
  - carbon
  - silicon
  - iron.
- Food cans are coated with tin and not with zinc because
  - zinc is costlier than tin.
  - zinc has a higher melting point than tin.
  - zinc is more reactive than tin.
  - zinc is less reactive than tin.
- You are given a hammer, a battery, a bulb, wires and a switch.
  - How could you use them to distinguish between samples of metals and non-metals?
  - Assess the usefulness of these tests in distinguishing between metals and non-metals.
- What are amphoteric oxides? Give two examples of amphoteric oxides.
- Name two metals which will displace hydrogen from dilute acids, and two metals which will not.
- In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?
- Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it, as shown in figure below.
  - What will be the action of gas on
    - dry litmus paper?
    - moist litmus paper?
  - Write a balanced chemical equation for the reaction taking place.
- State two ways to prevent the rusting of iron.
- What type of oxides are formed when non-metals combine with oxygen?
- Give reasons
  - Platinum, gold and silver are used to make jewellery.
  - Sodium, potassium and lithium are stored under oil.
  - Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.
  - Carbonate and sulphide ores are usually converted into oxides during the process of extraction.
- You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.
- Differentiate between metal and non-metal on the basis of their chemical properties.



15. A man went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?
16. Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

## Concept Mastery

## Exercise-2

### A. Very Short Answer Type Questions

1. Name two metals which do not react with cold or boiling hot water, but react with steam.
2. Name a metal which is non-lustrous and a non-metal which is lustrous.
3. What happens when  $ZnCO_3$  is heated in the absence of air? Give the relevant equation.
4. Which process is used for the enrichment of sulphide ores and oxide ore.
5. Give reason: Platinum, gold and silver are used to make jewellery.
6. Write down important properties of ionic compounds.
7. Explain why:
  - i. Covalent compounds have generally low melting points.
  - ii. Ionic compounds have generally high melting points.
8. Why should the metal sulphides and carbonates be converted to metal oxides in the process of extraction of metal from them?
9. Iqbal treated a lustrous, divalent element M with sodium hydroxide. He observed the formation of bubbles in react mixture. He made the same observations when this element was treated with hydrochloric acid. Suggest how can he identify the produced gas. Write chemical equation for both the reactions.
10. Name a metal of medium reactivity and write three main steps in the extraction of this metal from its sulphides ore.

### B. Short Answer Type Questions

11. You are given a hammer, a battery, a bulb, wires and switch.
  - (a) How would you use them to distinguish between samples of metals and non metals?
  - (b) Assess the usefulness of these tests to distinguish between metals and non-metals.
12. A cleaned aluminium foil was placed in an aqueous solution of zinc sulphate. When the aluminium foil was taken out of the zinc sulphate solution after 15 minutes, its surface was found to be coated with a silvery grey deposit. From the given observation, what can be concluded?
13. P, Q and R are 3 elements which undergo chemical reactions according to the following equations:
  - a.  $P_2O_3 + 2Q \rightarrow Q_2O_3 + 2P$
  - b.  $3RSO_4 + 2Q \rightarrow Q_2(SO_4)_3 + 3R$
  - c.  $3RO + 2P \rightarrow P_2O_3 + 3R$
 Answer the following questions:
  - i. Which element is most reactive?
  - ii. Which element is least reactive?
  - iii. State the type of reaction listed above.
14. Draw the electron-dot structures of the following compounds and state the type of bonding in each case:
  - i. KCl
  - ii.  $NH_3$
  - iii. CaO
  - iv.  $N_2$
  - v.  $CaCl_2$

15. A metal 'X' is found in the form of filings which burns vigorously when sprinkled on flame. When these filings are treated with sulphur a black coloured compound 'Y' is formed which is not attracted by magnet. 'X' reacts with dil HCl to liberate hydrogen gas. 'X' reacts with steam to form 'Z' along with hydrogen gas. Identify 'X', 'Y', and 'Z'. Write the reaction involved.
16. A student added a few pieces of aluminium metal to two test tubes A and B containing aqueous solutions of iron sulphate and copper sulphate. In the second part of her experiment, she added iron metal to another test tubes C and D containing aqueous solutions of aluminium sulphate and copper sulphate.
- In which test tube or test tubes will she observe colour change? On the basis of this experiment, state which one is the most reactive metal and why.
17. Student takes sodium and potassium and kept in open air then what happens with sodium and potassium?

### C. Long Answer Type Questions

18. What are the various methods used for concentration of ore/Ore dressing?
19. Give reasons for the following:
- Generally no hydrogen gas is evolved when metals react with dilute nitric acid.
  - Sodium hydroxide solution cannot be kept in aluminium containers.
  - Silver metal does not combine easily with oxygen but silver jewellery tarnishes after some time.
  - Sodium is obtained by the electrolysis of its molten chloride and not from its aqueous solution.
  - Aluminium reacts with dilute hydrochloric acid slowly in the beginning.
20. i. Predict the reaction, if any, between
- zinc and silver nitrate solution,
  - magnesium and iron (II) chloride solution,
  - copper and magnesium sulphate solution.
- Write the equations, with its physical form symbols, for the reaction.
- ii. A lump of element X can be cut by a knife. During its reaction with water, X floats and melts. What is X? Explain.
21. i. Write the electron-dot structures for sodium, oxygen and magnesium.
- ii. Show the formation of Na<sub>2</sub>O and MgO by the transfer of electrons.
- iii. What are the ions present in these compounds?
22. i. Define non-metals. Give five examples of non-metals.
- ii. Name a non-metal which conducts electricity.
- iii. Name a non-metal having lustre (shining surface).
- iv. Name a non-metal which is extremely hard.
- v. How do non-metals react with oxygen? Explain with an example. Give equation of the reaction involved.
- What is the nature of the product formed? How will you demonstrate it?

### D. True & False

23. (a) In calcination, ore is heated with calcium.  
(b) Rusting of iron nail can occur in distilled water.

### E. Fill in the Blanks

24. (a) Malleability and ductility are the important characteristics of \_\_\_\_\_.  
(b) All the non-metals are soft except \_\_\_\_\_.

## Accuracy Booster

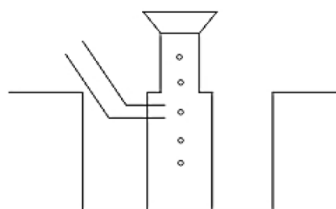
## Exercise-3

### A. Multiple Choice Questions

- Select the incorrect match.
  - A metal used in joining electric wires -Magnesium
  - A metal extracted by using electrolyticreduction – Aluminium
  - A metal whose oxide is soluble in both acidsand bases – Zinc
  - A metal unreactive towards oxygen anddilute acids – Gold
- Substance W does not conduct electricity under any condition, X conducts electricity only in aqueous solution, Y conducts electricity in both the molten and solid states while Z conducts electricity in both the molten state and in aqueous solution. Substances W, X, Y and Z could be respectively
  - S, NaCl, HCl and Pb
  - HCl, S, NaCl and Pb
  - Pb, HCl, NaCl and S
  - S, HCl, Pb and NaCl
- Which of the following oxide(s) of iron would be obtained on prolonged reaction of iron with steam?
  - $\text{Fe}_2\text{O}_3$  and  $\text{Fe}_3\text{O}_4$
  - $\text{FeO}$
  - $\text{Fe}_2\text{O}_3$
  - $\text{Fe}_3\text{O}_4$
- Galvanisation process involves elements of zinc and iron. Which of the two metals is sacrificing its life to save the life of the other?
  - None of these
  - Both sacrifice each other's life
  - Zn
  - Fe
- Latin name for royal water is X. It is a mixture of Y and Z in the ratio 3 : 1 . Some of the properties of X are different from Y and Z. What are X, Y and Z respectively?
  - $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{S}$ ,  $\text{SO}_3$
  - Aqua regia, HCl,  $\text{HNO}_3$
  - Aqua regia,  $\text{HNO}_3$ , HCl
  - $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ ,  $\text{SO}_2$
- Alloys are homogeneous mixtures of a metal with a metal or nonmetal. Which among the following alloys contain non-metal as one of its constituents?
  - Brass
  - Steel
  - Amalgam
  - Bronze
- Which of the following can be beaten into thin sheets?
  - Zinc
  - Oxygen
  - Sulphur
  - Phosphorus
- Generally, non-metals are not lustrous. Which of the following nonmetal is lustrous?
  - Iodine
  - Nitrogen
  - Sulphur
  - Oxygen
- Which metal is found in plants?
  - Cr
  - Fe
  - CO
  - Mg
- Which one of the following is metal?
  - C
  - N
  - Na
  - O
- When iron nail is placed in copper sulphate solution for a few hours the blue colour of solution will
  - Remain blue
  - Change to colourless
  - Change to pink
  - Change to green

- 12.** Fountain experiment demonstrates:
- (a) Manufacturing of  $\text{NH}_3$  (b) The solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$   
(c) None of these (d) The solubility of  $\text{SO}_2$  in water
- 13.** Chemical formula of sulphurous acid is:
- (a)  $\text{H}_2\text{SO}_4$  (b)  $\text{H}_2\text{SO}_3$   
(c)  $\text{SO}_3$  (d)  $\text{SO}_2$
- 14.** Which one of the following is non metal?
- (a) Al (b) Fe  
(c) N (d) Zn
- 15.** An ore on treatment with dilute hydrochloric acid gives a smell of rotten eggs. Which of the following processes can be used to obtain pure metal from the concentrated form of this ore?
- (a) Roasting followed by reduction with carbon  
(b) Both Roasting followed by reduction with carbon and Calcination followed by electrolytic reduction.  
(c) Roasting followed by heating.  
(d) Calcination followed by electrolytic reduction.
- 16.** Which one of the following metals do not react with cold as well as hot water?
- (a) Mg (b) Fe  
(c) Ca (d) Na
- 17.** Which of the following elements occurs in free state in nature?
- (a) Fe (b) Ni  
(c) Pt (d) CO
- 18.** Before keeping any eatables in the jar, Riya always keeps anhydrous  $\text{CaCl}_2$  in the bottle to:
- (a) All of these (b) To absorb moisture  
(c) Kill germs (d) To clean the bottle
- 19.** Which of the following are not ionic compounds?
- i. KCl ii. HCl  
iii.  $\text{CCl}_4$  iv. NaCl
- (a) (ii) and (iii) (b) (i) and (iii)  
(c) (i) and (ii) (d) (iii) and (iv)
- 20.** Which of the following non-metals is a liquid?
- (a) Carbon (b) Phosphorus  
(c) Sulphur (d) Bromine
- 21.** Generally, non-metals are not conductors of electricity. Which of the following is a good conductor of electricity?
- (a) Fullerene (b) Sulphur  
(c) Diamond (d) Graphite
- 22.** Name the reducing agent in the following reaction:  $3\text{MnO}_2 + 4\text{Al} \rightarrow 3\text{Mn} + 2\text{Al}_2\text{O}_3$
- (a)  $\text{Al}_2\text{O}_3$  (b) Al  
(c)  $\text{MnO}_2$  (d) Mn
- 23.** Which of the following substances produce hydrogen on reacting with metals?
- (a) All of these (b) Water ( $\text{H}_2\text{O}$ )  
(c)  $\text{C}_2\text{H}_5\text{OH}$  (d)  $\text{H}_2\text{SO}_4$

- 24.** Dried fruit plastic bags sold in the market are filled with:  
 (a) Hydrogen gas (b) All of these  
 (c) Helium gas (d) Nitrogen gas
- 25.** What happens when dilute sulphuric acid is poured on a copper plate?  
 (a) No reaction takes place. (b) Copper chloride formed.  
 (c) Zinc sulphate formed. (d) Copper sulphate formed.
- 26.** A non-metal X is an important constituent of our food. It forms two oxides Y and Z. Y is toxic and causes suffocation and even death while Z is responsible for global warming. Identify X, Y and Z.  
 (a) X = S , Y = SO<sub>2</sub>, Z = SO<sub>3</sub> (b) X = O, Y = O<sub>2</sub>, Z = O<sub>3</sub>  
 (c) X = C , Y = CO, Z = CO<sub>2</sub> (d) X = P, Y = P<sub>2</sub>O<sub>3</sub>, Z = P<sub>2</sub>O<sub>5</sub>
- 27.** The group of metals which do not react with oxygen:  
 (a) All of these (b) Na, Cs  
 (c) Au, Ag (d) Pt, Cu
- 28.** Magnesium imparts:  
 (a) Dazzling white colour flame (b) Yellowish orange colour flame  
 (c) None of these (d) Brick red colour flame
- 29.** Which of the following metal reacts neither with cold water nor with hot water but reacts with hot steam to produce hydrogen gas?  
 (a) Mg (b) Fe  
 (c) Ca (d) Na
- 30.** Which of the following property is generally shown by metals?  
 A. Electrical conduction B. Sonorous in nature  
 C. Dullness D. Ductility  
 (a) A and B (b) A and C  
 (c) All of these (d) A, B and D
- 31.** Aluminum is used for making cooking utensils. Which of the following properties of aluminum are responsible for the same?  
 i. Good thermal conductivity  
 ii. Good electrical conductivity  
 iii. Ductility  
 iv. High melting point  
 (a) (i) and (ii) (b) (i) and (iii)  
 (c) (ii) and (iii) (d) (i) and (iv)



- 32.** A metal is heated with dil H<sub>2</sub>SO<sub>4</sub>. The gas evolved is collected by the method shown in the figure. Answer the following questions based on it:  
 Name the method used for the collection of gas.  
 (a) Upward displacement method  
 (b) Downward replacement method  
 (c) Downward displacement method  
 (d) Upward replacement method
- 33.** An element A is soft and can be cut with a knife. This is very reactive to air and cannot be kept open in air. It reacts vigorously with water. Identify the element from the following.  
 (a) Na (b) P  
 (c) Mg (d) Ca

34. Ayush is putting  $H_2SO_4$  in the test tube containing water whereas Piyush is putting water in the test tube containing  $H_2SO_4$ . Which of the two is likely to face danger?  
 (a) Piyush (b) Ayush  
 (c) None of the two (d) Both Ayush and Piyush
35. An iron nail was dipped in a solution kept in a test tube. After half an hour, it was observed that the colour of the solution had changed. The solution in the test tube was:  
 (a) Iron sulphate (b) Copper sulphate  
 (c) Zinc sulphate (d) Aluminium sulphate

**B. Assertion & Reason Questions**

36. **Assertion (A):** Bronze is an alloy of lead and tin.  
**Reason (R):** Alloys are a heterogeneous mixture of metals with other metals and non-metals.  
 (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true but R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.
37. **Assertion (A):** Metals are sonorous.  
**Reason (R):** They are generally brittle in the solid-state; they break into pieces when hammered.  
 (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true but R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.

**C. Statement Type Questions**

38. Which of the following statement is correct:  
**Statement A:** Many compounds containing sulphur are used as medicines.  
**Statement B:** Cast iron contains 3% to 5% carbon.  
 (a) Both the statements are true. (b) Statement A is true; statement B is false.  
 (c) Statement A is false; statement B is true. (d) Both the statements are false.
39. Which among the following statements is incorrect for magnesium metal?  
 (a) It burns in oxygen with a dazzling white flame  
 (b) It reacts with steam to form magnesium hydroxide and evolves hydrogen gas  
 (c) It reacts with cold water to form magnesium oxide and evolves hydrogen gas  
 (d) It reacts with hot water to form magnesium hydroxide and evolves hydrogen gas

**D. Match the Column**

40. Match the following:

(a) Aqua regia	(i) used for making ornaments
(b) Gold	(ii) can dissolve all metals
(c) Copper	(iii) forms ionic chlorides
(d) Metal	(iv) less reactive than hydrogen

41. Match the following:

(a) Aluminum	(i) Cinnabar
(b) Mercury	(ii) Thermite reaction
(c) Copper	(iii) Purification of metals
(d) Refining	(iv) Electrolysis

42. Match the following with the correct response :

(1) Liquid metal	(A) Silver
(2) Best conductor of heat	(B) Sodium
(3) Poorest conductor of heat	(C) Lead
(4) Metal that can be cut with a knife	(D) Mercury

(a) 1-A, 2-C, 3-B, 4-D

(b) 1-B, 2-D, 3-A, 4-C

(c) 1-D, 2-A, 3-C, 4-B

(d) 1-C, 2-B, 3-D, 4-A

43. Match the following with the correct response :

(i) Bauxite	(a) Silver
(ii) Hematite	(b) Iron
(iii) Galena	(c) Aluminum
(iv) Argentite	(d) Lead

(a) (i) - (c), (ii) - (b), (iii) - (d), (iv) - (a)

(b) (i) - (c), (ii) - (d), (iii) - (a), (d) - (b)

(c) (i) - (d), (ii) - (a), (iii) - (c), (iv) - (b)

(d) (i) - (a), (ii) - (c), (iii) - (b), (iv) - (d)

### E. Case Study or Paragraph

44. Read the following and answer any four questions:

Metal has various physical properties which include metallic lustre that they have shining surfaces in their pure state. Metal can be easily beaten into thin sheets. They are ductile can drawn into wire due to which metal can be given different shapes according to their needs. Metal is a good conductor of heat and has high melting and boiling point.

i. Which of the following is the least reactive metal?

a. Sodium

b. Silver

c. Copper

d. Lead

ii. The metal which is most ductile \_\_\_\_\_.

a. gold

b. aluminium

c. copper

d. magnesium

iii. Which of the following metal exist in a liquid state?

a. Calcium

b. Potassium

c. Mercury

d. Sodium

iv. Which of the following metal is a poor conductor of heat?

a. Silver

b. Copper

c. Lead

d. All of these

v. The property of metal can be beaten in thin sheets is called \_\_\_\_\_.

a. ductility

b. malleability

c. metallic lustre

d. none of these

**45.** Read the following and answer any four questions:

The Earth's crust is a major source of metal. The element which occurs naturally in earth crust is known as mineral, metal is found in a free state, combined state as oxides. Ores are usually contaminated by impurities.

These impurities are removed by various methods such as roasting, calcination, and electrolytic refining, etc.

i. Which of the following pair of metals exist in their native state in nature?

- |              |              |
|--------------|--------------|
| a. Ag and Hg | b. Ag and Zn |
| c. Au and Hg | d. Au and Ag |

ii. Sulphide ore is converted into metal oxide by the process of:

- |                |              |
|----------------|--------------|
| a. carbonation | b. roasting  |
| c. calcination | d. anodizing |

iii. \_\_\_\_\_ is an ore of mercury.

- |             |                  |
|-------------|------------------|
| a. Cinnabar | b. Mercury oxide |
| c. Hematite | d. Bauxite       |

iv. Which of the following statement is correct?

- Na and K are the least reactive elements
- Mg and Al are highly reactive elements
- Zn, Fe are highly reactive elements
- Pb is the least reactive element

v. Which of the following alloys contains mercury as one of the constituents?

- |                    |                 |
|--------------------|-----------------|
| a. Stainless steel | b. Solder       |
| c. Duralumin       | d. Zinc amalgam |

**Question No. 46 to 49 are based on the given text. Read the text carefully and answer the questions:**

Metals are required for a variety of purposes. For this we need their extraction from their ores. Ores mined from the earth are usually contaminated with many impurities which must be removed prior to the extraction of metals. The extraction of pure metal involves the following steps:

- Concentration of ore
- Extraction of the metal from the concentrated ore
- Refining of the metal

**46.** Name an ore of Mercury and state the form in which Mercury is present in it.

**47.** What happens to zinc carbonate when it is heated strongly in a limited supply of air?

**48.** The reaction of a metal A with  $\text{Fe}_2\text{O}_3$  is highly exothermic and is used to join railway tracks.

I. Identify the metal A and name the reaction taking place.

II. Write the chemical equation for the reaction of metal A with  $\text{Fe}_2\text{O}_3$ .

**49.** We cannot use carbon to obtain sodium from sodium oxide. Why? State the reactions taking place at cathode and anode during electrolytic reduction of sodium chloride.

## Answer Key

### DPP-1

1. (c)    2. (c)    3. (a)    4. (c)    5. (b)    6. (c)    7. (c)  
8. (d)

### DPP-2

1. (c)    2. (b)    3. (a)    4. (b)    5. (a)    6. (b)    7. (c)  
8. (b)

### DPP-3

1. (d)    2. (d)    3. (c)    4. (d)    5. (c)    6. (b)    7. (a)  
8. (b)

### DPP-4

1. (a)    2. (a)    3. (a)    4. (c)    5. (d)    6. (c)    7. (a)  
8. (c)

### DPP-5

1. (b)    2. (c)    3. (a)    4. (a)    5. (a)    6. (a)    7. (b)  
8. (d)

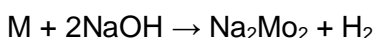
## Concept Mastery

## Exercise-2

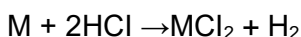
- Zinc and Iron do not react with cold or boiling hot water, but react with steam.
- Iron (due to corrosion on the surface) is a metal that is non-lustrous and iodine is a non-metal which is lustrous.
- When  $\text{ZnCO}_3$  is heated in the absence of air,  $\text{ZnO}$  and  $\text{CO}_2$  are formed.
- Froth floatation process is used for the enrichment of sulphide ores.  
Hydraulic washing or backing process is used in the enrichment of an oxide ore.
- Platinum, gold and silver are at the bottom of the reactivity series and hence they are able to maintain their shine for a long time.  
Moreover, these are highly ductile and malleable. These metals are un-reactive. They do not react with oxygen and other gases present in air and with moisture. Hence, these metals are used to make jewelry.
- Some of the properties of ionic compounds are:
  - Ionic compounds have high melting and boiling points.
  - They are generally solid.
  - They are soluble in water.
  - They are good conductors of electricity in molten state.

7. i. Covalent compounds are made up of electrically neutral molecules and force of attraction between the molecules of a covalent compound is very weak. Therefore, only a small amount of heat energy is required to break these bonds. As a result, melting point of covalent compounds is low.
- ii. Ionic compounds are made up of positive and negative ions. There is a strong electrostatic force of attraction between them. A lot of heat energy is required to break this force of attraction and to melt or boil the ionic compound. As a result, ionic compounds have high melting points.
8. This is because it is easier to obtain metals from their oxides (by reduction) than from carbonate or sulphide ores. So, before reduction, the ore must be converted into a metal oxide which can then be reduced. Calcination or roasting is done depending on the nature of ore, to convert the ore into oxide. A-carbonate ore is converted into oxide by calcination whereas a sulphide ore is converted into oxide by roasting.
9. Burning matchstick should be brought near the evolved gas. If matchstick burns with a pop sound, it indicates evolution of hydrogen gas.

Reaction with NaOH:



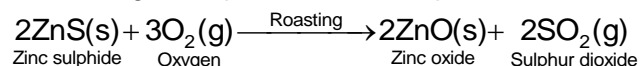
Reaction with HCl:



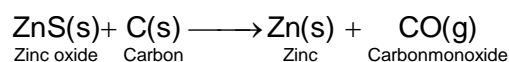
**10. Zinc**

The steps involved in extraction of zinc from zinc sulphide are:

- i. Roasting of sulphide ore in the presence of air to convert it into metal oxide.



- ii. Reduction of metal oxide with carbon to get the free metal.



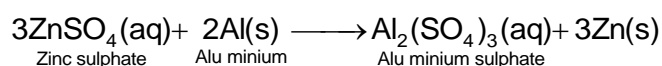
- iii. Reduction of metal oxide with carbon to get the free metal.

11. (a) With the help of the wires, try to convert the samples in the form of thin wires. Metals will be readily formed into thin wires being ductile whereas non metals being brittle will break. Now if we construct a cell using these wires the circuit which consists of metallic wires conducts electricity and the bulb will glow whereas non-metallic wires will not allow electricity to pass through them. Also, if beaten by a hammer, the metallic samples will produce a loud ringing sound indicating the metals are sonorous.

(b) From these tests we can say :

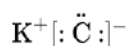
- (i) Metals are ductile whereas non-metals are not.  
(ii) Metals are good conductors of electricity while non metals are not.  
(iii) Metals are sonorous while non-metals are not.

12. Aluminium is more reactive than zinc hence it displaces zinc from zinc sulphate solution and forms silvery white zinc metal. The reaction is as follows:

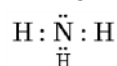


13. i. Q is the most reactive metal out of P, R and Q as it has replaced both P and R from their compounds.  
ii. R is the least reactive element as it has been displaced by both P and Q.  
iii. The type of reaction is Displacement reaction.

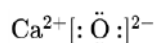
14. i. KCl form ionic bond



- ii. NH<sup>3</sup> forms covalent bond



iii. CaO form ionic bond

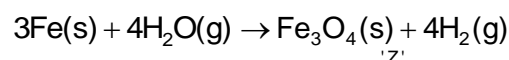
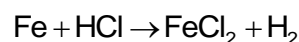
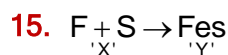
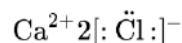


iv. N<sub>2</sub> form covalent bond



CaCl<sub>2</sub> form ionic bond

v. CaCl<sub>2</sub> form ionic bond



16.

Metal	Salt Solution in which added	Colour changes in solution	Reactivity
Aluminium (A)	FeSO <sub>4</sub> (A test tube)	The green colour of FeSO <sub>4</sub> disappears Iron metal settles down at the bottom of the beaker.	Reactivity of Al is higher than iron.
Aluminium (B)	CuSO <sub>4</sub> (B test tube)	The blue colour of CuSO <sub>4</sub> disappears the brown coloured copper particles settle down at the bottom of the test tube.	Reactivity of Al is higher than copper.
Iron (C)	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (C test tube)	The solution remains colourless (no changes)	Fe cannot displace Al from Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> solution. Reactivity of Fe < Al
Iron (D)	CuSO <sub>4</sub> (D test tube)	The blue colour of CuSO <sub>4</sub> changes to light green colour.	Reactivity of Fe > Cu.

Colour change is observed in test tubes - A, B, D

Most reactive metal is aluminium.

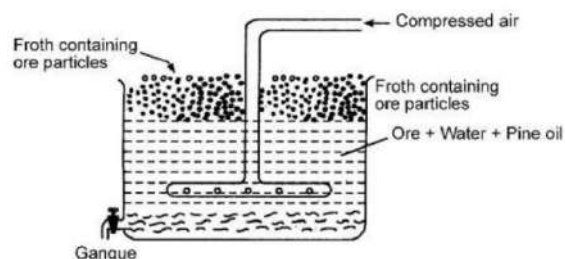
The reactivity series is a list of metals arranged in the order of their decreasing activities. According to the reactivity series, Aluminium is more reactive than Cu, Fe metals. Reactive metals displace less reactive metals from solutions of their compounds.

17. Both sodium and potassium are extremely reactive metals. They react violently with oxygen and moisture present in air even at the room temperature, which is an extremely exothermic reaction and (may catch fire). A large amount of heat is evolved. Firstly, they form oxide with oxygen which reacts with moisture present in air to form respective hydroxide. Hence these extremely reactive metals are not kept in open but are kept immersed in the kerosene.

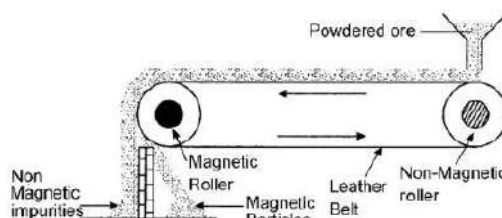
18. Concentration of Ore: The process of removal of unwanted impurities like sand, rocky material, earthy particles etc. from the ore is called ore concentration or ore dressing. The finely ground ore is concentrated by any of the following processes:

i. Hydraulic washing: This method depends upon the difference in the densities of the ore particles and the impurities (gangue). The crushed and powdered ore is taken in large wooden tables with small obstacles. A stream of water is passed over the shaking table. The lighter impurities are washed away with the running stream of water while the heavier ore particles are left behind. This method of concentration is usually applicable to oxide ores.

- ii. Froth floatation process: This method is used for the extraction of those metals in which the ore particles are preferentially wetted by oil and gangue by water. In this method, the powdered ore is mixed with water containing small quantities of oil (pine oil or eucalyptus oil) in a large tank (Fig.). The water is agitated by blowing air violently when a froth (or foam) is formed. The froth carries the lighter ore particles along with it to the surface. The heavier impurities are left behind in water and these settle to the bottom. Since the ore particles float with the froth at the surface, this process is called froth floatation process. The froth at the surface is transferred into another tank. The froth is broken by adding some acid and ore particles are separated by filtration and dried. For example, the froth floatation process is commonly used for the sulphide ores of copper, zinc, lead et



- iii. Magnetic separation: The ores which are attracted by a magnet can be separated from the non-magnetic impurities with the help of magnetic separation method. For example, this method is used for the concentration of haematite, an ore of iron. It consists of a leather belt moving over two rollers, one of which is magnetic in nature. This is shown in the figure. The powdered ore is dropped over the moving belt at one end. At the other end, the magnetic portion of the ore is attracted by the magnetic roller and falls nearer to the roller while the non-magnetic impurities fall farther off.



19. i. As Nitric acid ( $\text{HNO}_3$ ) is a strong oxidizing agent, it oxidizes the hydrogen formed into water ( $\text{H}_2\text{O}$ ) and itself, gets reduced to an oxide of nitrogen.
- ii. When sodium hydroxide ( $\text{NaOH}$ ), which is a strong base, is kept in a container made of Aluminium, it reacts to form sodium aluminate ( $\text{NaAlO}_2$ ) with the release of inflammable Hydrogen gas and will corrode the container.
- iii. Silver ( $\text{Ag}$ ) is a highly unreactive metal and does not chemically combine with oxygen but gradually it turns black (tarnish) due to the reaction of silver with the hydrogen sulphide ( $\text{H}_2\text{S}$ ) gas in air forming black colour silver sulphide ( $\text{Ag}_2\text{S}$ ).
- iv. If the electrolysis of aqueous solution of sodium chloride is carried out, the sodium metal obtained at the cathode reacts with water to form sodium hydroxide and hydrogen gas. Thus, instead of sodium, hydrogen gas is liberated at the cathode.
- v. Aluminium metal has a layer of Aluminium oxide or Alumina ( $\text{Al}_2\text{O}_3$ ) on its surface which is a highly stable compound which slows down the reaction first when reacting with acid.
20. i. a. Zinc is more reactive than silver. It will displace silver from silver nitrate solution and will form zinc nitrate in the solution.  

$$\text{Zn(s)} + 2\text{AgNO}_3(\text{aq}) \rightarrow \text{Zn(NO}_3)_2(\text{aq}) + 2\text{Ag(s)}$$
- b. Magnesium is more reactive than iron. It will displace iron from iron (II) chloride solution and will form magnesium chloride in the solution.  

$$\text{Mg(s)} + \text{FeCl}_2(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{Fe(s)}$$
- c. Copper is less reactive than magnesium. It will not displace magnesium from magnesium sulphate solution and, hence, no reaction will take place.  

$$\text{Cu(s)} + \text{MgSO}_4(\text{aq}) \rightarrow \text{No reaction}$$
- ii. X is potassium (K). Potassium is a soft metal that's why it can be cut with a knife and it is lighter than water that's why it floats on the surface of water and the heat produced melts the potassium.

21.

Metal	Symbol	Atomic Number	Electronic configuration K, L, M, N	No. of outermost electrons	Electron dot structures
Sodium	Na	11	2, 8, 1	1	Na
Oxygen	O	8	2, 6	6	:O::
Magnesium	Mg	12	2,8 2	2	Mg:

ii. Formation of Na<sub>2</sub>O:

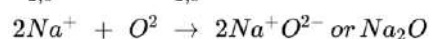
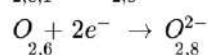
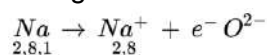
The atomic number of sodium is 11 and it has only one valence electron.

Hence, electronic configuration of <sub>11</sub>Na is 2, 8, 1.

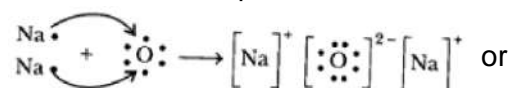
The atomic number of oxygen is 8 and it has 6 electrons in its valence shell.

Hence, electronic configuration of <sup>8</sup>O is 2, 6.

Sodium has a tendency to lose the valence electron and oxygen has a tendency to gain the electron lost by sodium. Since, sodium can lose only one electron of the valence shell, and oxygen atom needs two electrons to complete its octet in the valence electron, two atoms of sodium combine with one atom of oxygen. By losing valence electron, sodium is changed into Na<sup>+</sup> and by gaining two electrons lost by two sodium atoms, oxygen atom is changed into an oxide anion, O<sup>2-</sup>. In this process, both the atoms, sodium and oxygen, obtain the stable electronic configuration of the noble gas neon.



The oppositely charged sodium ion, Na<sup>+</sup>O<sup>2-</sup> and oxide ion, O<sup>2-</sup> are now held together by electrostatic force of attraction or by ionic or electrovalent bond. Na<sub>2</sub>O is, therefore, an ionic or electrovalent compound.

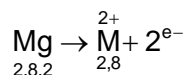


Formation of MgO:

The atomic number of magnesium = 12

Its electronic configuration is K,L,M  
<sub>2, 8, 2</sub>

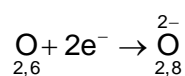
It has two electronic in its outermost shell. So, the magnesium atom donates its 2 valence electrons and forms a stable magnesium ion, Mg<sup>2+</sup> to attain the electronic arrangement of neon atom.



The atomic number of oxygen = 8

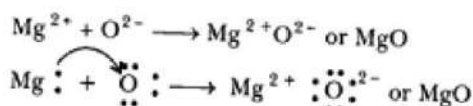
Electronic configuration = K,L  
<sub>2 6</sub>

It has 6 electrons in its valence shell. Therefore, it requires 2 more electrons to attain the stable electronic arrangement of neon gas. Thus, oxygen accepts 2 electrons donated by magnesium atom and forms a stable oxide ion, O<sup>2-</sup>



The oppositely charged magnesium ions, Mg<sup>2+</sup>, and oxide ions, are held together by a strong force of electrostatic attraction to form magnesium oxide compound.

Mg<sup>2+</sup> O<sup>2-</sup> or MgO.



MgO is ionic compound.

iii. The ions present in  $\text{Na}_2\text{O}$  are sodium ions ( $2\text{Na}^+$ ) and oxide ion  $\text{O}^{2-}$

The ions present in MgO are magnesium ion ( $\text{Mg}^{2+}$ ) and oxide ion  $\text{O}^{2-}$ .

- 22.** i. Non-metals are the elements that do not conduct heat and electricity and are neither malleable nor ductile. Example: Carbon, sulphur, phosphorus, silicon, and oxygen.  
 ii. Carbon is a non-metal which conducts electricity.  
 iii. Iodine is a non-metal having lustre.  
 iv. Carbon (Diamond) is a hard non-metal.  
 v. Non-metals react with oxygen to form acidic oxides or neutral oxides. Carbon burns in air to form carbon dioxide.  
 The nature of the product formed is acidic. When carbon dioxide dissolves in water, it forms carbonic acid. It turns blue litmus to red which shows it is acidic in nature.

**23.** State True or False:

- (i) (b) False  
 (ii) (b) False

**24.** Fill in the blanks:

- (i) 1. Metals (ii) 1. Diamond

## Accuracy Booster

## Exercise-3

1. (a)      2. (c)      3. (d)      4. (c)      5. (b)      6. (b)      7. (a)  
 8. (a)      9. (d)      10. (c)      11. (d)      12. (b)      13. (b)      14. (c)  
 15. (b)      16. (b)      17. (c)      18. (b)      19. (a)      20. (d)      21. (d)  
 22. (b)      23. (a)      24. (d)      25. (a)      26. (c)      27. (c)      28. (a)  
 29. (b)      30. (d)      31. (d)      32. (c)      33. (a)      34. (a)      35. (b)  
 36. (d)      37. (c)      38. (a)      39. (c)  
 40. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)  
 41. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)  
 42. (c) 1-D, 2-A, 3-C, 4-B  
 43. (b) (i) - (c), (ii) - (d), (iii) - (a), (d) - (b)  
 44. i. (b)      ii. (a)      iii. (c)      iv. (c)      v. (b)  
 45. i. (d)      ii. (b)      iii. (a)      iv. (b)      v. (d)  
 46. Cinnabar is the primary ore of mercury. It is a red-colored mineral that consists of mercury sulfide ( $\text{HgS}$ ), where mercury is present in the form of cinnabar crystals.  
 47. When zinc carbonate ( $\text{ZnCO}_3$ ) is heated in absence of air, carbon dioxide ( $\text{CO}_2$ ) and zinc oxide ( $\text{ZnO}$ ) are formed.  

$$\text{ZnCO}_3(\text{aq}) \xrightarrow{\Delta} \text{ZnO}(\text{s}) + \text{CO}_2(\text{g})$$
  
 48. i. Metal X is Aluminium, Thermite reaction  
 ii.  $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 + \text{heat}$   
 49. The metals high up in the activity series are very reactive. They cannot obtain by reduction of their oxides by carbon. Since, sodium is high up in the activity series, carbon cannot reduce the oxides of sodium because it has more affinity for oxygen than carbon.  
 During electrolysis of molten  $\text{NaCl}$ , sodium metal is deposited at the cathode, whereas, chlorine is liberated at the anode. The reactions are:  
 At cathode:  $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$   
 At anode:  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ .

## 👉 Quick Exam Revision

- An element consists of only one kind of atoms.
- Elements are classified into metals, non-metals and metalloids.
- Metals occur both in free and combined state in nature.
- Properties of Metals: Metals are:
  - (i) **hard** to touch.
  - (ii) **lustrous** i.e., freshly cut surfaces of metals have characteristic shining .
  - (iii) **malleable**; the property of metals by which they can be beaten into thin sheets is called malleability.
  - (iv) **ductile**; the property of metal by which they can .be drawn into wires are called ductility.
  - (v) **sonorous** i.e., produce ringing sound when struck on a hard surface.
  - (vi) good conductors of heat and electricity.
- Metals like **sodium** and **potassium** are **soft** and can be cut with a knife.
- Mercury is the only metal which is found in the liquid state at room temperature.
- Chemical Properties of Metals and Non-metals
  - (i) **Reaction with Oxygen** : Both metals and non-metals when burnt in oxygen, form their oxides. Oxides of metals are basic in nature while that of non-metals are generally acidic in nature e.g.,
 

(a)	2Mg	+	O <sub>2</sub>	→	2MgO	
	Magnesium		Oxygen		Magnesium oxide	(basic)

(b)	S	+	O <sub>2</sub>	→	SO <sub>2</sub>	
	Sulphur		Oxygen		Sulphur dioxide	(acidic)
  - (ii) **Reaction with Water** : Some metals react with water to produce metal hydroxide and hydrogen gas. Generally, non-metals do not react with water.
 

2Na	+	2H <sub>2</sub> O	→	2NaOH	+	H <sub>2</sub>
Sodium		Water		Sodium Hydroxide		Hydrogen
  - (iii) **Reaction with Acids** : Metals react with dil. acids and produce metal salt and hydrogen gas. Generally non-metals do not react with dil. acids.
  - (iv) **Reaction with Bases** : Metals react with bases to produce hydrogen gas.
  - (v) **Displacement Reaction** : More reactive metals displace less reactive metals from their metal compounds in aqueous solutions.
- **Uses of Metals and Non-metals**
  - (i) Metals are used in making machinery, automobiles, aeroplanes, trains, satellites, industrial gadgets, cooking utensils, water boilers etc.
  - (ii) Non-metals are also used in day-to-day life e.g.,
    - oxygen is essential for life.
    - nitrogen, phosphorus and potassium are used as fertilizers.
    - chlorine is used as water purifier.

CLASS 10 - CHEMISTRY

**Chapter-2 Metals and Non-Metals**

**Solutions**

**Concept Mastery**

**Exercise-2**

- Zinc and Iron do not react with cold or boiling hot water, but react with steam.
- Iron (due to corrosion on the surface) is a metal that is non-lustrous and iodine is a non-metal which is lustrous.
- When  $\text{ZnCO}_3$  is heated in the absence of air,  $\text{ZnO}$  and  $\text{CO}_2$  are formed.
- Froth floatation process is used for the enrichment of sulphide ores.  
Hydraulic washing or backing process is used in the enrichment of an oxide ore.
- Platinum, gold and silver are at the bottom of the reactivity series and hence they are able to maintain their shine for a long time.  
Moreover, these are highly ductile and malleable. These metals are un-reactive. They do not react with oxygen and other gases present in air and with moisture. Hence, these metals are used to make jewelry.
- Some of the properties of ionic compounds are:
  - Ionic compounds have high melting and boiling points.
  - They are generally solid.
  - They are soluble in water.
  - They are good conductors of electricity in molten state.
- Covalent compounds are made up of electrically neutral molecules and force of attraction between the molecules of a covalent compound is very weak. Therefore, only a small amount of heat energy is required to break these bonds. As a result, melting point of covalent compounds is low.
  - Ionic compounds are made up of positive and negative ions. There is a strong electrostatic force of attraction between them. A lot of heat energy is required to break this force of attraction and to melt or boil the ionic compound. As a result, ionic compounds have high melting points.
- This is because it is easier to obtain metals from their oxides (by reduction) than from carbonate or sulphide ores. So, before reduction, the ore must be converted into a metal oxide which can then be reduced. Calcination or roasting is done depending on the nature of ore, to convert the ore into oxide. A-carbonate ore is converted into oxide by calcination whereas a sulphide ore is converted into oxide by roasting.
- Burning matchstick should be brought near the evolved gas. If matchstick burns with a pop sound, it indicates evolution of hydrogen gas.  
Reaction with NaOH:  
$$\text{M} + 2\text{NaOH} \rightarrow \text{Na}_2\text{Mo}_2 + \text{H}_2$$
  
Reaction with HCl:  
$$\text{M} + 2\text{HCl} \rightarrow \text{MCl}_2 + \text{H}_2$$
- Zinc  
The steps involved in extraction of zinc from zinc sulphide are:
  - Roasting of sulphide ore in the presence of air to convert it into metal oxide.  

$$\underset{\text{Zinc sulphide}}{2\text{ZnS}(\text{s})} + \underset{\text{Oxygen}}{3\text{O}_2(\text{g})} \xrightarrow{\text{Roasting}} \underset{\text{Zinc oxide}}{2\text{ZnO}(\text{s})} + \underset{\text{Sulphur dioxide}}{2\text{SO}_2(\text{g})}$$
  - Reduction of metal oxide with carbon to get the free metal.  

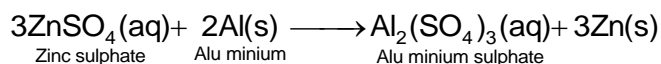
$$\underset{\text{Zinc oxide}}{\text{ZnS}(\text{s})} + \underset{\text{Carbon}}{\text{C}(\text{s})} \longrightarrow \underset{\text{Zinc}}{\text{Zn}(\text{s})} + \underset{\text{Carbonmonoxide}}{\text{CO}(\text{g})}$$
  - Reduction of metal oxide with carbon to get the free metal.
- (a) With the help of the wires, try to convert the samples in the form of thin wires. Metals will be

readily formed into thin wires being ductile whereas non metals being brittle will break. Now if we construct a cell using these wires the circuit which consists of metallic wires conducts electricity and the bulb will glow whereas non-metallic wires will not allow electricity to pass through them. Also, if beaten by a hammer, the metallic samples will produce a loud ringing sound indicating the metals are sonorous.

(b) From these tests we can say :

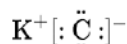
- (i) Metals are ductile whereas non-metals are not.
- (ii) Metals are good conductors of electricity while non metals are not.
- (iii) Metals are sonorous while non-metals are not.

12. Aluminium is more reactive than zinc hence it displaces zinc from zinc sulphate solution and forms silvery white zinc metal. The reaction is as follows:

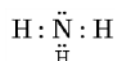


13. i. Q is the most reactive metal out of P, R and Q as it has replaced both P and R from their compounds.  
 ii. R is the least reactive element as it has been displaced by both P and Q.  
 iii. The type of reaction is Displacement reaction.

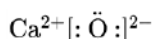
14. i. KCl form ionic bond



ii. NH<sup>3</sup> forms covalent bond



iii. CaO form ionic bond

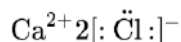


iv. N<sub>2</sub> form covalent bond

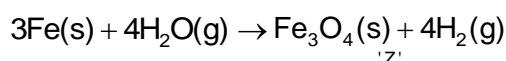
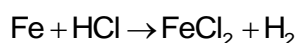


CaCl<sub>2</sub> form ionic bond

v. CaCl<sub>2</sub> form ionic bond



15.  $\text{F} + \text{S} \rightarrow \text{Fes}$



16.

Metal	Salt Solution in which added	Colour changes in solution	Reactivity
Aluminium (Al)	FeSO <sub>4</sub> (A test tube)	The green colour of FeSO <sub>4</sub> disappears Iron metal settles down at the bottom of the beaker.	Reactivity of Al is higher than iron.
Aluminium (Al)	CuSO <sub>4</sub> (B test tube)	The blue colour of CuSO <sub>4</sub> disappears the brown coloured copper particles settle down at the bottom of the test tube.	Reactivity of Al is higher than copper.
Iron	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (C test tube)	The solution remains colourless (no changes)	Fe cannot displace Al from Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> solution. Reactivity

			of Fe < Al
Iron	CuSO <sub>4</sub> (D test tube)	The blue colour of CuSO <sub>4</sub> changes to light green colour.	Reactivity of Fe > Cu.

Colour change is observed in test tubes - A, B, D

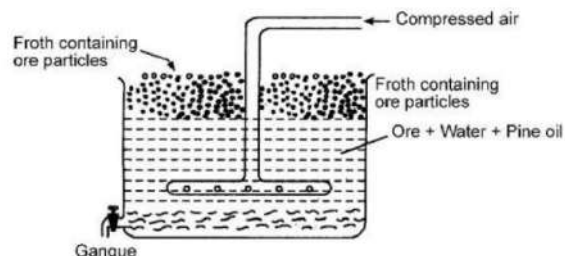
Most reactive metal is aluminium.

The reactivity series is a list of metals arranged in the order of their decreasing activities. According to the reactivity series, Aluminium is more reactive than Cu, Fe metals. Reactive metals displace less reactive metals from solutions of their compounds.

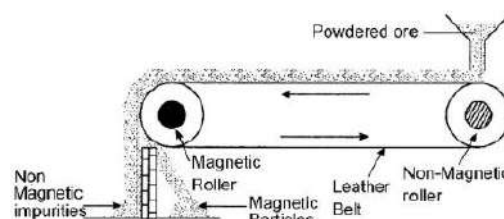
17. Both sodium and potassium are extremely reactive metals. They react violently with oxygen and moisture present in air even at the room temperature, which is an extremely exothermic reaction and (may catch fire). A large amount of heat is evolved. Firstly, they form oxide with oxygen which reacts with moisture present in air to form respective hydroxide. Hence these extremely reactive metals are not kept in open but are kept immersed in the kerosene.
18. Concentration of Ore: The process of removal of unwanted impurities like sand, rocky material, earthy particles etc. from the ore is called ore concentration or ore dressing. The finely ground ore is concentrated by any of the following processes:

i. Hydraulic washing: This method depends upon the difference in the densities of the ore particles and the impurities (gangue). The crushed and powdered ore is taken in large wooden tables with small obstacles. A stream of water is passed over the shaking table. The lighter impurities are washed away with the running stream of water while the heavier ore particles are left behind. This method of concentration is usually applicable to oxide ores.

ii. Froth floatation process: This method is used for the extraction of those metals in which the ore particles are preferentially wetted by oil and gangue by water. In this method, the powdered ore is mixed with water containing small quantities of oil (pine oil or eucalyptus oil) in a large tank (Fig.), The water is agitated by blowing air violently when a froth (or foam) is formed. The froth carries the lighter ore particles along with it to the surface. The heavier impurities are left behind in water and these settle to the bottom. Since the ore particles float with the froth at the surface, this process is called froth floatation process. The froth at the surface is transferred into another tank. The froth is broken by adding some acid and ore particles are separated by filtration and dried. For example, the froth floatation process is commonly used for the sulphide ores of copper, zinc, lead etc



iii. Magnetic separation: The ores which are attracted by a magnet can be separated from the non-magnetic impurities with the help of magnetic separation method. For example, this method is used for the concentration of haematite, an ore of iron. It consists of a leather belt moving over two rollers, one of which is magnetic in nature. This is shown in the figure. The powdered ore is dropped over the moving belt at one end. At the other end, the magnetic portion of the ore is attracted by the magnetic roller and falls nearer to the roller while the non-magnetic impurities fall farther off.



19. i. As Nitric acid (HNO<sub>3</sub>) is a strong oxidizing agent, it oxidizes the hydrogen formed into water (H<sub>2</sub>O) and itself, gets reduced to an oxide of nitrogen.
- ii. When sodium hydroxide (NaOH), which is a strong base, is kept in a container made of Aluminium, it reacts to form sodium aluminate (NaAlO<sub>2</sub>) with the release of inflammable Hydrogen

- gas and will corrode the container.
- iii. Silver (Ag) is a highly unreactive metal and does not chemically combine with oxygen but gradually it turns black (tarnish) due to the reaction of silver with the hydrogen sulphide (H<sub>2</sub>S) gas in air forming black colour silver sulphide (Ag<sub>2</sub>S).
  - iv. If the electrolysis of aqueous solution of sodium chloride is carried out, the sodium metal obtained at the cathode reacts with water to form sodium hydroxide and hydrogen gas. Thus, instead of sodium, hydrogen gas is liberated at the cathode.
  - v. Aluminium metal has a layer of Aluminium oxide or Alumina (Al<sub>2</sub>O<sub>3</sub>) on its surface which is a highly stable compound which slows down the reaction first when reacting with acid.
20. i. a. Zinc is more reactive than silver. It will displace silver from silver nitrate solution and will form zinc nitrate in the solution.  

$$\text{Zn(s)} + 2\text{AgNO}_3(\text{aq}) \rightarrow \text{Zn(NO}_3)_2(\text{aq}) + 2\text{Ag(s)}$$
- b. Magnesium is more reactive than iron. It will displace iron from iron (II) chloride solution and will form magnesium chloride in the solution.  

$$\text{Mg(s)} + \text{FeCl}_2(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{Fe(s)}$$
- c. Copper is less reactive than magnesium. It will not displace magnesium from magnesium sulphate solution and, hence, no reaction will take place.  

$$\text{Cu(s)} + \text{MgSO}_4(\text{aq}) \rightarrow \text{No reaction}$$
- ii. X is potassium (K). Potassium is a soft metal that's why it can be cut with a knife and it is lighter than water that's why it floats on the surface of water and the heat produced melts the potassium.

21.

Metal	Symbol	Atomic Number	Electronic configuration K, L, M, N	No. of outermost electrons	Electron dot structures
Sodium	Na	11	2, 8, 1	1	Na
Oxygen	O	8	2, 6	6	:O::
Magnesium	Mg	12	2, 8, 2	2	Mg:

ii. Formation of Na<sub>2</sub>O:

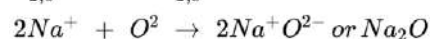
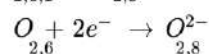
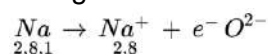
The atomic number of sodium is 11 and it has only one valence electron.

Hence, electronic configuration of <sub>11</sub>Na is 2, 8, 1.

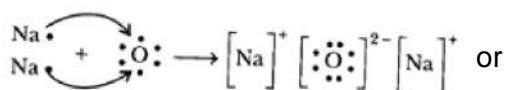
The atomic number of oxygen is 8 and it has 6 electrons in its valence shell.

Hence, electronic configuration of <sup>8</sup>O is 2, 6.

Sodium has a tendency to lose the valence electron and oxygen has a tendency to gain the electron lost by sodium. Since, sodium can lose only one electron of the valence shell, and oxygen atom needs two electrons to complete its octet in the valence electron, two atoms of sodium combine with one atom of oxygen. By losing valence electron, sodium is changed into Na<sup>+</sup> and by gaining two electrons lost by two sodium atoms, oxygen atom is changed into an oxide anion, O<sup>2-</sup>. In this process, both the atoms, sodium and oxygen, obtain the stable electronic configuration of the noble gas neon.



The oppositely charged sodium ion, Na<sup>+</sup>O<sup>2-</sup> and oxide ion, O<sup>2-</sup> are now held together by electrostatic force of attraction or by ionic or electrovalent bond. Na<sub>2</sub>O is, therefore, an ionic or electrovalent compound.

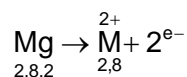


Formation of MgO:

The atomic number of magnesium = 12

Its electronic configuration is K,L,M  
2, 8, 2

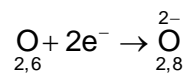
It has two electronic in its outermost shell. So, the magnesium atom donates its 2 valence electrons and forms a stable magnesium ion,  $\text{Mg}^{2+}$  to attain the electronic arrangement of neon atom.



The atomic number of oxygen = 8

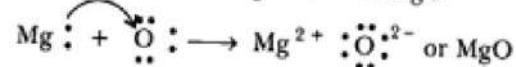
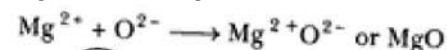
Electronic configuration = K,L  
2 6

It has 6 electrons in its valence shell. Therefore, it requires 2 more electrons to attain the stable electronic arrangement of neon gas. Thus, oxygen accepts 2 electrons donated by magnesium atom and forms a stable oxide ion,  $\text{O}^{2-}$



The oppositely charged magnesium ions,  $\text{Mg}^{2+}$ , and oxide ions, are held together by a strong force of electrostatic attraction to form magnesium oxide compound.

$\text{Mg}^{2+} \text{O}^{2-}$  or MgO.



MgO is ionic compound.

iii. The ions present in  $\text{Na}_2\text{O}$  are sodium ions ( $2\text{Na}^+$ ) and oxide ion  $\text{O}^{2-}$

The ions present in MgO are magnesium ion ( $\text{Mg}^{2+}$ ) and oxide ion  $\text{O}^{2-}$ .

22. i. Non-metals are the elements that do not conduct heat and electricity and are neither malleable nor ductile. Example: Carbon, sulphur, phosphorus, silicon, and oxygen.  
 ii. Carbon is a non-metal which conducts electricity.  
 iii. Iodine is a non-metal having lustre.  
 iv. Carbon (Diamond) is a hard non-metal.  
 v. Non-metals react with oxygen to form acidic oxides or neutral oxides. Carbon burns in air to form carbon dioxide.

The nature of the product formed is acidic. When carbon dioxide dissolves in water, it forms carbonic acid. It turns blue litmus to red which shows it is acidic in nature.

23. State True or False:

(i) (b) False

Explanation: False

(ii) (b) False

Explanation: False

24. Fill in the blanks:

(i) 1. Metals

(ii) 1. Diamond

## **Accuracy Booster**

## **Exercise-3**

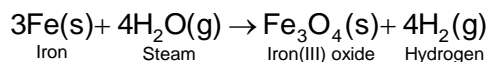
- (a) A metal used in joining electric wires – Magnesium  
Explanation: Copper metal is used in joining electric wires due to its high electrical conductivity, enough tensile strength and ductility.
- (c) Pb, HCl, NaCl and S  
Explanation: In reactivity series, the order of reactivity of given metals is as follows:  
 $Mg > Al > Zn > Fe > Cu$   
Thus, rate of evolution of  $H_2$  gas in case of Mg is maximum followed by Al, Zn and then Fe. Cu does not react with dil. HCl, so no evolution of  $H_2$  gas is observed.
- (d)  $Fe_3O_4$   
Explanation: Iron is a metal that will not directly react with cold water or hot water but forms a metal oxide when steam is passed over it.  
When red hot iron reacts with steam it forms iron(II, III) oxide and hydrogen, and the reaction is reversible.  
 $3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$
- (c) Zn  
Explanation:  
Galvanization is the process of applying a protective coating of zinc to iron to prevent the rusting of iron. The most common method is hot-dip galvanizing, in which steel sections are submerged in a bath of molten zinc.
- (b) Aqua regia, HCl,  $HNO_3$   
Explanation: Aqua regia (X) is the Latin name for 'royal water'. It is a freshly prepared mixture of concentrated hydrochloric acid (Y) and concentrated nitric acid (Z) in the ratio of 3 : 1 by volume. Some of the properties of aqua regia are different from that of conc. HCl and conc.  $HNO_3$ .
- (b) Steel  
Explanation: Steel is an alloy of metal iron and non metal carbon which makes it widely used in making utensils, pipes, conduits and various other purposes.
- (a) Zinc  
Explanation: Zinc
- (a) Iodine  
Explanation: Lustre means to shine. Shining metals are also called lustrous metal. For example, gold. Non-metals such as sulphur, oxygen, nitrogen are non-lustrous but iodine is a greyish black solid and crystals have a metallic lustre.
- (d) Mg  
Explanation: Mg
- (c) Na  
Explanation: Na
- (d) Change to green  
Explanation: When iron nail is placed in copper sulphate solution for few hours the blue colour of the solution will change to green due to displacement of copper by iron. Iron displaces copper from copper sulphate because iron is more reactive than copper. Therefore the colour of the copper sulphate solution changes to green.
- (b) The solubility of  $NH_3$  in  $H_2O$   
Explanation: The ammonia fountain demonstrates the solubility of ammonia in water.
- (b)  $H_2SO_3$   
Explanation:  $H_2SO_3$
- (c) N  
Explanation: N

15. (b) Both Roasting followed by reduction with carbon and Calcination followed by electrolytic reduction.

Explanation: The gas which smells like rotten eggs is hydrogen sulphide which is evolved from a sulphide ore. Sulphide ore is first concentrated by froth floatation process and then the concentrated ore is converted to metal by roasting followed by reduction with carbon or by direct heating.

16. (b) Fe

Explanation: Iron is a less reactive metal and does not show any reaction while treated with cold as well as hot water but will react with steam and form metal oxides and hydrogen gas.



17. (c) Pt

Explanation: Pt

18. (b) To absorb moisture

Explanation: Anhydrous calcium chloride is used to absorb moisture or as a packaging aid to ensure dryness.

19. (a) (ii) and (iii)

Explanation: Carbon tetrachloride is a covalent compound and dissolves in ether and alcohol like organic compounds.

Hydrochloric acid is the gas dissolved in water while hydrogen chloride is the gaseous compound that is covalent in nature by its molecular structure. NaCl and KCl are ionic compounds that dissociate into its ions in the aqueous solution.

20. (d) Bromine

Explanation: Bromine is a fairly abundant element but has a rare property. It is the only nonmetal to exist in liquid form at room temperature, and one of only two elements (the other being mercury) that is liquid at room temperature and pressure.

21. (d) Graphite

Explanation: Graphite is a good conductor of electricity and heat. Graphite has weak intermolecular forces between its layers.

Hence it has de-localized electrons. As electrons are free to move through its structure, it conducts heat and is a good conductor of electricity.

22. (b) Al

Explanation: Aluminium is the reducing agent in the reaction. It reduces manganese dioxide (MnO<sub>2</sub>) to manganese (Mn) and itself gets oxidized to aluminium oxide. Manganese dioxide acts as an oxidizing agent.

23. (a) All of these

Explanation: All of these produce hydrogen on reacting with metals.

- Metal + Water → Metal hydroxide + Hydrogen
- Metal + Steam → Metal oxide + Hydrogen (only those metals displace hydrogen from water (or steam) which are above hydrogen in the reactivity series.
- Metal + Acid → Metal salt + Hydrogen
- $2\text{C}_2\text{H}_5\text{OH} + \text{Na} \rightarrow 2\text{C}_2\text{H}_5\text{ONa} + \text{H}_2$  (This reaction is used as a test for ethanol).

24. (d) Nitrogen gas

Explanation: Nitrogen prevents the oxidation of dried fruits. It is used to prevent rancidity.

25. (a) No reaction takes place.

Explanation: No reaction takes place.

26. (c) X = C, Y = CO, Z = CO<sub>2</sub>

Explanation: The non-metal X is carbon (C) which is an important constituent of our food. Carbon forms two oxides Y (CO) and Z (CO<sub>2</sub>). CO is toxic and causes suffocation and even death while CO<sub>2</sub> is responsible for global warming.

27. (c) Au, Ag  
Explanation: Gold and Silver do not react with oxygen. They are less reactive metals and lie at the bottom of the reactivity series.
28. (a) Dazzling white colour flame  
Explanation: Magnesium burns in air with a dazzling white flame.
29. (b) Fe  
Explanation: Sodium reacts vigorously with water. Such is the reaction that it has to be stored under kerosene. Calcium can react with cold water. Magnesium reacts with hot water. Heated iron reacts with water when hot steam is passed over it.  
$$3\text{Fe (s)} + 4\text{H}_2\text{O (g)} \rightarrow \text{Fe}_3\text{O}_4 \text{ (s)} + 4\text{H}_2 \text{ (g)}$$
30. (d) A, B and D  
Explanation: Metals exhibit electrical conductivity (due to free electrons), sonority (production of ringing sound when struck) and ductility (ability to be drawn into wires).
31. (d) (i) and (iv)  
Explanation: Aluminium has good thermal conductivity and high melting point. These properties are useful in the making of utensils. The commonly used metals in making utensils are copper, steel (an alloy of iron) and aluminium.  
Copper and aluminium are the most preferred due to their conduction of heat.
32. (c) Downward displacement method  
Explanation: Using downward displacement method, hydrogen gas is collected over water.
33. (a) Na  
Explanation: Sodium (Na) is an alkali metal. It is so soft that it can be cut with a knife.  
Sodium is so reactive that it vigorously catches fire when kept open in the air and hence, we keep it immersed in kerosene oil.  
Sodium oxide is the basic oxide formed as sodium metal reacts with oxygen of air at room temperature.  
$$4\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{Na}_2\text{O(s)}$$
34. (a) Piyush  
Explanation: Piyush is likely to face danger. Addition of water to concentrated sulphuric acid is an exothermic reaction and can lead to explosions. Water should not be poured into a container containing an acid.
35. (b) Copper sulphate  
Explanation: The solution in the test tube was copper sulphate. Hydrated copper sulphate is blue in colour. Iron is more reactive than copper and displaces it from its solution. The solution turns green due to the formation of iron sulphate. A reddish brown coating of copper is formed on the nail. The less reactive copper comes out of the solution and more reactive iron goes into the solution.  
$$\text{CuSO}_4\text{(aq)} + \text{Fe(s)} \rightarrow \text{FeSO}_4\text{(aq)} + \text{Cu(s)}$$
36. (d) A is false but R is true.  
Explanation: Bronze is an alloy of copper and tin.
37. (c) A is true but R is false.  
Explanation: Metals are sonorous and hard, while non-metals are brittle.
38. (a) Both the statements are true.  
Explanation: Both statements are true. Cast iron contains 3% to 5% carbon. Many compounds containing sulphur are used as medicines. Sulphur and sulphur-containing compounds are one of the oldest antimicrobial substances in clinical use.
39. (c) It reacts with cold water to form magnesium oxide and evolves hydrogen gas  
Explanation: Magnesium metal reacts with cold water to form magnesium oxide and evolves

hydrogen gas is an incorrect statement. Magnesium when reacts with water gives magnesium hydroxide and hydrogen gas. The reaction of metals and water generally produce hydrogen gas and their respective hydroxide.

40. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

41. (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

42. (c) 1-D, 2-A, 3-C, 4-B

Explanation: Mercury is a liquid at room temperature. It is used in making thermometers. The best conductor of heat and electricity is silver. Lead is a poor conductor of heat. Sodium is so soft that it can be cut with a knife.

43. (b) (i) - (c), (ii) - (d), (iii) - (a), (d) - (b)

Explanation: (i) - (c), (ii) - (d), (iii) - (a), (d) - (b)

44. i. (b) Silver

ii. (a) Gold

iii. (c) Mercury

iv. (c) Lead

v. (b) Malleability

45. i. (d) - Au and Ag

ii. (b) - roasting

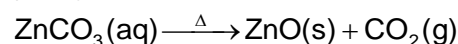
iii. (a) - Cinnabar

iv. (b) - Mg and Al are highly reactive elements

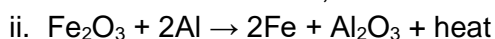
v. (d) - Zinc amalgam

46. Cinnabar is the primary ore of mercury. It is a red-colored mineral that consists of mercury sulfide (HgS), where mercury is present in the form of cinnabar crystals.

47. When zinc carbonate ( $\text{ZnCO}_3$ ) is heated in absence of air, carbon dioxide ( $\text{CO}_2$ ) and zinc oxide (ZnO) are formed.



48. i. Metal X is Aluminium, Thermite reaction



49. The metals high up in the activity series are very reactive. They cannot obtain by reduction of their oxides by carbon. Since, sodium is high up in the activity series, carbon cannot reduce the oxides of sodium because it has more affinity for oxygen than carbon.

During electrolysis of molten NaCl, sodium metal is deposited at the cathode, whereas, chlorine is liberated at the anode. The reactions are:



# PRE-FOUNDATION

CLASS X

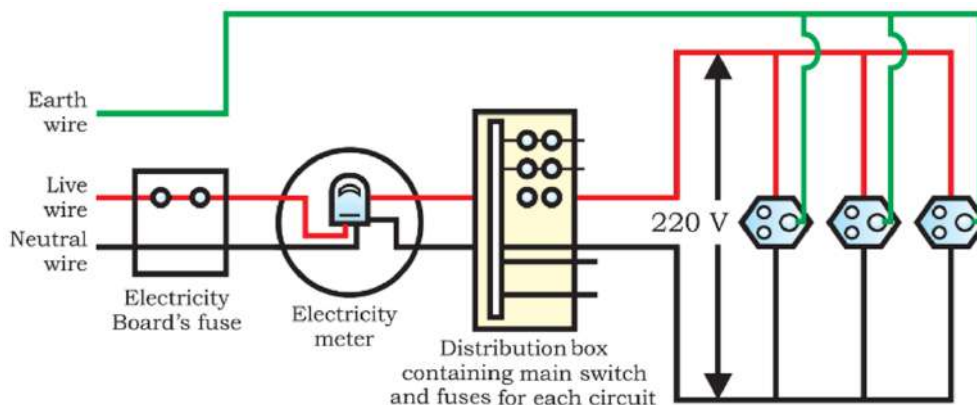
SAMPLE

# PHYSICS



# CHAPTER-1

## Electricity



### Chapter Flow

1. Introduction
2. Charge
3. Electric Field
4. Electric Potential and Potential Difference
5. Flow of Charge (Electric Current)
6. Electric Resistance
7. OHM'S Law
8. Combination of Resistances (or Resistors)
9. Kirchhoff's Law
10. Heating Effect of Electric Current
11. Joule's Law
12. Practical Applications of Heating effect of Electric Current
13. Electric Power
14. Electric Energy

DPP-1

DPP-2

DPP-3

DPP-4

Exercise-1 NCERT Basics

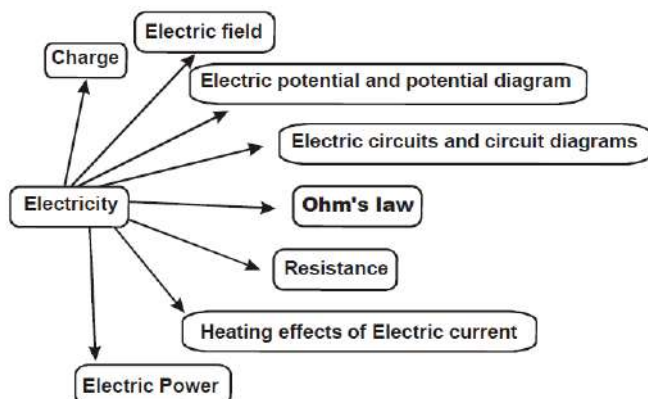
Exercise-2 Concept Mastery

Exercise-3 Accuracy Booster

 Quick Exam Revision

# Electricity

## Concept Tree :



## 1. Introduction

Electricity has great importance in the modern society. The modern devices in our day to day life require electricity for their operation. The most clean and convenient form of energy in our day to day life is electricity.

## 2. Charge

Charge is defined as the property of matter. When a charge is at rest, it produces electric field only, but when in motion, it also produces magnetic field. Charge can be positive or negative. The smallest stable possible charge is the charge on an electron.

### Properties of Electric Charge :

1. Electric charge is of two types viz., positive and negative charge. Proton is said to be charged positively and electron is said to be charged negatively. The magnitude of elementary positive or negative charge is same and is equal to  $1.6 \times 10^{-19}$  C.
2. Like charges repel and unlike charges attract each other. Thus a proton repels a proton and attracts an electron.
3. The force of attraction or repulsion between two charges is given by Coulomb's law.
4. **Charge is conserved** : Charge can neither be created nor be destroyed. The charge from one body can be transferred to another body but the total charge of a system remains constant. This is called the law of conservation of charge.
5. **Charge is quantized** : Protons and electrons are elementary charged particles. Though the charge on them is opposite in nature, the magnitude of charge possessed by them is same i.e.,  $1.6 \times 10^{-19}$  C. Charge on a body is always an integral multiple of this value. This is called quantization of charge. The charge exists in fixed packets i.e. when a body is charged the charge on it is an integral multiple of the charge on an electron.

$$q = \pm ne$$

### Reason for quantisation :

Since, electrons are indivisible, thus, only integral number of electrons can be transferred from one body to another, on rubbing. Hence, the charge bodies will have charges which are integral multiples of the charge on electron.

6. When a body gains electrons, it becomes negatively charged. When it loses electrons it becomes positively charged. The positive charge being bound firmly in the nucleus does not participate in charging.

7. Charge is invariant
8. Charge resides on the outer surface of the conductor. In insulators it remains where it is placed.
9. The electric charge is additive in nature.
10. Charge cannot exist without mass but mass can exist without charge.
11. Charge is scalar quantity and the SI unit of charge is coulomb, denoted by (C).

**Note :** The smallest possible charge is the charge on a quark i.e.  $\frac{2e}{3}$  and  $\frac{-e}{3}$ , but it is unstable in nature.

**Remember**

Mass of an electron =  $9.1 \times 10^{-31}$  Kg.

A body having a charge of +1C has an electron deficit of  $6.25 \times 10^{18}$  electrons.

The study of electricity is classified into two parts.

1. **Static electricity :** It deals with electric charges at rest and their effects.
2. **Current electricity :** It deals with charges in motion and their effects.

S.N.	Positive Charge	Negative Charge
1.	Glass Rod	Silk
2.	Woolen cloth or fur	Ebonite, Amber, Rubber
3.	Woolen cloth	Plastic
4.	Dry hair	Plastic Comb

This chapter deals with charges in motion i.e., current electricity.

### 3. Electric Field

The region of influence around a charge is called the region of electric field.

**Interaction of electric field between two charged particles :**

Two charged particles always interact with each other due to their electric field. There may be force of repulsion or attraction between two charged particles.

This force of attraction exists between unlike charges and force of repulsion exist between like charges.

The force between two point charges  $q_1$  and  $q_2$  separated by distance 'r' is given by Coulomb's law.

**Coulomb's law :**

In 1785, Coulomb gave two laws for the force of attraction or repulsion between two electrically charged bodies separated from each other by a definite distance. The laws are stated as follows

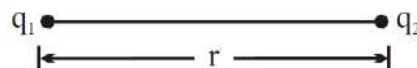
- (i) "The force of attraction or repulsion between two electric charges is directly proportional to the product of two charges."
- (ii) "The force of attraction or repulsion between two electric charges is inversely proportional to the square of the distance between them. This is known as inverse square law."

$$F \propto q_1 q_2$$

$$\propto \frac{1}{r^2}$$

$$F \propto \frac{q_1 q_2}{r^2}$$

$$F = k \frac{q_1 q_2}{r^2}$$



where K is proportionality constant (or Electrostatic Force constant or Coulomb's constant). Its value depends upon the medium between charges and units used for charge, distance and force.

The value of  $K = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}$

The constant  $\epsilon_0$  is called the permittivity of free space. Its value is  $8.9 \times 10^{-12} \text{ C}^2/\text{N-m}^2$ .

$$\Rightarrow \boxed{F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1q_2}{r^2}}$$

Force is a vector quantity.

Vector Form of coulomb's law  $\vec{F} = \frac{kq_1q_2}{r^2} \hat{r}$ ;  $\hat{r} = \frac{\vec{r}}{|\vec{r}|} \Rightarrow \vec{F} = \frac{kq_1q_2}{|\vec{r}|} \hat{r}$

### Intensity of electric field ( $\vec{E}$ )

The intensity of electric field at a point in the electric field is defined as the force experienced by a unit positive charge placed at that point

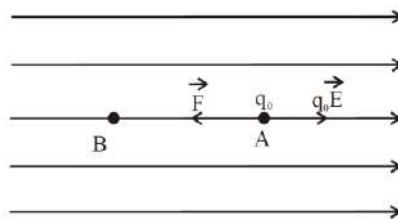
$$\boxed{\vec{E} = \frac{\vec{F}}{q_0}} \quad \text{where } q_0 = 1$$

$$F = K \frac{q \times 1}{r^2}$$

In terms of magnitude,  $E = \frac{F}{1} = K \frac{q}{r^2}$  where  $K = \frac{1}{4\pi\epsilon_0}$

Electric field is vector quantity and SI unit of electric field is N/C

## 4. Electric Potential and Potential Difference



If a positive test charge  $q_0$  is placed at a point A in an uniform electric field (see figure), a force  $q_0\vec{E}$  will act on this charge along the direction of electric field. Now if test charge  $q_0$  is displaced from A to B, by applying a force  $F = q_0\vec{E}$  in opposite direction to electric field intensity, then we have to do some work.

Let this work be  $W_{AB}$ .

In this way, work done in carrying a unit positive charge from point A to B is defined as potential difference between points B and A. i.e. potential difference between point B and A—

$$\boxed{V_B - V_A = \frac{W_{AB}}{q_0}}$$

The electrons (negative charges) in a conductor or a wire flow from one end to another end of the conductor if there is electric pressure difference called electric potential difference between the ends of the conductor.

If point A is considered as a reference point (initial point where potential is zero) at infinity, then—

$$V_B - V_A = \frac{W_{AB}}{q_0}$$

Electric potential at point B is defined by above equation. That is, work done in carrying a unit positive charge from infinity ( $V = 0$ ) to the point under consideration in electric field, without change of its kinetic energy, is called the electric potential of that point.

The S.I. unit for electric potential and potential difference is **joule/coulomb**, which is also known as Volt. "One volt potential at a point means that work done in carrying one coulomb charge from infinity to this point would be one joule." Electric potential and potential difference are scalar quantity. It is to be noted that "positive charge always moves from high potential to low potential, similarly negative charge moves from low potential to high potential." From reference point of view, the electric potential of earth is considered as zero.

### Remember

Smaller units of electric potential

$$1 \text{ mili volt (mV)} = 10^{-3} \text{ V}$$

$$1 \text{ micro volt } (\mu\text{V}) = 10^{-6} \text{ V}$$

Larger units of electric potential

$$1 \text{ kilovolt (kV)} = 10^3 \text{ V}$$

$$1 \text{ megavolt (MV)} = 10^6 \text{ V}$$

The electrons move only if there is a difference of electric pressure (i.e. the potential difference) along the conductor. This difference of potential may be produced by a battery, consisting of one or more electric cells.

The potential difference is measured by means of an instrument called the voltmeter.

Note : The voltmeter is always connected in parallel across the points between which the potential difference is to be measured.

"A continuous and closed path of an electric current is called an electric circuit."

### Concept of Electric Potential Difference

To understand the concept of electric potential take a vessel consisting of two arms A and B as shown in Figure. The water level in arm A is higher than the level in arm B, when valve is closed. We know that pressure exerted by a liquid in a vessel at the bottom of the vessel is directly proportional to the height of the liquid in the vessel.

Therefore, pressure exerted by water in arm A is greater than the pressure exerted by water in arm B. It means that there is pressure difference between the arms A and B. When the valve is opened, the water flows from arm A to arm B of the vessel due to pressure difference. This flow of water continues till the water level in both the arms of the vessel becomes equal or there is no pressure difference between the two arms. This activity shows that the water flows from higher pressure to lower pressure. In other words, water flow from one region to another region only if there is a pressure difference between the two regions.

### Concept of Electric Potential Difference

The electric potential difference across the ends of a conductor is maintained by a dry cell or a battery. The chemical reaction taking place in a cell makes one electrode of the cell as positive and the other electrode of the cell as negative. When, a conductor is connected across these electrodes of the cell, then one end of the conductor is at positive potential and the other end of the conductor is at negative potential. Thus, there exists an electric potential difference across the ends of the conductor. This electric potential difference moves the electrons (negative charges) in the conductor from one end to the other end.

**Illustration 1 :** Five joule of work is done in moving  $12.5 \times 10^{18}$  electrons from one end to other end of a conductor. What is the potential difference between the two ends of conductor ?

**Solution :** The charge on  $6.25 \times 10^{18}$  electrons is 1 C.  
 $\therefore$  When  $12.5 \times 10^{18}$  electrons move, the net charge transferred is 2 C.  
 $\therefore Q = 2C$ .

Work done (W) in moving 2C charge = 5 J. (given)

The potential difference (V) between the ends of conductor is

$$V = \frac{\text{Work done}}{\text{charge}} = \frac{5\text{J}}{2\text{C}} = 2.5\text{JC}^{-1}.$$

$$V = 2.5\text{volts}$$

## Key Concept

### Drift Velocity

In a conductor or a wire, negatively charged particles called electrons have random or zig-zag motion as shown in figure. Therefore, the net flow of electrons (or net flow of charge) across any cross-section of the conductor is zero. This is because number of electrons flowing through the given cross-section to the right side is equal to the number of electrons flowing to the left side through the given cross section.

Hence, there is no electric current in the conductor. However, when the ends of the conductor are connected across a dry cell, there is a potential difference across the conductor. Now, the electrons move from one end to another end of the conductor. But the motion of these electrons is not in straight lines. These electrons collide with the ions of the conductor while moving from one end to another end of the conductor. As a result of these collision, electrons drift from one end to another end with an average speed known as drift velocity. The drift velocity of electrons in a conductor is very small. Typical value of the drift velocity of an electron in a conductor is about  $2.22 \times 10^{-4}\text{ms}^{-1}$ . It means, electrons will take time about 2.5 hours to travel 5metre long conductor.

**Illustration 2 :** Electric potential at a point in an electric field is 0.5V when charge of 3C was brought from infinity to that point. Calculate the work done.

**Solution :** Electric potential (V) = 0.5 volts  
 Charge (Q) = 3C; Work done (W) = ?

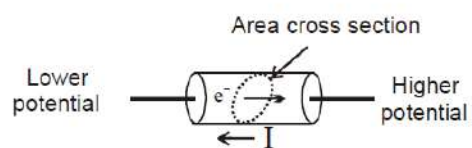
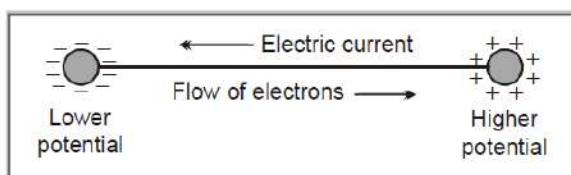
$$V = \frac{W}{Q}$$

$$\therefore W = VQ = 0.5\text{ V} \times 3\text{ C} = 1.5\text{ V C} = 1.5\text{ J Ans.}$$

## 5. Flow of Charge (Electric Current)

Electric current is defined as continuous rate of flow of electric charge. Consider flow of charges through a conductor as shown in figure. If  $\Delta Q$  charge flows in  $\Delta t$  time through the cross section of conductor

under consideration then the current over this time interval is defined as  $I = \frac{\Delta Q}{\Delta t}$



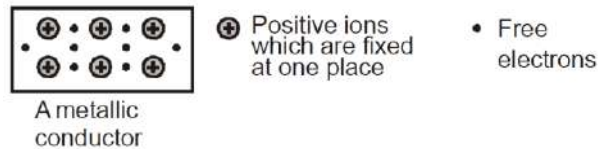
The S. I. unit of current is the **ampere** symbolically represented as **A**. Therefore also,

$$\text{Current (I)} = \frac{\text{Charge (Q)}}{\text{Time (t)}} = \frac{Q}{t}$$

$$1 \text{ mA} = 10^{-3} \text{ A}, 1 \mu\text{A} = 10^{-6} \text{ A}$$

### Knowledge Enhancer

In a metallic conductor, when an atom loses one or more electrons, then atom becomes a positive ion, which remains fixed at one place in the conductor. The electrons detached from an atom become free and capable of moving from one part to another part of the conductor. The electric current in a metallic conductor is due to the flow of electrons (i.e., negative charge carriers).



**Note :** 1 A of current is equivalent to one coulomb of charge passing through conductor in 1 second. Conventionally, we define the direction of the current in the direction of flow of negative charge. Whereas, the direction of current is considered opposite to the direction of flow of electrons.

An instrument called ammeter measures electric current in a circuit. It is always connected in series in a circuit.

### Remember

A conductor or a wire carrying current is neutral. That is, it has net charge on it equal to zero.

### Types of electrical Materials :

- (1) Insulators                      (2) Semiconductors                      (3) Conductors

Charge flow or conduction of electric current takes place only if free charge carriers are present. Since protons are bounded and present in the nucleus so the conduction takes place only due to electrons.

- (1) Insulators do not conduct electricity because of the absence of free electrons in them, Rubber is an excellent insulator.
- (2) Conductors conduct electricity due to presence of free electrons in them for example wire made of Cu, Al. are good conductors.
- (3) Semiconductors behave as insulators at low temperature whereas they behave as conductors at high temperatures.

### Points To Remember

However, because we tend to associate the word "positive" with "surplus" and "negative" with "deficiency." The standard label for electron charge does seem backward. Because of this, many engineers decide to retain the old concept of electricity with "positive" referring to a surplus of charge and "negative" referring to a deficiency of charge, and label charge flow(current) accordingly.

This is known as conventional flow notation.

Others chose to designate charge flow according to the actual motion of electrons in a circuit. This form of symbology is known as electron flow notation:

In conventional flow notation, we show the motion of charge according to the (technically incorrect) labels of + and -. In this way or method the labels are kept same, but the direction of charge flow is incorrect. In electron flow notation, we follow the actual motion of electrons in the circuit, but the + and - labels are same as before. Does it matter, really, how we designate charge flow in a circuit? Not really, so long as we're consistent in the use of our symbols. You may follow an imagined direction of current (conventional flow) or the actual (electron flow) as far circuit analysis is concerned.

Conventionally positive charge is at higher potential than negative charge flow always takes place from higher potential to lower potential. The flow of current takes place from positive charge to negative charge. The direction of electric current is from negative charge to positive charge i.e. the flow of electrons.

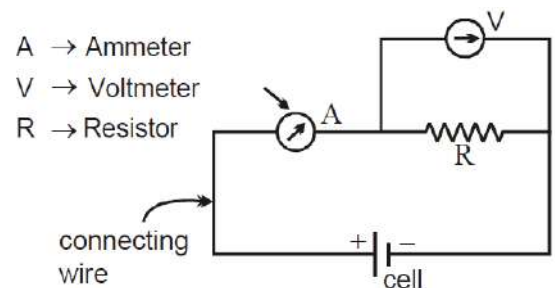
**Symbols of some commonly used components in circuit diagrams.**

1. An electric cell	
2. A battery or a combination of cells	
3. Plug key or switch (open)	
4. Plug key or switch (closed)	
5. A wire joint or junction	
6. Galvanometer	
7. Wires crossing without joining	
8. Heater	
9. Electric bulb	
10. A resistor of resistance R	
11. Tapping key	
12. Variable resistance or rheostat	
13. Ammeter	
14. Voltmeter	

**6. Electric Resistance**

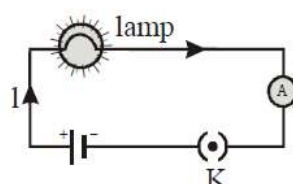
**Electric Circuit :**

An electric circuit is a closed conducting path containing a source of electric energy (i.e., a cell or a battery) and a device or element or load utilizing the electric energy. For example, an electric bulb or lamp connected with a cell with the help of connecting wires form simple electric circuit. In this circuit, a cell is a source of electric energy and an electric lamp is the load.



In fact, electric current is a means of transferring electric energy from the source to the load. Thus, "a closed conducting path containing the source of electric energy and the load through which electric current flows is known as electric circuit".

A simple electric circuit is shown in figure.



## Open and Closed Electric Circuits

**Open electric circuit :** An electric circuit through which no electric current flows is known as open electric circuit.

The electric circuit shown in figure will be open circuit if the plug of the key is taken out or if the connecting wire breaks from any point.

**Closed Circuit :** An electric circuit through which electric current flows continuously is known as closed circuit.

1. **Electric Cell :** An electric cell is a device which maintains a continuous flow of charge in a circuit. The Cell changes Chemical energy into electrical energy.
2. **Electro Motive Force (E.M.F.) of a cell :** The work done by the cell in forcing unit positive charge to flow in the whole circuit once, is called the electromotive force (e.m.f.) of the cell.

$$E = \frac{W}{q} \left( \frac{J}{C} \right)$$

The unit of emf is called '**volt**'(V). If in the flow of 1C of charge in a circuit the energy given by the cell by 1J, then the emf of the cell is 1V.

3. **Internal Resistance of a cell :** When we connect the plates of a cell by a wire, an electric current flows in the wire from the positive plate of the cell towards the negative plates, and in the electrolyte (inside the cell) it flows from the negative plate to wards the positive plate. The resistance offered by the electrolyte of the cell to the flow of current (ions) through it is called the 'internal Resistance' of the cell.
4. **Terminal Potential Difference :** The potential difference across the terminals of a cell or battery when the cell is in charging or discharging mode is called terminal potential difference.

## Electrical Resistance :

In a conductor whenever current flow takes place the motion of electrons takes place. During motion they are opposed to flow and this is known as electrical resistance. The SI unit of electrical resistance is Ohm denoted by  $\Omega$ .

### Factors which determine the electric resistance of a conductor :

- (1) The resistance of a conductor is directly proportional to its length  
 $R \propto l$
- (2) The resistance is inversely proportional to the area of cross-section of the conductor

$$R \propto \frac{1}{A}$$

- (3) The resistance depends upon the nature of the material of the conductor

- (4) Removing the proportionality sign we have

$$R = \rho \frac{l}{A}$$

- (5)  $\rho$  - Resistivity of the conductor.

**Resistivity :** The resistance of a unit volume of a substance is known as its resistivity.

Resistivity is also known as specific resistance and its SI unit is ohm m.

- (6) **Effect of temperature on resistance :**

The resistance of conductors increases with increase in temperature. Let the resistance of a conductor at  $0^\circ\text{C}$  be  $R_0$ .

Let the resistance of the conductor at  $t^\circ\text{C}$  be  $R_t$ .

Then,  $R_t = R_0 (1 + \alpha t)$ , where ' $\alpha$ ' is known as the **temperature coefficient of resistance**.

Pure metals have positive temperature coefficient of resistance. The resistance of metals increases with an increase in temperature.

Alloys have a very less temperature coefficient of resistance. So the resistance of alloy like Manganin and Constantan vary very little with an increase in temperature. Because of this property they are used in making standard resistances.

Semiconductors like germanium, silicon and bad conductors like glass, pure water etc., have negative temperature coefficient. The resistance of these materials decreases with an increase in temperature.

Reason for variation of resistance with temperature :

Resistance offered by a metallic conductor is due to the collisions between drifting electrons, and the ions present in the metallic conductor. When the temperature of the conductor increases, the amplitude of vibration of ions in the lattice increases and hence the collisions between electrons and the ions become more frequent. Therefore, the opposition to the flow of electrons (constituting the electric current) increases. In other words, resistance of the metallic conductor increases or decreases with the increase or decrease of the temperature respectively.

Then,  $R_t = R_0[1 + \alpha(t_2 - t_1)]$

Where,  $\alpha$  is the temperature coefficient of the resistance.

$$\alpha = \frac{(R_t - R_0)}{R_0(t_2 - t_1)}$$

Thus, temperature coefficient of resistance ( $\alpha$ ) is defined as the change in resistance per unit original resistance per degree rise in temperature.

S.I. unit of  $\alpha$  is  $\frac{\text{ohm}}{\text{ohm kelvin}}$  or  $\text{kelvin}^{-1}$  or  $\text{K}^{-1}$

$\alpha$  is positive for metallic conductors i.e. their resistance increases with the rise of temperature (i.e.  $R_t > R_0$ ).

$\alpha$  is negative for insulators and semi - conductors i.e., their resistance decreases with the rise of temperature (i.e.,  $R_t < R_0$ ).

$\alpha$  is very- very small for high resistivity alloys like manganin ( $\approx 10^{-5} \text{ }^\circ\text{C}^{-1}$ ) i.e. their resistance does not change appreciably with change in temperature. It is for this reason that manganin and constantan are used in making standard resistance coils.

**Illustration 3 :** The length of copper wire is 100m and its radius is 1mm. Calculate its resistance if resistivity of copper is  $1.72 \times 10^{-8} \Omega \text{ m}$ .

**Solution :** Length of copper wire ( $l$ ) = 100m.  
Area of cross section ( $a$ ) =  $\pi r^2 = 3.14 \times 10^{-6} \text{ m}^2$   
Resistivity ( $\rho$ ) of copper =  $1.72 \times 10^{-8} \Omega \text{ m}$   
Resistance offered by a conductor is given by

$$R = \rho \frac{l}{A}$$

$$= \frac{1.72 \times 10^{-8} \times 100}{3.14 \times 10^{-6}} = 0.55 \Omega.$$

In this numerical, length of copper wire is 100m. If the length is 1000 m i.e., 1 km, the resistance offered by it would be  $5.5 \Omega$  which is very less. Thus copper is a good conductor of electricity.

**Illustration 4 :** The resistance of 1m of nichrome wire is  $6 \Omega$ . Calculate its resistance if its length is 70cm.

**Solutions :** Given  
**1<sup>st</sup> case**  
Length of nichrome wire ( $l_1$ ) = 1m = 100 cm  
Resistance of nichrome wire ( $R_1$ ) =  $6 \Omega$

**2<sup>nd</sup> case**

$$l_2 = 70 \text{ cm}$$

$$R_2 = ?$$

By 1st law of resistance

$$\frac{R_1}{R_2} = \frac{l_1}{l_2}$$

$$\frac{6 \Omega}{R_2} = \frac{100 \text{ cm}}{70 \text{ cm}}$$

$$\therefore R_2 = 4.2 \Omega$$

**Illustration 5 :** Two wires made of German-silver are taken such that the length and area of cross-section of the second wire are twice and thrice respectively those of the first wire. If the resistance of the second wire is  $12 r$ , find the resistance of the first wire.

**Solutions :**

1st case

$l_1$  = length of German silver wire;

$a_1$  = area of cross section;

$R_1$  = resistance

$$R_1 = \rho \frac{l_1}{a_1} \quad \dots(i)$$

**2<sup>nd</sup> case**

$l_2$  = length of wire =  $2l_1$

$a_2$  = area of cross section of wire =  $3a_1$ .

$R_2$  = resistance of wire =  $12 \Omega$ .

$$R_2 = \rho \frac{l_2}{a_2}$$

$$\therefore 12 = \rho \frac{2l_1}{3a_2} \quad \dots(ii)$$

dividing (i) by (ii)

$$\frac{R_1}{12} = \frac{\rho l_1}{a_1} \times \frac{3a_1}{\rho(2l_1)} = \frac{3}{2} \quad \therefore R_1 = 18 \Omega.$$



**Remember**

Silver is the best conductor of electricity.

**Knowledge Enhancer**

1. The connecting wires in an electric circuit are made of copper and aluminium. The resistivity of pure metals is very low. So, electric current passes easily through them. Out of metals, silver is the best conductor of electricity because its resistivity is the lowest among all metals. Thus, connecting wires in an electric circuit must be made of silver. However, the silver metal is costly as compared to other metals like aluminium and copper. The resistivity of copper and aluminium are also low and these metals are cheaper than silver. Therefore, connecting wires are made of copper and aluminium metals.
2. Filament of an electric bulb is made of tungsten metal. Tungsten being a metal has high resistivity. Moreover, it does not burn (or oxidise) even at higher temperatures. The melting point of tungsten is very high i.e., about  $3380^\circ\text{C}$ . For these reasons, filament of an electric bulb (incandescent lamp) is made of tungsten.
3. Heating elements of electrical appliances like electric iron, electric heater, electric toaster, room heater, immersion rod are made of nichrome (an alloy of nickel, iron, chromium and manganese).

Nichrome is an alloy of metals. The resistivity of nichrome is more than the resistivity of the metals used to make it. Moreover, nichrome does not burn (or oxidise) even at higher temperature. The melting point of nichrome is 1500°C. That is why, heating elements of electrical appliances are made of nichrome i.e. an alloy.

4. Insulators are used to protect ourselves from the severe shock of electric current.

### 7. OHM'S Law:

"When physical conditions (temperature, length, cross section) remains the same, the current flowing through a conductor is directly proportional to the potential difference across the ends of a conductor".

i.e.  $I \propto V$

So we can also write

$\therefore V \propto I$

$$V = IR$$

$R = \frac{V}{I} = \text{Constant}$ , provided length, cross section and temperature of the conductor remains same.

#### Remember

Bigger units of resistance.

1 kilo ohm ( $K\Omega$ ) =  $10^3\Omega$

1 Mega ohm ( $M\Omega$ ) =  $10^6\Omega$

$$\Rightarrow 1\text{ohm} = \frac{1\text{Volt}}{1\text{Ampere}}$$

1 ohm is the resistance of a conductor is defined as when 1V of potential difference is applied across the conductor and then a current of 1A flows through it.

**Exception of Ohm's law**– In general almost all metal conductors obey the Ohm's law  $V = IR$  for which graph between  $V$  and  $I$  is a straight line as shown in figure. The conductors (or devices) obeying the ohm's law are called ohmic. However, there are some exceptions such as vacuum tube, semiconductor diode, transistor, liquid electrolytes etc. in which relation  $V = IR$  does not hold good. These devices are called **non-ohmic**.

Figure (a) shows  $V-I$  curve for a bulb. This appears from the figure that this device do not obey the relation  $V = IR$ .

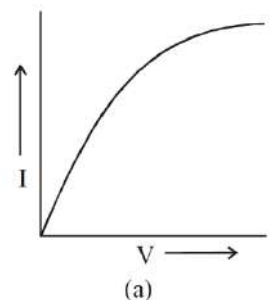
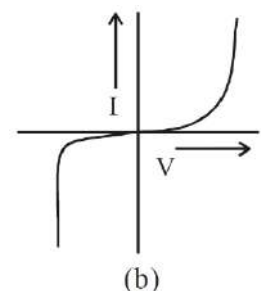


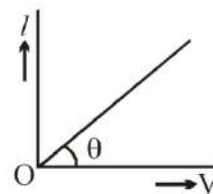
Figure (b) shows  $V-I$  curve for a semiconductor device such as diode or transistor. Again this graph is not fitted in the form of standard Ohm's law. Hence such devices are non-ohmic.



### Knowledge Enhancer

The substances which obey Ohm's law are called Ohmic or linear conductors. The resistance of such conductors is independent of magnitude and polarity of applied potential difference. Here the graph between  $I$  and  $V$  is a straight line passing through the origin. The reciprocal of slope of straight line gives resistance

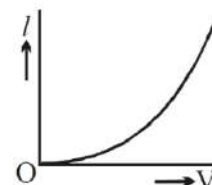
$$R = \frac{V}{I} = \frac{1}{\tan \theta} = \text{constant.}$$



Examples silver, copper, mercury, carbon, mica etc.

The substances which do not obey Ohm's law are called non-ohmic or non linear conductors. The  $I - V$  curve is not a straight line.

i.e. p-n diode, transistor, thermionic valves, rectifiers etc.



### Check Point

Choose the correct alternative :

- Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.
- Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.
- The resistance of graphite and most non-metals increases/decreases with increase in temperature.
- The resistivity of a semiconductor increases/decreases rapidly with increasing temperature.
- The resistivity of the alloy manganin is nearly independent of / increases rapidly with increases of temperatures.
- The resistivity of a typical insulator (e.g., amber) is greater than that of a metal by a factor of the order of ( $10^{22} / 10^{23}$ ).

### Solutions:

- Alloys of metals usually have greater resistivity than that of their constituent metals.
- Alloys usually have much lower temperature coefficients of resistance than pure metals.
- The resistance of graphite and most nonmetals decreases with increase in temperature.
- The resistivity of a semiconductor decreases rapidly with increasing temperature.
- The resistivity of the alloy manganin is nearly independent of increasing temperature.
- The resistivity of a typical insulator (e.g. amber) is greater than that of a metal by factor of the order of  $10^{22}$ .

#### Important terms :

**Resistor** : A component in an electric circuit which offers resistance (i.e. opposition) to the flow of electrons constituting electric current is known as a resistor. For example, a metallic wire or a conductor used in an electric circuit is known as resistor.

**Variable resistance** : In an electric circuit, sometimes current has to be increased or decreased. A component used in an electric circuit to change the current without changing the potential difference across the circuit is called variable resistance.

**Rheostat** is a device used in an electric circuit to change the resistance and hence current in the circuit. It means, rheostat acts as a variable resistance of unknown value in the circuit.

## 8. Combination of Resistances (or Resistors)

### Series Combination :

In this combination, the resistances are joined end to end. In series combination the current across each

resistance is same but the potential difference across each  $R_1$ ,  $R_2$  and  $R_3$  are  $V_1$ ,  $V_2$  and  $V_3$ . To replace  $R_1$ ,  $R_2$  and  $R_3$  by an equivalent resistance the potential difference across equivalent should be equal to the sum of the potential difference across the three resistances.

$$V_1 = IR_1$$

$$V_2 = IR_2$$

$$V_3 = IR_3$$

$$E = V_1 + V_2 + V_3$$

$$IR_{eq} = IR_1 + IR_2 + IR_3$$

$$R_{eq} = R_1 + R_2 + R_3$$

### Characteristics of series circuit :

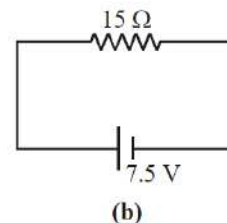
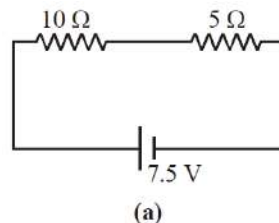
- (i) Same current is flowing through all the resistances.
- (ii) The effective resistance is the sum of the individual resistances. Effective resistance  

$$R_{eff} = R_1 + R_2 + R_3.$$
- (iii) The applied voltage  $V = V_1 + V_2 + V_3$ .
- (iv) The maximum power is consumed by the resistor having the highest resistance, or the voltage drop is maximum across the highest resistance.

### Disadvantage of a series arrangement of resistors :

- (i) Suppose all electric appliances like bulbs and electric tubes are connected in series in a circuit. If any one of them fuses (i.e., breaks), then all the other appliances will also not work. This is because series arrangement is not used in domestic electric circuits.
- (ii) Different electric appliances like bulbs, electric tubes, electric heaters, toaster etc. have different resistance and hence they require different amount of electric current for their operations. If they all are connected in series, they will not operate properly.

**Illustration 6 :** Calculate (a) the equivalent resistance, (b) the electric current, and (c) the potential difference across each resistor in the circuit shown in figure



**Solutions :** (a) Any current that passes through the resistor of  $10\ \Omega$  also passes through the resistor of  $5\ \Omega$ . So, the  $10\ \Omega$  and  $5\ \Omega$  resistors are connected in series. Their equivalent resistance is

$$R = 10\ \Omega + 5\ \Omega = 15\ \Omega$$

(b) The circuit is equivalent to that shown in figure (b). The current is

$$i = \frac{V}{R} = \frac{7.5\text{ V}}{15\ \Omega} = 0.5\text{ A}.$$

This is the current through both the resistors.

(c) The potential difference across the  $10\ \Omega$  resistor is

$$V_1 = iR_1 = (0.5\text{ A}) \times (10\ \Omega) = 5\text{ V}$$

The potential difference across the  $5\ \Omega$  resistor is

$$V_2 = iR_2 = (0.5\text{ A}) \times (5\ \Omega) = 2.5\text{ V}.$$

**Parallel Combination :**

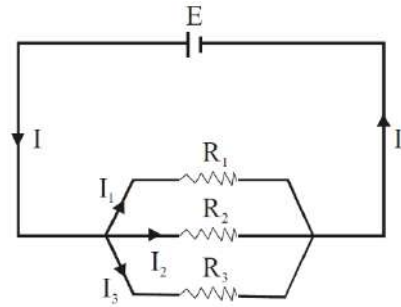
When two or more resistances are combined in such way that their first ends are connected to one point and the second ends to another point then this combination is in parallel. In this combination the potential difference between the ends of all the resistances is same but the current in different resistances are different.

$$I = I_1 + I_2 + I_3$$

$$I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$



The reciprocal of the equivalent resistance of the resistances connected in parallel is equal to the sum of the reciprocal of those resistances.

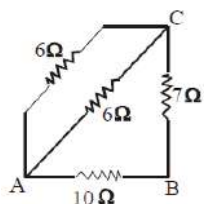
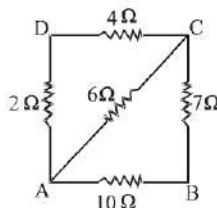
**Advantages of connecting electrical devices in parallel :**

1. In a series circuit the current is constant throughout the electric circuit. Thus it is obviously impracticable to connect an electric bulb and an electric heater in series, because they need currents of widely different values to operate properly.
2. Another major disadvantage of a series circuit is that when one component fails the circuit is broken and none of the components works.
3. On the other hand, a parallel circuit divides the current through the electrical gadgets. The total resistance in a parallel circuit is decreased. This is helpful particularly when each gadget has different resistance and requires different current to operate properly.

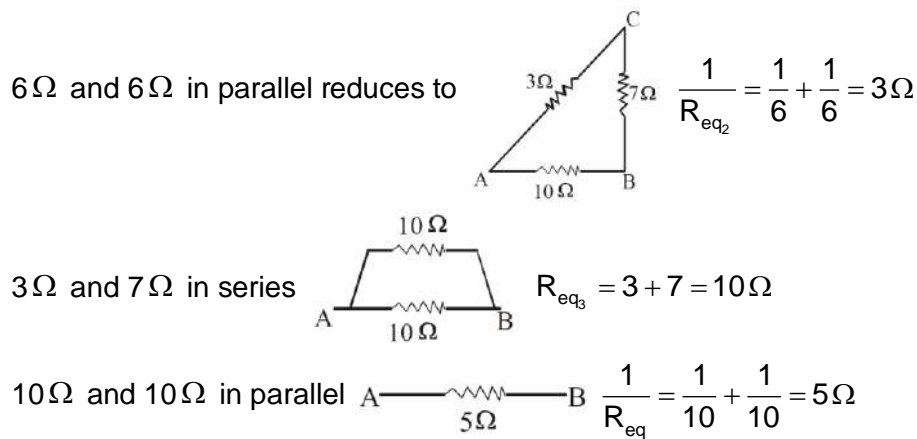
If 'n' number of resistors each of same value connected in parallel, then the equivalent resistance of the parallel combination of 'n' resistors is given by

$$R_{eq} = \frac{R}{n}$$

**Illustration 7 :** Determine the equivalent resistance between points A and B in the following circuits



**Solutions :**  $1\ \Omega$  and  $2\ \Omega$  in series  $R_{eq1} = 4 + 2 = 6\ \Omega$



### Check Point

- Q.** Given  $n$  resistors each of resistance  $R$ , how will you combine them to get the  
 (i) maximum  
 (ii) Minimum effective resistance? What is the ratio of the maximum to minimum resistance?

### Solution

(i) For maximum effective resistance, all the resistors should be joined in series.

$$R_{\max} = R + R + R + \dots \dots n \text{ or } R_{\max} = nR$$

(ii) For minimum effective resistance all the resistors should be joined in parallel.

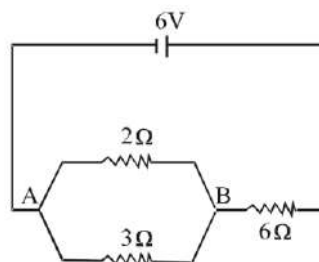
$$\frac{1}{R_{\min}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \dots \dots n \text{ or } \frac{1}{R_{\min}} = \frac{n}{R}$$

so,  $R_{\min} = \frac{R}{n}$

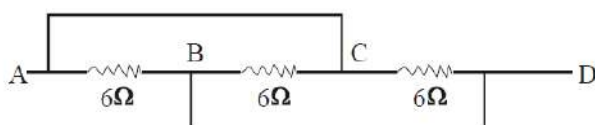
Now,  $\frac{R_{\max}}{R_{\min}} = n^2$ .

### Try yourself :

1. Determine the value of current in the 2 Ω resistance and the potential difference between A and B in the circuit diagram given



2. Find the equivalent resistance between the points A and D of the adjoining circuit diagram.



### Distribution of Current in Two Resistors in Parallel :

Consider the circuit in Figure. The resistance  $R_1$  and  $R_2$  are connected in parallel. The current  $i$  gets distributed in the two resistors.

We have  $i = i_1 + i_2$  .....(i)

Applying Ohm's law to the resistor  $R_1$ ,

$$V_A - V_B = R_1 i_1. \quad \dots\dots(ii)$$

And applying Ohm's law to the resistor  $R_2$ ,

$$V_A - V_B = R_2 i_2. \quad \dots\dots(iii)$$

From (ii) and (iii),  $R_1 i_1 = R_2 i_2$  or  $i_2 = \frac{R_1}{R_2} i_1$ .

Substituting for  $i_2$  in (i), we have

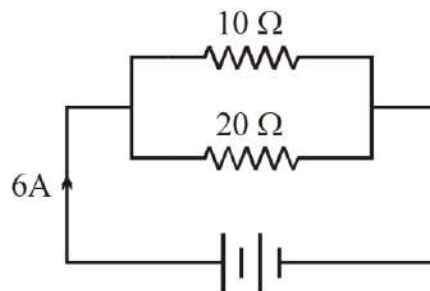
$$i = i_1 + \frac{R_1}{R_2} i_1 = i_1 \left( 1 + \frac{R_1}{R_2} \right) = i_1 = \frac{R_1 + R_2}{R_2} \quad \text{or} \quad i_1 = \frac{R_2}{R_1 + R_2} i$$

Similarly,  $i_2 = \frac{R_1}{R_1 + R_2} i$

Thus,  $\frac{i_1}{i_2} = \frac{R_2}{R_1}$ .

The current through each branch in a parallel combination of resistors is inversely proportional to its resistance.

**Illustration 8 :** Two resistors of resistance  $10 \Omega$  and  $20 \Omega$  are connected in parallel. A battery supplies 6 A of current to the combination, as shown in figure. Calculate the current in each resistor.



**Solution :** The current in the  $10 \Omega$  resistors is

$$i_1 = \frac{R_2}{R_1 + R_2} i = \frac{(20 \Omega) \times (6A)}{(10 \Omega) + (20 \Omega)} = 4A.$$

The current in the  $20 \Omega$  resistor is

$$i_2 = \frac{R_1}{R_1 + R_2} i = \frac{(10 \Omega) \times (6 \Omega)}{(10 \Omega) + (20 \Omega)} = 2A.$$

### 9. Kirchhoff's Law

#### Kirchhoff's First law or Junction Rule :

In an electric circuit, the 'algebraic' Sum of the currents meeting at any junction in the circuit is Zero, that is

$$\sum i = 0$$

$$I_1 + I_2 - I_3 - I_4 - I_5 = 0$$

$$I_1 + I_2 = I_3 + I_4 + I_5$$

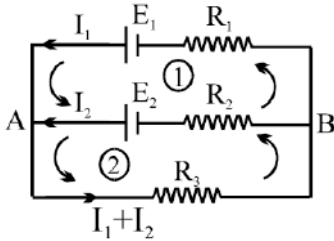
Kirchhoff's First law is a statement of the conservation of charge.

**Kirchhoff's second law or Mesh (loop) Rule :**

In any 'closed' mesh of a circuit the algebraic sum of the products of the current and the resistance in each part of the mesh is equal to the algebraic sum of the emf's in that mesh

$$\sum E = 0$$

Kirchhoff's second law is simply a statement of the conservation of energy.



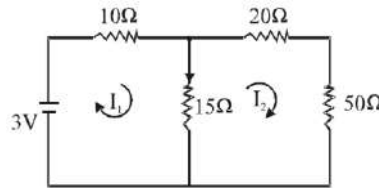
Kirchhoff's second law for mesh 1, we have

$$-I_1 R_1 + E_1 - E_2 + I_2 R_2 = 0 \tag{1}$$

Kirchhoff's second law for mesh 2, we have

$$-I_2 R_2 + E_2 - (I_1 + I_2) R_3 = 0 \tag{2}$$

**Illustration 9 :** Apply Kirchhoff's Voltage law to the adjoining circuit and obtain two equations for  $I_1$  and  $I_2$ .



**Solution :**

Mark the current distribution for the circuit.

Apply Kirchhoff's law for the first closed mesh, we have

$$I_1 \times 10 + (I_1 - I_2) \times 15 - 3 = 0$$

$$25I_1 - 15I_2 = 3 \tag{1}$$

Applying Kirchhoff's voltage law for the second closed mesh, we have

$$I_2 \times 20 + I_2 \times 50 - (I_1 - I_2) 15 = 0$$

$$17I_2 - 3I_1 = 0 \tag{2}$$

Solving equation (1) and (2), we get

$$I_1 = \frac{51}{380} = 0.134 \text{ A}$$

$$\text{and } I_2 = \frac{9}{380} = 0.024 \text{ A}$$

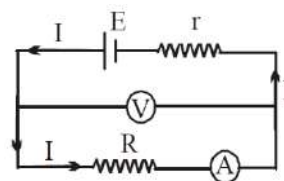
**Relation among Terminal Potential Difference, EMF and Internal Resistance of a cell :**

Let

$E$  = Emf of cell

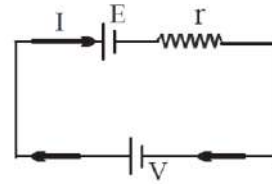
$V$  = Terminal Potential difference

$r$  = Internal resistance of cell



### During discharging Mode

$$V = E - Ir \quad \text{Where, } I = \frac{E}{R + r}$$



### During Charging Mode

$$V = E + Ir$$

## 10. Heating Effect of Electric Current

When conductor is connected to a source of electricity like cell or batteries, an electric field is developed across its ends and due to this field the free electrons of the conductor get moving in a definite direction. During their motion these free electrons experience the resistance due to the collisions with the ions or atoms already present in that conductor. Therefore, some energy of the electrons gets lost in this process which appears in the form of heat energy. This effect of electric current is known as heating effect of electric current. The electric appliances like electric kettle, heater, press etc. operate their functioning based on the heating effect of electric current. Passing of an electric current of strength 'i' through a conductor of resistance 'R' for time-interval  $\Delta t$  produces a potential difference 'V' across its ends then the total charge passing through the conductor in time-interval  $\Delta t$  will be

$q = \text{Strength of Current} \times \text{time-interval}$  or  $q = i \times \Delta t$

In this process the work done in carrying q coulomb of charge from one end to the other at potential difference V will be

$$W = q \cdot V \text{ or } W = (i \times \Delta t) \times V = i \times \Delta t \times (i \times R) = i^2 \times R \Delta t$$

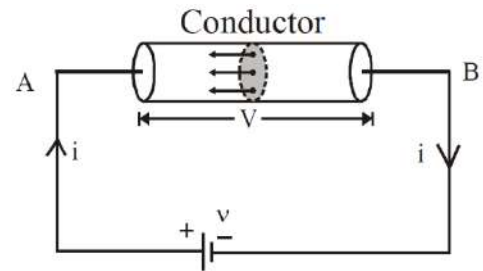
If this entire work is converted into heat then heat produced is;

$$H = \frac{W}{J} = \frac{Vi \Delta t}{J}$$

Here J is a conversion constant and known as the Mechanical equivalent of heat. Its value is 4.18 joule/calorie (1 cal = 4.18 J)

Hence the heat produced due to flow of current through a conductor.

$$H = \frac{Vi \cdot \Delta t}{4.18} = 0.239 Vi \cdot \Delta t = 0.239 i^2 R \Delta t \text{ (in calorie)}$$



### Remember

The production of heat in a conductor due to flow of electric current through it is called heating effect of electric current.

## 11. Joule's Law

These are as follows :-

- (i) The amount of heat (H) produced in a conductor in a definite time interval  $\Delta t$  is directly proportional to the square of the strength of current passing through it.

$$\text{Hence } H \propto I^2$$

It is also known as law of current.

- (ii) If the current of definite strength i passes through a conductor of resistance R for a definite time interval  $\Delta t$  then the amount of heat (H) produced in the conductor is directly proportional to its resistance R.

$$\text{Hence } H \propto R$$

It is also known as the law of resistance.

- (iii) If the current of definite strength  $i$  passes through a conductor of resistance  $R$  then the amount of heat ( $H$ ) produced in the conductor is directly proportional to the time interval  $\Delta t$  for which the current flows in it.

Hence  $H \propto \Delta t$

It is also known as the law of time.

Therefore the amount of heat produced ( $H$ ) when a current of strength  $i$  passes through a conductor of resistance  $R$  for a time interval  $\Delta t$  is given by

$$H \propto I^2 R \Delta t$$

$$H = I^2 R t \text{ Joule}$$

or 
$$H = \frac{1}{J} I^2 R \Delta t = 0.239 I^2 R \Delta t \text{ calorie}$$

This equation is a mathematical **expression of Joule's law**.

### Check Point

**Specimen Numerical :-** An electric heater of resistance 500 ohm is connected to a main supply for 30 minutes. If 5 A current flows through the filament of the heater, calculate the heat energy produced in the heater.

**Solution:** Here,  $I = 5\text{A}$ ;  $R = 500 \text{ ohm}$   
 $t = 30 \text{ minute} = 30 \times 60 \text{ s} = 1800 \text{ s}$ .

Using,  $H = I^2 R t$ , we get  
 $H = (5)^2 \times 500 \times 1800 = 22500000 \text{ J} = 2.25 \times 10^7 \text{ J}$

Thus, heat energy produced =  $2.25 \times 10^7 \text{ J}$

## 12. Practical Applications of Heating effect of Electric Current

### 1. Electric heater, electric iron and water heater etc. work on the heating effect of current.

When electric appliances like electric heater, electric iron and water heater etc. are connected to the main supply of electricity, these appliances become hot but the connecting wires remain cold.

The element of electric heater is made of nichrome. Nichrome has high value of resistivity and hence high resistance. We know, heat produced is directly proportional to the resistance of the material through which current flows. Since, resistance of nichrome is high, so a large amount of heat is produced in the element of the electric heater. Thus, filament of electric heater becomes red hot. On the other hand, connecting wires are made of copper or aluminium is very small, so a very small heat is produced in the connecting wires made of copper or aluminium.

### 2. Electric bulb glows when electric current flows through the filament of the bulb.

Filament of an electric bulb is made of a thin wire of tungsten. The melting point of filament is high i.e., about  $3380^\circ\text{C}$ . The filament of the bulb is enclosed in a glass envelope fixed over an insulated support. The glass envelope of electric bulb is filled with inactive gases like nitrogen and argon. Since resistance of thin filament is very high, so a large heat is produced as the electric current flows through the filament of the bulb becomes white hot. Hence, the filament of the bulb emits light and heat.

### 3. Electric fuse in the electric circuit melts when large current flows in the circuit.

Electric fuse is a safety device connected in series with the electric circuit. Electric fuse is a wire made of a material whose melting point is very low. Examples of the materials for making fuse wire are copper or tin-lead alloy. When large current flows through a circuit and hence through a fuse wire, a large amount of heat is produced. Due to this large amount of heat, the fuse wire melts and the circuit is broken so that current stops flowing in the circuit. This saves the electric circuit from burning.

**Remember**

Electric fuses used in electrical circuits are rated as 1A, 2A, 3A, 5A, 10A etc. When we say, electric fuse is rated as 1A, it means the maximum current that can flow through the fuse wire without melting it is 1A. If an electric current flows through the electric circuit is more than 1A, then the fuse rated as 1A will melt and the circuit breaks. For such electric circuit, fuse rated as 2A is used.

**13. Electric Power**

The rate of doing work, in an electric device due to flow of current in it, is defined as the power of that electric device. If, in a circuit with an electric source, the potential difference  $V$  is developed across the two ends of a conductor of resistance  $R$  as current of strength  $i$  passes through it for a time-interval  $\Delta t$  then work done in carrying a charge  $q$  through a potential difference  $V$  in the circuit will be–

$$W = q \times V = i \times \Delta t \times V$$

So the rate of work done, i.e., Power of the electric device ( $P$ );

$$P = \frac{W}{\Delta t} = \frac{i \times \Delta t \times V}{\Delta t} = i \times V$$

or 
$$P = V \times i = \frac{V^2}{R} = i^2 R$$

**Remember**

$P = VI$ , when either  $V$  or  $I$  or both  $V$  and  $I$  change.

$P = I^2 R$  is applied when current  $I$  is constant in the electric circuit.

$P = \frac{V^2}{R}$  is applied when potential difference is constant in the electric circuit.

1 VA = 1W

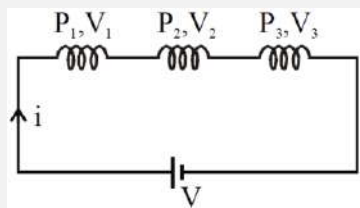
1 kVA = 1000W

1 h.p. = 746W

\*Equivalent power in series and parallel combination.

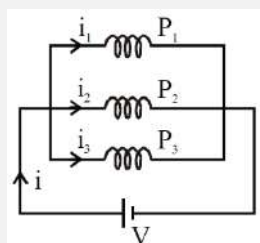
- In series combination

$$\frac{1}{P_{eq}} = \frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3}$$



- In parallel combination

$$P_{eq} = P_1 + P_2 + P_3$$



The S.I. unit of electric power is **watt**. Therefore in an electric circuit if 1 ampere current flows for a time-interval of 1 second through a potential difference of 1Volt then the power of the electric device is termed as 1watt.

In general kilowatt & Megawatt are used for measurement of electric power, Hence –

$$1 \text{ Kilowatt} = 1000 \text{ watt} = 10^3 \text{ watt}$$

and 
$$1 \text{ Megawatt} = 1000 \text{ kilowatt} = 10^6 \text{ watt}$$

In practice, Horse Power (H.P.) is also used for the measurement of electric power. The value of 1 Horse Power is 746Watt.

## 14. Electric Energy

The work done in moving an electric charge through a circuit is electric energy.

The work done by an electric source for the flow of current for a certain time interval is known as electric energy of the circuit. If electric power  $P$  is given for a small time  $\Delta t$  in a electric circuit then electric energy of the circuit will be  $W = P \times \Delta t$  so the electric energy of the electric circuit is–

$$W = P \times \Delta t = Vi \Delta t = i^2 R \Delta t$$

The unit for the measurement of electric energy is watt  $\times$  sec or joule. In practice kilo-watt hour is used for the measurement of Electric Energy. It is also known as Board of Trade Unit (B.O.T.U.) or simply Electric Unit i.e.,

1 Electric Unit = 1 k.w.h. = 1 kilo watt  $\times$  1 hour = 1000 watt  $\times$  3600 second

or 1 Electric Unit =  $3.6 \times 10^6$  watt  $\times$  second or joule. The rate of doing work, in an electric device due to flow of current in it, is defined as the power of that.

### How to calculate electricity bill?

Suppose electric appliances of a house have consumed 100 kWh of electric energy in a month and the cost of one unit is 50 paise. Then the total bill for a month =  $100 \times 50 = 5000$  paise = Rs. 50.00. Here 1 kWh = 1 unit.

### Let us Recapitulate

- Electric current : An electric current is defined as the amount of charge flowing through any cross-section of a conductor per unit time,  $I = \frac{Q}{t}$ . Electric current is a scalar quantity.
- Electric current in terms of number of electrons ( $n$ ) in a conductor,  $I = \frac{ne}{t}$ ,  $e$  = charge on an electron =  $-1.6 \times 10^{-19}$  C.
- In a metallic wire or conductor, the flow of electric current is due to the flow of electrons from one end to the other end of the wire.
- Charge carrier in a metallic wire are conduction elements.
- $6.25 \times 10^{18}$  electrons make one coulomb of charge.
- S.I. unit of electric current is ampere (A).
- Ampere (A) : Electric current through a conductor is said to be 1 ampere if one coulomb charge flows through any cross-section of the conductor in one second.
- Ammeter is used to measure electric current.
- Ammeter is always connected in series in an electric circuit.
- Electric potential is defined as work done per unit charge.

$$V = \frac{W}{q}$$

- Electric potential is a scalar quantity.
- Electric potential difference is defined as the work done in moving a unit positive charge from one point to another point.

$$dV = \frac{W}{q}$$

- SI unit of electric potential is volt (V).
- Voltmeter is used to measure the potential difference between two points in an electric circuit.
- Voltmeter is always connected in parallel in an electric circuit.

- **Ohm's Law** : This law states that, "the electric current flowing in a conductor is directly proportional to the potential difference across the ends of the conductor, provided the temperature and other physical conditions of the conductor remain the same".
- **Resistance (R)** : Resistance of a conductor is the ability of the conductor to oppose the flow of charge through it.
- Unit of resistance is ohm.
- 1 Ohm : Resistance of a conductor is said to be 1 ohm if a potential difference of 1 volt across the ends of the conductor produces a current of 1 ampere through it.
- Resistor is a component (say a metallic wire) in an electric circuit which offers resistance to the flow of electrons constituting the electric current in the electric circuit.
- Law of Resistance :
  - (i) Resistance of a conductor depends upon the nature of the material of the conductor.
  - (ii) Resistance of a conductor is directly proportional to the length of the conductor.
  - (iii) Resistance of a conductor is inversely proportional to the each of cross-section of the conductor.
  - (iv) Resistance of metallic conductor increases with the increase of temperature and decreases with the decrease of the temperature.
- $R = \frac{\rho l}{A}$
- Resistivity or Specific Resistance ( $\rho$ ) : Resistivity is defined as the resistance of the conductor of unit length and unit area of cross-section.
- Unit of Resistivity :
 

In CGS system, unit of resistivity is ohm-cm.  
In SI system, unit of resistivity is ohm-metre.
- Two or more resistors are said to be connected in series if same amount of current flows through these resistors.
- The effective resistance of series combination of resistors is the algebraic sum of the individual resistances of the resistors in the combination.
- An electric bulb or a heater or a metallic wire acts as a resistor.
- If one of the electric bulbs connected in a series is fused, then no electric bulb will glow inspite of the fact that the combination is connected with a source of electric current.
- Two or more resistors are said to be connected in parallel if the potential difference across each resistor is equal to the applied potential difference across the combination of the resistors.
- The effective resistance of the resistors connected in parallel is less than the minimum resistance of a resistor in the combination.
- Resistors are connected in series if the resistance of the electric circuit is to be increased.
- Resistors are connected in parallel if the resistance of the electric circuit is to be decreased.
- Joule's Law of Heating :
 

The amount of heat produced in a conductor is

  - (i) Directly proportional to the square of the electric current flowing through it.
  - (ii) Directly proportional to the resistance of the conductor.
  - (iii) Directly proportional to the time for which the electric current flows through the conductor.
$$H = I^2 R t \text{ (joule)}$$
- Electric fuse is a safety device used to save the electric appliances from burning.
- Electric fuse is a wire made of a material having low melting point.
- Electric fuse wire is made of copper or tin-lead alloy.
- Electric energy : The work done by a source of electricity to maintain a current in an electric circuit is known as electric energy.
 
$$E = VIt$$
- Electric power : Electric power is defined as the amount of electric work done in one second.

$$P = VI = I^2R = \frac{V^2}{R}$$

- SI unit of power is watt.
- Practical unit of power is horse power (h.p.)  
1 h.p. = 746 W
- Electric energy = Electric power × time
- Commercial unit of Energy: kilowatt-hour (kWh)
- 1 kWh =  $3.6 \times 10^6$  J

### Important

Electric Current	$i = \frac{Q}{t}$
Ohm's Law	$V = iR$
	$R = \rho \frac{l}{A}$
Resistors in series	$R_{eq} = R_1 + R_2 + R_3 + \dots$
Resistors in parallel	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
Heat produced by electric current	$U = i^2 Rt = \frac{V^2}{R} t = Vit$
Electric power	$P = \frac{U}{t} = i^2R = \frac{V^2}{R} = Vi$

## DPP-1

1. Choose the correct statement:
  - (a) The total charge of the universe is constant
  - (b) The total number of the charged particles is constant
  - (c) The total positive charge of the universe remains constant
  - (d) The total negative charge of the universe remains constant
2. If a charge body attracts another body, the charge on the other body
  - (a) must be negative
  - (b) must be positive
  - (c) must be zero
  - (d) may be negative or positive or net charge zero
3. When a body is negatively charged by friction it means
  - (a) The body has acquired excess of electrons
  - (b) The body has acquired excess of protons
  - (c) The body has lost some electrons
  - (d) The body has lost some neutrons
4. A neutral body has
  - (a) Equal values of positive and negative charges
  - (b) only positive charge
  - (c) only negative charge

- (d) no charge at all.
5. An electric charge on a body at rest produces  
 (a) a magnetic field only (b) an electric field only  
 (c) both electric and magnetic field (d) neither electric nor magnetic field.
6. One student Manoj said, he charged a body by  $Q = 1.7 \text{ C}$ . This charge is possible on a body  
 (a) True (b) false  
 (c) may be true or false (d) can't be determined
7.  $\frac{4}{25}$  coulomb of charge contains \_\_\_\_\_ electrons :  
 (a)  $10^{15}$  (b)  $10^{18}$  (c)  $10^{20}$  (d) none of these
8. Two same point charged bodies of  $1 \mu\text{C}$  are placed at 1m distance in vacuum. They applied force  $F$  on each other. Now this system placed in water. (Given  $\epsilon_r = 81$ ). Calculate the effect on the force.  
 (a)  $\frac{F}{81}$  (b)  $81 F$  (c)  $\frac{F}{9}$  (d)  $9F$

## DPP-2

1. Two particles having charges  $q_1$  &  $q_2$  when kept at a certain distance exert force  $F$  on each other. If distance is reduced to half, force between them becomes :  
 (a)  $\frac{F}{2}$  (b)  $2F$  (c)  $4F$  (d)  $\frac{F}{4}$
2. Electric current is defined as the :  
 (a) rate of flow of charges.  
 (b) total quantity of charges flowing through the circuit.  
 (c) number of electrons flowing through the circuit.  
 (d) number of ions flowing.
3. S.I. Unit of current is :  
 (a) Ampere (b) Coulomb (c) Volt (d) Watt
4. Conventionally, the direction of the current is taken as  
 (a) The direction of flow of negative charge (b) The direction of flow of atoms  
 (c) The direction of flow of molecules (d) The direction of flow of positive charge
5. If  $I$  is the current through a wire and  $e$  is the charge of electron, then the number of electrons in  $t$  second will be given by:  
 (a)  $\frac{Ie}{t}$  (b)  $Ite$  (c)  $\frac{e}{It}$  (d)  $\frac{It}{e}$
6. How many electrons constitute a current of one microampere ?  
 (a)  $6.25 \times 10^6$  (b)  $6.25 \times 10^{12}$  (c)  $6.25 \times 10^9$  (d)  $6.25 \times 10^{15}$
7. If  $Q = 2$  coulomb and force on it is  $F = 100$  newton, then the value of field intensity will be:  
 (a)  $100 \text{ N/C}$  (b)  $50 \text{ N/C}$  (c)  $200 \text{ N/C}$  (d)  $10 \text{ N/C}$
8. Electric potential is a  
 (a) scalar quantity. (b) vector quantity.  
 (c) constant. (d) dimensionless quantity

**DPP-3**

- If  $1\mu$  A current passes through a conductor in a time period of 1 hour, then the number of electrons passing through the conductor will be :  
 (a)  $2.25 \times 10^{-16}$       (b)  $2.25 \times 10^{16}$       (c)  $6.25 \times 10^{18}$       (d)  $3.6 \times 10^{-3}$
- If  $6.25 \times 10^{18}$  electrons pass through a conductor, in 5 minutes, then the current flowing in the conductor is:  
 (a)  $3.34 \times 10^{-3}$  mA      (b) 334mA      (c) 3.34mA      (d) 1mA
- Which of the following is not an electrical classification of material  
 (a) Semi conductor      (b) Insulator      (c) Semi-insulator      (d) Conductor
- A current  $I$  flows through a uniform wire of diameter  $d$  when the electron drift velocity is  $V$ . The same current will flow through a wire of diameter  $\frac{d}{2}$  made of the same material if the drift velocity of the electron is [Hint  $V_d \propto \frac{1}{A}$ ]  
 (a)  $\frac{V}{4}$       (b)  $\frac{V}{2}$       (c)  $2V$       (d)  $4V$
- The direction of drift velocity for electron in a metal is to that of  
 (a) Opposite to that of applied electric field      (b) In the direction of electric field  
 (c) Random direction      (d) All of these
- Among identical spheres A and B having charges as  $-5C$  and  $-16C$   
 (a)  $-5C$  is at higher potential      (b)  $-16C$  is at higher potential  
 (c) Both are at equal potential      (d) It cannot be said
- Which one of the following devices is used for detecting the direction and measuring the small currents.  
 (a) Galvanometer      (b) Ammeter      (c) Tapping key      (d) Rheostat
- What are the condition for an ideal circuit ?  
 (a) Resistance of Ammeter = 0 , Resistance of voltmeter =  $\infty$   
 (b) Resistance of voltmeter = 0 , Resistance of Ammeter =  $\infty$   
 (c) Ammeter is connected in parallel and voltmeter in series with the load  
 (d) Ammeter and voltmeter are connected anywhere in the circuit

**DPP-4**

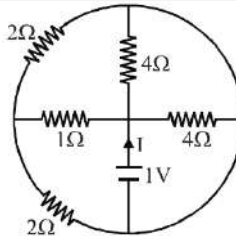
- The resistance of an air gap is :  
 (a) very large.      (b) very small.      (C) zero.      (D) negative.
- The resistance of a wire of cross-section 'A' and length 'l' is  $R_{ohm}$ . The resistance of the same wire and same length but cross section area  $2A$  will be  
 (a)  $2R$       (b)  $R/2$       (c)  $R/4$       (d)  $4R$
- Three copper wires of length and cross-sectional area are  $(l, A)$  ;  $\left(2l, \frac{A}{2}\right)$  ;  $\left(\frac{l}{2}, 2A\right)$   
 Resistance is minimum in:  
 (a) Wire of cross - sectional area  $\frac{A}{2}$       (b) Wire of cross - sectional area  $A$   
 (c) Wire of cross - sectional area  $2A$       (d) Same in all the three cases

- There are three resistance  $5\ \Omega$ ,  $6\ \Omega$  and  $8\ \Omega$  connected in parallel to a battery of  $15\ \text{V}$  and of negligible resistance. The potential drop across  $6\ \Omega$  resistance is :  
(a)  $10\ \text{V}$                       (b)  $15\ \text{V}$                       (c)  $20\ \text{V}$                       (d)  $8\ \text{V}$
- The unit of specific resistance is :  
(a) ohm.                      (b) ohm-meter.                      (c) ohm-1.                      (d) ohm meter-1.
- The maximum possible resistance that can be obtained by using the three resistors 2, 3 and 4 is :  
(a) 8                      (b) 9.                      (c) 10.                      (d) 7.
- In how many parts (equal) a wire of  $100\ \Omega$  be cut so that a resistance of  $1\ \Omega$  is obtained by connecting them in parallel?  
(a) 10                      (b) 5                      (c) 100                      (d) 50
- A nichrome wire is  $1\ \text{m}$  long and  $1 \times 10^{-6}\ \text{m}^2$  in cross-sectional area. When connected to a potential difference of  $2\ \text{V}$  a current of  $4\ \text{A}$  exists in the wire. The resistivity of nichrome is  
(a)  $10^{-7}\ \Omega\ \text{m}$                       (b)  $2 \times 10^{-7}\ \Omega\ \text{m}$                       (c)  $4 \times 10^{-7}\ \Omega\ \text{m}$                       (d)  $5 \times 10^{-7}\ \Omega\ \text{m}$

### DPP-5

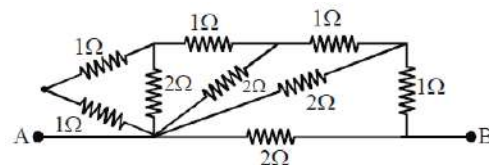
- Find the current ( $I$ ) in the given circuit

- (a)  $1\ \text{A}$                       (b)  $5.5\ \text{A}$   
(c)  $6\ \text{A}$                       (d)  $9\ \text{A}$



- What is the resistance between A & B in the following circuit

- (a)  $1\ \Omega$                       (b)  $2\ \Omega$   
(c)  $\frac{1}{2}\ \Omega$                       (d)  $\frac{3}{2}\ \Omega$



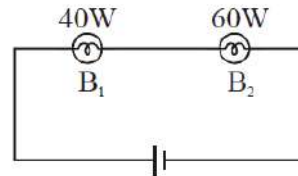
- The length of the wire ' $l$ ' having resistance  $R$  if the length of this wire is increased by 25% then resistance increased by  
(a) 25%                      (b) 50 %                      (c) 56.25%                      (d) 77.33%
- A uniform wire of resistance  $R$  is uniformly compressed along its length, until its radius becomes  $n$  times the original radius. Now, the resistance of the wire becomes :  
(a)  $R/n$                       (b)  $R/n^4$                       (c)  $R/n^2$                       (d)  $n\ R$
- If two bulbs, whose resistance are in the ratio of  $1 : 2$ , are connected in series. The power dissipated in them has the ratio of :  
(a)  $1 : 1$                       (b)  $1 : 2$                       (c)  $2 : 1$                       (d)  $1 : 4$
- Reading of ammeter in ampere for the following circuit is :  
(a)  $0.8$                       (b)  $1$                       (c)  $0.4$                       (d)  $2$

### DPP-6

- According to Joule's law if potential difference across a conductor having a material of specific resistance  $\rho$ , remains constant, then heat produced in the conductor is directly proportional to :

- (a)  $\frac{1}{\sqrt{\rho}}$                       (b)  $\frac{1}{\rho}$                       (c)  $\rho$                       (d)  $\rho^2$

- An electric bulb of 40W is connected to a source of 220V, the current drawn by the bulb will be :  
(a) 0.18A (b) 18A (c) 1.8A (d) 180A
- An electric motor takes 5A from a 220V, then the energy consumed in 2h will be :  
(a)  $7.92 \times 10^6$  J (b)  $7.92 \times 10^{-6}$  J (c)  $7 \times 10^6$  J (d)  $7 \times 10^{10}$  J
- The electric heater converts 1 kJ of electrical energy to heat energy every second with 100% efficiency.  
The power produced is :  
(a) 1W (b) 1 kW (c) 1 MW (d) 1 kJ
- An electric bulb is rated 220 volt – 100 watt. The power consumed by it when operated on 110 volt will be  
(a) 25 Watt (b) 50 Watt (c) 75 Watt (d) 40 Watt
- A refrigerator rated 400W operates 8 hour per day. The total number of commercial units for 30 days will be  
(a) 96 (b) 46 (c) 36 (d) 100
- Two bulbs of 40W and 60 W are connected as shown in the figure, then the ratio of heat generated in bulbs  $B_1$  and  $B_2$  is  
(a)  $\frac{2}{3}$  (b)  $\frac{3}{2}$   
(c)  $\frac{5}{3}$  (d)  $\frac{5}{2}$
- An electric heater can boil a certain amount of water in 10 minute and another heater can do it in 15 minute, both working at the same voltage. If the two heaters are connected in parallel across the same voltage as before how much time will they take to boil the same amount of water?  
(a) 9min (b) 12.5min (c) 7.5min (d) 6min



## NCERT Basics

## Exercise-1

- A piece of wire of resistance  $R$  is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is  $R'$ , then the ratio  $R/R'$  is –  
(a)  $1/25$  (b)  $1/5$   
(c) 5 (d) 25
- Which of the following terms does not represent electrical power in a circuit?  
(a)  $I^2R$  (b)  $IR^2$   
(c)  $VI$  (d)  $V^2/R$
- An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be –  
(a) 100 W (b) 75 W  
(c) 50 W (d) 25 W
- Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be –  
(a) 1:2 (b) 2:1  
(c) 1:4 (d) 4:1

5. How is a voltmeter connected in the circuit to measure the potential difference between two points?
6. A copper wire has diameter 0.5 mm and resistivity of  $1.6 \times 10^{-8} \text{ W m}$ . What will be the length of this wire to make its resistance 10 W? How much does the resistance change if the diameter is doubled?
7. The values of current  $I$  flowing in a given resistor for the corresponding values of potential difference  $V$  across the resistor are given below –
 

$I$ (amperes)	0.5	1.0	2.0	3.0	4.0
$V$ (volts)	1.6	3.4	6.7	10.2	13.2

 Plot a graph between  $V$  and  $I$  and calculate the resistance of that resistor.
8. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.
9. A battery of 9 V is connected in series with resistors of  $0.2 \Omega$ ,  $0.3 \Omega$ ,  $0.4 \Omega$ ,  $0.5 \Omega$  and  $12 \Omega$ , respectively. How much current would flow through the  $12 \Omega$  resistor?
10. How many 176 W resistors (in parallel) are required to carry 5 A on a 220 V line?
11. Show how you would connect three resistors, each of resistance  $6 \Omega$ , so that the combination has a resistance of (i)  $9 \Omega$ , (ii)  $4 \Omega$ .
12. Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?
13. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of  $24 \Omega$  resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?
14. Compare the power used in the  $2 \Omega$  resistor in each of the following circuits:
  - (i) a 6 V battery in series with  $1 \Omega$  and  $2 \Omega$  resistors, and
  - (ii) a 4 V battery in parallel with  $12 \Omega$  and  $2 \Omega$  resistors.
15. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?
16. Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?
17. An electric heater of resistance  $8 \Omega$  draws 15 A from the service mains 2 hours. Calculate the rate at which heat is developed in the heater.
18. Explain the following.
  - (a) Why is the tungsten used almost exclusively for filament of electric lamps?
  - (b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal?
  - (c) Why is the series arrangement not used for domestic circuits?
  - (d) How does the resistance of a wire vary with its area of cross-section?
  - (e) Why are copper and aluminium wires usually employed for electricity transmission?

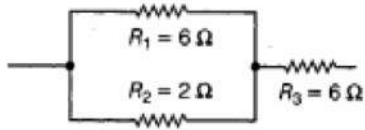
## Concept Mastery

## Exercise-2

### A. Very Short Answer Type Questions

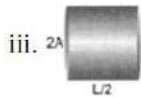
1. Write the formula of electric power ( $P$ ) in terms of:
  - a. Potential difference ( $V$ ) and current ( $I$ ).
  - b. Current ( $I$ ) and resistance ( $R$ ).
  - c. Potential difference ( $V$ ) and resistance ( $R$ ).

- A uniform wire with a resistance of  $32\ \Omega$  is divided into four equal parts and they are joined in parallel. Calculate the equivalent resistance of the parallel combination.
- Resistance of an incandescent filament of a bulb is comparatively much more than that when it is at room temperature. Why?
- The given figure shows three resistors



Find the combined resistance.

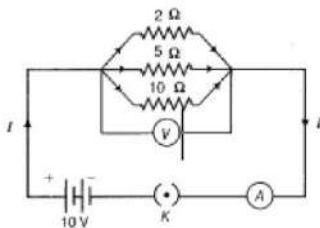
- In how much time will a bulb of 100 W consume the energy of 2 kWh?
- Why are fairy decorative lights always connected in parallel?
- A given length of a wire is doubled on itself. By what factor does the resistance of the wire change?
- What is meant by electric power? Give its units. How is it related to V and I?
- Figure (a), (b) and (c) show three cylindrical copper conductors along with their face areas and length. Which of the conductors will have highest resistance and why?



- An electric iron is rated 1 kW - 220 V. Calculate the following:
  - The resistance of its heating element.
  - The amount of current that will flow through the element.
  - The amount of heat that will be produced in 2 minutes.
  - The power consumed if the line voltage falls to 200 V.

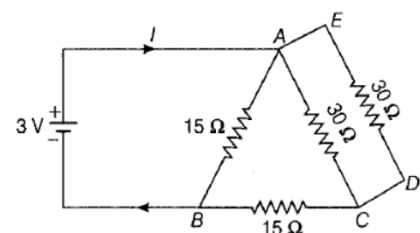
### B. Short Answer Type Questions

- A circuit diagram is given as shown below:



Calculate

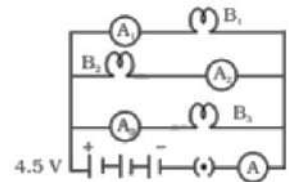
- the total effective resistance of the circuit.
  - the total current in the circuit and the current through each resistor.
- Find the value of current in the circuit given as below:
    - You have four resistors of  $8\ \Omega$  each. Show how would you connect these resistors to have effective resistance of  $8\ \Omega$  ?



13. i. An electric lamp of 100 ohms, a toaster of resistance 50 ohms and a water filter of resistance 500 ohms are connected in parallel to a 220V source. what is the resistance of the electric iron connected to the same source that takes as much current as all the three appliances and what is the current through it?  
ii. Which uses more energy, a 250 W TV set for 1 hour or a 1,200 W toaster for 10 minutes?
14. An electric geyser rated at 1500 W, 250 V is connected to a 250 V line mains. Solve  
i. the electric current drawn by it. and the energy consumed by it in 50 h.  
ii. cost of energy consumed if each unit costs Rs 6.
15. Calculate the total cost of running the following electrical devices in the month of September, if the rate of 1 unit of electricity is Rs. 6.00.  
i. Electric heater of 1000 W for 5 hours daily.  
ii. Electric refrigerator of 400 W for 10 hours daily.

### C. Long Answer Type Questions

16. What is meant by resistance of a conductor? Name and define its SI unit. List the factors on Which the resistance of a wire affected, if (i) its length is doubled, (ii) its radius is doubled?
17.  $B_1$ ,  $B_2$ , and  $B_3$  are three identical bulbs connected as shown in the figure. When all the three bulbs glow, a current of 3A is recorded by the ammeter A.  
i. What happens to the glow of the other two bulbs when the bulb  $B_1$  gets fused?  
ii. What happens to the reading of  $A_1$ ,  $A_2$ ,  $A_3$ , and A when the bulb  $B_2$  gets fused?  
iii. How much power is dissipated in the circuit when all the three bulbs glow together?
18. What is the resultant resistance when number of resistors are connected in parallel?
19. Draw a schematic diagram of a circuit consisting of a battery of 3 cells of 2 V each, a combination of three resistors of  $10\Omega$ ,  $20\Omega$  and  $30\Omega$  connected in parallel, a plug key and an ammeter, all connected in series. Use this circuit to find the value of the following:  
i. Current through each resistor  
ii. Total current in the circuit  
iii. Total effective resistance of the circuit
20. Two identical resistors, each of resistance  $15\Omega$ , are connected in series and parallel, in turn to a battery of 6 V. Calculate the ratio of the power consumed in the combination of resistors in each case.
21. An ammeter has a range of 0-3 ampere and there are 30 divisions on its scale. Calculate the least count of the ammeter.
22. In an experiment, a student connected two conducting wires of same material, equal length and equal diameter in series. How does the heat produced by the combination of resistors change?



### D. True & False

23. State True or False:  
(a) In an electric circuit, a device called rheostat is often used to change the resistance in the circuit.  
(b) One ampere is constituted by the flow of one coulomb of charge per second.

### E. Fill in the Blanks

24. (a) \_\_\_\_\_ is used almost exclusively for filaments of electric bulbs.

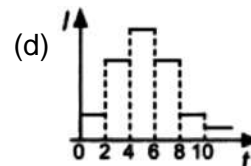
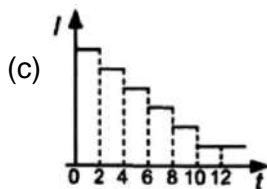
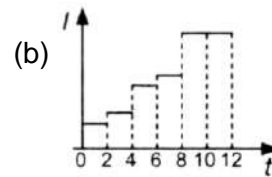
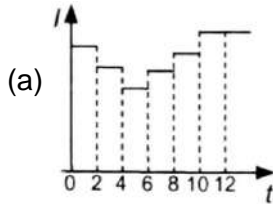
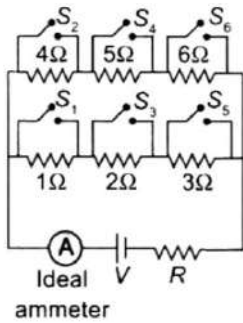
## Accuracy Booster

## Exercise-3

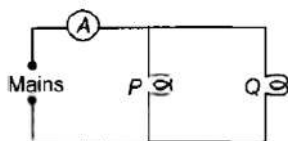
### A. Multiple Choice Questions

- The unit for expressing electric power is:
  - Coulomb
  - Joule
  - Watt
  - Volt
- The resistance of a resistor is reduced to half of its initial value. If other parameters of the electrical circuit remain unaltered, the amount of heat produced in the resistor will become:
  - half
  - two times
  - four times
  - one fourth
- If the potential difference between the end of a wire of fixed resistance is doubled, by how much does the electric power increase?
  - $\frac{4V}{R}$
  - $\frac{3V}{R}$
  - $\frac{6V}{R}$
  - $\frac{5V}{R}$
- The potential difference across a  $3\Omega$  resistor is 6V. The current flowing in the resistor will be:
  - 6 A
  - 2 A
  - 1 A
  - $\frac{1}{2}$  A
- The heat produced in a wire of resistance  $x$  when a current  $y$  flows through it in time  $z$  is given by:
  - $y \times z \times x$
  - $x^2 \times y \times z$
  - $x \times z \times y^2$
  - $y \times z^2 \times x$
- The resistivity of a metallic wire depends on:
  - Its shape
  - Its thickness
  - Nature of material
  - Its length
- Work done to move 1 coulomb charge from one point to another point in a charged conductor having a potential 10 volt is:
  - 1 Joule
  - 100 Joule
  - 10 Joule
  - Zero
- In a household, 250 unit electrical energy is consumed in particular months. In the standard unit, it means that the energy consumed is:
  - 250 KW/h
  - 250 KJ
  - 250 kWh
  - 500 kJ/h
- A current of 5 amperes flows through a wire whose ends are at a potential difference of 3 volts. The resistance of the wire:
  - 0.7 Ohms
  - 0.1 Ohms
  - 0.6 Ohms
  - 0.5 Ohms
- The values of mA and  $\mu$ A are
  - $10^{-3}$  A and  $10^{-9}$  A respectively
  - $10^{-6}$  A and  $10^{-3}$  A respectively
  - $10^{-6}$  A and  $10^{-9}$  A respectively
  - $10^{-3}$  A and  $10^{-6}$  A respectively
- Ohm's law gives a relation between:
  - Resistance and potential difference
  - Potential difference and electric charge
  - Current and potential difference
  - Current and resistance

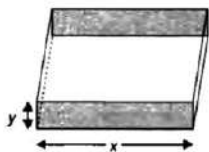
12. Say switches  $S_1, S_2$  and so on up to  $S_6$  are closed at regular intervals of 2 minutes starting from  $t = 0$ . The graph of current  $I$  (in ampere) versus time  $t$  (in minute) is best represented as



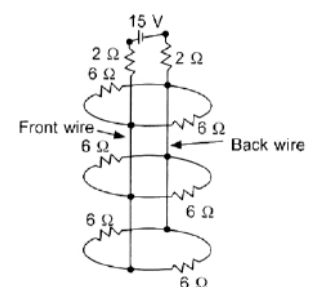
13. How will be the reading in the ammeter A affected if another identical bulb Q is connected in parallel to P? (The voltage in the mains is maintained at a constant value.)



- (a) The reading will be reduced to one-half. (b) The reading will not be affected.  
(c) The reading will be increased four-fold. (d) The reading will be doubled.
14. Consider a thin square sheet of side  $x$  and thickness  $y$  made of a material of resistivity  $\rho$ . The resistance between two opposite faces, shown by the shaded areas in the figure is



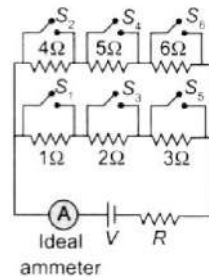
- (a) Directly proportional to  $x$  (b) Independent of  $x$   
(c) Independent of  $y$  (d) Directly proportional to  $y$
15. Which of the following obeys Ohm's law?  
(a) Nichrom (b) Filament of a bulb  
(c) LED (d) Transistor
16. Find the current supplied by the source in figure. The resistors are mounted in a cylindrical form.



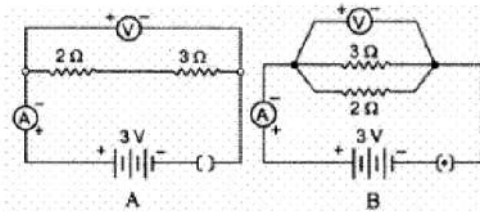
- (a)  $\frac{14}{13}$  A (b) 2 A  
(c) 3 A (d) 1.75 A


17. An electric bulb rated 220V, 60 W is working at full efficiency. Another identical bulb is connected in the same circuit having power supply of 220 V.
- If both the bulbs are connected in series then the total power consumption will be 60 W.
  - If only one bulb is connected then the total power consumption will be 30 W.
  - If the both bulbs are connected in parallel then the total power consumption will be 120 W.
- Which of the above statement(s) is/are correct regarding the circuit?
- (a) Only (iii) (b) Only (ii) and (iii)  
(c) Only (i) and (ii) (d) Only (i)
18. How many electrons are flowing per second past a point in a circuit in which there is a current of 5A?
- (a)  $31.25 \times 10^{17}C$  (b)  $31.25 \times 10^{19}C$   
(c)  $31.25 \times 10^{18}C$  (d)  $31.25 \times 10^{15}C$
19. What is the maximum power in kilowatts of the appliance that can be connected safely to a 13A, 230V mains socket?
- (a) 2.95 kW (b) 2.98 kW  
(c) 2.99 kW (d) 2.97 kW
20. Consider the room temperature is  $24^{\circ}C$  in summer, the electrical resistance of thermocoil which is used in the AC unit is  $150 \Omega$ . Then calculate the temperature of the thermocoil if the electrical resistance is  $175 \Omega$ . Given the temperature coefficient of the thermocoil is  $2.98 \times 10^{-4} \text{ }^{\circ}C^{-1}$
- (a)  $583^{\circ}C$  (b)  $512^{\circ}C$   
(c)  $597^{\circ}C$  (d)  $546^{\circ}C$
21. The resistance of the wire when the length of the wire increases two times:
- (a) Becomes 3 times (b) Becomes 6 times  
(c) Becomes 4 times (d) Becomes 2 times
22. At a given time, a house is supplied with 100 A at 220 V. How many 75 W, 220 V light bulbs could be switched on in the house at the same times if they are all connected in parallel?
- (a) 93 (b) 293  
(c) 193 (d) 393
23. The SI unit of energy is:
- (a) Ohm-meter (b) Joule  
(c) Watt (d) Coulomb
24. When an electric lamp is connected to 12 V battery, it draws a current of 0.5A. The power of the lamp is:
- (a) 0.5W (b) 24W  
(c) 12W (d) 6W
25. In a house, two 60W electric bulbs are lighted for 4 hours and three 100W bulbs for 5 hours every day. The electric energy is consumed in 30 days:
- (a) 59.4 kWh (b) 79.4 kWh  
(c) 100 kWh (d) 45 kWh
26. A piece of wire of resistance  $20\Omega$  is drawn out so that its length is increased to twice its original length. Resistance of the wire in the new situation:
- (a)  $70\Omega$  (b)  $50\Omega$   
(c)  $60\Omega$  (d)  $80\Omega$

27. The current drawn by ammeter is maximum if
- $S_2, S_4, S_5$  closed
  - $S_1, S_2, S_3$  are closed
  - $S_1, S_3, S_5$  are closed
  - $S_2, S_3, S_4$  closed



28. An ammeter has 20 divisions between mark 0 and mark 2 on its scale. The least count of the ammeter is
- 0.01 A
  - 0.02 A
  - 0.2 A
  - 0.1 A
29. If two resistors of  $25\ \Omega$  and  $15\ \Omega$  are joined together in series and then placed in parallel with a  $40\ \Omega$  resistor, the effective resistance of the combination is:
- $0.1\ \Omega$
  - $10\ \Omega$
  - $20\ \Omega$
  - $40\ \Omega$
30. For the circuits A and B shown below, find the voltmeter readings would be



- 5 V in both circuits
  - 0 V in both circuits
  - 0 V in circuit A and 3 V in circuit B
  - 0.6 V in circuit A and 2.5 V in circuit B
31. Electrical resistivity of an alloy of copper and nickel is \_\_\_\_\_ when compared with the electrical resistivity of an alloy of copper, manganese and nickel.
- Double
  - Same
  - Less
  - More
32. 

The above mentioned symbol is:

- Variable resistance or rheostat
  - Rheostat
  - Resistance
  - Variable resistance
33. The following instruments are available in a laboratory : Milliammeter  $A_1$  of range 0-300 mA and least count 10 mA Milliammeter  $A_2$  of range 0-200 mA and least count 20 mA Voltmeter  $V_1$  of range 0-5 V and least count 0.2 V Voltmeter  $V_2$  of range 0-3 V and least count 0.3 V.
- Out of the following pairs of instruments, which pair would be the best choice for carrying out the experiment to determine the equivalent resistance of two resistors connected in series ?
- Milliammeter  $A_2$  and voltmeter  $V_2$
  - Milliammeter  $A_1$  and voltmeter  $V_1$
  - Milliammeter  $A_2$  and voltmeter  $V_1$
  - Milliammeter  $A_1$  and voltmeter  $V_2$

### B. Assertion & Reason Questions

34. **Assertion (A):** Resistance of 50 W bulb is greater than that of 100 W.  
**Reason (R):** Resistance of bulb is inversely proportional to rated power.
- Both A and R are true and R is the correct explanation of A.
  - Both A and R are true but R is not the correct explanation of A.

- (c) A is true but R is false.  
(d) A is false but R is true.

**35. Assertion (A):** Voltmeter is always connected in parallel across the circuit while measuring the potential difference.

**Reason (R):** As the voltage in parallel circuits are measured to be the same.

- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.

**36. Assertion (A):** A torch bulb gives light if operated on AC of the same voltage and current as DC.

**Reason (R):** The heating effect is common to both AC and DC.

- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.

**37. Assertion (A):** Resistivity of the material may change with temperature.

**Reason (R):** Resistivity is a material property & independent of temperature.

- (a) Both A and R are true and R is the correct explanation of A.  
(b) Both A and R are true but R is not the correct explanation of A.  
(c) A is true but R is false.  
(d) A is false but R is true.

### C. Statement Type Questions

**38.** Which of the given statement is true or false:

**Statement A:** Resistivity increases with a decrease in temperature in insulators.

**Statement B:** Resistivity of a conductor increases with increasing temperature.

- (a) Statement A is true, Statement B is false.  
(b) Neither statement A nor statement B is true.  
(c) Statement A is false, Statement B is true.  
(d) Both the statements A and B are true.

**39.** Which of the following statements are correct about resistance?

- A. The resistance of a conductor is directly proportional to the length.  
B. The resistance of a conductor is directly proportional to the area of cross-section.  
C. The Resistance of a conductor depends on the nature of the material.  
D. The Resistance of a conductor is inversely proportional to the length.

- (a) A, B and D  
(b) A and B  
(c) A and C  
(d) A and D

### D. Match The Column

**40.** Match the column I with column II and select the correct option from the codes given.

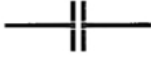



Column I	Column II
(a) Electric current	(i) volt
(b) emf	(ii) ohm
(c) Resistance	(iii) ohm-metre

(d) Resistivity	(iv) ampere
(a) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)	(b) (a) - (iv), (b) - (ii), (c) - (i), (d) - (iii)
(c) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)	(d) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

41. Match the following:

(a) Bulb filament	(i) Nichrome
(b) Heating element of electric Iron	(ii) Potential difference
(c) Super conductor	(iii) Zero resistivity
(d) EMF	(iv) Tungsten

42. Match the components in column A with the symbols in column B.

Column A	Column B
(a) 	(i) Wire joint
(b) 	(ii) Capacitor
(c) 	(iii) Diode
(d) 	(iv) Capacitor

- (a) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)  
(c) (a) - (iii), (b) - (iv), (c) - (iii), (d) - (ii)

- (b) (a) - (i), (b) - (ii), (c) - (i), (d) - (iv)  
(d) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

### E. Case Study or Paragraph

43. Read the following and answer any four questions:

A battery is a source of electrical energy. The chemical reaction within the cell generates the potential difference between its 2 terminal that sets the electron in the motion to flow the current through the resistor for the steady current  $I$ , the amount of heat  $H$  produce in time  $T$  is  $H = VIT$  applying ohm's law, we get joule's law of heating. The heating effect of electric current has many useful applications such as electric laundry iron, toaster etc. Another common application of joules heating is a fuse.

i. Joule's law of heating implies that heat production in a resistor is:

- directly proportional to the square of current for a given resistor
- directly proportional to resistance for a given current
- directly proportional to time for which current flow through the resistor
- all of these

ii. Joule's law of heating is:

- $H = IR^2T$
- $H = I^2RT$
- $H = IRT^2$
- $H = IRT$

iii. The melting point of tungsten is:

- $3380^\circ\text{C}$
- $4450^\circ\text{C}$
- $3370^\circ\text{C}$
- $3350^\circ\text{C}$

iv. The bulbs are usually filled with:

- a. chemically inactive nitrogen  
b. argon gases  
c. both (a) and (b)  
d. none of these  
v. The fuse is placed in \_\_\_\_\_ with the device.  
a. series  
b. parallel  
c. perpendicular  
d. diagonal

**44.** Read the following and answer any four questions:

For the flow of charge in a conductor metallic wire, gravity does not play any role. The electron moves only if there is a difference in electric potential. The difference of potential may be produced by a battery, consist of one or more electric cells. The chemical action with a cell generate the potential difference across the terminal of the cell, even when no current is drawn from it, potential difference set the charges in motion in the conductor produce an electric current, the cell has to expend its chemical energy stored in it.

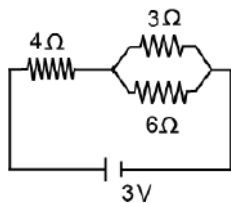
i. The potential difference between 2 points is measured as:

- a.  $V = \frac{W}{Q}$   
b.  $V = \frac{R}{I}$   
c.  $V = \frac{Q}{I}$   
d.  $V = IR$

ii. Keeping the potential difference constant, the resistance of the circuit is halved. The current will become:

- a. one-fourth  
b. four times  
c. half  
d. double

iii. The potential difference across the 3-ohm resistance in the following diagram is:



- a.  $\frac{1}{9}$  V  
b. 3 V  
c. 2 V  
d. 1 v  
iv. The other name of the potential difference is:  
a. amperage  
b. wattage  
c. voltage  
d. potential energy  
v. The S.I unit of electric potential difference is volt (V) named after:  
a. Alessandra volta  
b. Alandra volta  
c. Alessandra volt  
d. Alexandra volt

**45.** Read the Case study followed by 3 questions Part (i) and (ii) are compulsory. However, an internal choice has been provided in part (iii):

The heating effect of current is obtained by transformation of electrical energy into heat energy. Just as mechanical energy used to overcome friction is covered into heat, in the same way, electrical energy is converted into heat energy when an electric current flows through a resistance wire. The heat produced in a conductor, when a current flows through it is found to depend directly on (a) strength of current (b) resistance of the conductor (c) time for which the current flows.

The mathematical expression is given by  $H = I^2Rt$ . The electrical fuse, electrical heater, electric iron, electric geyser etc. all are based on the heating effect of current.

i. What are the properties of heating element?

- ii. What are the properties of electric fuse?  
 iii. When the current is doubled in a heating device and time is halved, what will be the heat energy produced?

OR A fuse wire melts at 5 A. It is desired that the fuse wire of same material melt at 10 A. Find the new radius of the wire?

46. Read the Case study followed by 3 questions Part (i) and (ii) are compulsory. However, an internal choice has been provided in part (iii):

The rate of flow of charge is called electric current. The SI unit of electric current is Ampere (A). The direction of flow of current is always opposite to the direction of flow of electrons in the current.

The electric potential is defined as the amount of work done in bringing a unit positive test charge from infinity to a point in the electric field. The amount of work done in bringing a unit positive test charge from one point to another point in an electric field is defined as potential difference.

$$V_{AB} = V_B - V_A = \frac{W_{BA}}{q}$$

The SI unit of potential and potential difference is volt.

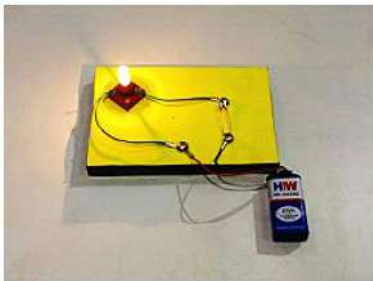
- i. The 2 C of charge is flowing through a conductor in 100 ms, then what would be the current in the circuit?  
 ii. What would be the potential difference between the two terminals of a battery, if 100 joules of work is required to transfer 20 coulombs of charge from one terminal of the battery to other?  
 iii. What is the number of electrons flowing per second in a conductor if 1 A current is passing through it?

OR

Write the formula of voltage in terms of work done, current, time and charge.

**Question No. 47 to 50 are based on the given text. Read the text carefully and answer the questions:**

How do we express electric current? Electric current is defined by the amount of charge flowing through a particular area in unit time. In other words, it is the rate of flow of electric charges. In circuits using metallic wires, electrons constitute the flow of charges. However, electrons were not known at the time when the phenomenon of electricity was first observed. So, electric current was considered to be the flow of positive charges and the direction of flow of positive charges was taken to be the direction of electric current. Conventionally, in an electric circuit, the direction of electric current is taken as opposite to the direction of the flow of electrons, which are negative charges.



47. If a net charge Q, flows across any cross-section of a conductor in time t, then the current I, through the cross-section is given by which formula?  
 48. What is the SI unit of electric charge? It is equivalent to how many numbers of electrons?  
 49. The electric current is expressed in which unit? Define the unit used to measure electric current.  
 50. If the amount of charge passing through the cell in 4 seconds is 12 C then find the current supplied by a cell.

## Answer Key

### DPP-1

1. (a)    2. (d)    3. (a)    4. (a)    5. (b)    6. (a)    7. (b)  
8. (a)

### DPP-2

1. (c)    2. (a)    3. (a)    4. (d)    5. (d)    6. (b)    7. (b)  
8. (a)

### DPP-3

1. (b)    2. (c)    3. (c)    4. (d)    5. (a)    6. (a)    7. (a)  
8. (a)

### DPP-4

1. (a)    2. (c)    3. (c)    4. (b)    5. (b)    6. (b)    7. (a)  
8. (d)

### DPP-5

1. (a)    2. (a)    3. (c)    4. (b)    5. (b)    6. (b)

### DPP-6

1. (b)    2. (a)    3. (a)    4. (b)    5. (a)    6. (a)    7. (b)  
8. (d)

### NCERT Basics

### Exercise-1

1. (d)    2. (b)    3. (d)    4. (c)    5. Parallel  
6. 122.7 m;  $\frac{1}{4}$  times    7. 3.33 W    8. 4.8 kW  
9. 0.67 A    10. 4 resistors    12. 110 bulbs  
13. 9.2 A, 4.6 A, 18.3 A    14. (i) 8 W; (ii) 8 W    15. 0.73 A  
16. 250 W TV set in 1 hour    17. 120 W  
18. (b) High resistivity of alloys  
(d) inversely.

## Concept Mastery

## Exercise-2

- $P = VI$
  - $P = I^2R$
  - $P = \frac{V^2}{R}$
- Resistance of each part,  $R_1 = \frac{32}{4} \Omega = 8\Omega$

When connected in parallel, the equivalent resistance is

$$\frac{1}{R} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$$

or  $R = 2\Omega$

- This is because when the bulb is switched on, then the temperature of filament rises, and we know that resistance is directly proportional to the temperature. That's why resistance of filament increases.
- Let the three resistors are  $R_1$ ,  $R_2$  and  $R_3$ . Here  $R_1$  and  $R_2$  are parallel to each other and  $R_3$  is in series with them then equivalent resistance can be obtained by the given formula:

$$\therefore \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{2} = \frac{1+3}{6} = \frac{4}{6} = \frac{2}{3}$$

$$\Rightarrow R = \frac{3}{2} \Omega$$

Now,  $R$  and  $R_3$  are in series.

$$\therefore \text{Combined resistance } R_4 = R + R_3$$

$$= \frac{3}{2} + 6 = 1.5 + 6 = 7.5 \text{ Ohm}$$

- Given energy = 2 Kwh, power = 100 W  
We also know that:

$$\text{Time, } t = \frac{\text{Energy}}{\text{Power}} = \frac{2\text{kWh}}{100\text{W}}$$

$$= \frac{2000\text{Wh}}{100\text{W}} = 20\text{h}$$

So time taken by the bulb to consume 2kwh energy = 20 hours.

- When the fairy lights are connected in series the resistance offered will be greater and brightness of the bulbs will be affected. But in parallel connection all the bulbs will glow with same intensity and if any bulb gets fused the other bulbs will continue to glow.
- When given length of wire is doubled on itself, its new length  $L' = \frac{L}{2}$  and new cross-section area  $A' = 2A$ . Hence, its new resistance.

$$R' = \frac{\rho L'}{A'} = \frac{\rho \left(\frac{L}{2}\right)}{(2A)} = \frac{1}{4} \frac{\rho L}{A} = \frac{R}{4}$$

Thus, resistance is reduced to one-fourth of its original value.

- Power is the rate of doing work. The electric power of an appliance is its rate of consumption of electric energy.

The power of an electric appliance is 1Ω (watt) if it consumes 1J (joule) of energy in 1 second.

If  $I$  ampere of the current flows for  $t$  second through a coil whose ends are maintained at a potential difference of  $V$  volt, then the energy consumed or the work done.

$$\Omega = VIt \text{ joule}$$

$$\text{Power} = \frac{W}{t} = \frac{VIt \text{ joule}}{t \text{ second}}$$

$$\text{or } P = V \times I \text{ joule/second} = VI \text{ watt}$$

$$P(\text{watt}) = V(\text{volt}) \times I(\text{ampere}) \text{ or watt} = \text{volt} \times \text{ampere}$$

$$\text{Again we know that } V = IR$$

$$P = VI = (IR)I = I^2R \text{ or } P = I^2R$$

$$\text{Also, } I = V/R, \text{ therefore}$$

$$P = I^2R = \left(\frac{V}{R}\right)^2 R \text{ or } P = \frac{V^2}{R}$$

Bigger unit of power usually kW (kilowatt)

$$1\text{k}\Omega = 1,000 \Omega$$

$$P(\text{in kW}) = \frac{\text{Watt}}{1000} = \frac{V(\text{volt}) \times I(\text{ampere})}{1000}$$

9. All of them are made of copper, the resistivity remains same. Let the resistivity be  $\rho$

$$\text{i. } R_a = \rho \frac{L}{A}$$

$$\begin{aligned} \text{ii. } R_b &= \rho \left( \frac{2L}{A/2} \right) \\ &= \rho \left( \frac{4L}{A} \right) \\ &= 4R_a \end{aligned}$$

$$\text{iii. } R_c = \rho \left( \frac{L}{2(2A)} \right) = \frac{1}{4} \rho \left( \frac{L}{A} \right) = \frac{1}{4} R_a$$

∴ Conductor(b) has the highest resistance. It has the largest length and the smallest area of cross-section compared to other two. The following conclusion is also proved mathematically.

10. Here,  $V = 220$  volt,  $P = 1 \text{ kW} = 1000 \text{ W}$ ,  $t = 2 \text{ minute} = 2 \times 60 = 120 \text{ s}$

i. Resistance of the heating element,

$$R = \frac{V^2}{P} = \frac{(220)^2}{1000} = 48.4 \Omega$$

$$\text{ii. Current through the element, } I = \frac{P}{V} = \frac{1000}{220} = 4.54 \text{ A}$$

iii. Heat produced in 2 minutes =  $P t$

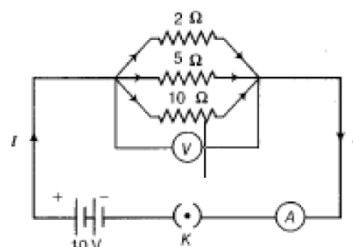
$$= 1000 \times 120 = 1.2 \times 10^5 \text{ J}$$

iv. If line voltage falls to 200 V, the power consumed is,

$$\begin{aligned} P &= \frac{V^2}{R} = \frac{(200)^2}{48.4} \\ &= 826.44 \text{ W} \end{aligned}$$

11. i. Effective resistance is,

$$\begin{aligned} \frac{1}{R_{\text{eff}}} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \\ &= \frac{1}{2} + \frac{1}{5} + \frac{1}{10} = \frac{5+2+1}{10} = \frac{8}{10} \end{aligned}$$



$$\Rightarrow R_{\text{eff}} = \frac{10}{8} = 1.25 \Omega$$

ii. Total current,

$$I = \frac{V}{R_{\text{eff}}}$$

$$= \frac{10}{1.25}$$

$$= 8A$$

iii. Current through each resistor,

$$I_1 = \frac{V}{R_1} = \frac{10}{2} = 5A,$$

$$I_2 = \frac{V}{R_2} = \frac{10}{5} = 2A$$

and

$$I_3 = \frac{V}{R_3} = \frac{10}{10} = 1A.$$

12. According to the question,

i.  $R_{AC}$  and  $R_{ED}$  are in parallel,

$$\frac{1}{R'_P} = \frac{1}{R_{AC}} + \frac{1}{R_{ED}} = \frac{1}{30} + \frac{1}{30} = \frac{1}{15}$$

$$\Rightarrow R'_P = 15 \Omega$$

Now,  $R'_P$  and  $R_{BC}$  are in series,

$$R'_S = R'_P + R_{BC} = 15 + 15 = 30 \Omega$$

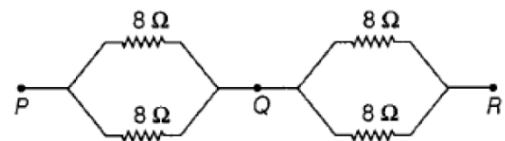
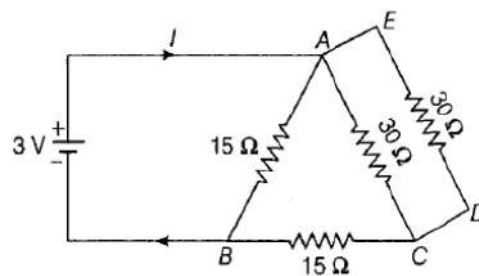
Again,  $R_{AB}$  and  $R'_S$  are in parallel,

$$\frac{1}{R''_P} = \frac{1}{R_{AB}} + \frac{1}{R'_S} = \frac{1}{15} + \frac{1}{30} = \frac{1}{10}$$

$$\therefore R''_P = 10 \Omega$$

$$\text{So, current is } I = \frac{V}{R''_P} = \frac{3}{10} = 0.3A$$

ii. Two  $8 \Omega$  resistors are connected in parallel. Two such parallel combination must be connected in series to get effective resistance of  $8 \Omega$ .



13. i. Combined resistance of 100, 50 and 500 in parallel

$$\text{i.e. } R_P \text{ is given by } \frac{1}{R_P} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500} = \frac{5+10+1}{500} = \frac{125}{500} = \frac{1}{4} = 31.25$$

Resistance of electric iron =  $31.25 \Omega$

$$\text{Current through electric iron} = \frac{V}{R} = \frac{220}{31.25} = 7.04A$$

ii. Energy consumed  $E_1 = P_1 t_1 = 250 \text{ W } 1\text{h} = 250 \frac{\text{J}}{\text{S}} \times 3600\text{s}$

$$E_1 = 900000\text{J}$$

$$E_2 = P_2 t_2 = 12000\text{W} \times 10 \text{ min}$$

$$E_2 = 1200 \frac{\text{J}}{\text{S}} \times 600\text{s}$$

$$E_2 = 720000\text{J}$$

∴ 250Ω TV set consumes more energy.

14. Given, power,  $P = 1500\text{W}$ , voltage,  $V = 230\text{ V}$

i. Electric down drawn,

$$I = \frac{P}{V} = \frac{1500}{250} = 6\text{A}$$

ii. Energy consumed,  $E = \text{power} \times \text{Time}$

$$= 1500 \times 50$$

$$= 75000\text{Wh} [\because 1\text{ kW} = 1000\text{ W}]$$

$$= 75\text{kWh} [\because 1\text{ unit} = 1\text{ kWh}]$$

iii. Cost of energy consumed =  $75 \times 6$

$$= \text{Rs } 450.$$

15.  $P_1 = \frac{1000\text{W}}{1000} = 1\text{kW}$

$$t_1 = 5\text{ h}$$

$$P_2 = \frac{400\text{W}}{1000} = 0.4\text{kW}$$

$$t_2 = 10\text{ h}$$

No. of days  $n = 30$

Energy consumed by heater:

$$E_1 = P_1 \times t_1 \times n = 1\text{ kW} \times 5\text{ h} \times 30 = 150\text{ kWh}$$

Energy consumed by refrigerator:

$$E_2 = P_2 \times t_2 \times n = 0.4\text{ kW} \times 10\text{ h} \times 30 = 120\text{ kWh}$$

$$\text{Total energy} = (150 + 120)\text{ kWh} = 270\text{ kWh}$$

We know that  $1\text{kWh} = 1\text{unit}$ , so

$$270\text{ kWh} = 270\text{ units}$$

Cost of 1 unit is Rs. 6.00

$$\text{Total cost} = 270 \times 6 = \text{Rs. } 1620$$

16. Property to oppose the flow of electric current is called resistance. Its SI unit is ohms. If 1V potential difference is there and 1A current is flowing then it is said that there is 1 ohm resistance.

i. ∴  $R = \frac{\rho l}{A}$  [where,  $l$  = length of wire,  
A area of cross – section of wire]

$$R' = \frac{\rho l \times 2}{A}$$

$$\therefore R' = 2R$$

i.e. resistance will be doubled, if length of the wire is doubled.

ii. ∴  $R = \frac{\rho l}{A} \Rightarrow R = \frac{\rho l}{\pi r^2}$  [∵  $A = \pi r^2$ ]

Thus, resistance will decrease by four times, if radius of wire is doubled.

17. i. There will be no effect on the glow of the other two bulbs and will remain the same when B1 gets fused because the three bulbs are connected in parallel and the glowing of the bulb depends on power and the potential difference and resistance remains same of other two bulbs.

ii. When there are parallel connections:

$$\text{Net resistance will be } \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Since resistance is the same so,  $R' = \frac{1}{R_3}$

Applying ohm's law  $V = IR$

$$R = 4.5\Omega$$

Since  $B_2$  gets fused, so now only two bulbs  $B_1$  and  $B_3$  are in parallel

Therefore net resistance in parallel  $\frac{1}{R'} = \frac{2}{R}$

$$R' = \frac{4.2}{2}\Omega$$

$$I = \frac{V}{R'} = 2 \times \frac{4.5}{4.5}$$

$$I = 2A$$

So, current will be distributed in both the bulbs as 1 A each.

iii. The power dissipated when all three bulbs glow together is

$$P = V \times I$$

$$P = 4.5 \times 3 = 13.5 W$$

18. A circuit in which two or more resistors are connected across common points so as to provide separate paths is called parallel circuit.

In this case, the same potential difference will be maintained between the two ends of every resistor and the current will divide itself in various branches.

Let the resistors  $R_1$ ,  $R_2$  and  $R_3$  be joined in parallel to the points A and B. Let the current  $I$  reaching A divide itself into three parts

$I_1$ ,  $I_2$  and  $I_3$  along  $R_1$ ,  $R_2$  and  $R_3$  respectively. Let  $V$  be the potential difference between the points A and B. The current flowing in the individual resistors are then given by :

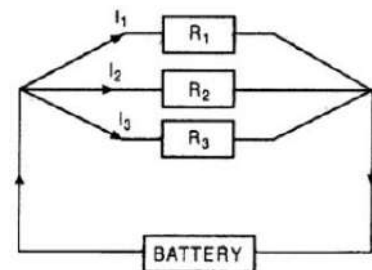
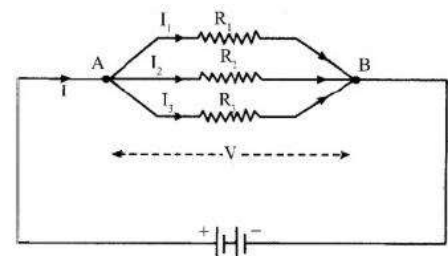
$$I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2} \text{ and } I_3 = \frac{V}{R_3}$$

Let  $R_p$  be the resistance of the combination, then  $I = \frac{V}{R_p}$  But

$$I = I_1 + I_2 + I_3$$

$$\text{or } \frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \text{ or } \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

The result holds true for any number of resistors.



19. a. Current through each resistor.  
through  $R_1$ ,  $R_1 = 10\Omega$ ,  $V = 6V$

$$V = IR$$

$$I = \frac{V}{R} = \frac{6}{10} = 0.6A$$

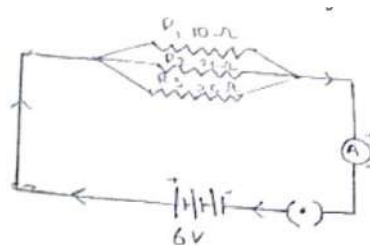
through  $R_2$ ,  $R_2 = 10\Omega$ ,  $V = 6V$

$$V = IR$$

$$I = \frac{V}{R} = \frac{3}{10} = 0.3A$$

through  $R_3$ ,  $R_3 = 30\Omega$ ,  $V = 6V$

$$I = \frac{V}{R} = \frac{6}{30} = 0.2A$$



b. Total current,  $I = I_1 + I_2 + I_3$   
 $= 0.6 + 0.3 + 0.2 = 1.1 \text{ A}$

c. Total Resistance is parallel

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_p} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30}$$

$$\frac{1}{R_p} = \frac{6+3+2}{60}$$

$$\frac{1}{R_p} = \frac{11}{60}$$

(Current Rexpicol)  $= R_p = \frac{60}{11} = 5.4 \Omega$

20. i. Series combination:

Here,  $R_1 = 15 \Omega$ ,  $R_2 = 15 \Omega$

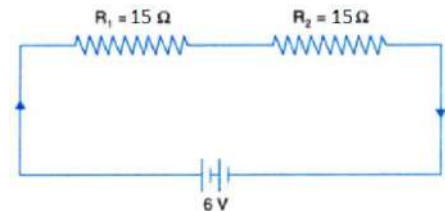
Total resistance of the series combination is given by,  $R_s$   
 $= R_1 + R_2 = 15 + 15 = 30 \Omega$

Applied voltage is given by  $V = 6 \text{ V}$

So, Power consume by resistor given by

$$P_1 = \frac{V^2}{R_s} = \frac{6^2}{30} = \frac{36}{30} = 1.2 \text{ W}$$

Thus, power consume in series is 1.2W



ii. Parallel combination:

Here,  $R_1 = 15 \Omega$ ,  $R_2 = 15 \Omega$

Total resistance  $R_p$  of the parallel combination is given by,

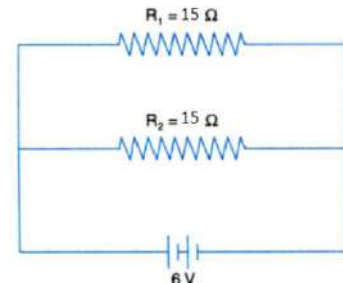
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{15} + \frac{1}{15} = \frac{2}{15}$$

$$\text{Power, } P_2 = \frac{V^2}{R_p} = \frac{6^2}{5} = \frac{36 \times 2}{15} = 4.8 \text{ W}$$

Power consume in parallel is 4.8W Now, the ratio of the powers consumed in the two combinations is given by,

$$\frac{P_1}{P_2} = \frac{1.2}{4.8} = \frac{12}{48} = \frac{1}{4}$$

$$\therefore P_1 : P_2 = 1 : 4$$



21. The range of ammeter= 3 A

Number of divisions in ammeter= 30

$$\text{Least count} = \frac{\text{Range}}{\text{Total Division}} = \frac{3}{30} = 0.1 \text{ A}$$

22. As the two equal conductors are connected in series the resultant resistance of the combination too doubles.

Heat Produced in the coil  $= i^2 R t$ ,

If the electric current and the time period are same the heat produced by the coil is directly proportional to the resistance hence it is directly proportional to the length.

So if the length of the conducting wire is doubled without changing its area of cross section the heat produced by it is also doubled.

23. State True or False:

(i) (a) True Explanation: True

(ii) (a) True Explanation: True

24. Fill in the blanks:

(i) 1. Tungsten

## Accuracy Booster

## Exercise-3

- |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (c)  | 2. (b)  | 3. (a)  | 4. (b)  | 5. (c)  | 6. (c)  | 7. (c)  |
| 8. (c)  | 9. (c)  | 10. (d) | 11. (c) | 12. (b) | 13. (d) | 14. (b) |
| 15. (a) | 16. (c) | 17. (a) | 18. (c) | 19. (c) | 20. (a) | 21. (c) |
| 22. (b) | 23. (b) | 24. (d) | 25. (a) | 26. (d) | 27. (c) | 28. (d) |
| 29. (c) | 30. (c) | 31. (d) | 32. (a) | 33. (b) | 34. (b) | 35. (a) |
| 36. (a) | 37. (c) | 38. (c) | 39. (c) | 40. (c) |         |         |

41. (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

42. (d) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

43. i. (d) ii. (b) iii. (a) iv. (c) v. (a)

44. i. (a) ii. (d) iii. (d) iv. (c) v. (a)

45. i. Low resistance, high melting point

ii. High resistance, low melting point

iii. Given:  $H = I^2Rt$

$$\text{So, } H' = (2I)^2 \cdot \frac{R}{2} t = 2H$$

iv. Given:  $I = 5 \text{ A}$ , resistance =  $R$ . Let  $r$  be the new radius.

Now,  $H = I^2Rt$  ... (a)

Also  $H' = I'^2R' t$  ... (b)

$$\text{From (a) and (b), } 5^2 \times \rho \frac{L}{\pi r^2} t = 10^2 \times \rho \frac{L}{\pi r'^2} \cdot t$$

$$\frac{25}{r^2} = \frac{100}{r'^2} \Rightarrow \frac{r'}{r} = 2 \Rightarrow r' = 2r$$

46. i.  $q = 2 \text{ C}$ ,  $t = 100 \text{ ms} = 0.1 \text{ s}$

$$I = \frac{q}{t} = \frac{2}{0.1} = 20 \text{ A}$$

ii.  $W = 100 \text{ J}$ ,  $q = 20 \text{ C}$

$$V = \frac{W}{q} = \frac{100}{20} = 5 \text{ V}$$

iii.  $I = 1 \text{ A}$ ,  $t = 1 \text{ s}$

$$q = It = 1 \times 1 = 1 \text{ Cn} = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

$$\text{OR } V = \frac{W}{q} = \frac{W}{It}$$

47. If a net charge  $Q$ , flows across any cross-section of a conductor in time ' $t$ ', then the current ' $I$ ', through the cross-section is given by

$$I = Q/T$$

48. The SI unit of electric charge is the coulomb (C), which is equivalent to the charge contained in nearly  $6 \times 10^{18}$  electrons.

49. The electric current is expressed by a unit called ampere (A). One ampere is constituted by the flow of one coulomb of charge per second.

$$50. I = \frac{Q}{t} = \frac{12}{4} = 3 \text{ A}$$

## Quick Exam Revision

- An element consists of only one kind of atoms.
- Elements are classified into metals, non-metals and metalloids.
- Metals occur both in free and combined state in nature.
- Properties of Metals: Metals are:
  - (i) **hard** to touch.
  - (ii) **lustrous** i.e., freshly cut surfaces of metals have characteristic shining .
  - (iii) **malleable**; the property of metals by which they can be beaten into thin sheets is called malleability.
  - (iv) **ductile**; the property of metal by which they can .be drawn into wires are called ductility.
  - (v) **sonorous** i.e., produce ringing sound when struck on a hard surface.
  - (vi) good conductors of heat and electricity.
- Metals like **sodium** and **potassium** are **soft** and can be cut with a knife.
- Mercury is the only metal which is found in the liquid state at room temperature.
- Chemical Properties of Metals and Non-metals
  - (i) **Reaction with Oxygen** : Both metals and non-metals when burnt in oxygen, form their oxides. Oxides of metals are basic in nature while that of non-metals are generally acidic in nature e.g.,
 

(a)	$2\text{Mg}$	+	$\text{O}_2$	$\longrightarrow$	$2\text{MgO}$	
	Magnesium		Oxygen		Magnesium oxide	(basic)

(b)	$\text{S}$	+	$\text{O}_2$	$\longrightarrow$	$\text{SO}_2$	
	Sulphur		Oxygen		Sulphur dioxide	(acidic)
  - (ii) **Reaction with Water** : Some metals react with water to produce metal hydroxide and hydrogen gas. Generally, non-metals do not react with water.
 

$2\text{Na}$	+	$2\text{H}_2\text{O}$	$\longrightarrow$	$2\text{NaOH}$	+	$\text{H}_2$
Sodium		Water		Sodium Hydroxide		Hydrogen
  - (iii) **Reaction with Acids** : Metals react with dil. acids and produce metal salt and hydrogen gas. Generally non-metals do not react with dil. acids.
  - (iv) **Reaction with Bases** : Metals react with bases to produce hydrogen gas.
  - (v) **Displacement Reaction** : More reactive metals displace less reactive metals from their metal compounds in aqueous solutions.
- **Uses of Metals and Non-metals**
  - (i) Metals are used in making machinery, automobiles, aeroplanes, trains, satellites, industrial gadgets, cooking utensils, water boilers etc.
  - (ii) Non-metals are also used in day-to-day life e.g.,
    - oxygen is essential for life.
    - nitrogen, phosphorus and potassium are used as fertilizers.
    - chlorine is used as water purifier.

CLASS 10 - PHYSICS

Chapter-1 Electricity

**Solutions**

**Concept Mastery**

**Exercise-2**

1. a.  $P = VI$

b.  $P = I^2R$

c.  $P = \frac{V^2}{R}$

2. Resistance of each part,  $R_1 = \frac{32}{4} \Omega = 8\Omega$

When connected in parallel, the equivalent resistance is

$$\frac{1}{R} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$$

or  $R = 2\Omega$

3. This is because when the bulb is switched on, then the temperature of filament rises, and we know that resistance is directly proportional to the temperature. That's why resistance of filament increases.

4. Let the three resistors are  $R_1$ ,  $R_2$  and  $R_3$ . Here  $R_1$  and  $R_2$  are parallel to each other and  $R_3$  is in series with them then equivalent resistance can be obtained by the given formula:

$$\therefore \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{2} = \frac{1+3}{6} = \frac{4}{6} = \frac{2}{3}$$

$$\Rightarrow R = \frac{3}{2} \Omega$$

Now,  $R$  and  $R_3$  are in series.

$$\therefore \text{Combined resistance } R_4 = R + R_3$$

$$= \frac{3}{2} + 6 = 1.5 + 6 = 7.5 \text{ Ohm}$$

5. Given energy = 2 Kwh, power = 100 W

We also know that:

$$\text{Time, } t = \frac{\text{Energy}}{\text{Power}} = \frac{2\text{kWh}}{100\text{W}}$$

$$= \frac{2000\text{Wh}}{100\text{W}} = 20\text{h}$$

So time taken by the bulb to consume 2kwh energy = 20 hours.

6. When the fairy lights are connected in series the resistance offered will be greater and brightness of the bulbs will be affected. But in parallel connection all the bulbs will glow with same intensity and if any bulb gets fused the other bulbs will continue to glow.

7. When given length of wire is doubled on itself, its new length  $L' = \frac{L}{2}$  and new cross-section area  $A' =$

2A. Hence, its new resistance.

$$R' = \frac{\rho L'}{A'} = \frac{\rho \left(\frac{L}{2}\right)}{(2A)} = \frac{1}{4} \frac{\rho L}{A} = \frac{R}{4}$$

Thus, resistance is reduced to one-fourth of its original value.

8. Power is the rate of doing work. The electric power of an appliance is its rate of consumption of electric energy.

The power of an electric appliance is 1Ω (watt) if it consumes 1J (joule) of energy in 1 second.

If I ampere of the current flows for t second through a coil whose ends are maintained at a potential difference of V volt, then the energy consumed or the work done.

$$\Omega = VIt \text{ joule}$$

$$\text{Power} = \frac{W}{t} = \frac{VIt \text{ joule}}{t \text{ second}}$$

$$\text{or } P = V \times I \text{ joule/second} = VI \text{ watt}$$

$$P(\text{watt}) = V(\text{volt}) \times I (\text{ampere}) \text{ or watt} = \text{volt} \times \text{ampere}$$

Again we know that  $V = IR$

$$P = VI = (IR)I = I^2R \text{ or } P = I^2R$$

Also,  $I = V/R$ , therefore

$$P = I^2R = \left(\frac{V}{R}\right)^2 R \text{ or } P = \frac{V^2}{R}$$

Bigger unit of power usually kΩ (kilowatt)

$$1\text{k}\Omega = 1,000 \Omega$$

$$P(\text{in kW}) = \frac{\text{Watt}}{1000} = \frac{V(\text{volt}) \times I(\text{ampere})}{1000}$$

9. All of them are made of copper, the resistivity remains same. Let the resistivity be  $\rho$

$$\text{i. } R_a = \rho \frac{L}{A}$$

$$\text{ii. } R_b = \rho \left( \frac{2L}{A/2} \right)$$

$$= \rho \left( \frac{4L}{A} \right)$$

$$= 4R_a$$

$$\text{iii. } R_c = \rho \left( \frac{L}{2(2A)} \right) = \frac{1}{4} \rho \left( \frac{L}{A} \right) = \frac{1}{4} R_a$$

∴ Conductor(b) has the highest resistance. It has the largest length and the smallest area of cross-section compared to other two. The following conclusion is also proved mathematically.

10. Here,  $V = 220$  volt,  $P = 1 \text{ kW} = 1000 \text{ W}$ ,  $t = 2 \text{ minute} = 2 \times 60 = 120 \text{ s}$

i. Resistance of the heating element,

$$R = \frac{V^2}{P} = \frac{(220)^2}{1000} = 48.4\Omega$$

ii. Current through the element,  $I = \frac{P}{V} = \frac{1000}{220} = 4.54 \text{ A}$

iii. Heat produced in 2 minutes =  $P t$

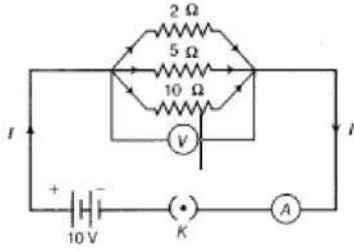
$$= 1000 \times 120 = 1.2 \times 10^5 \text{ J}$$

iv. If line voltage falls to 200 V, the power consumed is,

$$P = \frac{V^2}{R} = \frac{(200)^2}{48.4}$$

$$= 826.44 \text{ W}$$

11.



i. Effective resistance is,

$$\frac{1}{R_{\text{eff}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \frac{1}{2} + \frac{1}{5} + \frac{1}{10} = \frac{5+2+1}{10} = \frac{8}{10}$$

$$\Rightarrow R_{\text{eff}} = \frac{10}{8} = 1.25\Omega$$

ii. Total current,

$$I = \frac{V}{R_{\text{eff}}}$$

$$= \frac{10}{1.25}$$

$$= 8\text{A}$$

iii. Current through each resistor,

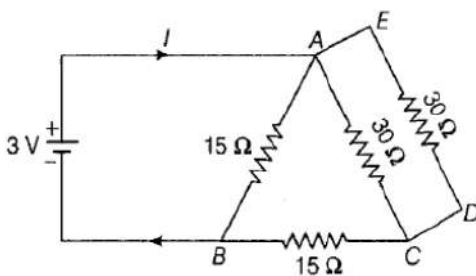
$$I_1 = \frac{V}{R_1} = \frac{10}{2} = 5\text{A},$$

$$I_2 = \frac{V}{R_2} = \frac{10}{5} = 2\text{A}$$

and

$$I_3 = \frac{V}{R_3} = \frac{10}{10} = 1\text{A}.$$

12. According to the question,



i.  $R_{AC}$  and  $R_{ED}$  are in parallel,

$$\frac{1}{R'_P} = \frac{1}{R_{AC}} + \frac{1}{R_{ED}} = \frac{1}{30} + \frac{1}{30} = \frac{1}{15}$$

$$\Rightarrow R'_P = 15\Omega$$

Now,  $R'_P$  and  $R_{BC}$  are in series,

$$R'_S = R'_P + R_{BC} = 15 + 15 = 30\Omega$$

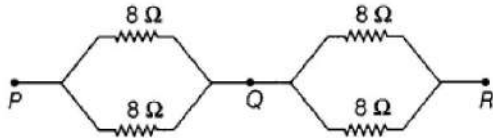
Again,  $R_{AB}$  and  $R'_S$  are in parallel,

$$\frac{1}{R_p''} = \frac{1}{R_{AB}} + \frac{1}{R_S} = \frac{1}{15} + \frac{1}{30} = \frac{1}{10}$$

$$\therefore R_p'' = 10\Omega$$

$$\text{So, current is } I = \frac{V}{R_p''} = \frac{3}{10} = 0.3\text{A}$$

ii. Two  $8\Omega$  resistors are connected in parallel. Two such parallel combination must be connected in series to get effective resistance of  $8\Omega$ .



13. i. Combined resistance of 100, 50 and 500 in parallel

$$\text{i.e. } R_p \text{ is given by } \frac{1}{R_p} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500} = \frac{5+10+1}{500} = \frac{125}{500} = \frac{1}{4}$$

Resistance of electric iron =  $31.25\Omega$

$$\text{Current through electric iron} = \frac{V}{R} = \frac{220}{31.25} = 7.04\text{A}$$

ii. Energy consumed  $E_1 = P_1 t_1 = 250 \text{ W } 1\text{h} = 250 \frac{\text{J}}{\text{S}} \times 3600\text{s}$

$$E_1 = 900000\text{J}$$

$$E_2 = P_2 t_2 = 12000\text{W} \times 10 \text{ min}$$

$$E_2 = 1200 \frac{\text{J}}{\text{S}} \times 600\text{s}$$

$$E_2 = 720000\text{J}$$

$\therefore$  250 $\Omega$  TV set consumes more energy.

14. Given, power,  $P = 1500\text{W}$ , voltage,  $V = 230 \text{ V}$

i. Electric down drawn,

$$I = \frac{P}{V} = \frac{1500}{250} = 6\text{A}$$

ii. Energy consumed,  $E = \text{power} \times \text{Time}$

$$= 1500 \times 50$$

$$= 75000\text{Wh} [\because 1 \text{ kW} = 1000 \text{ W}]$$

$$= 75\text{kWh} [\because 1 \text{ unit} = 1 \text{ kWh}]$$

iii. Cost of energy consumed =  $75 \times 6$

$$= \text{Rs } 450.$$

$$15. P_1 = \frac{1000\text{W}}{1000} = 1\text{kW}$$

$$t_1 = 5 \text{ h}$$

$$P_2 = \frac{400\text{W}}{1000} = 0.4\text{kW}$$

$$t_2 = 10 \text{ h}$$

No. of days  $n = 30$

Energy consumed by heater:

$$E_1 = P_1 \times t_1 \times n = 1 \text{ kW} \times 5 \text{ h} \times 30 = 150 \text{ kWh}$$

Energy consumed by refrigerator:

$$E_2 = P_2 \times t_2 \times n = 0.4 \text{ kW} \times 10 \text{ h} \times 30 = 120 \text{ kWh}$$

Total energy = (150 + 120) kWh = 270 kWh

We know that 1kWh = 1unit, so

270 kWh = 270 units

Cost of 1 unit is Rs. 6.00

Total cost = 270 × 6 = Rs. 1620

16. Property to oppose the flow of electric current is called resistance. Its SI unit is ohms. If 1V potential difference is there and 1A current is flowing then it is said that there is 1 ohm resistance.

$$i. \therefore R = \frac{\rho l}{A} \left[ \begin{array}{l} \text{where, } l = \text{length of wire,} \\ \text{A area of cross – section of wire} \end{array} \right]$$

$$R' = \frac{\rho l \times 2}{A}$$

$$\therefore R' = 2R$$

i.e. resistance will be doubled, if length of the wire is doubled.

$$ii. \therefore R = \frac{\rho l}{A} \Rightarrow R = \frac{\rho l}{\pi r^2} \left[ \because A = \pi r^2 \right]$$

Thus, resistance will decrease by four times, if radius of wire is doubled.

17. i. There will be no effect on the glow of the other two bulbs and will remain the same when B1 gets fused because the three bulbs are connected in parallel and the glowing of the bulb depends on power and the potential difference and resistance remains same of other two bulbs.

ii. When there are parallel connections:

$$\text{Net resistance will be } \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\text{Since resistance is the same so, } R' = \frac{1}{R_3}$$

Applying ohm's law  $V = IR$

$$R = 4.5\Omega$$

Since B<sub>2</sub> gets fused, so now only two bulbs B<sub>1</sub> and B<sub>3</sub> are in parallel

$$\text{Therefore net resistance in parallel } \frac{1}{R'} = \frac{2}{R}$$

$$R' = \frac{4.2}{2} \Omega$$

$$I = \frac{V}{R'} = 2 \times \frac{4.5}{4.5}$$

$$I = 2A$$

So, current will be distributed in both the bulbs as 1 A each.

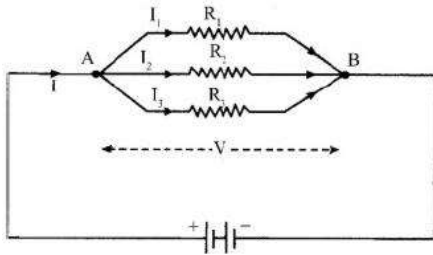
- iii. The power dissipated when all three bulbs glow together is

$$P = V \times I$$

$$P = 4.5 \times 3 = 13.5 \text{ W}$$

18. A circuit in which two or more resistors are connected across common points so as to provide separate paths is called parallel circuit.

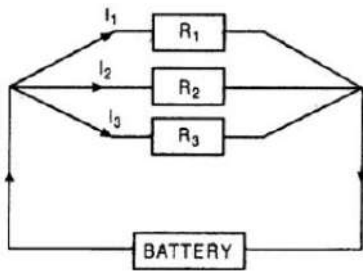
In this case, the same potential difference will be maintained between the two ends of every resistor and the current will divide itself in various branches.



Let the resistors  $R_1$ ,  $R_2$  and  $R_3$  be joined in parallel to the points A and B. Let the current  $I$  reaching A divide itself into three parts

$I_1$ ,  $I_2$  and  $I_3$  along  $R_1$ ,  $R_2$  and  $R_3$  respectively. Let  $V$  be the potential difference between the points A and B. The current flowing in the individual resistors are then given by :

$$I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2} \text{ and } I_3 = \frac{V}{R_3}$$

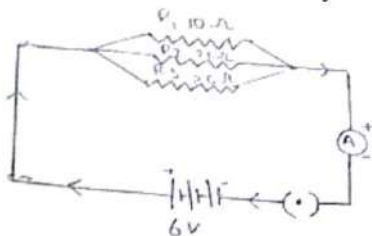


Let  $R_p$  be the resistance of the combination, then  $I = \frac{V}{R_p}$  But  $I = I_1 + I_2 + I_3$

$$\text{or } \frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \text{ or } \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

The result holds true for any number of resistors.

19.



a. Current through each resistor.

through  $R_1$ ,  $R_1 = 10\Omega$ ,  $V = 6V$

$$V = IR$$

$$I = \frac{V}{R} = \frac{6}{10} = 0.6A$$

through  $R_2$ ,  $R_2 = 10\Omega$ ,  $V = 6V$

$$V = IR$$

$$I = \frac{V}{R} = \frac{3}{10} = 0.3A$$

through  $R_3$ ,  $R_3 = 30\Omega$ ,  $V = 6V$

$$I = \frac{V}{R} = \frac{6}{30} = 0.2A$$

b. Total current,  $I = I_1 + I_2 + I_3$

$$= 0.6 + 0.3 + 0.2 = 1.1A$$

c. Total Resistance is parallel

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

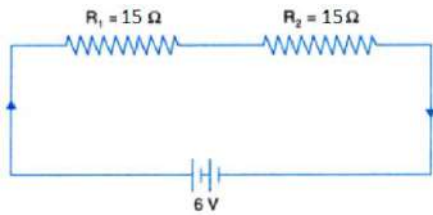
$$\frac{1}{R_p} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30}$$

$$\frac{1}{R_p} = \frac{6+3+2}{60}$$

$$\frac{1}{R_p} = \frac{11}{60}$$

(Current Rexpicol) =  $R_p = \frac{60}{11} = 5.4\Omega$

20. i. Series combination:



Here,  $R_1 = 15\Omega$ ,  $R_2 = 15\Omega$

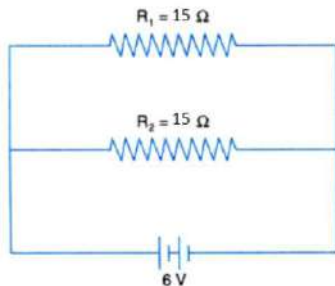
Total resistance of the series combination is given by,  $R_s = R_1 + R_2 = 15 + 15 = 30\Omega$

Applied voltage is given by  $V = 6V$

So, Power consume by resistor given by  $P_1 = \frac{V^2}{R_s} = \frac{6^2}{30} = \frac{36}{30} = 1.2W$

Thus, power consume in series is 1.2W

ii. Parallel combination:



Here,  $R_1 = 15\Omega$ ,  $R_2 = 15\Omega$

Total resistance  $R_p$  of the parallel combination is given by,

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{15} + \frac{1}{15} = \frac{2}{15}$$

Power,  $P_2 = \frac{V^2}{R_p} = \frac{6^2}{5} = \frac{36 \times 2}{15} = 4.8W$

Power consume in parallel is 4.8W Now, the ratio of the powers consumed in the two combinations is given by,

$$\frac{P_1}{P_2} = \frac{1.2}{4.8} = \frac{12}{48} = \frac{1}{4}$$

$\therefore P_1 : P_2 = 1 : 4$

21. The range of ammeter = 3 A  
Number of divisions in ammeter = 30  
Least count =  $\frac{\text{Range}}{\text{Total Division}} = \frac{3}{30} = 0.1\text{A}$
22. As the two equal conductors are connected in series the resultant resistance of the combination too doubles.  
Heat Produced in the coil =  $i^2Rt$ ,  
If the electric current and the time period are same the heat produced by the coil is directly proportional to the resistance hence it is directly proportional to the length.  
So if the length of the conducting wire is doubled without changing its area of cross section the heat produced by it is also doubled.
23. State True or False:  
(i) (a) True Explanation: True  
(ii) (a) True Explanation: True
24. Fill in the blanks:  
(i) 1. Tungsten

## Accuracy Booster

## Exercise-3

1. (c) Watt  
Explanation: Watt is the unit that is used for expressing the electric power.
2. (b) two times  
Explanation: If  $V$  is constant, then  $H$  is inversely proportional to  $R$  because  $H = V^2 t/R$ .  $H$  will therefore double if  $R$  does.
3. (a)  $\frac{4V}{R}$   
Explanation: We know that,  
$$P = \frac{V^2}{R}$$
  
 $R$  is constant  
 $V$  is doubled  
Therefore,  $P = \frac{2(V^2)}{R}$   
Therefore, when the resistance is doubled, power becomes four times the actual value.
4. (b) 2 A  
Explanation: 2 A
5. (c)  $x \times z \times y^2$   
Explanation:  $x \times z \times y^2$
6. (c) Nature of material  
Explanation: Resistivity is 'an intrinsic property of a material' that quantifies how strongly a given material opposes the flow of electric current. The resistivity of a metallic wire depends on the nature of the material. It does not depend on the physical dimensions (length, thickness, shape, etc.) of the metallic wire.
7. (c) 10 Joule  
Explanation: Work done =  $V \times C = 10 \times 1 = 10$  joule

8. (c) 250 kWh

Explanation: Electricity consumption is measured in Kilowatt-hour which is commonly called a unit. So, 250 unit is equal to 250 kWh. Also, 1 kWh = 3600000 J or 3.6 Mega Joules (MJ).

9. (c) 0.6 Ohms

Explanation: Given,

Current,  $I = 5A$

Potential difference,  $V = 3V$

We know that,

$$V = IR$$

Therefore,

$$3 = 5 \times R$$

$$R = \frac{3}{5} = 0.6 \text{ Ohms}$$

10. (d)  $10^{-3} A$  and  $10^{-6} A$  respectively

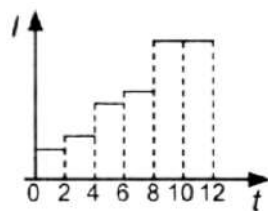
Explanation:  $\mu A = 10^{-6} a$

$mA = 10^{-3} a$

11. (c) Current and potential difference

Explanation: Current and potential difference

12. (b)



Explanation: After regular closing of switches, total resistance decreases, thus increasing the current.

13. (d) The reading will be doubled.

Explanation: Let, resistance of bulb P and Q be R. So, reading of ammeter before connecting Q to the circuit is

$$I = \frac{V}{R} \dots(i)$$

After connecting Q to the circuit, resultant resistance of the circuit is

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \text{ or } R_{eq} = \frac{R}{2} \Omega$$

Thus, new reading of ammeter will be

$$I' = \frac{V}{R/2} = \frac{2V}{R}$$

or  $I' = 2I$  (From (i))

14. (b) Independent of x

Explanation: We know that,  $R = \rho \frac{l}{A}$

Here, resistivity =  $\rho$ ,  $l = x$ ,  $A = xy$

$$\therefore R = \rho \frac{l}{A} = \rho \frac{x}{xy}$$

$$\text{or } R = \frac{\rho}{y}$$

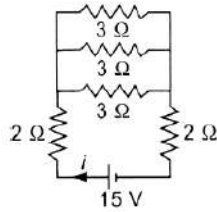
Thus, resistance between two opposite faces, shown by the shaded areas in the figure is independent of  $x$ .

15. (a) Nichrom

Explanation: Nichrom

16. (c) 3 A

Explanation: The given circuit can be redrawn as follows



$$\frac{1}{R'} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$$

or  $R' = 1\Omega$

$\therefore R_{\text{Total}} = 2 + 1 + 2 = 5\Omega$

Hence,  $i = \frac{V}{R} = \frac{15}{5} = 3\text{ A}$

17. (a) Only (iii)

Explanation: Given:  $V = 220\text{ V}$ ,  $P = 60\text{ W}$

$$P = \frac{V^2}{R} \dots(i)$$

As bulbs are connected in series, then

$$P' = \frac{V^2}{R_{\text{eq}}} = \frac{V^2}{R + R} = \frac{V^2}{2R}$$

or  $P' = \frac{1}{2}P$  (From (i))

or  $P' = \frac{60}{2} = 30\text{ W}$

As bulbs are connected in parallel, then

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R} + \frac{1}{R} \text{ or } R_{\text{eq}} = \frac{R}{2}$$

So power  $P_{\text{eq}} = \frac{V^2}{R_{\text{eq}}} = \frac{V^2}{R} \times 2$

or  $P_{\text{eq}} = 2P = 2 \times 60 = 120\text{ W}$

18. (c)  $31.25 \times 10^{18}\text{ C}$

Explanation: Given,

Current,  $I = 5\text{ A}$

Time taken,  $t = 1\text{ s}$

We know that,

$$I = \frac{Q}{t}$$

$Q = I \times t = 5 \times 1 = 5\text{ C}$

Number of electrons present in  $1.6 \times 10^{19}\text{ C} = 1$

Number of electrons present in  $5\text{ C} = \frac{(5)}{(1.6 \times 10^{19})} = 31.25 \times 10^{18}\text{ C}$

19. (c) 2.99 kW

Explanation: Given,

$$I = 13 \text{ amp}$$

$$V = 230 \text{ V}$$

$$P = VI$$

$$P = 2.99 \text{ kW}$$

20. (a) 583 °C

Explanation: 583 °C

21. (c) Becomes 4 times

Explanation: Becomes 4 times

22. (b) 293

Explanation: A total of 293 bulbs can be used when they are all connected in parallel and have 75 W and 220 V.

23. (b) Joule

Explanation: The SI unit of energy is joule.

24. (d) 6W

Explanation: We know that power is calculated as  $P = VI$ . Substituting the values of  $V$  and  $I$  we get  $P = 6W$ .

25. (a) 59.4 kWh

Explanation: Case 1:

$$\text{Power, } P_1 = 60W$$

$$\text{Number, } n_1 = 2$$

$$\text{Time for use, } T_1 = 4 \text{ hours everyday}$$

$$\text{Energy consumed, } E_1 = n_1 \times P_1 \times T_1$$

$$E_1 = 2 \times 60 \times 4 = 480 \text{ watt-hour} = 0.48\text{kWh}$$

$$\text{Therefore, energy consumed for 30 days} = 30 \times 0.48 = 14.4 \text{ watt-hour}$$

Case 2:

$$\text{Power, } P_2 = 100W$$

$$\text{Number, } n_2 = 3$$

$$\text{Time for use } T_2 = 5 \text{ hours everyday}$$

$$\text{Energy consumed, } E_2 = n_2 \times P_2 \times T_2$$

$$E_2 = 3 \times 100 \times 5 = 1500 = 1.5\text{kWh}$$

$$\text{Therefore, energy consumed for 30 days} = 30 \times 1.5 = 45\text{kWh}$$

$$\text{Therefore, overall energy consumed} = 14.4 + 45 = 59.4\text{kWh}$$

26. (d) 80 Ω

Explanation: We know that,

$$R = \frac{\rho l}{A}$$

Given that,

$$l' = 2l$$

$$A' = \frac{A}{2}$$

And  $\rho' = \rho$  (as the material of the wire is the same)

Therefore,

$$R' = \frac{\rho' l'}{A'}$$

$$= \frac{\rho 2l}{\left(\frac{A}{2}\right)}$$

$$= \frac{4\rho l}{A}$$

$$= 4R$$

Therefore,  $R' = 4 \times 20 = 80 \Omega$

27. (c)  $S_1, S_3, S_5$  are closed

Explanation: Current is maximum when resistance in the circuit is minimum, i.e., when  $S_1, S_3, S_5$  are closed because then all resistances will be short-circuited  $I_{\max} = \frac{V}{R}$

28. (d) 0.1 A

Explanation: Last count =  $\frac{\text{Range}}{\text{Total divisions}} = \frac{2}{20} = \frac{1}{10} = 0.1 \text{ A}$

29. (c) 20  $\Omega$

Explanation: The resultant resistance obtained from the resistors that are placed in series combination is connected with 40  $\Omega$  in parallel such that the overall resistance obtained is equal to 20  $\Omega$ .


30. (c) 0 V in circuit A and 3 V in circuit B

Explanation: Only circuit B, with a dot within the symbol of the plug key, is a closed circuit in which current is flowing and will show non-zero voltage. The voltmeter reading, for the set-ups shown, would be (nearly) equal to the voltage of the battery.

31. (d) More

Explanation: More

32. (a) Variable resistance or rheostat

Explanation: The symbol  represents a variable resistance or a rheostat. It is used to change the resistance in an electric circuit.

33. (b) Milliammeter A1 and voltmeter V1

Explanation: Milliammeter A1 and voltmeter V1 gives maximum measuring range with lowest least count. So, the combination of these two is best for two resistances connected in series.

34. (b) Both A and R are true but R is not the correct explanation of A.

Explanation: Both A and R are true but R is not the correct explanation of A.

35. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Voltage measured in the parallel circuits are always equal. As all the parallel circuits start from one point and end at another point and always the potential difference between the two points will always be the same. So, this is the reason why voltmeter is always connected in parallel across the circuit. Thus, both assertion and reason are true and reason is the correct explanation of assertion.

36. (a) Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

37. (c) A is true but R is false.

Explanation: A is true but R is false.

$$\rho = \rho_0(1 + \alpha \Delta T)$$

38. (c) Statement A is false, Statement B is true.

Explanation: Electrical resistivity (also known as resistivity) is an intrinsic property of a material that quantifies how strongly a given material opposes the flow of electric current. The low resistivity of a material indicates that the material readily allows the flow of electric current.

Both the resistance and resistivity of a material vary with temperature. The resistivity of a conductor increases with an increase in temperature. The resistivity of semiconductors decreases with an increase in temperature.

39. (c) A and C

**Explanation:** Resistance (R) of a conductor at a given temperature:

- R is directly proportional to the length (l).
- R is inversely proportional to the area of cross-section (a).
- R depends on the nature of the material ( $\rho$ ).

$$R = \rho \times \frac{l}{a}$$

40. (c) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

Explanation: (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

41. (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

42. (d) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

Explanation: (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

43. i. (d) all of these

ii. (b)  $H = I^2RT$

iii. (a)  $3380^\circ\text{C}$

iv. (c) both (a) and (b)

v. (a) series

44. i. (a)  $V = \frac{W}{Q}$

ii. (d) double

iii. (d) 1 V

iv. (c) voltage

v. (a) Alessandra volta

45. i. Low resistance, high melting point

ii. High resistance, low melting point

iii. Given:  $H = I^2Rt$

$$\text{So, } H' = (2I)^2 \cdot \frac{R}{2} t = 2H$$

iv. Given:  $I = 5 \text{ A}$ , resistance = R. Let r be the new radius.

Now,  $H = i^2Rt \dots(a)$

Also  $H' = I'^2R' t \dots(b)$

$$\text{From (a) and (b), } 5^2 \times \rho \frac{L}{\pi r^2} t = 10^2 \times \rho \frac{L}{\pi r'^2} \cdot t$$

$$\frac{25}{r^2} = \frac{100}{r'^2} \Rightarrow \frac{r'}{r} = 2 \Rightarrow r' = 2r$$

46. i.  $q = 2 \text{ C}$ ,  $t = 100 \text{ ms} = 0.1 \text{ s}$

$$I = \frac{q}{t} = \frac{2}{0.1} = 20 \text{ A}$$

ii.  $W = 100 \text{ J}$ ,  $q = 20 \text{ C}$

$$V = \frac{W}{q} = \frac{100}{20} = 5 \text{ V}$$

iii.  $I = 1 \text{ A}$ ,  $t = 1 \text{ s}$

$$q = It = 1 \times 1 = 1 \text{ Cn} = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

OR

$$V = \frac{W}{q} = \frac{W}{It}$$

47. If a net charge  $Q$ , flows across any cross-section of a conductor in time ' $t$ ', then the current ' $I$ ', through the cross-section is given by  
 $I = Q/T$
48. The SI unit of electric charge is the coulomb (C), which is equivalent to the charge contained in nearly  $6 \times 10^{18}$  electrons.
49. The electric current is expressed by a unit called ampere (A). One ampere is constituted by the flow of one coulomb of charge per second.
50.  $I = \frac{Q}{t} = \frac{12}{4} = 3A$

# PRE-FOUNDATION

CLASS IX

SAMPLE

# MENTAL ABILITY



# MENTAL SPORTS

## CONTENTS

S.No.	Page
<b>General Mental Ability &amp; Verbal Reasoning</b>	
1.	Alphabet Test
2.	Coding Decoding
3.	Series
4.	Classification
5.	Analogies
6.	Blood Relation
7.	Direction Test
8.	Calendar
<b>Logical Ability &amp; Analytical Reasoning</b>	
9.	Venn diagram
10.	Syllogism
11.	Character Puzzles
12.	Statement & Assumption
<b>Numerical Ability &amp; Quantitative Reasoning</b>	
13.	Number System
14.	HCF and LCM
15.	Simplification
16.	Algebra Basics
17.	Indices & Surds
18.	Distance, Time & Speed
19.	Time & Work
20.	Mensuration
<b>Non Verbal Reasoning</b>	
21.	Mirror & Water Images
22.	Paper Cutting & Paper Folding
23.	Embedded Images
24.	Figure Counting

## 1. VENN DIAGRAM

**Venn diagram** is a pictorial way of representation of the relationships between sets.

It uses **circles** as basic element to represent sets and illustrates the **overlap of circles** to represent the relationships between them. The overlapping areas between the circles show the common elements or characteristics shared by the sets.

### Key components of a Venn diagram:

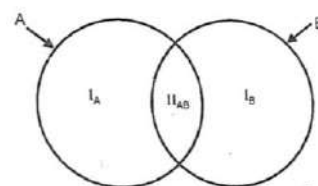
**Sets:** Each circle represents a set. The elements of the set are contained within the circle.

**Overlapping Regions:** The overlapping regions between circles represent the elements that are common to both sets. The size of the overlap indicates the extent of the common elements.

**Non-overlapping Regions:** The non-overlapping regions of the circles represent elements that are unique to each set and do not belong to the other set(s).

For example, Venn diagram has two circles overlapping each other and making three regions  $I_A$ ,  $II_{AB}$  and  $I_B$ .

This Venn diagram is interpreted as – There are two sets A & B of elements with region  $I_A$  represents elements of set A only,  $I_B$  represents elements of set B only &  $II_{AB}$  represents elements of both sets A and B.

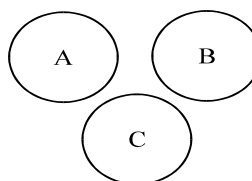


### Different Cases of Venn Diagram :

1. If the terms evidently belong to three different groups, then the representation is in the form of three disjoint circles.

Example : **Doctors, Engineers, Lawyers**

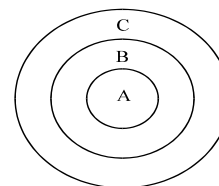
These three terms bear no relationship to each other. So, they are represented by 3 disjoint circles as shown in adjoining figure.



2. If one term belongs to the class of second and second belongs to the class of third, then the representation is in the form of three concentric circles.

Example : **Seconds, Minutes, Hours**

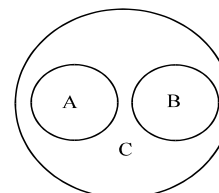
Clearly, seconds are a part of minutes and minutes are a part of hours. So, the Venn diagram would be as shown in the adjoining figure with circle A representing Seconds, Circle B representing Minutes and Circle C representing Hours.



3. If two separate terms belong to the class of third, they are represented by two disjoint circles inside a bigger circle.

Example : **Table, Chair, Furniture**

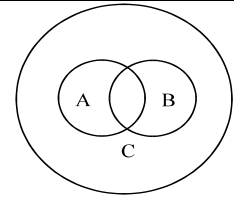
Clearly, table and chair are separate terms but both are terms of furniture. So, they would be represented as in the adjoining figure with circle A representing Table, circle B representing Chair and circle C representing Furniture.



4. If two terms belong to the class of third such that some terms of each of these two groups are common in relationship, then they are represented by two intersecting circles enclosed within a bigger circle.

Example : **Males, Fathers, Brothers**

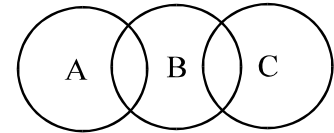
Clearly, some fathers may be brothers. So, fathers and brothers would be represented by two intersecting circles. Also, both fathers and brothers are males. So, the diagrammatic representation would be, with circle A representing Fathers, circle B representing Brothers and circle C representing Males.



5. If two terms are partly related to the third, and are themselves independent of each other they are represented by three intersecting circles in a line.

Example : **Dogs, Pets, Cats**

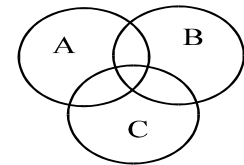
Clearly, some dogs and some cats are pets. But all the pets are not dogs or cats. Also, dogs and cats are not related to each other. So, the given terms would be represented as shown below with circle A representing Dogs, circle B representing Pets and circle C representing cats.



6. If the three terms are partly related to each other, they are represented by three intersecting circles.

Example : **Clerks, Government Employees, Educated Persons**

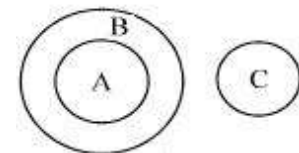
Clearly, some clerks may be government employees and some may be educated. Similarly, some government employees may be clerks and some may be educated. Also, some educated persons may be clerks and some may be government employees. So, the given terms may be represented as shown with three different circles denoting the three classes.



7. If one term belongs to the class of second while third term is entirely different from the two, then they may be represented by two concentric circles with a separate circle.

Example : **Engineers, Human Beings, Rats**

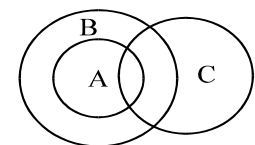
Clearly, all engineers are human beings. This would be represented by two concentric circles. But the class of rats is entirely different from these two. Thus, these terms would be represented as shown with circle A representing Engineers, circle B representing Human Beings and circle C representing Rats.



8. If one terms belongs to the class of second and the third terms is partly related to these two, they are represented by two concentric circles with the third circle intersecting these two circles.

Example : **Females, Mothers , Doctors**

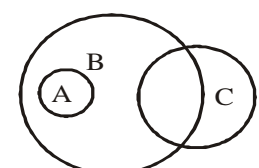
Clearly, all mothers are females. This would be represented by two concentric circles. But some females and some mothers can be doctors. So, the circle representing doctors would intersect the two concentric circles. Thus, the Venn diagram is as shown with circle A representing Mothers, circle B representing Females and circle C representing Doctors.



9. If one term belongs to the class of second and the third term is partly related to second, they are represented by two concentric circles with the third circle intersecting the bigger circle.

Example : **Males, Fathers, Children**

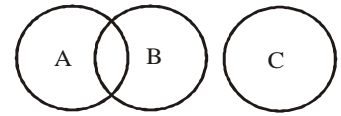
Clearly, all fathers are males. This would be represented by two concentric circles. But some males are children. But children cannot be fathers. Thus, the Venn diagram becomes as shown with circle A representing Fathers, circle B representing Males and circle C representing Children.



10. If two terms are partly related to each other and the third term is entirely different from the two, they are represented by two intersecting circles with a separate circle.

Example : **Professor, Author, Children**

Clearly, some professors can be authors and vice versa. This would be represented by two intersecting circles. But the class of children would be entirely different from these two. Thus, the diagram would be as shown below with circle A representing Professors, circle B representing Authors and circle C representing Children.

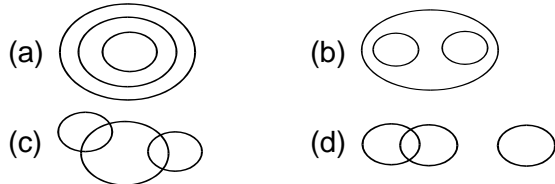


Venn diagrams are commonly used in mathematics, logic, statistics, and other fields to visually represent the relationships between different sets. They can be used to compare and contrast the characteristics of different groups, identify commonalities, and analyze data.

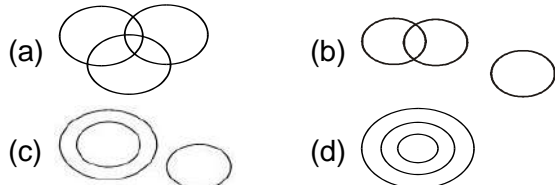
### PRACTICE EXERCISE

**Directions (1 - 15) :** Which of the Venn diagrams given in the alternatives best represents the relation between the given items?

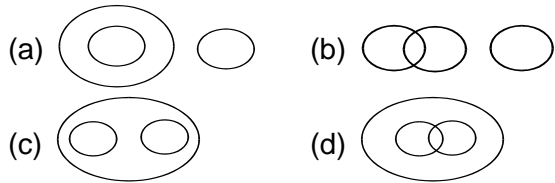
1. Carrot, Food, Vegetable



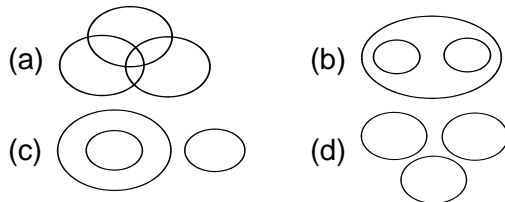
2. Judge, Thief, Criminal



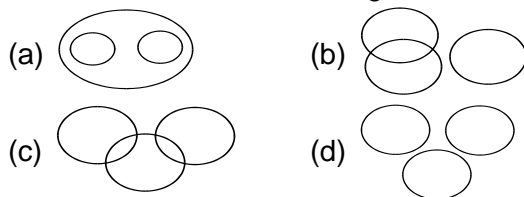
3. Languages, French, German



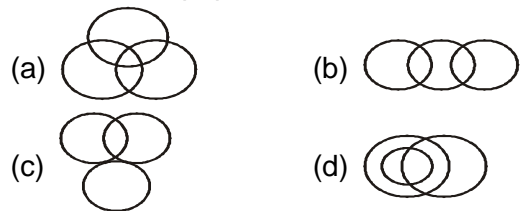
4. Triangle, Four-sided figure, Square



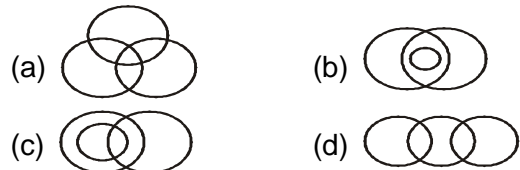
5. Doctor, Nurse, Human Being



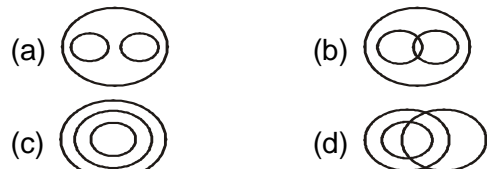
6. Books, Newspaper, Words



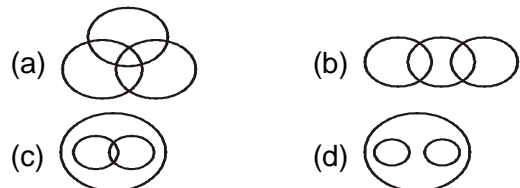
7. Boys, Students, Players



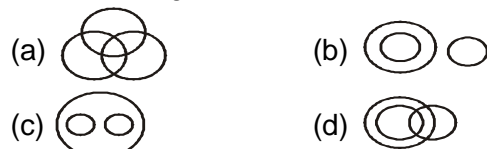
8. Animals, Cows, Grass-eating animals



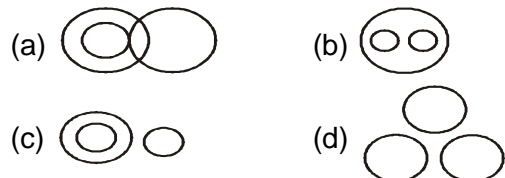
9. Mammals, Tigers, Cows



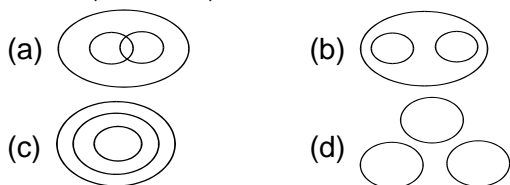
10. Mothers, Engineers, Females



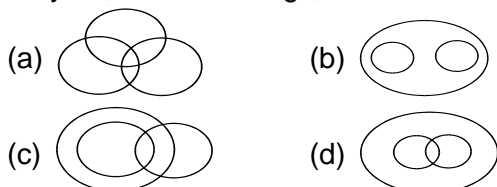
11. Crows, Birds, Snakes



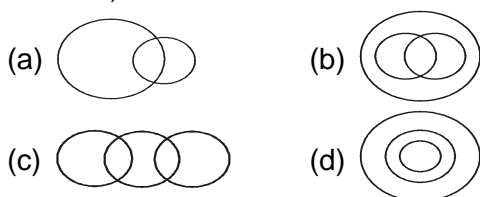
12. House, Kitchen, Bedroom



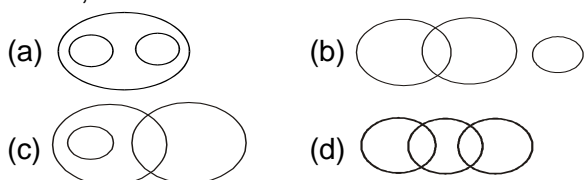
13. Players, Human Beings, Students



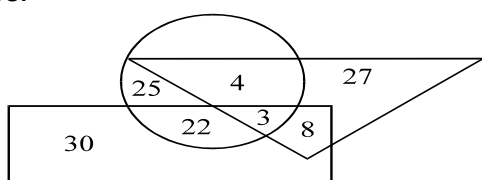
14. Women, Mothers and Parents



15. Cows, Horses and Animals



**Directions (16 - 20) :** Study the following figure carefully and answer the questions given below it. The rectangle represents artists, the circle represents players and the triangle represents doctors.



16. How many players are neither artists nor doctors?

- (a) 3 (b) 8  
(c) 22 (d) 25

17. How many artists are players?

- (a) 30 (b) 29  
(c) 25 (d) 22

18. How many doctors are both players and artists?

- (a) 3 (b) 4  
(c) 8 (d) 11

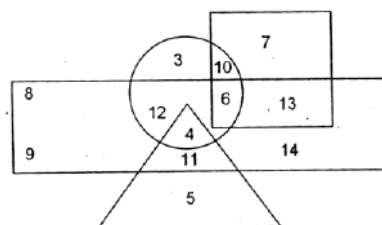
19. How many doctors are neither players nor artists?

- (a) 30 (b) 27  
(c) 22 (d) 5

20. How many artists are neither players nor doctors?

- (a) 22 (b) 24  
(c) 29 (d) 30

**Direction (21 - 25) :** The following questions based on the diagram given below. The rectangle represents males, the triangle represents educated, the circle represents urban and the square represents civil servants.



21. Who among the following is an educated male who is not an urban resident?

- (a) 4 (b) 5  
(c) 9 (d) 11

22. Who among the following is neither a civil servant nor educated but is urban and not a male?

- (a) 2 (b) 3  
(c) 6 (d) 10

23. Who among the following is a female, urban resident and also a civil servant?

- (a) 6 (b) 7  
(c) 10 (d) 13

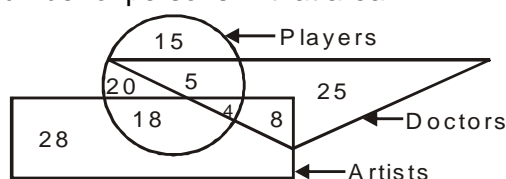
24. Who among the following is an educated male who hails from urban area?

- (a) 4 (b) 2  
(c) 11 (d) 5

25. Who among the following is uneducated and also an urban male?

- (a) 2 (b) 3  
(c) 11 (d) 12

**Directions : (26 - 30) :** The following questions are based on the figure given below. In this figure the rectangle represents artists, the circle represents players and the triangle represents doctors. The numbers in different sections refer to the number of persons in that area.



26. How many players are neither artists nor doctors?  
(a) 35 (b) 28  
(c) 24 (d) 18
27. How many doctors are players but not artists?  
(a) 4 (b) 5  
(c) 20 (d) 25
28. What percentage of doctors has at least one more interest - either arts or sports in life?  
(a) 55% (b) 50%  
(c) 45% (d) 40%
29. How many players are artists but not doctors?  
(a) 28 (b) 25  
(c) 18 (d) 5
30. In terms of number, arrange artists, players and doctors in decreasing order (Those with maximum number first, with minimum number last)  
(a) Players, Artists, Doctors  
(b) Players, Doctors, Artists  
(c) Artists, Doctors, Players  
(d) Artists, Players, Doctors

**ANSWER KEY**

- |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1.  | (a) | 2.  | (c) | 3.  | (c) | 4.  | (c) | 5.  | (a) | 6.  | (b) | 7.  | (a) |
| 8.  | (c) | 9.  | (d) | 10. | (d) | 11. | (c) | 12. | (b) | 13. | (d) | 14. | (a) |
| 15. | (a) | 16. | (d) | 17. | (c) | 18. | (a) | 19. | (b) | 20. | (d) | 21. | (d) |
| 22. | (b) | 23. | (c) | 24. | (a) | 25. | (d) | 26. | (a) | 27. | (b) | 28. | (d) |
| 29. | (c) | 30. | (a) |     |     |     |     |     |     |     |     |     |     |

# PRE-FOUNDATION

CLASS X

SAMPLE

# MENTAL ABILITY



# MENTAL SPORTS

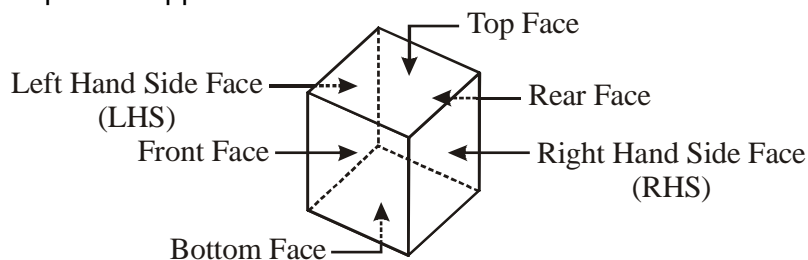
## CONTENTS

S.No.	Page
<b>General Mental Ability &amp; Verbal Reasoning</b>	
1.	Ranking
2.	Dice
3.	Cube and Cuboids
4.	Dictionary
5.	Clock
6.	Symbols & Notions
<b>Logical Ability &amp; Analytical Reasoning</b>	
7.	Sitting Arrangement
8.	Data Sufficiency
9.	Logical Deductions
10.	Statement & Argument
11.	Cause and Effect
<b>Numerical Ability &amp; Quantitative Reasoning</b>	
12.	Average
13.	Percentage
14.	Ratio & Propositions
15.	Simple & Compound Interest
16.	Profit Loss & Discount
17.	Arithmetic Reasoning
18.	Geometry
19.	Permutation & Combination
20.	Probability
21.	Data Interpretation
<b>Non Verbal Reasoning</b>	
22.	Classification
23.	Pattern Completion
24.	Analogy
25.	Picture Series

## 10. DICE

**Dice** are cubical or cuboidal shape objects containing numbers / figures / symbols embedded on their surfaces. Dice are used for gambling and non-gambling such as craps, ludo etc.

In a dice, every face touches the four other faces and remaining one face is called the opposite face. Thus, a dice has three pairs of opposite faces.

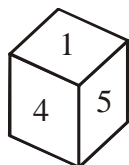


### Important points :

There are some important points that will help in solving problems based on dice.

1. In a **standard dice** the sum of numbers on the opposite face is 7.

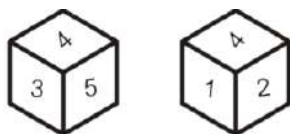
For example, consider the following standard dice :



In this, the number opposite to 4 will be 3 ( $\because 4 + 3 = 7$ ). Similarly, the number opposite to 5 will be 2 and the number opposite to 1 will be 6.

2. If two positions of a dice are shown and one element is common and present at the same position then the remaining surfaces of both dice are opposite to each other.

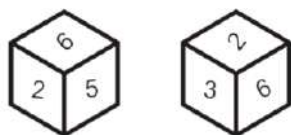
For example, consider the following dice :



In this, the number 4 is common in both dice and at same position. So, the numbers 3 and 5 on first dice and 1 and 2 on the second dice are opposite to each other respectively i.e. the number 3 is opposite to number 1 and number 5 is opposite to number 2.

3. If two positions of a dice are shown and two numbers are common irrespective of their position on the dice then the remaining third number on both the dice are opposite to each other.

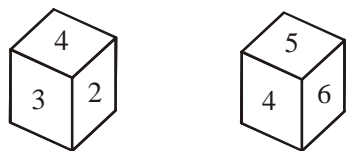
For example, consider the following dice :



In this, the two numbers 6 and 2 are common in both the dice but positions are different. So, the third number 5 on the first dice and number 3 on the second dice are opposite to each other.

4. If two positions of a dice are shown and one element is common on both the dice then to get the numbers on opposite surface, write the numbers in clockwise direction starting from common element in both dice and corresponding numbers are the numbers on opposite face.

For example, consider the following dice :



In this, the number 4 is common in both dice. Now, starting from 4 write the numbers which appear in clockwise direction in both dice.

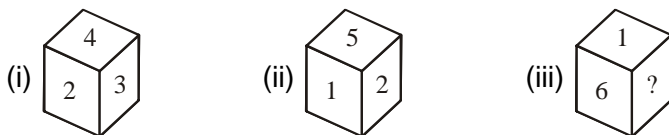
In first dice,  $4 \rightarrow 2 \rightarrow 3$

In second dice,  $4 \rightarrow 5 \rightarrow 6$

So, the number opposite to 2 will be 5 and the number opposite to 3 will be 6 and the remaining number which is not shown in both dice i.e. 1 will be opposite to 4.

5. When three positions of a dice are shown and one face is left blank in the third position, then to find the number of that place, first find all the opposite faces of the dice using first 2 figures. Then using the missing number dice and one of the remaining two dice which have one element common with the missing number dice, write the numbers in clockwise direction starting from common number. The opposite number of the number which corresponds to missing place will come in place of missing number.

For example, consider the following figures of the dice



In this, it is required to find the number which will come in place of '?'.

First, find all the opposite faces of the dice in figures (i) & (ii) using point 4.

In first dice,  $2 \rightarrow 4 \rightarrow 3$

In second dice,  $2 \rightarrow 1 \rightarrow 5$

So opposite face numbers are  $4 \leftrightarrow 1$ ;  $3 \leftrightarrow 5$ ;  $2 \leftrightarrow 6$

Now, the number 1 is common in figures (ii) & (iii). So, writing the numbers in clockwise direction starting from 1 in figures (ii) & (iii).

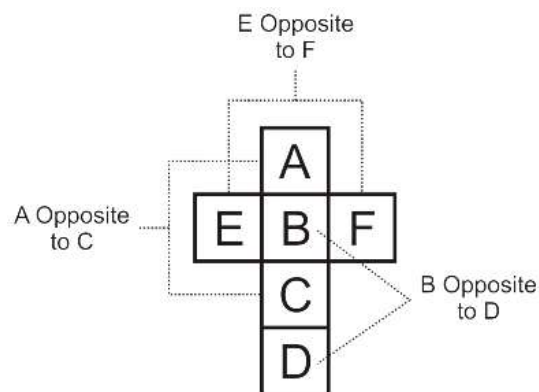
In second dice,  $1 \rightarrow 5 \rightarrow 2$

In third dice,  $1 \rightarrow ? \rightarrow 6$

So, 5 corresponds to '?'. Hence, '?' will be replaced by opposite number of 5 i.e. 3.

6. An **open dice** is one in which all the 6 faces of the dice are shown.

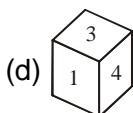
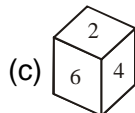
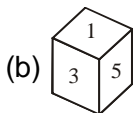
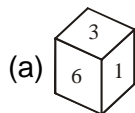
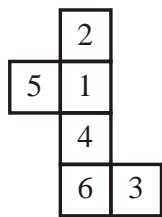
Consider the following open dice :



In this, the faces E & F, A & C, B & D are opposite to each other and their surfaces never touch each other.

7. To construct a dice from open dice, remember that two opposite faces cannot be adjacent to each other. So, two opposite faces cannot be seen simultaneously.

For example, consider the following open dice and four dice given as alternative.



From the given open dice, the number 2 will be opposite to 4, the number 1 will opposite to 6, the number 5 will opposite to 3.

So,  $2 \longleftrightarrow 4$

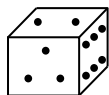
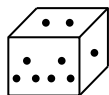
$1 \longleftrightarrow 6$

$5 \longleftrightarrow 3$

Since, two opposite faces cannot be adjacent. So, the correct folded form of the open dice is present only in alternative (d).

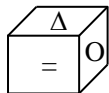
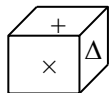
### PRACTICE EXERCISE

- In a standard dice, which number will come opposite to 5 ?  
(a) 1 (b) 4  
(c) 6 (d) 2
  - From the following figures of dice, find the number which will be at the bottom if 5 is at top.  
  
  
(a) 1 (b) 2  
(c) 3 (d) 6
  - Based on two figures of dice, find the number that will be on the opposite face of number 5.  
  
  
(a) 1 (b) 3  
(c) 4 (d) 5
- Direction (4 - 6) :** Following questions are based on the two positions of a dice shown below.
- 
- 
- 
- Which number will come opposite to number 2 ?  
(a) 5 (b) 1  
(c) 6 (d) 3
  - Which number will come opposite to number 6 ?  
(a) 1 (b) 5  
(c) 4 (d) 3
  - Which number will come opposite to number 4 ?  
(a) 3 (b) 5  
(c) 1 (d) 2
7. All the surfaces of the dice contain different numbers in the form of dots. Consider both the figures of dice and find how many dots are contained on the face opposite to the face that contains four dots.
- 
- 
- 
- 
- (a) 2 (b) 3  
(c) 5 (d) 6
8. When number 1 is at the top, which number will be at the bottom ?



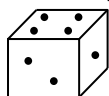
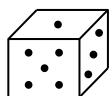
- (a) 1 (b) 2  
(c) 3 (d) 6

9. Which symbol will appear on the opposite surface to the symbol 'X' ?



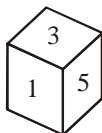
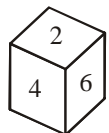
- (a) ÷ (b) =  
(c) Δ (d) O

10. Two positions of a dice are shown below. When there are two dots at the bottom, the number of dots at the top will be



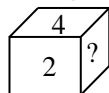
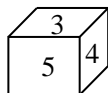
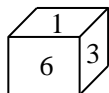
- (a) 2 (b) 3  
(c) 5 (d) 6

11. From the following figures of dice, what should be the number opposite 5?



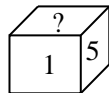
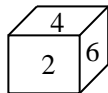
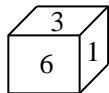
- (a) 2 (b) 4  
(c) 6 (d) 1

12. Three positions of the same dice are given below. Observe the figures carefully and find which number will come in place of '?'.



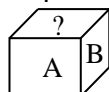
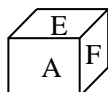
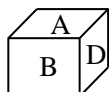
- (a) 1 (b) 6  
(c) 3 (d) 5

13. Based on the following figures find which number will come in place of '?'.



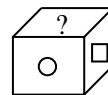
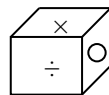
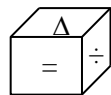
- (a) 2 (b) 3  
(c) 6 (d) 4

14. Which letter will come in place of '?'.



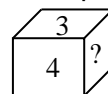
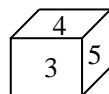
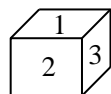
- (a) C (b) A  
(c) D (d) E

15. Which symbol will appear in place of '?'.



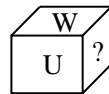
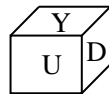
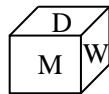
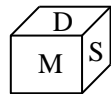
- (a) x (b) =  
(c) ÷ (d) Δ

16. Which number will come in place of '?'



- (a) 1 (b) 6  
(c) 5 (d) 2

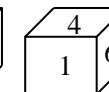
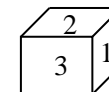
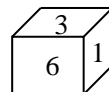
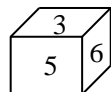
17. A cube on whose faces letters have been written, is shown below in different positions as can be seen from different directions. Find the letter in place of '?'.



- (a) S (b) D  
(c) Y (d) W

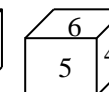
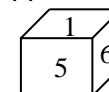
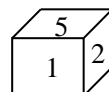
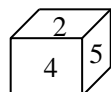
- Directions (18 - 25) :** In each of the following questions four positions of the same dice have been shown. You have to see these figures and select the number opposite to the number as asked in each question.

18. Which number is on the opposite surface of number 3 ?



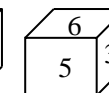
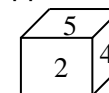
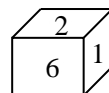
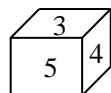
- (a) 4 (b) 6  
(c) 5 (d) 1

19. Which number is opposite to number 1 ?



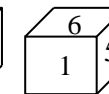
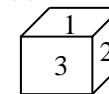
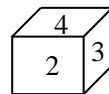
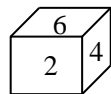
- (a) 4 (b) 6  
(c) 2 (d) 3

20. Which number is opposite to number 5 ?



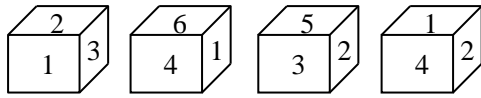
- (a) 6 (b) 5  
(c) 1 (d) 3

21. Which number is opposite to number 2 ?



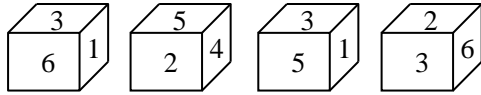
- (a) 4 (b) 6  
(c) 5 (d) 3

22. Which number is opposite to number 5 ?



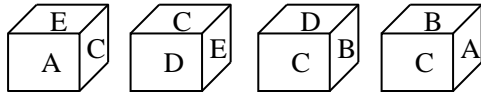
- (a) 4 (b) 6  
(c) 1 (d) 3

23. Which number is on the opposite surface of number 3 ?



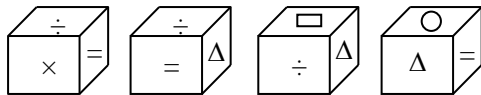
- (a) 2 (b) 3  
(c) 4 (d) 6

24. Which letter will be opposite to letter D ?



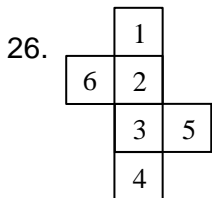
- (a) A (b) B  
(c) E (d) F

25. Which symbol will come opposite to symbol ÷

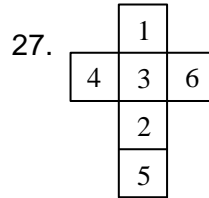


- (a) 0 (b) =  
(c) × (d) Δ

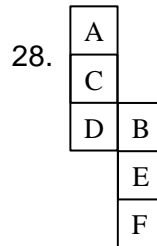
**Directions (26 - 30) :** In each of the following questions, the unfolded form of a cubical dice is shown followed by four different figures of dice. Select the figure which represents the correct folded form of the dice.



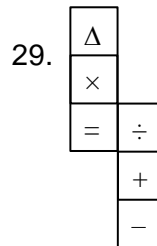
- (a) (b)   
(c) (d)



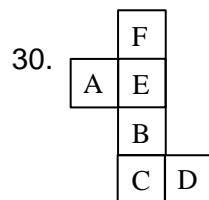
- (a) (b)   
(c) (d)



- (a) (b)   
(c) (d)



- (a) (b)   
(c) (d)



- (a) (b)   
(c) (d)

**ANSWER KEY**

- |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1.  | (d) | 2.  | (b) | 3.  | (c) | 4.  | (d) | 5.  | (a) | 6.  | (b) | 7.  | (d) |
| 8.  | (d) | 9.  | (d) | 10. | (b) | 11. | (a) | 12. | (a) | 13. | (b) | 14. | (c) |
| 15. | (a) | 16. | (a) | 17. | (c) | 18. | (a) | 19. | (a) | 20. | (c) | 21. | (c) |
| 22. | (d) | 23. | (c) | 24. | (a) | 25. | (a) | 26. | (c) | 27. | (d) | 28. | (b) |
| 29. | (c) | 30. | (b) |     |     |     |     |     |     |     |     |     |     |

6th to 10th Pre-Foundation		
Class	Subjects	No of Booklets
6th	Physics / Chemistry / Biology / Mathematics	5
	English Grammar	1
	History / Geography / Civics	1
	Mental Ability	1
7th	Physics / Chemistry / Biology / Mathematics	5
	English Grammar	1
	History / Geography / Civics	3
	Mental Ability	1
8th	Physics / Chemistry / Biology / Mathematics	5
	English Grammar	1
	History / Geography / Civics	3
	Mental Ability	1
9th	Physics / Chemistry / Biology / Mathematics	5
	English Grammar / English Text	2
	History / Geography / Political Science / Economics	4
	Mental Ability	1
10th	Physics / Chemistry / Biology / Mathematics	5
	English Grammar / English Text	2
	History / Geography / Political Science / Economics	4
	Mental Ability	1

JEE & NEET Foundation		
Class		No of Booklets
11th JEE	Physics / Chemistry / Mathematics	12
11th NEET	Physics / Chemistry / Biology	13
12th JEE	Physics / Chemistry / Mathematics	12
12th NEET	Physics / Chemistry / Biology	13

Other Exam Study Material		
Class		No of Booklets
NDA	Mathematics	2
	General Aptitude Test	7
CUET Science	English	1
	General Test	2
	Physics	1
	Chemistry	1
CUET Commerce	Biology / Mathematics	1
	English	1
	General Test	2
	Accountancy	1
	Business Studies	1
CUET Humanities	Economics	1
	English	1
	General Test	2
	History	1
	Geography	1
	Political Science	1

Crash Course with Test Series		
Class		No of Booklets
JEE Main	Physics / Chemistry / Mathematics	6
	8 PT + 2SM + 10FT	20
NEET	Physics / Chemistry / Biology	6
	8 PT + 2SM + 10FT	20
MH CET	Physics / Chemistry / Mathematics	6
	8 PT + 2SM + 10FT	20
JEE Advanced	Physics / Chemistry / Mathematics	6
	8 PT + 2SM + 10FT	20




## Facilities:

- ▶ Customized Authentic Study Material for School & Competitive Exams
- ▶ As per New Syllabus & Pattern
- ▶ Study Material Prepared by Experienced Subject Experts
- ▶ Also Available in Hindi & English Language
- ▶ Available for Class 1 to 12 For more details and sample kindly contact
- ▶ CET Study Material also Available

 **Ved Educational Services**  
Private Limited, Kota



Payment Gateway

-  Address 911, Subhash Nagar II, Near Bombay Yojna, Rangbari Mukti Dham, KOTA - 324005
-  Contact No. 7891105056
-  Website [www.vededucational.in](http://www.vededucational.in)