

**2000+**

**NEW PATTERN**

- Assertion Reason
- Case Based
- Subjective
- Match the Columns

# FOUNDATION EDGE SERIES

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**Concept-Based Learning**



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# 1

# Exploring Magnets

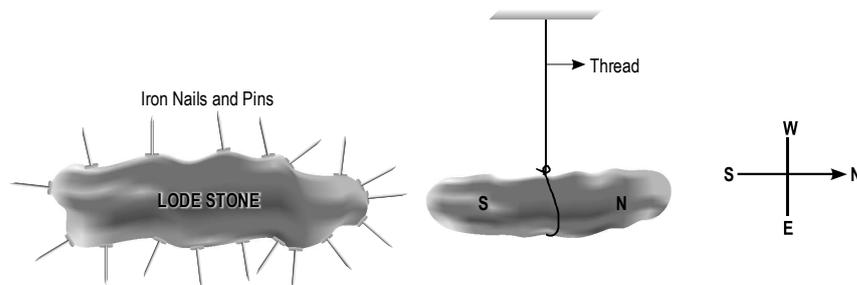
## 1. INTRODUCTION

Magnetism has been a source of curiosity for ages. Magnets are commonly found in science laboratories, toys and in the magnetic stickers that we stick to refrigerators and steel almirahs. The earth itself acts as a magnet.

## 2. MAGNET

A mineral was discovered in the town of magnesia which was found to have a wondrous property. It could attract pieces of iron towards it. This mineral is called magnetite. Further it was found that thin strips of magnetite always align themselves in a particular direction when suspended freely in air. It was found that magnetite is mainly composed of oxides of iron ( $\text{Fe}_3\text{O}_4$ ). Magnetite ( $\text{Fe}_3\text{O}_4$ ) is the magnet.

A substance which attracts small pieces of iron, nickel, cobalt and steel and points in North-South direction when freely suspended (or hanged freely) is known as a magnet.



### Let's know

#### Can you think why?

Why does the door of a refrigerator, left slightly open, shut automatically.

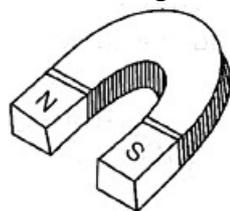
## 3. TYPES OF MAGNET

**3.1 Natural magnet :** A magnet which occurs naturally and is not made by any artificial means is called a natural magnet. Natural magnets are irregular in shape, moreover they are weak magnets. The natural magnet made from magnetite, which is an ore of iron [ $\text{Fe}_3\text{O}_4$ ].

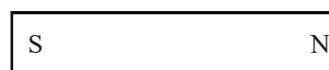
**3.2 Artificial magnet :** A substance to which properties of the natural magnet are imparted by artificial means is called artificial magnet. The artificial magnets made from iron, steel, cobalt and nickel.

**Example :** An iron bar can be made a magnet by rubbing it with a natural magnet. Such a magnet is known as Man made or artificial magnet.

Artificial magnets are of different shapes. A bar magnet (i.e. rectangular in shape) and U-shaped magnet are common example of artificial magnets.



U-shaped magnet



Bar magnet

U shaped magnet : Both poles are in same direction hence creates a strong magnetic field in the surroundings.



### Let's know

#### Can you think why ?

Why do magnets align themselves in the north–south direction.

## 4. IMPORTANT PROPERTIES OF MAGNETS

- **Property of attraction :** Magnets attract small pieces of materials like iron, nickel, and cobalt. The property of a magnet to attract small pieces of iron seems to be concentrated in small regions at the ends of the magnet. These regions are called magnetic poles. The pole which points towards geographic north is called North pole of the magnet. The pole which points towards geographic south is called South pole of the magnet.
- **Property of direction :** A freely suspended magnet always aligns itself in the North-South direction.
- Like-poles of magnets repel each other and unlike-poles attract each other, just as like-charges repel and unlike-charges attract. Since a magnet can attract small pieces of iron and also the opposite pole of another magnet, property of attraction is not a sure test to find whether a given piece is a magnet or not. Repulsion is a sure test to confirm whether a given piece is a magnet or not. Surest test of magnet is repulsion because like poles of magnet repel but unlike poles and magnetic material shows attraction.
- **Property of induction :** A magnet can induce magnetism in substances like soft iron, cobalt, nickel etc.
- Breaking a magnet successively into smaller pieces would still produce tiny magnets each with a north pole and south pole. The above phenomena is observed till we reach molecular stage.
- Magnetic poles always exist in opposite pairs. Single magnetic poles never exist.

## 5. TEMPORARY AND PERMANENT MAGNETS

**5.1 Temporary Magnets :** The magnets which cannot retain their magnetism for a long time are called temporary magnets. The temporary magnets are made from the soft iron.

**Exmple :** Electromagnet.

**5.2 Permanent Magnets :** The magnets which retain their magnetism for a very long time are called permanent magnets. The permanent magnets are generally made from steel. More powerful permanent magnets are made from Alnico, an alloy of aluminium, nickel and cobalt or from ferrite. The ferrite made permanent magnets are quite strong.

## 6. TYPES OF SUBSTANCES

**6.1 Magnetic Substances :** Those substances that are attracted by magnets are called magnetic substances.

**Example :** Iron, cobalt, nickel, steel etc.

**6.2 Non-Magnetic Substances :** Those substances that are not attracted by magnets are called non-magnetic substances.

**Example :** Plastic, rubber, glass etc.

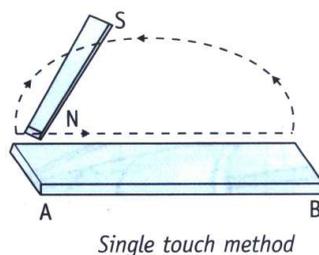
## 7. MAKING A MAGNET

The methods by which an ordinary piece of any magnetic material, like iron or steel, can be made a magnet are single touch method, double touch method and electrical method. Let us study each method separately.

**7.1 Single touch method :** A piece of any magnetic material, like iron or steel (a nail, knitting needle, bolt, etc.), is taken and placed on a bench or a table. A bar magnet is brought close to the magnetic material (say an iron piece AB). One end of the bar magnet is stroked against it, moving from end A to end B of the iron piece.

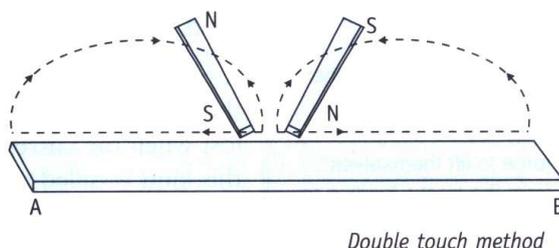
When the bar magnet reaches end B, it is lifted and the stroke repeated from end A to end B, it is lifted and the stroke repeated from end A to B. This procedure is repeated several times, keeping two things in mind.

- (i) The same pole of the bar magnet should be used every time
- (ii) Strokes should be in the same direction.



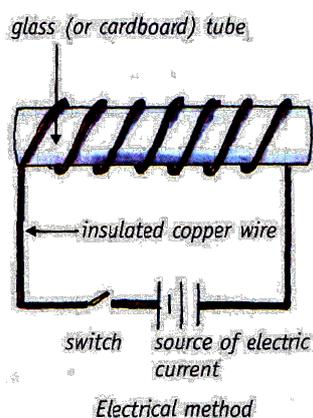
By Stroking the iron piece with the north pole of the bar magnet, end A becomes the north pole and end B the south pole.

**7.2 Double Touch Method :** The iron piece to be magnetized, say AB, is placed on a bench and two bar magnets of equal strengths are taken. Here, the opposite poles of both the magnets are stroked, at the same time, from the centre to the opposite ends of the iron piece being magnetized. This step is repeated many times.



Then, the end A of the iron piece becomes the north pole and end B becomes the south pole.

**7.3 Electrical Method :** Hans Christian Oersted, a Danish scientist, discovered in 1819 that a wire carrying electric current behaves like a magnet. This discovery provided the best method to make magnets by using an electric current.

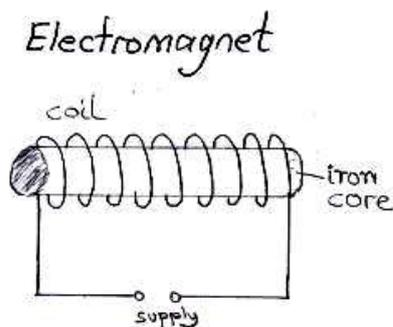


**Let's know**

When magnets are dropped frequently or they are hammered or brought into contact with other magnets repeatedly, they lose their magnetism. Heating a magnet to a certain temperature can also produce the same effect.

A long, insulated copper wire is taken. About 300 or more turns of the wire are wound around a glass or cardboard tube. The turns of the wire are kept as close together as possible. The ends of the wire are connected to a source of electric current and a switch. A knitting needle is put inside the tube and the current switched on for a short period of time. When the needle is removed from the tube, it behaves like a magnet.

## 8. ELECTROMAGNET



When the current carrying coil is brought near a suspended bar magnet one side of the coil repels the north pole of the magnet. The other side of the coil attracts the north pole of the magnet. Thus, a current carrying coil has both north and a south pole like a magnet. Such a magnet is called electromagnet.

### Factors which effect the strength of electromagnet :

- (A) magnetic effect of current depends on number of turns.
- (B) magnetic effect of current depends the value of current.
- (C) magnetic effect of current depends on the nature of core inside the coil.

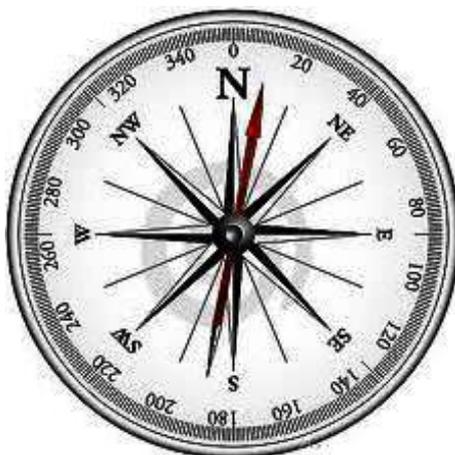
### Uses of electromagnets

- (i) They are used to lift heavy iron pieces. They are fitted on cranes lifting heavy objects of scrap iron.
- (ii) They are used in many devices like electric bell, electric horn, telephone receiver, electric relay, microphones, radio set, television, loudspeakers etc.
- (iii) The electromagnets are also used to separate magnetic material from the junk.
- (iv) Doctors use tiny electromagnets to take out small pieces of magnetic material that have fallen in the eye.

Electromagnet		Permanent Magnet (Bar Magnet)	
1	It behaves as a magnet as long as electric current passes through the solenoid surrounding it. It is demagnetised when electric current stops passing through the solenoid. Thus, electromagnet is a temporary magnet.	1	It cannot be demagnetised easily.
2	Electromagnet gives a strong magnetic field and the strength of the magnetic field produced by the electromagnet can be increased or decreased by increasing or decreasing electric current through the solenoid.	2	Magnetic field of a permanent magnet is weak. The strength of magnetic field of the permanent magnet cannot be changed.
3	The polarity (i.e. North and South poles) of an electromagnet can be reversed by reversing the direction of electric current through the solenoid.	3	The polarity of a permanent magnet cannot be reversed.

## 9. THE MAGNETIC COMPASS

When people think of instruments that help with direction finding, the first one that strikes to mind is probably the magnetic compass. It is the oldest instrument for navigation and has been a vital tool for navigators at sea for centuries. The compass allows ships to steer a selected course. By taking bearings of visible objects with a compass, the navigator is also able to fix a ship's position on a chart.



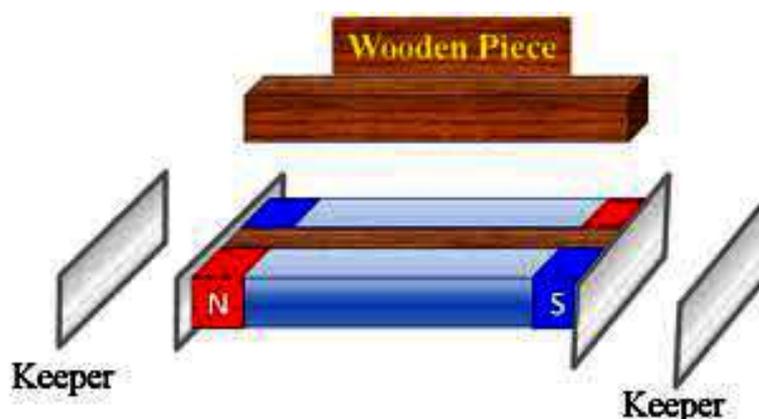
First time, it used by chinese people. The Chinese were probably aware that an iron bar stroked with a lodestone acquired a directional north-south property as long as 2000 years ago. However, the precise date at which this knowledge was used to create the first magnetic compass is unknown. By the 10th century, the idea had been brought to Europe, probably from China, by Arab traders. Magnetic compasses of a very simple kind were certainly in use in the Mediterranean as early as the 12th century. However, early compasses were not very reliable. Although the magnetic compass was in general use in the Middle Ages, little was known about precisely how it worked.

A compass is an extremely simple device. A magnetic compass (as opposed to a gyroscopic compass) consists of a small, lightweight magnet balanced on a nearly frictionless pivot point. The magnet is generally called a needle. One end of the needle is often marked "N," for north, or coloured in some way to indicate that it points toward north. On the surface, that's all there is to a compass.

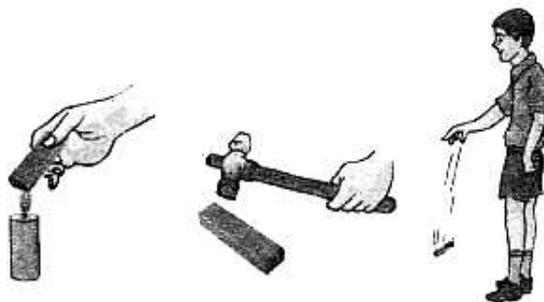
## 10. METHODS OF DEMAGNETISING A PERMANENT MAGNET

### 10.1 Magnet can be demagnetised by :

- (A) If the magnet is stored without using magnetic keepers, Self-demagnetisation will be possible. Magnets tend to become weak after some time. This weakening is called self-demagnetisation. Small pieces of soft iron are placed in contact with their opposite poles. These pieces of soft iron are called magnetic keepers.



- (B) Dropping it from a height or by rough handling.  
 (C) Heating or hammering the magnet.



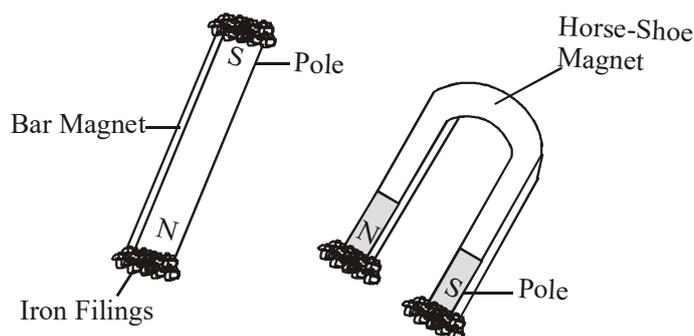
**Magnets lose their property on heating hammering and dropping**

## Extended Learning – Activities and Projects

### 1. Phenomenon of attraction property of magnet

Spread out some iron fillings over a sheet of paper. Now, move a bar magnet in the fillings taking care that all parts of the magnet moves through iron fillings .

We will notice that most of the iron fillings cling near the ends of the magnet while there are a few iron fillings near the middle.



Repeat the experiment with a horseshoe magnet. This experiment explains the attractive property of magnets.

### 2. Magnetise an iron needle using a bar magnet.

Insert the magnetised needle through a small piece of cork or foam. Let the cork float in water in a bowl or a tub. Make sure that the needle does not touch the water. Your compass is now ready to work. Make a note of the direction in which the needle points when the cork is floating. Rotate the cork with the needle fixed in it, in different directions. Note the direction in which the needle points when the cork begins to float again without rotating. Does the needle always point in the same direction, when the cork stops rotating?



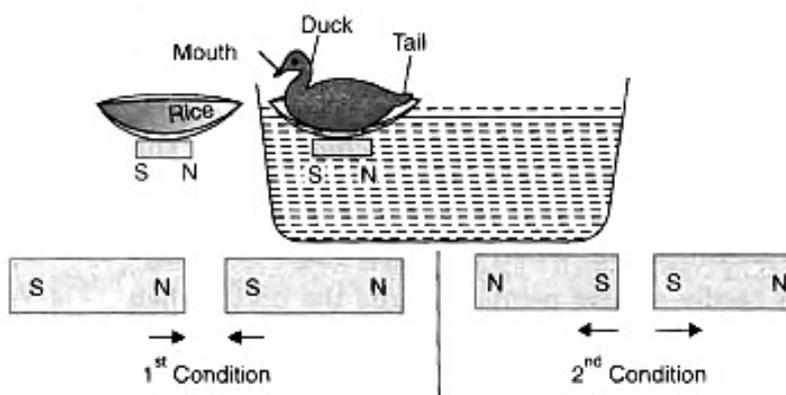
Yes, the needle always points towards the north when the cork stops rotating.

**3. Phenomenon of attraction and repulsion property of magnet.**

Bhawana witnessed an interesting game at the fair. A duck was floating in a tub. When a plate containing some grains of rice was brought close to the duck, the duck moved towards the plate. But, when a plate containing some pebbles was brought close to the duck, it moved away from the plate. Explain how this could have been possible.

This game is based on the plate containing rice may have magnet attached to its bottom. The magnet is fitted in such a way that its north-pole points towards rice grains, while south-pole indicates towards pebbles. A magnet (bar magnet) may also be fitted in the bottom of the duck, where south-pole points towards mouth and north-pole towards tail of the duck.

When the rice portion of the plate is brought closer to the duck, the duck moves towards rice grains because unlike poles of two magnets attract each other. In second situation, same (like) poles repel each other. So the duck moves away.



## EXERCISE-I

## NCERT Essentials

- Q.1** Fill in the blanks
- Unlike poles of two magnets each other, whereas like poles each other.
  - The materials that are attracted towards a magnet are called .
  - The needle of a magnetic compass rests along the direction.
  - A magnet always has poles.
- Q.2** State whether the following statements are True (T) or False (F).
- A magnet can be broken into pieces to obtain a single pole.
  - Similar poles of a magnet repel each other.
  - Iron filings mostly stick in the middle of a bar magnet when it is brought near them.
  - A freely suspended bar magnet always aligns with the north-south direction.
- Q.3** Column I shows different positions in which one pole of a magnet is placed near that of the other. Column II indicates the resulting interaction between them for different situations. Fill in the blanks.

Column I	Column II
N – N	
N –	Attraction
S – N	
– S	Repulsion

- Q.4** Atharv performed an experiment in which he took a bar magnet and rolled it over a heap of steel U-clips (Fig.).

**Bar magnet and heap of steel U-clips**

According to you, which of the options given in Table 4.3 is likely to be his observation?

**Table 4.3****Number of pins attracted by the magnet at its various positions**

	Position A	Position B	Position C
(i)	10	2	10
(ii)	10	10	2
(iii)	2	10	10
(iv)	10	10	10

- Q.5** Reshma bought three identical metal bars from the market. Out of these bars, two were magnets and one was just a piece of iron. How will she identify which two amongst the three could be magnets (without using any other material)?
- Q.6** You are given a magnet which does not have the poles marked. How can you find its poles with the help of another magnet which has its poles marked?
- Q.7** A bar magnet has no markings to indicate its poles. How would you find out near which end its North pole is located without using another magnet?
- Q.8** If the earth is itself a magnet, can you guess the poles of earth's magnet by looking at the direction of the magnetic compass?
- Q.9** While a mechanic was repairing a gadget using a screw driver, the steel screws kept falling down. Suggest a way to solve the problem of the mechanic on the basis of what you have learnt in this chapter.
- Q.10** Two ring magnets X and Y are arranged as shown in Fig. It is observed that the magnet X does not move down further. What could be the possible reason? Suggest a way to bring the magnet X in contact with magnet Y, without pushing either of the magnets.

**Two ring magnets**

- Q.11** Three magnets are arranged on a table in the form of the shape shown in Fig. What is the polarity, N or S, at the ends 1, 2, 3, 4 and 6 of the magnets? Polarity of one end (5) is given for you.

**Three bar magnets**

**EXERCISE-II****Brain Booster MCQs****MCQ BASED QUESTIONS :**

- Q.1** Which is an example of a magnetic substance?  
 (A) Iron (B) Nickel  
 (C) Cobalt (D) All of these
- Q.2** Magnets have a shape  
 (A) Cylindrical (B) Ball ended  
 (C) horse shoe (D) All of these
- Q.3** When a bar magnet is brought near iron dust, most of the dust sticks  
 (A) near the middle  
 (B) equally everywhere  
 (C) near two ends  
 (D) at the middle and ends
- Q.4** A freely suspended bar magnet rests in  
 (A) north-south directions  
 (B) east-west directions  
 (C) upside down  
 (D) any direction by chance
- Q.5** Attraction is seen between the poles of two bar magnets in the case of  
 (A) N-pole of one magnet with N-pole of other  
 (B) N-pole of one magnet with S-pole of other  
 (C) S-pole of one magnet with S-pole of other  
 (D) all of these cases will show attraction
- Q.6** Which is a natural magnet?  
 (A) Magnetite (B) Haemetite  
 (C) Bakelite (D) Copper
- Q.7** Choose the wrong statement:  
 (A) Heat can destroy magnetic properties of a magnet  
 (B) Magnets are made up of different materials and different shapes  
 (C) There is a maximum attraction in middle of a magnet  
 (D) Magnetite does not show magnetic properties
- Q.8** The magnetic properties of a magnet cannot be destroyed by  
 (A) hammering  
 (B) heating  
 (C) dropping on hard surface  
 (D) boiling
- Q.9** Which two ends of a magnet are called magnetic poles?  
 (A) North pole  
 (B) South pole  
 (C) North and south pole  
 (D) Self demagnetisation
- Q.10** Magnets attract  
 (A) wood (B) plastic  
 (C) paper (D) iron
- Q.11** The magnetic compass needle indicates:  
 (A) East-West direction  
 (B) North-South direction  
 (C) Up-Down direction  
 (D) All directions
- Q.12** Which pole of a magnet is usually painted red?  
 (A) South pole (B) North pole  
 (C) Both poles (D) Neither pole
- Q.13** When two north poles of magnets are brought close:  
 (A) They attract  
 (B) They repel  
 (C) Nothing happens  
 (D) They become neutral
- Q.14** Lodestones are:  
 (A) Artificial magnets  
 (B) Natural magnets  
 (C) Non-magnetic stones  
 (D) Magnetic compasses
- Q.15** The maximum iron filings stick to:  
 (A) Middle of the magnet  
 (B) Poles of the magnet  
 (C) Entire magnet equally  
 (D) None of these

- Q.16** A magnetic compass is used for:  
(A) Measuring time  
(B) Finding directions  
(C) Measuring weight  
(D) Measuring temperature
- Q.17** The magnetic effect of a magnet can pass through:  
(A) Iron only  
(B) Magnetic materials only  
(C) Non-magnetic materials  
(D) Nothing
- Q.18** A single pole magnet:  
(A) Can exist  
(B) Cannot exist  
(C) Exists in nature  
(D) Can be made artificially
- Q.19** The needle of a magnetic compass is:  
(A) Made of plastic  
(B) A small magnet  
(C) Non-magnetic  
(D) Made of wood
- Q.20** When a magnet is broken into pieces:  
(A) It loses magnetism  
(B) Each piece has both poles  
(C) Only one pole remains  
(D) It becomes non-magnetic
- Q.21** The ancient Indian navigation device was called:  
(A) Compass  
(B) Matsya-yantra  
(C) Magnetic needle  
(D) Direction finder
- Q.22** Which of the following can affect a magnetic compass?  
(A) Mobile phones  
(B) Remote controls  
(C) Other magnets  
(D) All of these
- Q.23** The magnetic compass was first used by:  
(A) Europeans  
(B) Americans  
(C) Indians and Chinese  
(D) Africans
- Q.24** When a south pole is brought near a north pole:  
(A) They repel  
(B) They attract  
(C) Nothing happens  
(D) They break
- Q.25** A magnet can attract:  
(A) All metals  
(B) Only iron, nickel, and cobalt  
(C) All materials  
(D) Only iron
- Q.26** The region around a magnet where its effect can be felt is called:  
(A) Magnetic area  
(B) Magnetic field  
(C) Magnetic zone  
(D) Magnetic space
- Q.27** Which direction does the red end of a compass needle point?  
(A) South  
(B) East  
(C) West  
(D) North
- Q.28** A temporary magnet can be made from:  
(A) Plastic  
(B) Wood  
(C) Iron  
(D) Glass
- Q.29** Sailors in ancient times used \_\_\_\_\_ to find directions at night:  
(A) Sun  
(B) Stars  
(C) Moon  
(D) Compass
- Q.30** A piece of iron can be magnetized by:  
(A) Heating  
(B) Rubbing with a magnet  
(C) Cooling  
(D) Painting
- Q.31** The magnetic effect can pass through:  
(A) Paper  
(B) Glass  
(C) Plastic  
(D) All of these
- Q.32** Which pole of the Earth's magnet is near the geographic North Pole?  
(A) North pole  
(B) South pole  
(C) Both  
(D) Neither

- Q.33** A magnet loses its properties when:  
(A) Kept properly  
(D) Used frequently  
(C) Heated strongly  
(D) Painted
- Q.34** The term 'lodestone' means:  
(A) Leading stone  
(D) Heavy stone  
(C) Light stone  
(D) Colorful stone
- Q.35** The end of compass needle painted red indicates:  
(A) South  
(D) East  
(C) West  
(D) North
- Q.36** Artificial magnets are made from:  
(A) Natural stones  
(D) Iron and steel  
(C) Wood  
(D) Plastic
- Q.37** A magnet can work through:  
(A) Magnetic materials only  
(D) Non-magnetic materials only  
(C) Both types of materials  
(D) No materials
- Q.38** The magnetic field is strongest at:  
(A) Middle of magnet  
(D) Poles of magnet  
(C) Everywhere equally  
(D) Outside the magnet
- Q.39** Ancient travellers used magnetic compass for:  
(A) Time measurement  
(D) Navigation  
(C) Weather prediction  
(D) Communication
- Q.40** Magnets are used in:  
(A) Speakers  
(D) Hard drives  
(C) MRI machines  
(D) All of these

**EXERCISE-III****Concept Check****TRUE AND FALSE:**

- Q.1** Lodestone is composed of oxides of iron.
- Q.2** North and south poles are found to exist separately.
- Q.3** Magnetite doesn't show magnetic properties.
- Q.4** If we cut a bar magnet in two halves we will have two magnets.
- Q.5** Heat can destroy magnetic properties of a magnet.
- Q.6** Magnets are made up of different materials and in different shapes.
- Q.7** Compass needle is made of a magnet.
- Q.8** There is a maximum attraction in middle of a bar magnet.

**FILL IN THE BLANKS:**

- Q.1** When north-pole of one magnet is brought near the ..... of another magnet, they attract one another
- Q.2** When the north-pole of one magnet is brought close to the ..... of another magnet, they repel each other.
- Q.3** Similar poles of two magnets ..... one another.
- Q.4** A compass needle always points in a ..... direction.
- Q.5** Stickers with pieces of magnet inside them easily stick to ..... surfaces like the doors of refrigerator.
- Q.6** Materials which get ..... towards magnet are known as magnetic.
- Q.7** The ..... of magnet where maximum iron filings get clung, are known as .....

- Q.8** Magnetic effect can pass through .....
- Q.9** We should not drop the magnet, shouldn't heat it shouldn't ..... it.
- Q.10** The south pole of the earth's magnet is near the geographical ..... pole
- Q.11** Magnetic poles always ..... in pairs.
- Q.12** Hammering destroys the ..... of small magnets inside.

**ASSERTION & REASON**

**Instructions:** Each question contains an Assertion

(A) and a Reason (R). Choose:

- (A) Both A and R are true, and R is correct explanation of A
- (B) Both A and R are true, but R is not correct explanation of A
- (C) A is true but R is false
- (D) A is false but R is true

- Q.1** **Assertion (A):** Earth's geographic and magnetic poles are different.  
**Reason (R):** Earth's magnetic field varies.
- Q.2** **Assertion (A):** Magnets can pick objects through water.  
**Reason (R):** Water is non-magnetic.
- Q.3** **Assertion (A):** Ancient Indians used matsya-yantra.  
**Reason (R):** It was used for navigation at sea.
- Q.4** **Assertion (A):** Magnets are made in different shapes.  
**Reason (R):** Different applications require different shapes.
- Q.5** **Assertion (A):** Mobile phones affect compass needles.  
**Reason (R):** Mobile phones have magnets.

**MATCH THE COLUMN:****[A] [ONE TO ONE]:**

**Column-I** and **column-II** contain **four** entries each. One entry of column-I is to be matched with one entry of column-II.

**Q.1 Match the column**

Column A		Column B	
<b>a</b>	Magnetite	<b>p</b>	Non-magnetic substances
<b>b</b>	Iron, nickel, cobalt	<b>q</b>	Used to find out N-S directions
<b>c</b>	Leather, plastic, wax	<b>r</b>	Attract each other
<b>d</b>	Lodestone	<b>s</b>	Natural magnet
<b>e</b>	Compass	<b>t</b>	Repel each other
<b>f</b>	Like poles of two magnets	<b>u</b>	Discovered magnet incidently
<b>g</b>	Opposite poles of two magnets	<b>v</b>	Magnetic substances
<b>g</b>	Magnus	<b>w</b>	Name of first magnet

(A) (a)-(s), (b)-(v), (c)-(p), (d)-(w), (e)-(q), (f)-(t), (g)-(r), (h)-(u)

(B) (a)-(q), (b)-(s), (c)-(p), (d)-(r), (e)-(u), (f)-(w), (g)-(v), (h)-(t)

(C) (a)-(p), (b)-(s), (c)-(w), (d)-(r), (e)-(q), (f)-(v), (g)-(t), (h)-(u)

(D) (a)-(p), (b)-(r), (c)-(s), (d)-(q), (e)-(t), (f)-(w), (g)-(v), (h)-(u)

**Q.2 Match the scientists/inventors:**

Column A		Column B	
(a)	Ancient Indians	(1)	Modern compass
(b)	Ancient Chinese	(2)	Matsya-yantra
(c)	Europeans	(3)	Magnetic studies
(d)	Modern scientists	(4)	Navigation compass

**Q.3 Match the magnetic applications:**

Column A		Column B	
(a)	Navigation	(1)	Magnetic compass
(b)	Medical	(2)	MRI machines
(c)	Entertainment	(3)	Speaker magnets
(d)	Data storage	(4)	Hard disk drives

**Q.4 Match the magnetic properties:**

Column A		Column B	
(a)	Temporary magnet	(1)	Loses magnetism easily
(b)	Permanent magnet	(2)	Retains magnetism
(c)	Electromagnet	(3)	Uses electricity
(d)	Natural magnet	(4)	Found in nature

**Q.5 Match the experimental observations:**

Column A		Column B	
(a)	Iron filings at poles	(1)	Weak magnetic field
(b)	Iron filings at center	(2)	Strong magnetic field
(c)	Compass deflection	(3)	Magnetic interaction
(d)	No compass movement	(4)	No magnetic effect

**Q.6 Match the safety measures:**

Column A		Column B	
(a)	Keep away from	(1)	Mobile phones
(b)	Store properly	(2)	With unlike poles
(c)	Don't heat	(3)	Above 80°C
(d)	Handle carefully	(4)	Avoid dropping

**ACTIVITY BASED QUESTION:**

- Q.1** When repeating magnet experiments, results should be:
- (A) Always different
  - (B) Always same
  - (C) Randomly different
  - (D) Consistently similar
- Q.2** The best way to record observations is:
- (A) Memory only
  - (B) Written notes
  - (C) Drawings only
  - (D) Video only
- Q.3** Before starting any magnet activity, you should:
- (A) Predict results
  - (B) Gather materials
  - (C) Read instructions
  - (D) All of these
- Q.4** Iron filings stick to magnet because they:
- (A) Are sticky
  - (B) Are magnetic
  - (C) Are light
  - (D) Are small
- Q.5** The magnetic compass needle moves because:
- (A) Wind blows it
  - (B) It is affected by Earth's magnetism
  - (C) Water moves it
  - (D) Gravity pulls it

**EXERCISE-IV****Subjective Assessment****MAGNETIC AND NON-MAGNETIC MATERIALS :**

**Q.1** Make a list of given substances into two groups magnetic and non magnetic.

Key, Wood, Glass, Alpin, Chalk, Pencil, Cup of tea, Book, Rubber, Needle, Fork.

**Ans.**

<b>Magnetic substances</b>	<b>Non-magnetic substances</b>
Key, alpin, nail, needle, fork (because all these stick to the magnet)	Wood, glass, chalk, pencil, cup of tea, book, rubber. (none of these sticks to the magnet)

**Q.2** Who discovered magnet?

**Ans.** An old shepherd lived on Create Island named Magnes discovered it.

**Q.3** Name the country in which it (magnet) was discovered ?

**Ans.** Greece.

**Q.4** When was magnetite discovered?

**Ans.** Magnetite was discovered around 800 B.C.

**Q.5** What is magnetite called now?

**Ans.** Magnetite like materials are called magnets now.

**Q.6** What are magnetic materials (substances)?

**Ans.** Materials which get attracted by the mangnet are called magnetic materials (substances).

**Q.7** What are non-magnetic substances?

**Ans.** Substances which are not attracted by magnet are called non-magnetic substances.

**Q.8** Write the example of some non-magnetic substances.

**Ans.** Rubber, Cotton, Plastic, Wood, Butfon, Cloth, etc.

**Q.9** Name the first magnet.

**Ans.** Lodestone.

**Q.10** What is lodestone?

**Ans.** Lodestone is a type of iron. It bears the properties of magnet.

**Q.11** What are the properties of a magnet?

**Ans.** (i) It attracts iron pieces towards itself.  
(ii) It always aligns itself in the same direction, if left to rotate freely.  
(iii) It is composed of oxides of iron ( $\text{Fe}_3\text{O}_4$ )

**Q.12** What are soft and hard magnetic materials?

**Ans.** Soft iron is called soft magnetic material because it loses its magnetism easily. Soft iron is used in making electromagnets. Steel is called a 'hard' magnetic material because it does not lose its magnetism so easily. It is used to make permanent magnets.

**POLES OF MAGNET :**

**Q.13** How many poles are there in a magnet?

**Ans.** There are two poles in a magnet, north-pole and south-pole.

**Q.14** To which part of the magnet do the most of the iron filings (or pins) stick?

**Ans.** Most of the iron filings (or pins) stick to the poles, i.e., north and south poles. At these poles of magnet, magnetic effect is maximum.

**Q.15** To which part of the magnet do none or only a few iron filings (or pins) stick?

**Ans.** Minimum number of iron filings stick to the middle part of the magnet. Magnet has its magnetic effect least in this part (middle part).

**Q.16** Are both poles of a magnet similar?

**Ans.** No, the two poles of a magnet are not similar (alike). Both have different tendency. The pole that points towards the north is called north-pole while the pole pointing always towards the south is called south-pole.

**Q.17** Which is the north-pole of a bar magnet?

**Ans.** It is the tip of a bar magnet which points towards the north direction.

**Q.18** Which is the south-pole of a bar magnet?

**Ans.** It is the tip of a bar magnet that points towards the south direction.

**Q.19** Why does bar magnet always point in north-south directions?

**Ans.** Bar magnet always points in north-south directions when left freely suspended because earth itself behaves like a magnet and north-pole of bar magnet is attracted towards south-pole of earth's magnet and vice versa.

**Q.20** Where are south and north poles of earth's magnet?

**Ans.** Earth's magnetic south-pole is near the geographic north-pole and north-pole of earth's magnet is near geographic south-pole.

**Q.21** Can we isolate north-pole or south-pole?

**Ans.** No, we cannot isolate north-pole of a magnet from its south-pole or vice versa. If you break a bar magnet into two halves, you will not get a single north or south pole but two magnets each with its north and south-poles.

**Q.22** Do magnetic poles exist separately like charges? Explain.

**Ans.** Magnetic poles do not exist separately like positive and negative charges. This means that it is not possible to isolate a north pole of a magnet from its south pole by cutting the magnet from the middle. Whenever a bar magnet is cut into two halves, we get two new magnets, each with its north and south poles. This will continue indefinitely even if extremely small pieces of bar magnets are obtained. Thus magnetic poles always exist in pairs.

**Q.25** Mark the north-poles of two bar magnets and bring the poles of the magnets near each other, and note down your observations in table.

**Ans.**

Poles, facing one another	They are called	We observe
North-South	Opposite Poles	Attraction
North-North	Similar poles	Repulsion
South-South	Similar poles	Repulsion
South-North	Opposite Poles	Attraction

**Q.26** What will happen to the magnet when we cut it into two pieces?

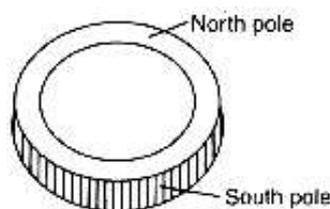
**Ans.** When we cut a bar magnet into two pieces, both these pieces act as magnets and we get two magnets



**Q.23** What happens when a pole of a bar magnet say its north-pole is marked with a chalk and suspended freely? What do you observe on rotating the bar magnet?

**Ans.** The marked pole comes to rest in north direction. On rotating, after some time, it again comes to rest in north direction.

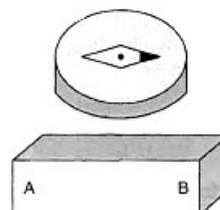
**Q.24** Where are the poles of a circular magnet? How will you find this?



**Ans.** Ring type or circular magnet also has two poles. Its exterior and interior parts act like different poles.

To find out the nature of the two poles, we suspend circular magnet with a piece of thread. We bring another magnet near it. Both attract each other. It clearly concludes that one surface of the circular magnet is attracted but the other surface is repelled by the same pole of the other magnet.

**Q.27** When a bar magnet was brought close to a compass, the orientation of the needle became as shown in figure. Identify the poles on the ends of the bar magnet marked 'A' and 'B'. Explain how you arrived at your answer.



**Ans.** Orientation of the needle clearly shows that red marked end (north-pole) attract the end of bar magnet marked "A". It means both these are unlike poles and the end of bar magnet marked "N" is south-pole. End marked 'E' is north-pole because like (same) poles repel each other.

**Q.28** Fill in the blanks:

- (i) When a suspended magnet comes to rest, one pole always points towards the .....
- (ii) And the other pole always points towards the .....

**Ans.** (i) North (ii) South

### FINDING DIRECTIONS :

**Q.29** In which direction does freely suspended magnet rest?

**Ans.** A freely suspended magnet always points in the north-south direction.

**Q.30** How did we come to know that magnet is helpful to find (detect) directions?

**Ans.** About 800 years ago, Chinese saw that a hanging lodestone always comes to rest in a particular direction i.e., north-south. Therefore, they came to know about finding the direction with the help of lodestone.

**Q.31** Why is compass needle kept in a closed glass vessel?

**Ans.** Compass needle is a small and thin magnet used to find the direction. If it is kept in open, it may deflect in any direction due to pressure exerted by air. So to know right direction, it is kept covered by glass covering.

**Q.32** Does the compass needle point in different directions?

**Ans.** The compass needle has a magnetic needle closed in a glass covering. The needle can rotate on its pin pointed base. Its red marked end always indicates towards the north direction. It always rests in north-south directions. We use it to find out the direction

**Q.33** Hang a bar magnet with a thread on a stand and rotate the base of stand. What will happen?

**Ans.** The direction of bar magnet is not changed as we rotate the stand. It is because a freely suspended magnet comes to rest in particular direction, i.e., north-south directions. In this activity, only stand changes its direction.

**Q.34** How do the shipmen find the direction even .when north pointing pole star is not visible?

**Ans.** Shipmen during navigation can find the direction with the help of magnetic needle. This is believed to be first used by Chinese.

### MAKE YOUR OWN MAGNET :

**Q.35** Can an ordinary vessel (lota) be magnetised?

**Ans.** Yes, to magnetise ordinary vessel, it would have to be buried in the earth for many years.

**Q.36** Can a magnet be demagnetised? How?

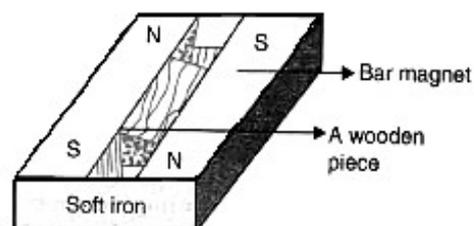
**Ans.** Yes, a magnet can be demagnetised:

- (i) By packing like poles of two magnets in same direction.
- (ii) By hammering the magnet hard.
- (iii) By heating the magnet strongly.

**Q.37** How should two-bar magnets be kept?

**Ans.** After using it, two-bar magnets should be placed inside a wooden box so that:

- (i) the poles of two magnets lie opposite to each other.
- (ii) a wooden piece should be kept between the two magnets.
- (iii) metallic caps should be put on the poles, otherwise they will attract other magnetic objects.



### ATTRACTION AND REPULSION BETWEEN MAGNETS :

**Q.38** What happens when similar poles come close to each other?

**Ans.** They repel each other.

**Q.39** When do two magnets attract each other?

**Ans.** Two magnets attract each other when their unlike (opposite) poles come close to each other.

**Q.40** How can you show that unlike poles attract each other while like poles repel each other?

**Ans.** Suspend a magnet on a stand with the help of a string. Now it rests in N-S directions. Take another magnet which has marked N-S on it and bring N-pole of this magnet near the N-pole of the suspended magnet.

You will find that the suspended magnet rotates and moves away showing that like poles repel each other. The same can be repeated by bringing south-pole of one magnet near south-pole of suspended magnet.

Now you must have found that during the above experiment, south-pole comes towards north-pole and vice versa. It can be repeated by bringing south-pole near a north-pole and north-pole near south-pole of suspended magnet. You will find that unlike poles attract each other.

**Q.41** What do you mean by magnetic field?

**Ans.** The region around the magnet where its magnetic influence can be felt is called the magnetic field of the magnet.

**Q.42** What is MRI?

**Ans.** Magnetic Resonance Imaging (MRI) is a medical diagnostic technique which uses the magnetic field inside the body for obtaining images of different parts of the body.

### LONG ANSWER TYPE QUESTIONS:

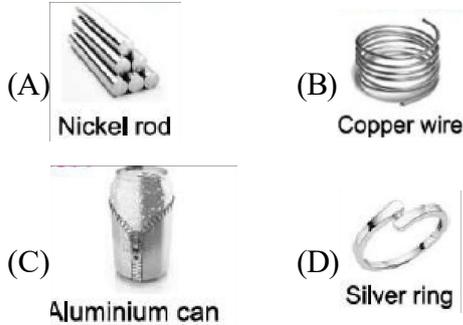
- Q.1** Explain the historical development of magnetic compass and its importance in navigation. Include the story of matsya-yantra.
- Q.2** Write a detailed account of Reshma's story and explain how the magnetic compass solved the navigation problem of ancient sailors.
- Q.3** Describe the Earth's magnetism and explain how it affects compass needles. Include the difference between geographic and magnetic poles.
- Q.4** Write a comprehensive guide on proper storage and care of magnets. Explain why these precautions are necessary and what happens if they are not followed.
- Q.5** Explain the process of magnetization and demagnetization. Include methods to make temporary magnets and factors that can destroy magnetism.
- Q.6** Discuss the applications of magnets in modern technology. Cover at least five different fields with specific examples.
- Q.7** Describe how to make a simple magnetic compass at home. Include detailed steps, scientific explanation, and troubleshooting tips.
- Q.8** Explain the concept of magnetic field and field lines. Describe how they can be visualized and their properties.
- Q.9** Analyze the environmental and health impacts of magnets. Include both beneficial applications and potential risks.
- Q.10** Create a comprehensive project report on "Exploring Magnets" that includes theory, experiments, observations, applications, and future scope.

**EXERCISE-V**

**Competition Edge**

**PREVIOUS YEAR NSO QUESTIONS:**

**Q.1** Which one of the following can be attracted by a magnet? (NSO-2012)



**Q.2** A student tries to magnetise a short steel rod. Which of the following tests will show that he has succeeded? (NSO-2012)

- (A) Both ends of a magnet attract the rod.
- (B) One end of a magnet repels the rod.
- (C) The rod picks up a small piece of paper.
- (D) When freely suspended, the rod points in any direction.

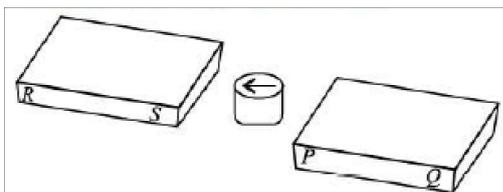
**Q.3** Magnets lose their properties if- (NSO-2012)

- (A) Left in the open
- (B) Heated strongly
- (C) Dropped from a height
- (D) All of these

**Q.4** Shaving blades are usually made of steel. They will be- (NSO-2012)

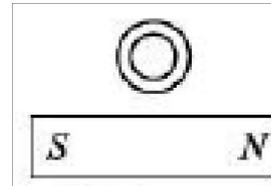
- (A) Attracted by a magnet
- (B) Repelled by a magnet
- (C) Attracted only by natural magnets
- (D) Unaffected by magnets

**Q.5** A small plotting compass is placed between two strong magnets. The tip of the arrow represents the N-pole of the compass. What is the polarity of the end P of the right-hand side magnet? (NSO-2013)



- (A) South      (B) North
- (C) East      (D) West

**Q.6** A small compass is placed beside the middle of a bar magnet. (NSO-2013)



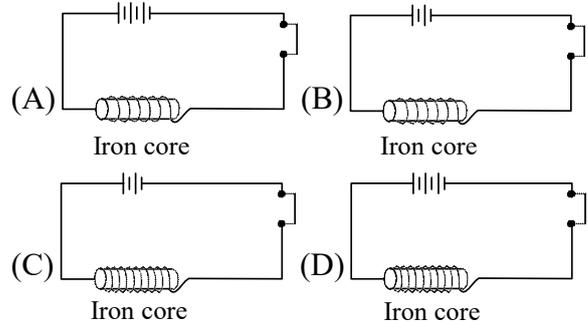
In which direction will the compass needle point?

- (A)
- (B)
- (C)
- (D)

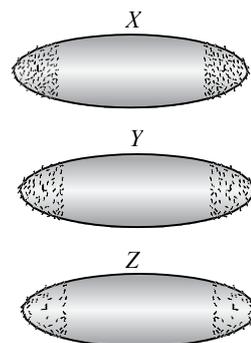
**Q.7** If a piece of metal was thought to be a magnet, which one of the following observations would offer conclusive evidence? (NSO-2013)

- (A) It attracts a known magnet.
- (B) It repels a known magnet.
- (C) It attracts a steel screw driver.
- (D) None of these

**Q.8** Which of the following iron cores has more strength as compared to others? (NSO-2013)



**Q.9** Three magnets X, Y and Z were dipped on by one in heap of iron filings. Figure shown the amount of the iron filings stuck to them. (NSO-2014)

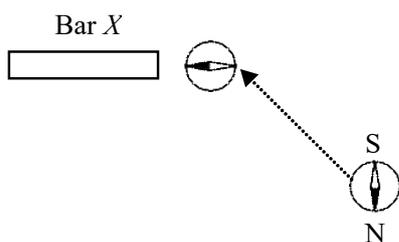


- (A) X > Y > Z      (B) X < Y < Z
- (C) X = Y = Z      (D) X < Y > Z

- Q.10** To demagnetise a magnet using the heating method, which of the following is the correct step ? (NSO-2014)  
 (A) Heat the magnet to become red hot, and allow it to cool in the east-west direction.  
 (B) Heat the magnet to become red hot, and allow it to cool in the north-south direction.  
 (C) Heat the magnet in boiling water, and allow it to cool in the north-south direction.  
 (D) Both A and B.

- Q.11** The north pole of a bar magnet picks up an iron nail. Which of the following options is correct regarding the pole(s) induced in the nail ? (NSO-2014)  
 (A) South pole only  
 (B) North pole only  
 (C) A north pole and a south pole  
 (D) None of these

- Q.12** A plotting compass is moved slowly towards the metal bar along the path as shown in figure. The final position of the compass needle is shown in the given figure. (NSO-2014)

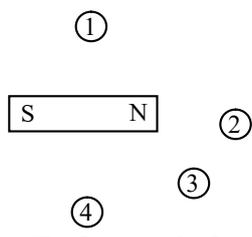


- What can you conclude about bar X based on the diagram?  
 (A) Bar X is a magnetic material.  
 (B) Bar X is a magnet.  
 (C) Bar X is a non-magnetic material.  
 (D) Bar X is either a magnet or a magnetic material.

- Q.13** Four plotting compasses are placed near a bar magnet. One compass appears like this

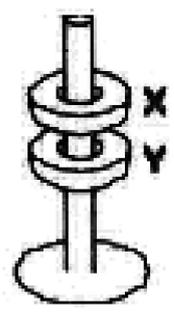


- What is a possible position for the compass? (NSO-2015)  
 (Ignore any effects of the Earth's magnetic field.)



- (A) 1 (B) 2 (C) 3 (D) 4

- Q.14** The figure shows a ring magnet, X, 'floating' above another ring magnet, Y. This is because: (NSO-2015)



- (A) Magnet X is lighter than magnet Y  
 (B) Magnet Y is more powerful than magnet X  
 (C) The like poles of both magnets are facing each other and they repel each other  
 (D) The unlike poles of both magnets are facing each other and they attract each other.

- Q.15** Magnet can be made weaker by: (NSO-2015)

- (A) Keeping it wrapped in cotton wool  
 (B) Using it as a hammer  
 (C) Keeping it in a cool room  
 (D) Playing with it

- Q.16** Reeta puts two different objects in each of the following containers- (NSO-2015)

- Container (i) : Copper coin and iron nail  
 Container (ii) : Steel nail and aluminium earring. dđ

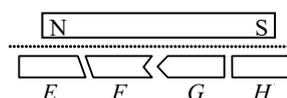
- Container (iii) : Marble and gold coin  
 Container (iv) : Nickel coin and steel nail  
 She can use a magnet to separate the objects in containers

- (A) (i) & (ii) (B) (i), (ii) & (iii)  
 (C) (i), (ii) & (iv) (D) (i), (ii), (iii) & (iv)

- Q.17** You should not store a floppy disk near a magnet because. (NSO-2015)

- (A) The magnet will rust  
 (B) The magnet will become weaker  
 (C) The information in the disk may be erased  
 (D) The magnet will break the disk.

- Q.18** A bar magnet gets broken into four pieces E, F, G and H. (NSO-2016)



Which of the following options shows the correct poles in broken pieces ?

- (A)  $\boxed{N \ N} \ \boxed{S \ S} \ \boxed{N \ N} \ \boxed{S \ S}$
- (B)  $\boxed{N \ S} \ \boxed{S \ N} \ \boxed{N \ S} \ \boxed{S \ N}$
- (C)  $\boxed{N \ S} \ \boxed{N \ S} \ \boxed{N \ S} \ \boxed{N \ S}$
- (D)  $\boxed{S \ N} \ \boxed{S \ N} \ \boxed{N \ S} \ \boxed{N \ S}$

**Q.19** Fill in the blanks by choosing an appropriate option. (NSO-2016)

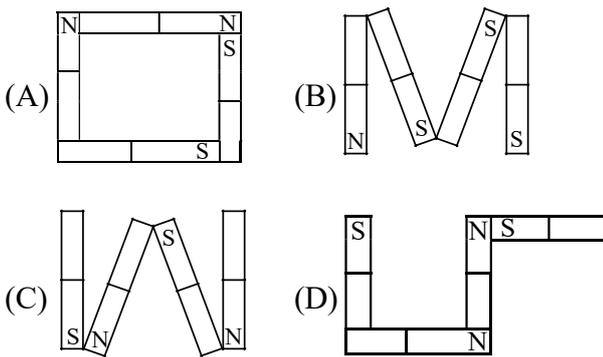
Magnetic strength of a bar magnet is

- (i) at its poles and
- (ii) at its centre.
- (iii) Two poles attract each other whereas
- (iv) Two poles repel each other.

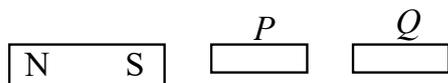
(i)            (ii)            (iii)            (iv)

- (A) Maximum    Minimum    Opposite    Similar
- (B) Maximum    Maximum    Opposite    Similar
- (C) Minimum    Minimum    Similar      Opposite
- (D) Minimum    Maximum    Similar      Opposite

**Q.20** Which of the following arrangements of four bar magnets is not possible ? (NSO-2017)



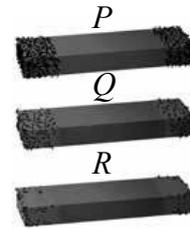
**Q.21** The figure shows two pieces of steel *P* and *Q* arranged in line with a bar magnet.



Which of the following is true about the magnetic forces on *P* and *Q*? (NSO-2018)

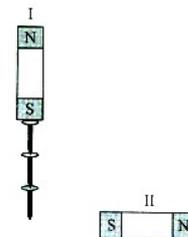
- |     | Force on P | Force on Q |
|-----|------------|------------|
| (A) | Attractive | Repulsive  |
| (B) | Attractive | Attractive |
| (C) | Repulsive  | Repulsive  |
| (D) | Repulsive  | Attractive |

**Q.22** Three magnets *P*, *Q* and *R* were dipped one by one in a heap of iron filings. Figure shows the amount of the iron filings sticking to them. (NSO-2018)



The strength of these magnets will be  
 (A)  $P > Q > R$             (B)  $P < Q < R$   
 (C)  $P = Q = R$             (D)  $P < Q > R$

**Q.23** A magnet II is being moved slowly towards another magnet which has attracted steel pins. As shown in the figure. The string of attracted pins \_\_\_\_\_ . (NSO-2019)



- (A) Remains stationary
- (B) Gets attracted to the right
- (C) Gets repelled to the left
- (D) None of these

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**ANSWER KEY**


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**EXERCISE-II**


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**MULTIPLE CHOICE QUESTIONS :**

**Q.1** D    **Q.2** D    **Q.3** C    **Q.4** A    **Q.5** B    **Q.6** A    **Q.7** D  
**Q.8** D    **Q.9** C    **Q.10** D

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**EXERCISE-III**


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**TRUE AND FALSE :**

**Q.1** True            **Q.2** False            **Q.3** False            **Q.4** True    **Q.5** True  
**Q.6** True            **Q.7** True            **Q.8** False

**FILL IN THE BLANKS :**

**Q.1** south pole    **Q.2** north pole    **Q.3** repel            **Q.4** north-south  
**Q.5** iron            **Q.6** attracted    **Q.7** ends, poles    **Q.8** screen  
**Q.9** hammer      **Q.10** north        **Q.11** exist            **Q.12** magnetism

**ASSERTION & REASON :**

**Q.1**                    **Q.2**                    **Q.3**                    **Q.4**                    **Q.5**

**MATCH THE COLUMN :**

**Q.1** A                    **Q.2**                    **Q.3**                    **Q.4**                    **Q.5**                    **Q.6**

**ACTIVITY BASED QUESTION:**

**Q.1**                    **Q.2**                    **Q.3**                    **Q.4**                    **Q.5**

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**EXERCISE-V**


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**Q.1** A    **Q.2** B    **Q.3** D    **Q.4** A    **Q.5** B    **Q.6** D    **Q.7** B  
**Q.8** D    **Q.9** A    **Q.10** A    **Q.11** C    **Q.12** B    **Q.13** C    **Q.14** C  
**Q.15** B    **Q.16** A    **Q.17** C    **Q.18** C    **Q.19** A    **Q.20** C    **Q.21** B  
**Q.22** C    **Q.23** B

# 4

# Methods of Separation in Everyday Life

## 1. INTRODUCTION

Many useful compounds are being mixture of various impurities, it means they need to be separated. They are useful to us only if impurities are separated out from them. That's why we need to separate the substances.

There are many instances when we notice a substance being separated from a mixture of materials.

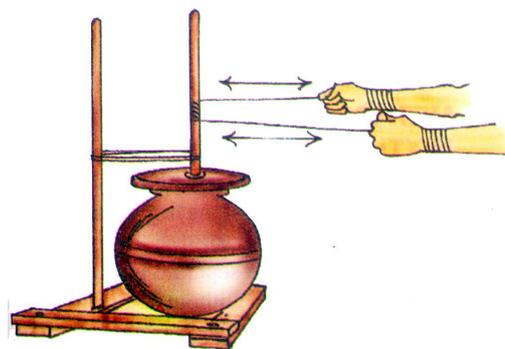
For example, (i) Tea leaves are separated from the liquid with a strainer, while preparing tea.

For example, (ii) Grain is separated from stalks, while harvesting.

For example, (ii) Milk or curd is churned to separate the butter.



Separating tea leaves with a strainer



Butter is taken out by churning milk or curds

## 2. MIXTURE

✦ A **mixture** is formed when **two or more substances** are mixed together **in any proportion**.

✦ The substances in a mixture **do not lose their individual properties**.

✦ Components of a mixture **can be separated by simple physical methods**.

Example: **salt + water, sand + water, air, tea**

### Components (Constituents) of a Mixture

✦ The substances that make up a mixture are called **components** or **constituents**.

✦ Each component **retains its own properties** in the mixture.

✦ Example:

In salt solution → **salt and water** are components.

### Types of Mixtures

Mixtures are of **two types**:

#### 1. Homogeneous Mixture

✦ Has **uniform composition throughout**.

✦ Components **cannot be seen separately**.

✦ Looks the **same everywhere**.

✦ Example:

○ **Salt solution**

○ **Sugar solution**

○ **Air**

## 2. Heterogeneous Mixture

- ✦ Has **non-uniform composition**.
- ✦ Components can be seen separately.
- ✦ Different parts look **different**.
- ✦ Example:
  - **Sand and water**
  - **Mud and water**
  - **Oil and water**

S.No.	Mixtures	Examples
1	Solid In solid	Alloys (Brass, bronze, etc.)
2	Solid in liquid	Salt in water
3	Solid in gas	Smoke
4	Liquid in Solid	Jam, jelly, shoe polish, butter
5	Liquid in liquid	Milk in water, alcohol in water
6	Liquid in gas	Humidity
7	Gas in solid	Sponge, pumice stone
8	Gas in liquid	Aerated drinks
9	Gas in gas	Air

## 3. NEED FOR SEPARATION OF SUBSTANCES FROM MIXTURE

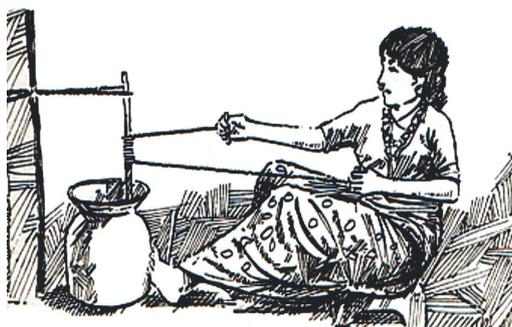
### 3.1 To remove undesirable and harmful substances :

- (i) The milk you drink is not pure as it is mixture of substances like pond water containing bacteria.
- (ii) Wheat and rice grains are stored for a long period. The grains may develop insects, larvae and eggs.
- (iii) Wheat is not cleaned after collecting it from the field. It may contain small stones and seeds of weeds.
- (iv) The water supplied to our homes is cleaned and treated by the municipal authorities. In all these cases, it is necessary to remove undesirable and harmful substances before use.

### 3.2 To obtain useful components of a mixture :

Sometimes we separate useful components of a mixture if we need to use them separately. For example, preparation of butter from curd.

Many useful components of crude oil, like petrol, diesel and kerosene are separated and then used separately.



Butter preparation from curd



### Let's know

- ✦ Mixture consists of two or more types of particles.
- ✦ Pure substances consist of particles of only one kind.

## 4. METHODS OF SEPARATION

### 4.1 Separation of solids from other solids :

- (i) **Hand picking** : The method of handpicking can be used for separating slightly larger sized impurities like the pieces of dirt, stone, and husk from wheat, rice or pulses. Handpicking method is used in the three situations, when :
- The quantity of the mixture is not very large,
  - The undesirable substance differ from the useful ones in shape, size or colour, and
  - The undesirable substances are present in small quantities.



**Handpicking stones from grain**

### ➤ ACTIVITY-1

**AIM** : to separate impurities from grain by hand picking .

**Materials required** : A packet of grain.

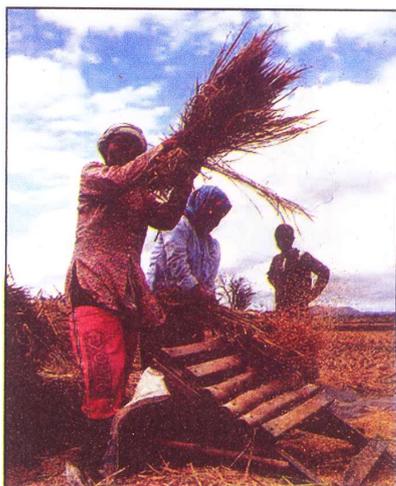
**Method** : Spread the grain on a sheet of paper. This contains pieces of stones, husks and other grain particle. Now, remove with hand the pieces of stone, husks and other grains from it. This method of handpicking can be used for separating slightly larger sized impurities like the pieces of dirt, stone, and husk from wheat, rice or pulses. The quantity of such impurities is usually not very large.

**Conclusion** : we find that handpicking is a convenient method of separating substances.

### 4.2 Threshing :

Threshing is the process of separating grains from the stalks. Threshing can be done in the following three ways :

- by beating the stalks with sticks on the ground,
- by allowing animals like bullocks to trample the stalks, and
- by using machines.



**Threshing of rice grain**



**Bullocks threshing the wheat grain**

### 4.3 Winnowing :

Winnowing is used to separate heavier and lighter components of a mixture by wind or by blowing air. This method is commonly used by farmers to separate lighter husk particles from heavier seeds of grain.

The husk particles are carried away by the wind. The seeds of grain get separated and form a heap near the platform for winnowing.

The separated husk is used for many purpose such as fodder for cattle.



**Winnowing**

➤ **ACTIVITY-2**

**AIM :** To separate pieces of paper from cardboard pieces by winnowing.

**Method :** Take a sheet of newspaper and a cardboard of the same dimensions. Cut these into very small pieces of almost equal size. Now keep them in a tray and mix them.

Switch on the fan and raise the tray to the height of your shoulder. Now tilt the tray and allow the pieces to fall down.

**Conclusion :** We will observe that the pieces of cardboard will fall closer to you than those of paper.



**Let's know**

The dry outer covering of grains is called husk. It is lighter than grains.

**4.4 Sieving :**

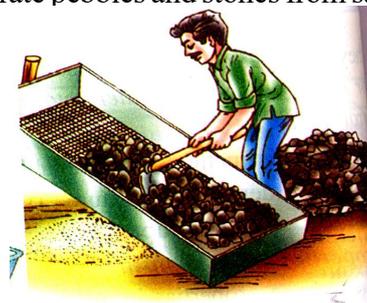
Sieving is a method used to separate the components of a mixture which are of different sizes. The fine components pass through the sieve, and the bigger components remains on the sieve.

For example, In a flour mill, impurities like husk and stones are removed from wheat before grinding it. Usually, a bagful of wheat is poured on slanting sieve. Sieving removes pieces of stones, stalk and husk that may still remain with wheat after threshing and winnowing.

Similar big sieves are used at construction sites to separate pebbles and stones from sand.



**Sieving**



**Pebbles and stones are removed from sand by sieving**

➤ **ACTIVITY-3**

**AIM :** To separate components of mixture by sieving.

**Method :**

- Take wheat flour and mix it with chalk powder or common salt. Pass this mixture through sieve. Note down what happens.
- Now, mix wheat flour with stones or pulses. Pass the mixture through the sieve. Note down what happens in this case.

**Conclusion :** In the first case, the chalk powder or common salt cannot be separated from the wheat flour by sieving. In the second case, they are separated.



**Let's know**

Sieve is a piece of mesh held in a frame.

### 4.5 Magnetic Separation

Magnetic separation is a method used to separate **magnetic substances** from **non-magnetic substances** using a **magnet**.



#### Explanation

Some substances like **iron** are attracted towards a magnet, while others like sand, husk, or flour are **not attracted**. When a magnet is brought near a mixture containing magnetic and non-magnetic substances, the magnetic substances stick to the magnet and get separated easily.

#### Example

- Separating **iron filings from sand**
- Removing **iron pieces from waste material**

#### Conclusion

Magnetic separation helps in separating magnetic components from non-magnetic components by using a magnet.

### 4.6 Separation of insoluble solids from liquids :

(i) **Sedimentation and Decantation** : Sedimentation is a process in which heavier particles of an insoluble solid in a liquid settles down. The solid particles called sediments settle down during sedimentation forming a layer.

Decantation is the process of pouring out the liquid or water (which contains the dust or soil particles) without disturbing the sediments.

For example, there may be lighter impurities like dust or soil particles in rice or pulses.

Rice or pulses are usually washed before cooking. When you add water to these, the impurities like dust and soil particles get separated. These impurities go into water, which becomes a little muddy.

When the heavier component in a mixture settles after water is added to it, the process is called sedimentation. When the water (along with the dust) is removed, the process is called decantation.

The same principle is used for separating a mixture of two liquids that do not mix with each other. For example, oil and water from their mixture can be separated by this process. If a mixture of such liquids is allowed to stand for some time, they form two separate layers. The component that forms the top layer can then be separated by decantation.



Separating two components of a mixture by sedimentation and decantation

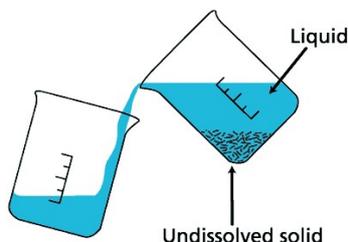
➤ **ACTIVITY-4**

**AIM :** To separate sand and water from a mixture

**Method :** To separate a mixture of sand and water, the technique of sedimentation and decantation can be used.

Take a mixture of sand and water in a beaker. Leave the beaker undisturbed for some time. You will find that the sand settles down (sedimentation) while the water forms the upper layer. It can be poured out into another beaker (decantation) and separated.

**Conclusion :** Sand particles are separated from water by sedimentation and decantation.



### Sedimentation and Decantation

(ii) **Filtration :** The process in which two substances (an insoluble solid and a liquid) are separated by using a filter is called filtration. It is commonly used method in our homes.

Some examples of filtration are as follows :

- Removing pulp from fresh fruit juice.
- Preparing cottage cheese (paneer) at home.
- Cleaning muddy water.
- Separation of tea leaves from the tea.

During filtration, the insoluble solid particles are retained in the filter, and the liquid passes through it. However, the particles of the insoluble solid should be bigger than the holes in the filter so that these are retained in the filter.

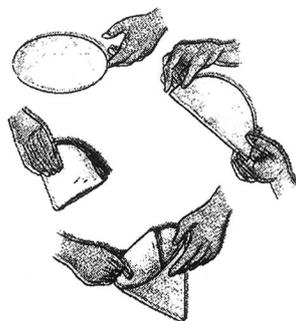


Fig. Folding a filter paper to make a cone



Fig. Filtration using a filter paper

The figure shows the steps involved in using a filter paper. A filter paper folded in the form of a cone is fixed onto a funnel. The mixture is then poured on the filter paper. Solid particles in the mixture do not pass through it and remain on the filter.

Fruit and vegetable juices are usually filtered before drinking to separate the seeds and solid particles of pulp.

➤ **ACTIVITY-5**

**AIM :** To separate mud and water from muddy water by filtration.

**Method :**

- Take a circular piece of filter paper and fold it twice in the form of a cone.
- Place the cone-shaped filter paper inside a funnel and keep a beaker below the funnel.
- Pour the muddy water into the filter paper cone using a glass rod.



Filtration

- After some time we find that clean water collects in the beaker, while the mud particles remain inside the cone.

**Conclusion :** We observe that filtration is a better method of separating mud and water.

(iii) **Loading :** Loading is a method used to separate very fine, suspended impurities from a liquid by adding a suitable chemical. This chemical sticks to the tiny impurity particles and makes them heavier. In muddy water, very fine mud particles do not settle easily. When a substance like **alum** is added, these fine particles stick together, become heavier, and settle at the bottom of the container. The clear water above can then be separated easily by **decantation or filtration**.

(iv) **Churning :** The method used to separate butter from curd is called **churning**. In earlier times, churning was done by hand using a wooden churner known as *mathani*. Today, different tools and machines are used for this purpose. Churning works on the principle of **centrifugation**, in which lighter substances separate from heavier ones. During churning, butter being lighter rises to the surface, while the liquid part called **buttermilk** remains below.

## 5. SEPARATION OF SOLUBLE SOLIDS FROM LIQUIDS :

(a) **Evaporation :** It is the process of converting a liquid into its vapour at any temperature below its boiling point.

The process of conversion of water into its vapour below its boiling point is called evaporation. The process of evaporation takes place continuously wherever water is present.

### ➤ ACTIVITY-6

**AIM :** Evaporation of water containing salt.

**Materials required :** (i) beaker (ii) water (iii) stand (iv) burner

**Method :** Allow the water to boil as shown. If we continue heating, water disappears completely.



### Heating a beaker containing salt water

Now, add two spoons of salt to water in another beaker and stir it well. Heat the beaker containing the salt water. Let the water boil away. In this activity, we used the process of evaporation, to separate a mixture of water and salt. The process of conversion of water into its vapour is called evaporation. The process of evaporation takes place continuously wherever water is present. In this activity water is boiled out as vapours and salt is remained in the beaker.

**Conclusion :** No water is left in the beaker after some time. Only salt is left behind. This activity shows that water has evaporated.

(b) **Condensation :** It is the process of conversion of water vapour into its liquid form.



Condensation process

We will notice that water drops are formed under the plate that was used to cover the boiled milk. The water vapour have condensed into its liquid form, the water drops. This explains the process of condensation.

(c) **Crystallisation** : While evaporating a solution, a stage comes when the amount of solvent is very less, it is called concentrated solution. When this solution is allowed to cool slowly, crystals of the dissolved substance start separating. This process is called crystallisation and is used to obtain a substance in its pure form.

## 6. SEPARATION OF LIQUIDS

Liquids can be separated based on whether they mix with each other or not. If two liquids mix completely and cannot be seen separately, they are called **miscible liquids**, such as milk and water. If two liquids do not mix and form separate layers, they are called **immiscible liquids**, for example oil and water.

## 7. SEPARATION OF TWO MISCIBLE LIQUIDS

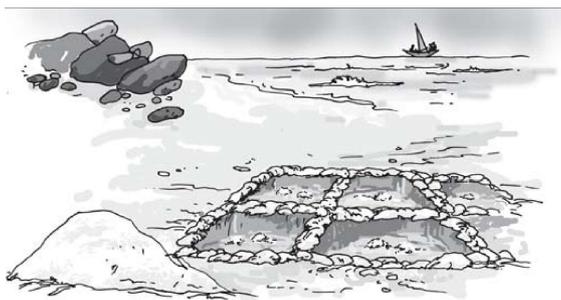
A mixture of two miscible liquids can be separated by the process of **distillation**, which involves heating the mixture so that the liquid with the lower boiling point evaporates first and then condenses back into liquid form on cooling. This method is used only when the boiling points of the liquids differ sufficiently.

## 8. SEPARATION OF TWO IMMISCIBLE LIQUIDS

To separate a mixture of two immiscible liquids such as oil and water, a **separating funnel** is used. A separating funnel is a glass funnel with a narrow stem and a stopper at the bottom to control the flow of liquid.

## 9. SEPARATION OF SALT FROM SEA WATER

Sea water contains many salts mixed in it. One of these salts is the common salt. When sea water is allowed to stand in shallow pits, water gets heated by sunlight and slowly turns into water vapour, through evaporation. In a few days, the water evaporates completely leaving behind the solid salts. Common salt is then obtained from this mixture of salts by further purification.



Obtaining salt from sea water

## 10. USE OF MORE THAN ONE METHOD OF SEPARATION :

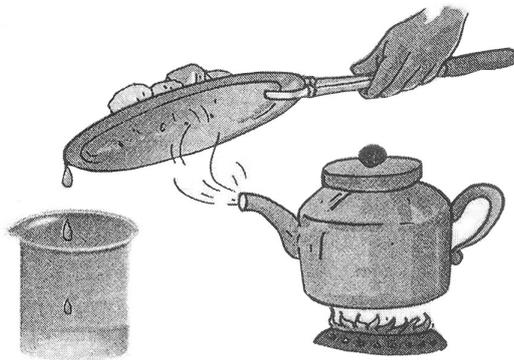
Often, one method is not sufficient to separate the different substances present in a mixture. In such a situation, we need to use more than one of these methods.

### For example :

If we take a mixture of sand and salt. Handpicking would not be a practical method for separating these. In order to separate them we keep this mixture in a beaker and add some water to it and leave it aside for some time. We will see the sand settling down at the bottom. The sand can be separated by decantation or filtration.

Now, we need to separate salt and water from the decanted liquid. For this we transfer this liquid to a kettle and close its lid. The kettle is heated for some time. We notice steam coming out from the spout of the kettle.

Then we hold a metal plate with some ice on it just above the spout of the kettle. Let all the water in the kettle boil off.



*Fig. Evaporation and condensation*

When the steam comes in the contact with the metal plate cooled with ice, it condenses and forms liquid water. The process of conversion of water vapour into its liquid form is called condensation.

After all the water has evaporated, salt is left behind in the kettle.

We have thus, separated salt, sand and water using processes of decantation, filtration, evaporation and condensation.

## 11. CAN WATER DISSOLVE ANY AMOUNT OF A SUBSTANCE

Many substances dissolve in water and form a solution. The solution made in water are called aqueous solutions.

**Activity :** Pour half a cup of water in the beaker. Add one teaspoonful of salt and stir it well, until the salt dissolve completely. Again add a teaspoonful of salt and stir well. Go on adding salt, one teaspoonful at a time and stir.

After adding a few spoons of salt, we find that some salt remains undissolved and settles at the bottom of the beaker. This means that no more salt can be dissolved in the amount of water we have taken. The solution is now said to be **saturated**.

Now, add a small quantity of salt to this saturated solution and heat it.

We find that now salt dissolves in it. Such solution which contains more amount of substances dissolved in it than required to form a saturated solution is called **super saturated solution**. Let this hot solution cool. We notice that salt appear to settle at the bottom of the beaker again.

A solution that contains less amount of solute than required to form a saturated solution is called an **unsaturated solution**.

## EXERCISE-I

## NCERT Essentials

Q.1 What purpose does handpicking serve in the process of separation?

- (i) Filtration
- (ii) Sorting
- (iii) Evaporation
- (iv) Decantation

Q.2 Which of the following substances are commonly separated using the churning method?

- (i) Oil from water
- (ii) Sand from water
- (iii) Cream from milk
- (iv) Oxygen from air

Q.3 Which factor is usually essential for the filtration?

- (i) Apparatus size
- (ii) Presence of air
- (iii) Pore size
- (iv) Temperature of the mixture

Q.4 State with reason(s) whether the following statements are True [T] or False [F]. Also, correct the False statement(s).

- (i) Salt can be separated from salt solution by keeping it under the Sun.
- (ii) Handpicking should be used only when the quantity of one component is less.
- (iii) A mixture of puffed rice and rice grains can be separated by threshing.
- (iv) A mixture of mustard oil and lemon water can be separated by decantation.
- (v) Sieving is used to separate a mixture of rice flour and water.

Q.5 Match the mixtures in Column I with their method of separation in Column II.

Column I		Column II	
(i)	Gram flour mixed with black gram	(a)	Handpicking
(ii)	Chalk powder mixed with water	(b)	Magnetic separation

(iii)	Corn mixed with potatoes	(c)	Decantation
(iv)	Iron powder mixed with sawdust	(d)	Sieving
		(e)	Filtration

Q.6 In what situations would you use decantation instead of filtration to separate solids from liquids?

Q.7 Can you relate the presence of nasal hair to any separation process?

Q.8 During the COVID-19 pandemic, all of us wore masks.

Generally, what material are they made of? What is the role of these masks?

Q.9 A mixture containing potatoes, salt and sawdust has been given to you. Outline a stepwise procedure for separating each component from this mixture.

Q.10 Read the following story titled 'Intelligent Leela' and tick the most appropriate options. Provide a suitable title of your choice for the paragraph.

Leela was working in the farm with her father when she realized that they left their drinking water at home. Before her father felt **thirsty/hungry**, she went to the nearby pond to fetch some **water/grains**. After obtaining some water in the container, she noticed that the water was muddy and **fit/unfit** for drinking. To purify the water, she kept it for some time and then she **filtered/churned** the muddy water using a piece of **paper/muslin cloth**. Leela, then, **cooled/boiled** the water for about 10 minutes in a covered pan. After **cooling/boiling**, she **filtered/churned** it again and made it **fit/unfit** for drinking. She served this water to her father while having food, who blessed her and appreciated her efforts.

**EXERCISE-II****Brain Booster MCQs**

- Q.1** Tea leaves are separated from tea by:  
(A) Decantation (B) Filtration  
(C) Evaporation (D) Condensation
- Q.2** Salt can be obtained from seawater by:  
(A) Filtration (B) Evaporation  
(C) Decantation (D) Sieving
- Q.3** Which method is used to separate butter from curd?  
(A) Churning (B) Filtering  
(C) Evaporation (D) Sieving
- Q.4** Iron nails can be separated from sawdust using:  
(A) Filtration  
(B) Magnetic separation  
(C) Evaporation  
(D) Decantation
- Q.5** The traditional tool used for winnowing is:  
(A) Sieve  
(B) Magnet  
(C) Scoop (bamboo tray)  
(D) Filter paper
- Q.6** Muddy water can be made clear by:  
(A) Filtration  
(B) Evaporation  
(C) Magnetic separation  
(D) Winnowing
- Q.7** The process of removing liquid by tilting is called:  
(A) Sedimentation (B) Decantation  
(C) Filtration (D) Evaporation
- Q.8** Which method would you use to separate oil from water?  
(A) Filtration  
(B) Evaporation  
(C) Decantation  
(D) Magnetic separation
- Q.9** Threshing machines are also called:  
(A) Separators  
(B) Threshers  
(C) Sieves  
(D) Filters
- Q.10** Which method is used to separate different sized particles?  
(A) Sieving  
(B) Magnetic separation  
(C) Decantation  
(D) Evaporation
- Q.11** Winnowing works on the principle of:  
(A) Magnetic attraction  
(B) Difference in weight  
(C) Difference in size  
(D) Difference in color
- Q.12** Which method is used to separate cream from milk?  
(A) Filtration  
(B) Churning  
(C) Evaporation  
(D) Magnetic separation
- Q.13** Tea bags are made of:  
(A) Plastic (B) Metal  
(C) Filter paper (D) Rubber
- Q.14** The process of separating soluble substances from solution is:  
(A) Filtration (B) Evaporation  
(C) Decantation (D) Sieving
- Q.15** Which method combines both threshing and winnowing?  
(A) Handpicking  
(B) Threshing machines  
(C) Sieving  
(D) Filtration
- Q.16** Which method would you use to remove dust from flour?  
(A) Handpicking  
(B) Sieving  
(C) Magnetic separation  
(D) Evaporation
- Q.17** The traditional method of obtaining salt from seawater involves:  
(A) Filtration  
(B) Natural evaporation  
(C) Magnetic separation  
(D) Sieving

- Q.18** Which property is NOT used for handpicking?  
(A) Size  
(B) Color  
(C) Shape  
(D) Magnetic attraction
- Q.19** The process of separating grain from chaff using wind is:  
(A) Threshing  
(B) Winnowing  
(C) Sieving  
(D) Handpicking
- Q.20** Sieving is NOT suitable for separating:  
(A) Sand from gravel  
(B) Rice from stones  
(C) Salt from water  
(D) Flour from bran
- Q.21** COVID-19 masks work on the principle of:  
(A) Magnetic separation  
(B) Filtration  
(C) Evaporation  
(D) Sedimentation
- Q.22** Which method would be used to separate coconut pieces from rice flour?  
(A) Magnetic separation  
(B) Filtration  
(C) Sieving  
(D) Evaporation
- Q.23** The liquid that remains after decantation is:  
(A) Clear liquid  
(B) Muddy liquid  
(C) Sediment  
(D) Residue
- Q.24** Which separation method is used by fishermen?  
(A) Sieving  
(B) Filtration  
(C) Magnetic separation  
(D) Decantation
- Q.25** Sour milk can be processed using:  
(A) Filtration  
(B) Evaporation  
(C) Churning  
(D) Magnetic separation
- Q.26** Methods of separation of components from a mixture are:  
(A) only one  
(B) only two  
(C) only three  
(D) many
- Q.27** Method of separation of grains from stalks is :  
(A) winnowing  
(B) threshing  
(C) handpicking  
(D) sieving
- Q.28** The process of separation of tea leaves by strainer is called :  
(A) filtration  
(B) sedimentation  
(C) evaporation  
(D) condensation
- Q.29** The process of conversion of water into vapour is called :  
(A) evaporation  
(B) condensation  
(C) both of them  
(D) none of them
- Q.30** When no more salt dissolves in water at a particular temperature then the solution at that temperature is called:  
(A) unsaturated  
(B) saturated  
(C) sometimes saturated sometimes unsaturated  
(D) none of them
- Q.31** Butter is separated from milk by  
(A) sedimentation (B) filtration  
(C) churning (D) decantation
- Q.32** Filtration is a method to separate the components of a  
(A) solution  
(B) mixture of a liquid and an insoluble substance  
(C) both (A) and (B)  
(D) pure substance
- Q.33** Threshing is done by  
(A) beating  
(B) bullocks  
(C) machines  
(D) all of these

- Q.34** Which method is used to separate pebbles and stones from sand ?  
(A) handpicking (B) Winnowing  
(C) Sieving (D) Any of these
- Q.35** The components of a solution (say sugar in water) can be separated by  
(A) filtration (B) evaporation  
(C) sedimentation (D) decantation
- Q.36** Sand from water is separated by  
(A) sieving  
(B) evaporation  
(C) filtration  
(D) sedimentation and decantation
- Q.37** The process of conversion of water vapours into liquid is called  
(A) condensation  
(B) decantation  
(C) sedimentation  
(D) evaporation
- Q.38** The process of conversion of water into its vapours is called  
(A) evaporation  
(B) condensation  
(C) guttation  
(D) transpiration
- Q.39** A mixture of ammonium chloride and sand is separated by  
(A) evaporation  
(B) decantation  
(C) sublimation  
(D) filtration
- Q.40** The property which forms the basis of sieving  
(A) difference in weight  
(B) difference in colour  
(C) difference in shape  
(D) difference in size

## EXERCISE-III

## Concept Check

## TRUE/FALSE QUESTIONS

- Q.1** Tea bags work on the principle of filtration. T/F
- Q.2** Churning is used to separate butter from curd. T/F
- Q.3** Sieving can separate oil from water. T/F
- Q.4** Filter paper has very fine pores. T/F
- Q.5** Threshing machines perform both threshing and winnowing. T/F

## FILL IN THE BLANKS

- Q.1** Cream is separated from milk by \_\_\_\_\_.
- Q.2** Common salt is obtained from sea water by \_\_\_\_\_.
- Q.3** Husk is separated from rice by \_\_\_\_\_.
- Q.4** The method used to settle down the suspended particles in muddy water is called \_\_\_\_\_.
- Q.5** Peanuts are separated from a mixture of wheat and peanut by \_\_\_\_\_.

## ASSERTION &amp; REASON

**Instructions:** Choose the correct option:

- (A) Both assertion and reason are true, and reason is correct explanation of assertion
- (B) Both assertion and reason are true, but reason is not correct explanation of assertion
- (C) Assertion is true but reason is false
- (D) Assertion is false but reason is true

- Q.1** **Assertion:** Modern threshing machines save time and labor.  
**Reason:** They perform multiple separation processes simultaneously.
- Q.2** **Assertion:** Soop (bamboo tray) is used for winnowing.  
**Reason:** Its design allows effective separation by wind.
- Q.3** **Assertion:** Filtration can remove bacteria from water.  
**Reason:** Bacteria are larger than the pores in filter paper.

- Q.4** **Assertion:** Evaporation occurs only when water is heated.  
**Reason:** Heat is required to convert liquid to vapor.
- Q.5** **Assertion:** Crystallization is related to evaporation.  
**Reason:** When solution evaporates, dissolved substance forms crystals.

## CASE STUDY

## Case Study 1: Industrial Applications

A recycling plant receives mixed waste containing paper, plastic, iron pieces, and glass. The plant needs to separate these materials for recycling.

- Q.1** Which method would be most effective for separating iron pieces?  
(A) Sieving  
(B) Magnetic separation  
(C) Filtration  
(D) Decantation
- Q.2** To separate different sized particles, which method would be used?  
(A) Magnetic separation  
(B) Filtration  
(C) Sieving  
(D) Evaporation
- Q.3** The separation of iron using magnets is based on:  
(A) Size difference  
(B) Color difference  
(C) Magnetic properties  
(D) Weight difference
- Q.4** This recycling process helps in:  
(A) Waste reduction  
(B) Resource conservation  
(C) Environmental protection  
(D) All of the above

## MATCH THE COLUMNS

- Q.1** Match the tools with their separation methods:

Column A		Column B	
(a)	Soop (bamboo tray)	(p)	Filtration
(b)	Magnet	(q)	Winnowing
(c)	Sieve	(r)	Magnetic separation
(d)	Filter paper	(s)	Sieving

**Q.2** Match the mixtures with suitable separation methods:

Column A		Column B	
(a)	Rice and stones	(p)	Filtration
(b)	Muddy water	(q)	Winnowing
(c)	Salt solution	(r)	Magnetic separation
(d)	Iron filings and sand	(s)	Sieving

**Q.3** Match the terms with their definitions:

Column A		Column B	
(a)	Filtrate	(p)	Solid left on filter
(b)	Residue	(q)	Liquid that passes through filter
(c)	Sediment	(r)	Settled particles at bottom
(d)	Threshing	(s)	Beating stalks to remove grains

**Q.4 Match the column**

**Column–A**

- The method of separating slightly larger sized impurities.
- The process that is used to separate grain from stalks.

(c) The method used to separate heavier and lighter components from a mixture

(d) The process of conversion of water into its vapour

**Column–B**

- Winnowing
  - evaporation
  - Threshing
  - handpicking
- (A) (a)-(r), (b)-(q), (c)-(s), (d)-(r)  
 (B) (a)-(s), (b)-(r), (c)-(p), (d)-(q)  
 (C) (a)-(s), (b)-(r), (c)-(q), (d)-(p)  
 (D) (a)-(p), (b)-(r), (c)-(s), (d)-(q)

**Q.5 Column–A**

- condensation
- sieving
- sedimentation
- churning

**Column–B**

- Separating butter from milk
  - Settling of heavier components at bottom
  - The process of conversion of water vapour into its liquid
  - Separating bran from flour
- (A) (a)-(r), (b)-(s), (c)-(q), (d)-(p)  
 (B) (a)-(q), (b)-(s), (c)-(p), (d)-(r)  
 (C) (a)-(s), (b)-(r), (c)-(q), (d)-(p)  
 (D) (a)-(p), (b)-(r), (c)-(s), (d)-(q)

**EXERCISE-IV****Subjective Assessment****VERY SHORT TYPE QUESTIONS :**

- Q.1** What is strainer?
- Q.2** Name the method used to separate cream from curd.
- Q.3** How will you separate mango from a mixture of mango and apple?
- Q.4** You are given a mixture of salt and sand. Can you separate them by picking?
- Q.5** Name the method used to separate the pieces of stone from grain.
- Q.6** How can you separate grains from stalk?
- Q.7** What types of material can we separate by using handpicking?
- Q.8** Name the other methods used to separate solid materials of different size.
- Q.9** Name the process used to separate heavier and lighter components of a mixture.
- Q.10** Can the above stated method be used if both the components have same weight?
- Q.11** What is evaporation?
- Q.12** Name the method by which we get salt from ocean water.
- Q.13** Define condensation.
- Q.14** Write opposite process of evaporation.
- Q.15** What is mixture ?

**SHORT TYPE QUESTIONS:**

- Q.16** Define the term handpicking.
- Q.17** How will you separate oil and water from their mixture ?
- Q.18** What is evaporation?
- Q.19** The following diagram shows the method used in taking out butter from milk and curd. Answer the questions after observing the diagram carefully.
- Q.20** Write various methods of separation of components from their mixture.

**LONG TYPE QUESTIONS:**

- Q.21** Explain the method that can be used for separating the following mixture :
- (i) Sand and husk
  - (ii) Wheat, sugar and stalk
  - (iii) Water and petrol
  - (iv) Rice and salt
  - (v) Sand and salt
- Q.22** Describe the process of separation of salt from sea water.
- Q.23** Explain the saturated supersaturated and unsaturated solution. also write its example.
- Q.24** Identify process of to obtain butter from curd or milk is which one process and explain it.
- Q.25** Explain the process 'sedimentation' 'decantation' and 'filtration'.

<b>ANSWER KEY</b>
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<b>EXERCISE-II</b>
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<b>Q.1</b>	(B)	<b>Q.2</b>	(B)	<b>Q.3</b>	(A)	<b>Q.4</b>	(B)	<b>Q.5</b>	(C)	<b>Q.6</b>	(A)	<b>Q.7</b>	(B)
<b>Q.8</b>	(C)	<b>Q.9</b>	(B)	<b>Q.10</b>	(A)	<b>Q.11</b>	(B)	<b>Q.12</b>	(B)	<b>Q.13</b>	(C)	<b>Q.14</b>	(B)
<b>Q.15</b>	(B)	<b>Q.16</b>	(B)	<b>Q.17</b>	(B)	<b>Q.18</b>	(D)	<b>Q.19</b>	(B)	<b>Q.20</b>	(C)	<b>Q.21</b>	(B)
<b>Q.22</b>	(C)	<b>Q.23</b>	(A)	<b>Q.24</b>	(D)	<b>Q.25</b>	(C)	<b>Q.26</b>	(D)	<b>Q.27</b>	(B)	<b>Q.28</b>	(A)
<b>Q.29</b>	(A)	<b>Q.30</b>	(B)	<b>Q.31</b>	(C)	<b>Q.32</b>	(B)	<b>Q.33</b>	(D)	<b>Q.34</b>	(C)	<b>Q.35</b>	(B)
<b>Q.36</b>	(D)	<b>Q.37</b>	(A)	<b>Q.38</b>	(A)	<b>Q.39</b>	(C)	<b>Q.40</b>	(D)				

<b>EXERCISE-III</b>
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<b>TRUE/FALSE QUESTIONS</b>
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<b>Q.1</b>	(T)	<b>Q.2</b>	(T)	<b>Q.3</b>	(F)	<b>Q.4</b>	(T)	<b>Q.5</b>	(T)
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<b>FILL IN THE BLANKS</b>
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<b>Q.1</b>	churning	<b>Q.2</b>	evaporation	<b>Q.3</b>	winnowing
<b>Q.4</b>	loading and decantation	<b>Q.5</b>	handpicking		

<b>ASSERTION &amp; REASON</b>
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<b>Q.1</b>	(A)	<b>Q.2</b>	(A)	<b>Q.3</b>	(C)	<b>Q.4</b>	(D)	<b>Q.5</b>	(A)
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<b>CASE STUDY</b>
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<b>Case Study 1: Industrial Applications</b>
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<b>Q.1</b>	(B) Magnetic separation	<b>Q.3</b>	(C) Magnetic properties
<b>Q.2</b>	(C) Sieving	<b>Q.4</b>	(D) All of the above

<b>MATCH THE COLUMNS</b>
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<b>Q.1 Match the tools with their separation methods:</b>
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- Soop (bamboo tray) → Winnowing
- Magnet → Magnetic separation
- Sieve → Sieving
- Filter paper → Filtration

<b>Q.2 Match the mixtures with suitable separation methods:</b>
---

- Rice and stones → Handpicking
- Muddy water → Filtration
- Salt solution → Evaporation
- Iron filings and sand → Magnetic separation

<b>Q.3 Match the terms with their definitions:</b>
--

- Filtrate → Liquid that passes through filter
- Residue → Solid left on filter
- Sediment → Settled particles at bottom
- Threshing → Beating stalks to remove

<b>Q.4</b>	B	<b>Q.5</b>	A
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# 2. Diversity in the Living World

## 1. INTRODUCTION

Diversity in the living world refers to the wide variety of living organisms found on Earth. It includes different kinds of plants, animals, and even tiny life forms like bacteria and viruses that cannot be seen with the naked eye. Living organisms are found in many habitats such as forests, oceans, deserts, and grasslands. Each organism is unique and adapted to its surroundings. Because of this variety, living beings can be grouped and classified based on their similarities and differences.

## 2. DIVERISTY IN PLANTS AND ANIMALS

We see different types of plants and animals around us, showing great diversity in nature. Some plants are small while others are big; some have green leaves, while others have colourful leaves. Similarly, animals also differ in size, shape, colour, and habits. Some plants have huge red flowers, while others have small blue ones. These differences help plants and animals survive in different surroundings. By observing their features such as leaves, stems, flowers, body structure, and habitats, we can understand the wide diversity present in plants and animals around us.



(a) Grass



(b) Tulsi (Holy Basil)



(c) Hibiscus (Gudhal)

S. no.	Local name of plant	Stem	Leaves (shape/ arrangement of leaves)	Flowers	Any other observations and features
1.	Common grass	Soft and thin	A single leaf grows alternatively from different points on the stem		Green leaves
2.	Tulsi	Hard and thin	Arrangement of a pair of leaves in the opposite directions	Pinkish purple	
3.	Hibiscus	Hard			
4.	Neem	Hard and thick			Leaves with smooth surface
5.	Any other				

Animals show great diversity in their living places, food habits, and movements. Some animals live on land, some live in water, while others live both on land and in water. Birds usually live on trees, fishes live in water, and animals like frogs and crocodiles can live on land as well as in water. Animals also differ in the kind of food they eat and the way they move, such as walking, running, flying, or swimming. These differences help animals survive in different environments and show the diversity present among animals.

Name of the animal (local name)	Place where they live	Food they eat	The way they move around	Any other observations and features
Crow	Tree	Insects	Fly and walk	Carrying a twig in its beak
Ant	Nest in soil and burrow	Leaves, seeds and insects		Have six legs
Cow		Grasses, leaves		
Any other				

The variety of plants and animals found in a region is called biodiversity. Biodiversity includes different species of plants, animals, and microorganisms living together on Earth. It helps in maintaining a healthy and balanced ecosystem, as different organisms depend on one another. Trees provide food and shelter to animals, while animals help plants by spreading seeds. Bees help in pollination by carrying pollen from one flower to another. Thus, biodiversity plays an important role in supporting life and keeping the environment balanced.

### 3. TYPE OF PLANTS

On the basis of their size and shape, plants have been divided into the following three categories.

#### I. Herbs

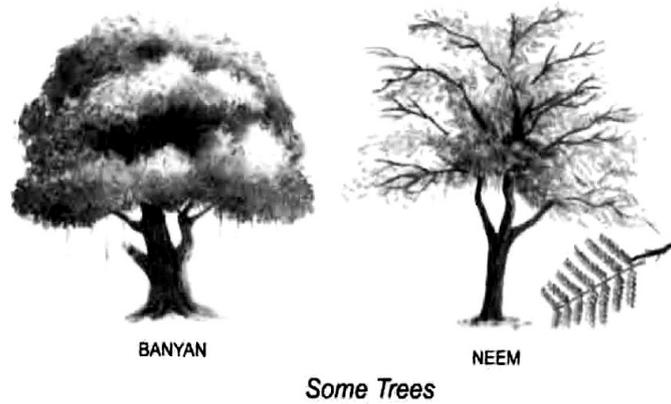
#### II. Shrubs

#### III. Trees

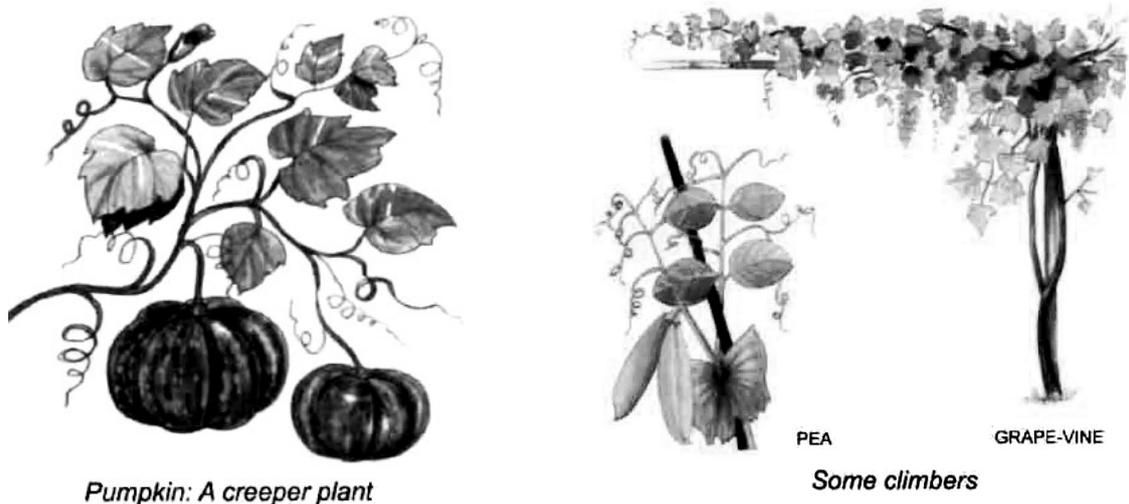
#### IV Creepers

#### V. Climbers

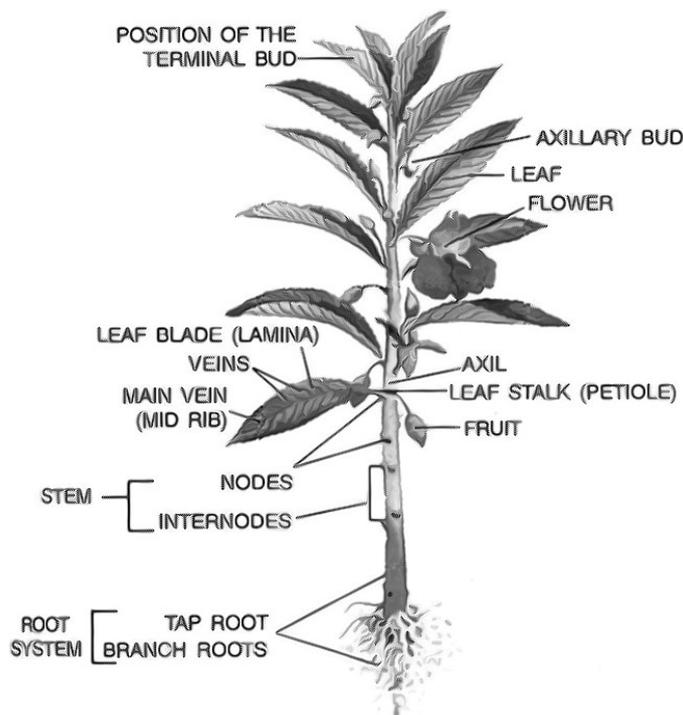
- I. **Herbs** : Plants which have soft, green and perishable stems are called herbs. They are generally smaller in size, they are not more than one metre in height and may live for 1-2 seasons. Examples of some herbs are grass, maize, rice, mint, coriander, etc.
- II. **Shrubs** : Plants with woody stems, with branches of almost equal size arising from the stem immediately above the soil are called shrubs. They look like bushes and are medium-sized plants. They survive for many years, though less than trees. Example : China rose, lemon, pomegranate, jasmine, nerium, etc.
- III. **Tree** : The trees are tall and big plants. They have one hard woody stem called trunk. It bears woody branches, twigs and leaves at some distance above the ground. Coconut and palm are also trees, though they do not contain branches. Trees generally survive for many years. Examples : Mango, neem, palm, banyan, etc.



- IV. **Creepers** : Plants with weak stems that can not stand upright and spread on the ground are called creepers eg. Bottle gourd, bitter gourd, pumpkin.
- V. **Climbers** : Plants which take support on neighbouring structure and climb up are called climbers eg. Betel, grapes, Money plants.



- 4. **PARTS OF FLOWERING PLANTS**
  - I. Stem
  - II. Leaves
  - III. Roots
  - IV. Flower
  - V. Seeds
  - VI. Fruit



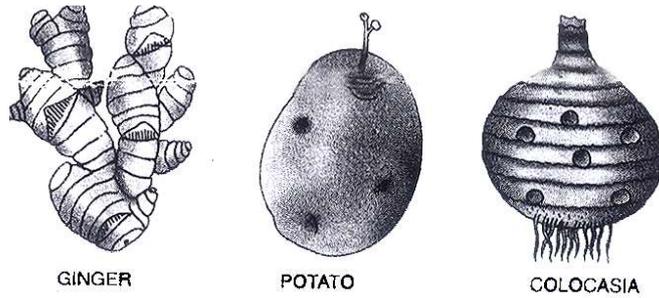
**Parts of a Plant**

### I. Stem :

- The shoot is the aerial part on which buds, leaves, flowers and fruits are borne.
- It grows from the plumule of the embryo of a seed.
- It forms the main axis that connects the root system with the rest of the plant body.
- It grows away from the soil and towards sunlight.
- The stem may be branched or unbranched.
- The young stem is usually green and soft though it is hard and woody in some plants.
- Stem conduct water.
- Minerals dissolved in water also move up in the stem along with the water.
- The water and minerals go to leaves and other plant part attached to the stem through narrow tube inside the stem.
- The stem conducts water from roots to the leaves (and other parts) and food from leaves to other parts of the plant.
- The leaves grow on the stem at definite points called **nodes**.
- There may be one or more leaves at a node.
- The part of the stem between two successive nodes is the **internode**.
- The angle formed between the base of a leaf and the stem is termed as leaf **axil**.

#### (A) Primary Function of Stem :

- (i) **Support** : It supports branches, leaves, flowers, fruits and buds.
- (ii) **Transportation** : It helps in the transportation of water and minerals salts absorbed by the roots of the plant and helps in supply of food from the leaves to various parts of the plant.
- (iii) **Food storage** : The stem also functions as the storehouse of food material as in case of potato, garlic, ginger.



Some storage stems

- (iv) **Climbing** : In weak plants like the gourd, bitter gourd the stem gets modified to form tendrils which help the climbers in climbing.
- (v) **Photosynthesis** : The green stem can make food for the plant as in the case of cactus.
- (vi) **Perennation** : Certain underground stems like potato, garlic and ginger help the plant to tide over unfavourable climatic conditions this is called perennation.

**(B) Secondary Function of Stem :**

- (i) **Support** : In plant such as bean, cucurbita, sweet potato and morning glory the stem spirals around a support as it is weak and slender. Climbers are also known as **twinnners**.



Tendril in a cucurbita plant

- (ii) **Making food** : In plants such as cacti which grow in dry climates, leaves are reduced to spines or scales to prevent loss of water. Such plants have a flattened or cylindrical green stem to manufacture food. This kind of stem is called **phylloclade**. It also stores food and water for the plant.



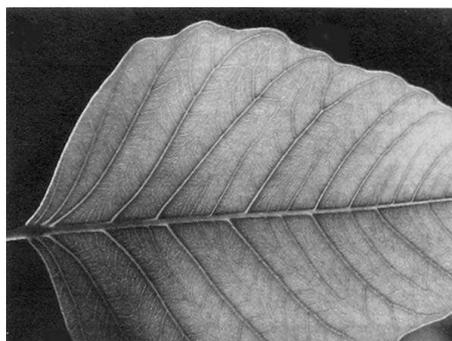
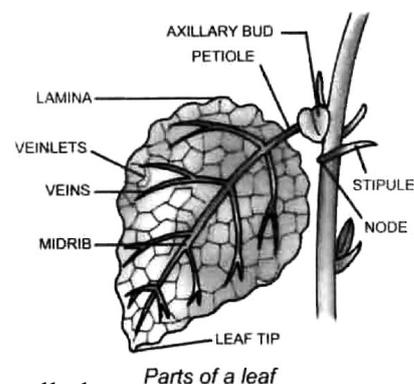
Phylloclade

- (iii) **Storage of Food** : In some plants the entire stem remains underground and only leaves and flowering shoots are seen above the ground. It is thickened to store excess food which helps plants to survive through long bad seasons. Examples are ginger, potato and onion. Potato, onion and ginger not considered as root. These have node and internodes and scaly leaves.

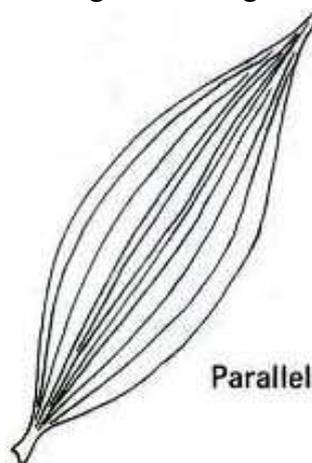
## II. Leaf :

- The following parts of a leaf :

- (i) **Petiole** : The parts of a leaf by which it is attached to the stem is called petiole.
- (ii) **Lamina** : The broad green part of the leaf is called lamina
- (iii) **Veins** : Lines on the leaf are called veins.
- (iv) **Midrib** : A thick vein in the middle of the leaf called the midrib.
- (v) **Leaf venation** : The design made by veins in a leaf is called the leaf venation. It is mainly two types :
- (a) **Reticulate venation** : If leaf design made by veins in a leaf is net like on both sides of midrib the venation called Reticulate.e.g. Leaves of Mango, Pea etc.



- (b) **Parallel venation** : If veins are parallel to one another in a leaf then venation called parallel venation. e.g. leaves of grass.



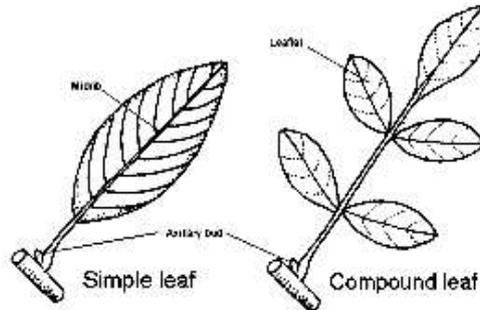
### (A) Types of Leaf

**(i) Simple leaves :**

A simple leaf is one that consist of a single lamina, which is not divided into segments. Plants like mango, guava and money plant have simple leaves.

**(ii) Compound leaves :**

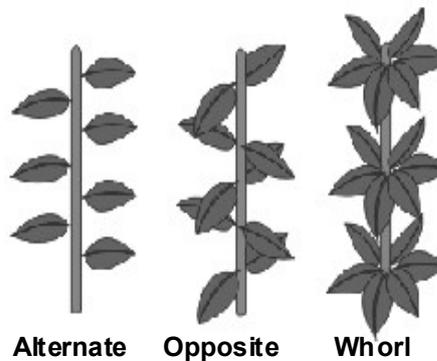
A compound leaf is one in which the lamina is divided into several small segments or leaflet each attached to the same petiole. The leaflet may be arranged on opposite sides of the petiole like in rose and neem or may arise from a common point at the petiole like in palm leaves.

**(B) Arrangement of Leaf**

**Phyllotaxy :** Arrangement of leaves on stem at each node is called phyllotaxy.

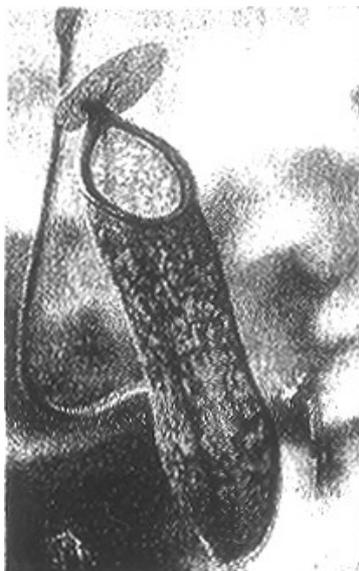
Leaves can be arranged along the stem in different ways.

- (i) Alternate arrangement :** In some plant, a single leaf grows from each point e.g. Mango, sunflower and mustard.
- (ii) Opposite arrangement :** In some plants two leaves grow opposite to each other from the same node. e.g. Guava and Tulsi.
- (iii) Whorled arrangement :** In some plans, three or more leaves grow from the same node.e.g. nerium and asparagus.

**(C) Modification of the Leaf**

- (i) Leaf tendrils :** In plants like pea and sweet pea leaves are modified into long, slender, coiled structures called tendrils.
  - These are used by the plants for climbing.
  - Leaves are fully or partly modified to help the plant climb and support.
- (ii) Leaf spines :** In cacti and plants such as pineapple the leaves are modified into spines that are sharp, pointed structures.
  - These structure protect the plant from grazing animals.
  - In dry area, the leaves are reduced to spines to prevent loss of water by transpiration.
- (iii) Leaves modified to eat insects :** In some insectivorous plants, the leaves are modified into pitcher or bladder like structures to trap, hold and digest insect and small animals.

- These trapped insect are digested within these structures and serve as a source of nitrogen to the plant.



**Pitcher plant**

**(D) Functions of Leaf :**

- (i) **Manufacturing of Food :** The leaf is called “the food factory” of a plant . Green plants make their own food by the process of photosynthesis. Leaves prepare their food in the presence of sunlight and green coloured substance (chlorophyll) present in them by utilizing carbon dioxide and water by releasing oxygen.
- (ii) **Transpiration :** The excess of water absorbed by the root hairs lost through the stomata. Process through which water comes out of leaves in the form of vapour. Plants release a lot of water into the air through this process.
- (iii) **Gaseous exchange :** Exchange of gases occurs during respiration and photosynthesis.
- (iv) **Vegetative propagation :** In some plants, leaves bear buds in the marginal notches from which new plants grow and develop. eg. *Bryophyllum*, *Begonia*.
- (v) Leaves reduced to spines in a cactus plant. In a xerophytic plant, this modification helps to reduce water loss from the plant body.

Stem is fleshy and green in a cactus plant. Stem takes over the function of leaves as the leaves are reduced to spines.

**III. Root :**

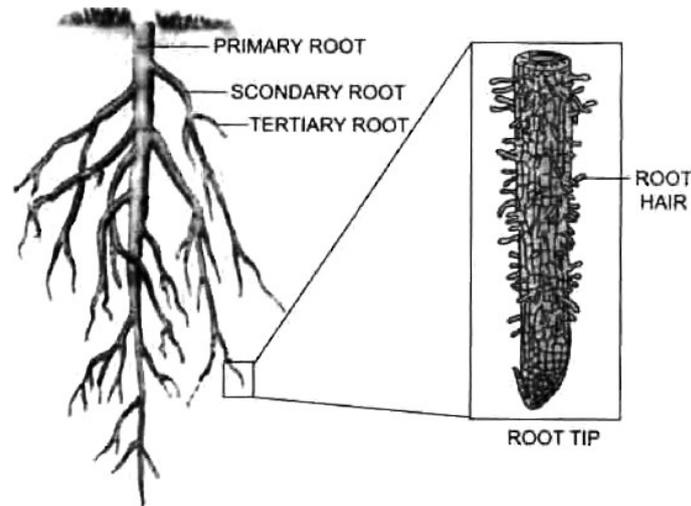
The roots help in holding the plant firmly in the soil they are said to anchor the plant to the soil.

**(A) Types of Roots**

- (i) Tap roots**                      **(ii) Fibrous Roots**

- (i) **Tap root system :** When a dicot seed (seeds with two seed leaves) germinates, the radicle gives rise to a long deep - seated root. It is thick and large this is called the primary root or tap root.
  - The primary root gets divided into branches which are known as secondary roots.
  - The branches of secondary roots are called tertiary roots
  - The primary root is longer than its branches and grows vertically downward into the soil.

- It is found in most of the dicot plants like castor, pea, mango, gram and beans.



*Tap root system*

**(ii) Fibrous Root system**

- In the fibrous root, the primary root is short - lived and is replaced by a cluster of thin fibre like roots. These are called fibrous roots.
- These roots spread from a common point and are about the same size.
- They spread out in the soil and give firm support to the plant.
- They are found in most of the monocot plants. (Plants that have seeds with single seed - leaf) Like wheat, maize, barley and grasses.



*Fibrous root system*

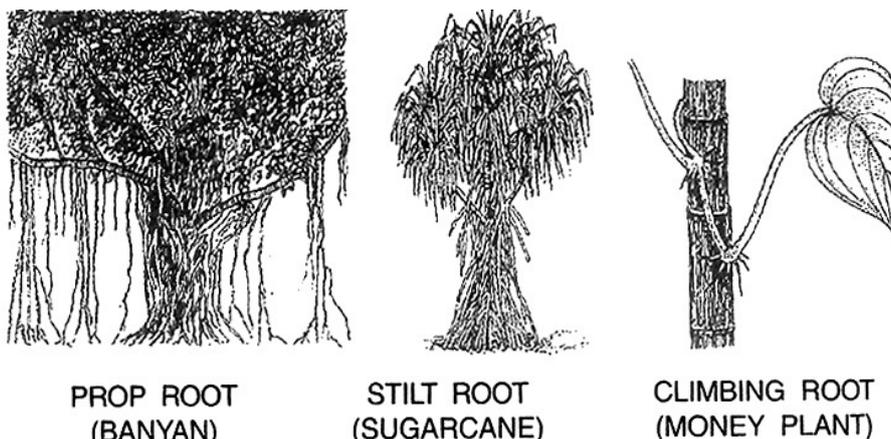


**Let's know**

**Leaf venation and the type of roots in a plant are related :** Plants having leaves with reticulate venation have tap root while plants having leaves with parallel venation have fibrous roots.

**(iii) Supporting Roots**

- In plants such as black pepper, money plant and betel the roots help the plant to climb up a support as the stems are too weak to stand on their own Hence they are known as climbing roots
- In plant such as banyan new roots grow downwards from the main stem or branches. These are aerial roots that grown towards the soil and act as pillar to support the plant. They are known as prop roots.



**Modification of roots for support**

**(iv) Sucking Roots**

Plants such as dodder are non-green (golden yellow) and without normal roots. They do not prepare their own food and live as parasite on other green host plants. They bear specialized roots arising from their stem. These roots penetrate into the stem of the host, at the points where they come in close contact and suck water and nutrients from the body of the host. Dodder is a parasite. The organism which supports a parasite with nutrition is called a **host**. The roots helping a parasite in sucking water and food from a host are called **sucking or parasitic roots**.



**(B) Function of Roots**

- (i) **Fixation** : It fixes the plant firmly in the soil.
- (ii) **Absorption** : The root hairs help in the absorption of water and minerals from the soil.
- (ii) **Prevention of soil erosion** : Roots bind the soil finely and prevent soil erosion
- (iv) **Storage** : In plant like carrot, turnip, radish and sweet potato and tapioca, the roots are modified for the storage of food.

<b>DIFFERENCES BETWEEN ROOT AND STEM</b>	
<b>Root</b>	<b>Stem</b>
Nodes and internodes absent.	Nodes and internodes present.
Never green.	Often green.
Leaves and buds absent.	Bears leaves and buds.
Generally develops below ground.	Generally develops above ground.

**IV. Flower :**

- The Flower is the site of sexual reproduction in plants .
- A flower may be defined as a modified shoot in which nodes and internodes are highly condensed.
- It develops from the floral bud.
- **Parts of a Flower :** Flowers vary in size, shape and colour but all flowers have the same basic parts. A Flower consists of following parts :
  - Pedicel and Thalamus
  - Calyx or Sepals
  - Corolla or Petiols
  - Androecium / stamen / Male Reproductive organ
  - Gynoecium / Pistils/ Female Reproductive organ.

**(A) Pedicel and Thalamus :**

- The Flower is borne on a stalk called pedicel.
- The upper most end of the pedicel is some what swollen. This swollen part of the pedicel is known as the Thalamus.
- It bears all the four whorls of a flower.

**(B) Calyx :** It is the First outermost whorl of a Flower.

- It consist of leaf like structures called sepals.
- Sepals are generally green in colour and manufacture food.
- They also protect the new delicate inner parts of the flower during the bud stage.

**(C) Corolla :** It is the second whorl of a flower.

- Each segment of the corolla is known as a petals.
- Petals are usually brightly coloured due to the presence of pigments.
- The bright colour, sweet smell and nectar attract the insect which in turn, help in pollination.

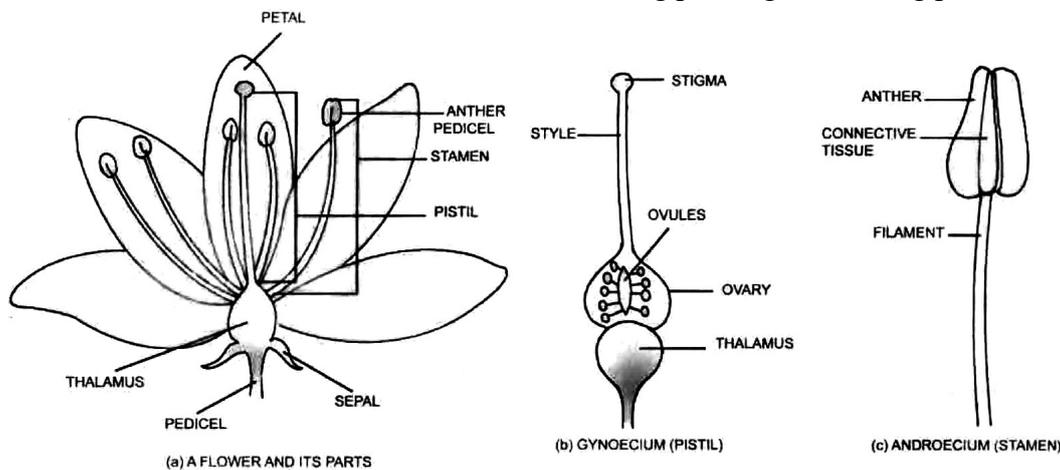
**(D) Androecium / stamen / male Reproductive organ :**

- It is the third floral whorl which is composed of one or more male reproductive organs called stamen A typical stamen is differentiated into three parts they are filament, connective and anther.
  - (i) Filament :** It forms the stalk that bears more or less cylindrical or ovoid anther
  - (ii) Connective :** It connects anther to filament.
  - (iii) Anther :** It is present on the top of filament. Each anther consist of two lobes that is why it is called as bilobed.
    - Each anther lobe has two pollen sac which contain millions of tiny microscopic pollen grain, called as microspores.
    - The pollen grains are like yellow dusty powder in appearance.

**(E) Gynoecium / pistil / Female Reproductive organ :**

- It is located in the centre of flower.
- The gynoecium is the fourth whorl which is composed of one or more carpels.
- The freely occuring units of the carpels in a flower are called pistils .
- Each pistil usually consist of three distinct parts :
  - (i) Ovary      (ii) Style      (iii) Stigma**
  - (i) Ovary :** It is a basal swollen part of the pistil. The ovary bears the ovules on a raised tissue called the placenta. Each ovule contains the female reproductive cell.

- (ii) **Style** : From the top of the ovary arise a long elongated structure which connects the stigma with ovary. It is meant for raising the level of the stigma.
- (iii) **Stigma** : The terminal end of style is called as stigma.
- The stigma is normally rough, hairy and sticky.
  - It is meant for receiving pollen grains during pollination.



Parts of a flower

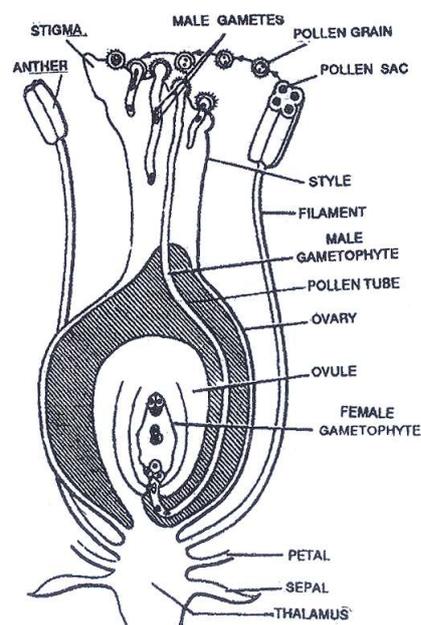
**NOTE** : Structure of the flower is not always the same. The number of sepals, petals, stamens and pistils may also be different in different flowers. Sometimes, some of these parts may even be absent. When choosing flowers to study, avoid using Marigold, chrysanthemum and sun flower. These are not single flowers but group of flowers.

### ➤ **Reproduction :**

- Flower is a reproductive unit of a plant and it grows into the fruit which bears seeds.
  - A typical flower possesses male and female reproductive organs.
  - The male sex cells are contained in the pollen grains found in the anther.
  - The Female sex cells are contained in the ovules found in the ovaries.
  - **Pollination** : Pollen grains are transferred from the anther to the stigma by a process called pollination.
  - **Fertilization** : After pollination, a male cell and a female cell fuse together and this process is called fertilization.
  - Under favourable conditions seed germinate and give rise to seedling which develop into new plants.
- This process is called sexual Reproduction.

### ➤ **Usefulness of flowers For Human Beings :-**

- Aesthetic** : Flowering plants are grown in houses gardens , parks and roadside for their brilliant colour, beautiful shapes and sweet smell.
- Perfumes or scents** : Flowers yield perfumes or scents. The common ones are rose, Jasmine .
- Spices** : cloves, so often used as a spice and in medicine, are the dried Flower buds of the clove plant.



Fertilisation in Plant

### V. **Seed :**

- After fertilization an ovule develops into an seed

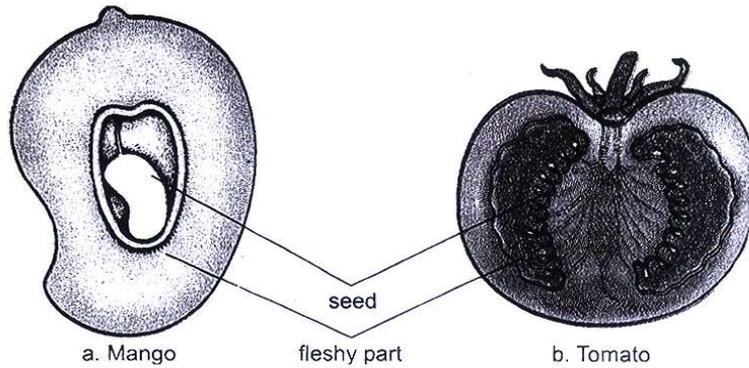
- The seed contains stored food which is used in the development of a new plant.

**(A) The Seed contains**

- A seed contains the plumule which grows into the shoot and the radicle which grows into the root.
- Seed has one or two seed leaves or cotyledons which contain food for the baby plant.
- A seed coat that generally covers the seed and it protects the seed

**VI. Fruit :**

- The fruit is ovary of the flower develops into fruit and the ovules in it become seeds after fertilization.
- A fruit is actually a ripened ovary and seeds are ripened ovules of a flower.



**Cut section of Mango and Tomato**

**5. GROUPING OF ANIMALS**

**Types of movements in animals**

Movement is the change in position of a part of the body. Animals move in variety of ways like running, jumping, hopping, flying, creeping, crawling, slithering, etc. They may use legs, wings, other body parts for moving.

S. no.	Name of the animal	Type of movement	Body parts used for movement
1.	Ant		Legs
2.	Goat	Walks and jumps	Legs
3.	Pigeon	Walks and flies	Legs and wings
4.	Housefly	Walks and flies	Legs and wings
5.	Fish		Fins
6.	Any other		
7.			
8.			

**Table : Movements in animals and their body parts involved**

**Know a scientist**

Janaki Ammal (1897–1984) was an Indian botanist dedicated to environmental work and helped to document and preserve India’s rich plant biodiversity. She played a key role in the ‘Save Silent Valley’ movement. As the head of the Botanical Survey of India, she initiated programmes to document the plant diversity of India.

**6. TYPES OF MOVEMENT AND ANIMALS**

Movement in animals refers to a change in the position of the whole body or any part of the body. Animals move in different ways depending on their body structure and surroundings. Some animals move by walking, running, hopping, or jumping on land, while others crawl, slither, or wriggle. Birds fly using their wings, and fish swim with the help of fins. Animals use different body parts such as legs, wings, fins, or muscles to move from one place to another. Movement helps animals search for food, escape from enemies, and find shelter.

S. no.	Name of the animal	Type of movement	Body parts used for movement
1.	Ant		Legs
2.	Goat	Walks and jumps	Legs
3.	Pigeon	Walks and flies	Legs and wings
4.	Housefly	Walks and flies	Legs and wings
5.	Fish		Fins
6.	Any other		
7.			
8.			

**7. HABITAT AND ADAPTATION (FULL)****I. Habitat :**

The term habitat refers to the surroundings where organisms live. Every habitat is home for a certain living creature. Plants and animals have different features that help them to survive in their own habitat.

**(A) Components Of Habitat :**

- (i) **Biotic component** : All living things of habitat are included in biotic component. E.g.: all plants and animals.
- (ii) **Abiotic component** : All non living things of habitat are included in abiotic component. E.g.: light, temperature, water, air, soil, fire etc.

**(B) Types Of Habitats :**

Habitats are divided into different groups

- (i) **Terrestrial habitats** : They are places on land where all plants and animals live and survive.

Three types of terrestrial habitats include

- (a) Desert                      (b) Mountains                      (c) Forest and grassland

- (ii) **Aquatic habitats** : They are places in water bodies where animals and plants survive.

2 types of aquatic habitat are found on earth

- (a) **Fresh water habitats** include pond, river, puddles, swamps etc.  
(b) **Marine water habitats** include sea, ocean, lake etc.

- (C) **Arboreal habitat** : It includes habitats on trees. Organisms that live on trees like monkeys and squirrels are arboreal organisms.

## II. Adaptation :

Plants and animals develop certain features or certain habits that help them survive in their surroundings, and this is known as adaptation. Different living creatures adapt to their habitats in different ways. For example, fish have gills that help them to live in water and use the oxygen dissolved in it. Plants that live in water have special tissues that help to take in dissolved gas from water. For example the ulva has **ribbon-like leaves**.

It takes thousands of years for a living being to adapt to its habitat.

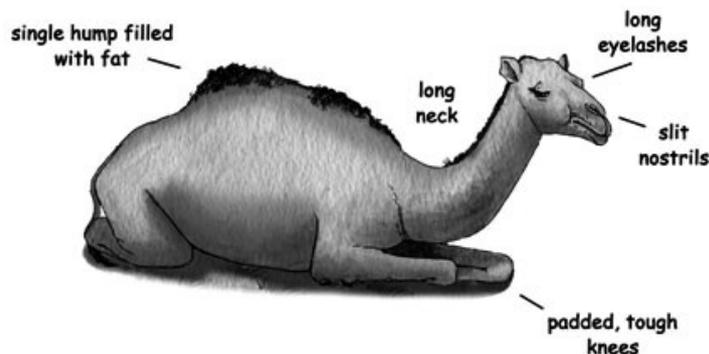
### (A) Adaptation in different habitats :

#### (i) Terrestrial Habitats :

- (a) **Deserts** : Desert is a water depleted area so basically plants and animals are adapted for little or less of water. Deserts are areas which receive very little rainfall. **Sahara** and **Kalahari** are two examples of deserts. Deserts are very hot and dry. Camels, cactus, date palm tree, rattle snake, are example of organisms found in deserts.

#### (a. i) Adaptation In Desert Animals and Plants :

- Desert animals include camel, rats and snakes.
- To stay away from the intense heat during the day, rats and snakes stay in burrows deep in the sand. They come out only during the night, when it is cooler (**Nocturnal animals**).
- Camel's nostrils have long hairs to prevent the entry of sand and dust. They have no sweat glands in their skin.
- These animals become active when water is available and remain dormant (inactive stage) for rest of the time. This is called summer sleep or aestivation.
- They excrete small amount of urine and dry dung to conserve water.
- They have large, flat and paddy feet which help them to walk easily on soft sand.



- Adaptation in desert plants lose very less little water through transpiration.
- Desert plants either have no leaves or they have small or spine shaped leaves to reduce transpiration.
- Photosynthesis is usually carried out by stems.
- The stem is covered with a thick waxy layer which helps it to retain water.
- They have deep roots for absorbing water.
- Stomata are few, sunken in pits or covered with fine hairs.



**Opuntia**

- (b) **Mountain regions :** These regions are characterized by high hills area, cool and windy climate. The grounds are covered with snow. These conditions make it difficult for plants to grow and for animals to move around and find food.
- (b. i) **Adaptation In Mountain Animals and Plants :**  
They are normally very cold and windy. In some places, snowfall may take place during winter.
- The leaves of some trees are needle - like so that snow and rain water can slide off easily.



- Animals have thick skin or fur to protect them from cold.
- Yaks have long hair to keep them warm.
- Snow leopard has thick fur on its body including feet and toes. This protects its feet from the cold when it walks on the snow.
- The mountain goat has strong hooves for running up the rocky slopes of the mountains.



(c) **Grasslands**

Grassland is a large piece of land covered with grass which is used for grazing. They have hot dry summers with low water availability.

Tropical regions have plenty of rainfall throughout the year giving rise to growth of forests.

Forest is a bigger land mass covered by long trees, herbs and shrubs. A large number of animals found in these forests

(c. i) **Adaptation In Grassland Animals and Plants :**

- Lion lives in grassland.
- Its light brown colour helps it to hide in dry grasslands when it hunts for prey.
- The eyes in front of the face allow it to have a correct idea about the location of its prey.
- A deer has strong teeth for chewing hard plant stems.
- It has long ears to hear the movement of the predators.
- The eyes on the side of its head allow it look in all directions for danger.
- The speed of the deer helps them to run away from the predators.
- In forest all types of plants such as herbs, shrubs and trees can be found.
- Tropical rainforest is very thick and not much sun light is able to penetrate to the forest floor. Some plants grow on the other plant to reach the sun light.
- In grasslands extensive root systems prevent grazing animals from pulling roots out of ground.
- Soft stems enable grasses to bend in the wind.

(ii) **Aquatic Habitats :**

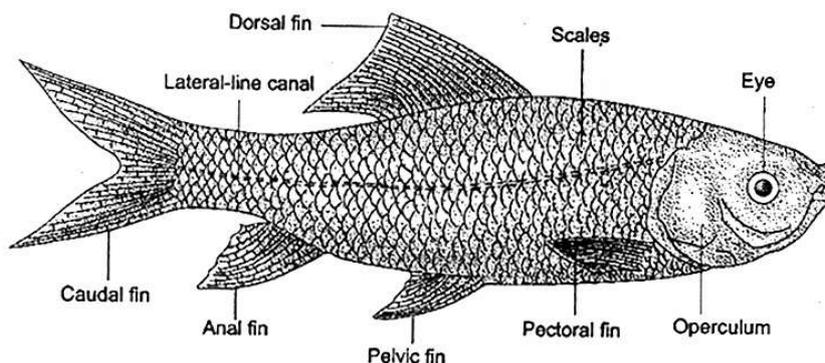
**Aquatic Adaptations**

The animals which live in water are known as **aquatic animals**. Common aquatic animals -are fish, whale, crab, octopus, lobster, etc.

(a) **Adaptation In Aquatic Animals and Plants**

- They have streamlined body without a neck.
- They have powerful tail and fins for swim.ming.
- They have gills for respiration.
- Some fishes have air bladder to make floating easier.

- They have special body covering like cuticle, scales, shells and waxy coating which prevent rotting and decay.

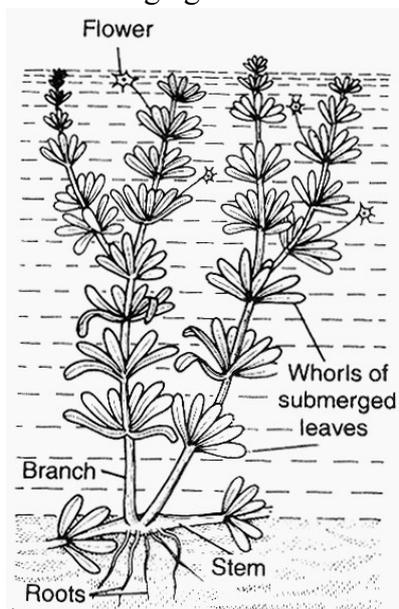


### ➤ Oceans :

- Sea animals like squid and octopus stay near the seabed and catch any prey that move towards them. When they move in water, they make their body shapes streamlined.
- Generally aquatic animals have gills to help them use the oxygen dissolved in water.
- Dolphins and whales do not have gills. They breathe in air through nostrils or blowholes that are located on the upper parts of their heads. This allows them to breathe in air when they swim near the surface of water.
- They can stay inside the water for a long time without breathing.

### ➤ Ponds and Lakes

- Roots of plants are much reduced in size and their main function is to hold the plant in place.
- The stem is long, hollow and light.
- The stems grow upto the surface of water while the leaves and flowers float on the surface of water.
- Some plants are totally submerged in water, i.e, all parts of the plant grow under water. These plants have narrow and thin ribbon like leaves. Through highly divided leaves, the water can easily flow without damaging them.



### • Amphibious Adptations In Animals

The animals which can live both on land as well as in water are called **amphibious animals**. Common amphibious animals are: frogs, toads and salamanders.

#### Adaptation In Amphibious Animals and Plants :

- The skin is moist and slimy which help in respiration.
- They can also respire through lungs.
- The hind legs are long and strong which help in hopping movements on the land.

- (iv) They have webbed feet for swimming.



**Amphibian of plants kingdom :** These plants can not live away from water. These plants though live in soil but they need water for sexual reproduction. E.g.: bryophytes.

### III. Aerial or Volant Adaptations

Animals which are adapted for the aerial mode of life (flying) are known as **volant animals**. Common volant animals are an birds and bats.

They have the following adaptations:

- (i) They have streamlined body which is covered with feathers.
- (ii) Their forelimbs are modified into wings.
- (iii) The bones are light, hollow, spongy and contain many air cavities.
- (iv) They have lungs for respiration.
- (v) The nervous system and sense organs are well developed.
- (vi) The flight muscles are well-developed and their eyesight is very sharp.



#### Let's know

- **Hibernation :** It is a deep sleep that help animal to save energy and survive without eating much. During hibernation the animal body temperature drops and its heart beat, breathing slows down so that it does not use much energy.

### 8. LOSS OF BIODIVERSITY

Loss of biodiversity means the reduction or disappearance of different plants and animals from a region. It mainly occurs due to human activities such as deforestation, pollution, urbanisation, and overuse of natural resources. When forests are cut or water bodies are polluted, many organisms lose their natural habitats and food, leading to a decline in their population. This loss disturbs the balance of nature and affects food chains and ecosystems. Protecting biodiversity is essential to keep the environment healthy and to ensure the survival of all living organisms.

#### Bullet Points:

- Biodiversity includes all kinds of plants, animals, and microorganisms.
- Habitat destruction is the main cause of biodiversity loss.
- Pollution and climate change also reduce species survival.
- Loss of biodiversity disturbs food chains and ecological balance.
- Conservation of forests and wildlife helps protect biodiversity.

**EXERCISE-I**

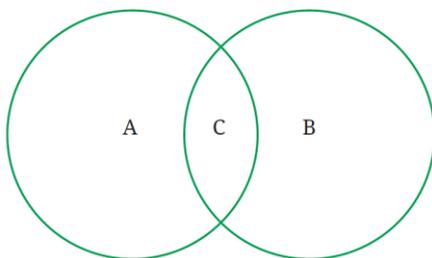
**NCERT Essentials**

**Q.1** Here are two types of seeds. What differences do you find among the roots and leaf venation of their plants?



**Q.2** Names of some animals are given below. Group them based on their habitats. Write the names of aquatic animals in the area marked 'A' and terrestrial animals in the area marked 'B'. Enter the names of animals living in both habitats in part 'C'.

Horse, Dolphin, Frog, Sheep, Crocodile, Squirrel, Whale, Earthworm, Pigeon, Tortoise



**Q.3** Manu's mother maintains a kitchen garden. One day, she was digging out radish from the soil. She told Manu that radish is a kind of root. Examine a radish and write what type of root it is. What type of venation would you observe in the leaves of radish plant?

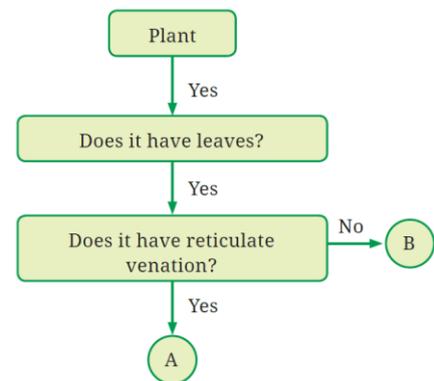
**Q.4** Look at the image of a mountain goat and a goat found in the plains. Point out the similarities and differences between them. What are the reasons for these differences?



**Q.5** Group the following animals into two groups based on any feature other than those discussed in the chapter—cow, cockroach, pigeon, bat, tortoise, whale, fish, grasshopper, lizard.

**Q.6** As the population grows and people want more comfortable lives, forests are being cut down to meet various needs. How can this affect our surroundings? How do you think we can address this challenge?

**Q.7** Analyse the flowchart. What can be examples of 'A' and 'B'?



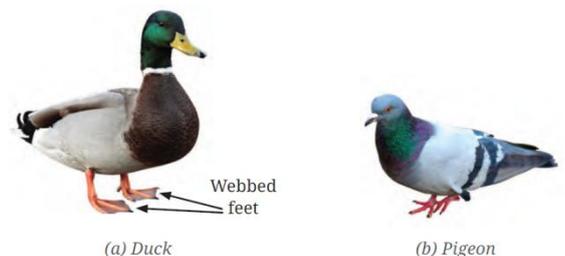
**Q.8** Raj argues with his friend Sanjay that "Gudhal (hibiscus) plant is a shrub." What questions can Sanjay ask for clarification?

**Q.9** Based on the information in the table, find out examples of these plants for each group.

Group	Type of seed	Type of root	Examples
A	Dicot	Taproot	
B	Monocot	Fibrous roots	

- (a) What other similarities do plants of group A have?
- (b) What other similarities do plants of group B have?

**Q.10** Observe the labelled part of a duck in the picture given below. What differences do you observe in the feet of the duck compared to the other birds? Which activity would the duck be able to perform using this part?



## EXERCISE-II

### Brain Booster MCQs

- Q.1** Which is an example of a shrub?  
 (A) Spinach (B) Mango tree  
 (C) Tomato plant (D) Lemon
- Q.2** Which of the following type of plants has thick, hard and woody stem?  
 (A) Tree (B) Shrub  
 (C) Herb (D) All of these
- Q.3** Which is not a part of a leaf?  
 (A) Petiole (B) Lamina  
 (C) Veins (D) Nodes
- Q.4** Parallel venation is not found in  
 (A) sugarcane (B) peepal  
 (C) maize (D) wheat
- Q.5** Which one of the following is a function of leaves?  
 (A) Photosynthesis (B) Transpiration  
 (C) Both (A) and (B) (D) Support fruits
- Q.6** Leaf venation and type of root is correctly paired in  
 (A) parallel venation, fibrous roots  
 (B) parallel venation, taproot  
 (C) no relation exists in leaf venation and type of roots  
 (D) reticulate venation, fibrous roots
- Q.7** Male reproductive part of flower is  
 (A) sepals (B) petals  
 (C) stamens (D) pistil
- Q.8** Which is a correct set of parts of a pistil?  
 (A) Ovary, style and filament  
 (B) Ovary, style and stigma  
 (C) Ovary, anther and filament  
 (D) Filament and anther
- Q.9** Which of the following has fibrous root?  
 (A) Peas (B) Wheat  
 (C) Radish (D) Neem
- Q.10** The process of loss of water by a plant through leaves is called  
 (A) evaporation (B) condensation  
 (C) photosynthesis (D) transpiration
- Q.11** Which type of venation is found in hibiscus leaves?  
 (A) Parallel (B) Reticulate  
 (C) Linear (D) Circular
- Q.12** Plants with fibrous roots generally have:  
 (A) Reticulate venation  
 (B) Parallel venation  
 (C) No venation  
 (D) Mixed venation
- Q.13** Which of the following is a monocot plant?  
 (A) Hibiscus (B) Rose  
 (C) Wheat (D) Neem
- Q.14** Plants that are small with soft green stems are called:  
 (A) Trees (B) Shrubs  
 (C) Herbs (D) Climbers
- Q.15** The special features that help plants and animals survive in their environment are called:  
 (A) Variations (B) Adaptations  
 (C) Modifications (D) Changes
- Q.16** The place where plants and animals live is called their:  
 (A) Environment (B) Habitat  
 (C) Ecosystem (D) Community
- Q.17** Plants that live on land are said to live in:  
 (A) Aquatic habitats  
 (B) Terrestrial habitats  
 (C) Aerial habitats  
 (D) Underground habitats
- Q.18** Which plant has thick fleshy stems to store water?  
 (A) Rose (B) Mango  
 (C) Cactus (D) Tulsi
- Q.19** The pattern of veins on a leaf is called:  
 (A) Arrangement (B) Venation  
 (C) Structure (D) Design

- Q.20** Deodar trees have a \_\_\_\_\_ shape to let snow slide off easily.  
(A) Round (B) Flat  
(C) Conical (D) Square
- Q.21** The process of arranging things into groups based on common features is called:  
(A) Classification (B) Grouping  
(C) Organizing (D) Categorizing
- Q.22** Banyan is an example of a:  
(A) Herb (B) Shrub  
(C) Tree (D) Climber
- Q.23** Animals that can live both on land and in water are called:  
(A) Terrestrial  
(B) Aquatic  
(C) Amphibians (D) Arboreal
- Q.24** The study of biodiversity was significantly contributed to by:  
(A) Only scientists  
(B) Only local communities  
(C) Both scientists and local communities  
(D) Only government
- Q.25** Sacred groves are examples of:  
(A) Government protected areas  
(B) Community protected areas  
(C) Private forests  
(D) Commercial plantations
- Q.26** The branching pattern in shrubs typically starts:  
(A) High up on the stem  
(B) Close to the ground  
(C) At the top  
(D) In the middle
- Q.27** The Silent Valley movement was primarily about:  
(A) Protecting tigers  
(B) Saving forests  
(C) Protecting rivers  
(D) Saving birds
- Q.28** Which part of the plant helps in classification into herbs, shrubs, and trees?  
(A) Leaves (B) Flowers  
(C) Stem (D) Roots
- Q.29** Rhododendrons in different regions show:  
(A) Same features  
(B) Different adaptations  
(C) No variations  
(D) Similar height
- Q.30** The term 'biodiversity' includes diversity in:  
(A) Only plants  
(B) Only animals  
(C) Both plants and animals  
(D) Only microorganisms

## EXERCISE-III

### Concept Check

#### TRUE/FALSE QUESTIONS

- Q.1** Herbs are usually short and sometimes do not have branches.
- Q.2** In shrubs, branches arise from the base of the stem.
- Q.3** In trees, branches arise from the upper part of stem.
- Q.4** Stem absorbs water and minerals from the soil.
- Q.5** Roots hold the plant firmly in the soil.
- Q.6** Leaves manufacture the food in presence of sunlight by the process of transpiration.
- Q.7** Plants having leaves with reticulate venation have fibrous roots.
- Q.8** All plants have colourful flowers.
- Q.9** The parts of a flower are usually present in whorls.
- Q.10** Pistil is female reproductive part of a flower.

#### FILL IN THE BLANKS

- Q.1** Water travels up the stem through \_\_\_\_\_ inside the stem.
- Q.2** Thick vein in the centre of leaf is called \_\_\_\_\_.
- Q.3** Design made by \_\_\_\_\_ in a leaf is called venation.
- Q.4** Leaves Bicchu (*Meltes*) give you \_\_\_\_\_ on touching.
- Q.5** Leaves have \_\_\_\_\_ shapes, sizes, edges, tips, etc.
- Q.6** Water comes out of leaves in the form of vapour by a process called \_\_\_\_\_.
- Q.7** Green leaves make food from \_\_\_\_\_ air and water by a process called photosynthesis.
- Q.8** The fine hair like structures on the lateral roots are \_\_\_\_\_.
- Q.9** Potatoes and yams are \_\_\_\_\_.
- Q.10** Small fine particles present in the anther are called \_\_\_\_\_.
- Q.11** \_\_\_\_\_ is the lower most part of a pistil.
- Q.12** After maturation, ovary is converted into a \_\_\_\_\_.

#### ASSERTION & REASON

**Instructions:** Each question contains an Assertion (A) and a Reason (R). Choose:

- (A) Both assertion and reason are true, and reason is correct explanation of assertion
- (B) Both assertion and reason are true, but reason is not correct explanation of assertion
- (C) Assertion is true but reason is false
- (D) Assertion is false but reason is true

- Q.1** **Assertion:** Cactus plants have thick fleshy stems.  
**Reason:** This helps them store water in desert conditions
- Q.2** **Assertion:** Frogs are amphibians.  
**Reason:** They can live both on land and in water.
- Q.3** **Assertion:** Habitat loss affects biodiversity.  
**Reason:** Animals lose their food and shelter.
- Q.4** **Assertion:** All aquatic animals have fins.  
**Reason:** Fins help in swimming.
- Q.5** **Assertion:** Adaptations are not important for survival.  
**Reason:** All environments are the same.

#### CASE STUDY

##### Case Study 1:

Desert Adaptations Priya visited Rajasthan and observed camels and cactus plants. She noticed that camels had wide hooves and humps, while cactus plants had thick stems and no visible leaves.

- Q.1** Why do camels have wide hooves in hot deserts?
- Q.2** What is the function of humps in camels?
- Q.3** How do thick stems help cactus plants?
- Q.4** Why don't cactus plants have broad leaves?
- Q.5** What are these special features called that help organisms survive?

**Case Study 2:**

Sacred Grove Conservation A village community has been protecting a small forest patch for generations. No one is allowed to cut trees or harm animals there. This area has many rare plants and animals.

- Q.6** 1What is such a protected forest patch called?
- Q.7** 1Who protects these areas?
- Q.8** 1Why are these areas important for biodiversity?
- Q.9** 1How do local communities contribute to conservation?
- Q.10** 1What can happen if such areas are not protected?

**MATCH THE COLUMNS**

**Q.1** Match the following

Column A		Column B	
(a)	Hibiscus	(i)	Desert plant
(b)	Wheat	(ii)	Monocot seed
(c)	Gram	(iii)	Reticulate venation
(d)	Maize	(iv)	Parallel venation
(e)	Cactus	(v)	Dicot seed

- (A) a-iii, b-v, c-iv, d-ii, e-i
- (B) a-iv, b-iii, c-ii, d-v, e-i
- (C) a-v, b-iv, c-iii, d-ii, e-i
- (D) a-iii, b-iv, c-v, d-ii, e-i

**Q.2** Match the following

Column A		Column B	
(a)	Rose	(i)	Aquatic plant
(b)	Mango	(ii)	Tree
(c)	Grass	(iii)	Shrub
(d)	Deodar	(iv)	Herb
(e)	Lotus	(v)	Mountain plant

- (A) a-iii, b-ii, c-iv, d-v, e-i
- (B) a-ii, b-iii, c-iv, d-i, e-v
- (C) a-iv, b-ii, c-iii, d-v, e-i
- (D) a-iii, b-iv, c-ii, d-v, e-i

**Q.3** Match the following

Column A		Column B	
(a)	Camel	(i)	Webbed feet
(b)	Frog	(ii)	Amphibian
(c)	Fish	(iii)	Hooked beak
(d)	Eagle	(iv)	Streamlined body
(e)	Duck	(v)	Desert adaptation

- (A) a-v, b-i, c-iv, d-ii, e-iii
- (B) a-iv, b-ii, c-v, d-iii, e-i
- (C) a-v, b-ii, c-iv, d-iii, e-i
- (D) a-ii, b-v, c-iv, d-iii, e-i

**Q.4** Match the following

Column A		Column B	
(a)	Salim Ali	(i)	Community protection
(b)	Janaki Ammal	(ii)	1973
(c)	Silent Valley	(iii)	Birdman of India
(d)	Project Tiger	(iv)	Kerala
(e)	Sacred grove	(v)	Botanist

- (A) a-v, b-iii, c-iv, d-ii, e-i
- (B) a-iii, b-v, c-iv, d-ii, e-i
- (C) a-iii, b-iv, c-v, d-ii, e-i
- (D) a-iii, b-v, c-ii, d-iv, e-i

**Q.5** Match the following

Column A		Column B	
(a)	Taproot	(i)	Aquatic plants
(b)	Fibrous root	(ii)	Desert plants
(c)	Needle leaves	(iii)	Mountain plants
(d)	Floating leaves	(iv)	Monocot plants
(e)	Spines	(v)	Dicot plants

- (A) a-v, b-iv, c-iii, d-i, e-ii
- (B) a-iv, b-v, c-ii, d-i, e-iii
- (C) a-v, b-iii, c-iv, d-i, e-ii
- (D) a-ii, b-iv, c-iii, d-v, e-i

## EXERCISE-IV

### Subjective Assessment

#### VERY SHORT QUESTION

- Q.1 What are weeds?
- Q.2 Why are leaves generally green?
- Q.3 What are the modifications seen in a pitcher plant?
- Q.4 What is a fruit? How does it differ from a seed?
- Q.5 Write the functions of sepals and petals.
- Q.6 If a plant has fibrous root, what type of venation do its leaves likely to have?
- Q.7 Name the part of the plant which produces its food. Name the process also.
- Q.8 In which part of a flower, you are likely to find the ovary?
- Q.9 Which is the most attractive part of a flowering plant?
- Q.10 Name any two functions of roots.
- Q.11 What is adaptation?
- Q.12 What is habitat?
- Q.13 What are aquatic habitats?
- Q.14 Define ecology.
- Q.15 Why does a fish have slippery scales on its body?

#### SHORT QUESTION

- Q.1 What are climbers and creepers? Give some examples.
- Q.2 Pitcher plant has green leaves which can prepare food by photosynthesis then why does it eat insects?
- Q.3 What do you mean by (a) leaf venation, (b) reticulate venation, and (c) parallel venation?
- Q.4 Explain the main functions of leaf.
- Q.5 What are the main functions of roots?
- Q.6 Do all flowers have the same parts and are they arranged in the same way?
- Q.7 Name any two modifications of roots along with their functions and examples.

- Q.8 What are the main parts of the shoot system?
- Q.9 Write any two functions of the stem.
- Q.10 List any two stem modifications.
- Q.11 What are terrestrial habitats? Give examples.
- Q.12 What adaptation of desert animals protect themselves from deficiency of water?
- Q.13 What is the ultimate source of energy for every ecosystem? Which biotic component can trap solar energy and how?
- Q.14 What are nocturnal animals? Give two examples of nocturnal animals.
- Q.15 Plants in hilly areas have to bear high speed winds and cold. Which adaptation best helps them to face such conditions?

#### LONG ANSWER

- Q.1 Explain the difference between **tap roots** and **fibrous roots** with the help of diagrams.
- Q.2 With the help of diagrams, describe the two root systems found in plants.
- Q.3 Describe the structure of a leaf with the help of a labeled diagram.
- Q.4 Describe the parts of a typical flower with the help of a diagram.
- Q.5 Describe pollination and fertilization.
- Q.6 Explain different adaptations found in camel.
- Q.7 What kinds of features help fishes to live in water?
- Q.8 How are roots and stems of water plants adapted?
- Q.9 How are the abiotic conditions different in desert from those found in mountains?
- Q.10 What kinds of adaptations are found in desert plants?

## ANSWER KEY

## EXERCISE-II

Q.1 (D)	Q.7 (C)	Q.13 (C)	Q.19 (B)	Q.25 (B)
Q.2 (B)	Q.8 (B)	Q.14 (C)	Q.20 (C)	Q.26 (B)
Q.3 (D)	Q.9 (B)	Q.15 (B)	Q.21 (A)	Q.27 (B)
Q.4 (B)	Q.10 (D)	Q.16 (B)	Q.22 (C)	Q.28 (C)
Q.5 (C)	Q.11 (B)	Q.17 (B)	Q.23 (C)	Q.29 (B)
Q.6 (A)	Q.12 (B)	Q.18 (C)	Q.24 (C)	Q.30 (C)

## EXERCISE-III

## TRUE/FALSE QUESTIONS

Q.1 True	Q.3 True	Q.5 True	Q.7 False	Q.9 True
Q.2 True	Q.4 False	Q.6 False	Q.8 False	Q.10 True

## FILL IN THE BLANKS

Q.1 narrow tubes	Q.5 different	Q.9 stem
Q.2 midrib	Q.6 transpiration	Q.10 pollen grains
Q.3 veins	Q.7 sunlight	Q.11 Ovary
Q.4 rashes and itching	Q.8 root hair	Q.12 fruit

## ASSERTION &amp; REASON

Q.1 (A)	Q.2 (A)	Q.3 (A)	Q.4 (C)	Q.5 (D)
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## CASE STUDY

## Case Study 1: Desert Adaptations

- Q.1 Camels have wide hooves → **To walk easily on sand without sinking.**  
 Q.2 Function of humps → **Store fat (energy) for survival.**  
 Q.3 Thick stems in cactus → **Store water.**  
 Q.4 No broad leaves → **To reduce water loss; leaves are modified into spines.**  
 Q.5 These special features are called → **Adaptations.**

## Case Study 2: Sacred Grove Conservation

- Q.6 Protected forest patch → **Sacred grove.**  
 Q.7 Protected by → **Local communities/villagers.**  
 Q.8 Importance → **They conserve rare plants & animals, protect biodiversity.**  
 Q.9 Local community role → **Restrict cutting, hunting, and maintain balance.**  
 Q.10 If not protected → **Loss of biodiversity, extinction of species.**

## MATCH THE COLUMNS

Q.1 (D)	Q.2 (A)	Q.3 (C)	Q.4 (B)	Q.5 (A)
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## 1. INTRODUCTION

A fraction is defined as a part of a whole number. It can be expressed as a ratio between two integers separated by a solidus. The number in the upper part of a fraction is termed as numerator whereas the number in the lower part is termed as the denominator.

## 2. FRACTIONS

A **fraction** is a number representing a part of a whole. It is written as  $\frac{a}{b}$  where  $a$  is the numerator and

$b$  is the denominator. We can also say that  $\frac{a}{b} = a \div b$ .

Examples of fractions are  $\frac{2}{7}$ ,  $\frac{5}{9}$ ,  $\frac{6}{13}$  etc.

### 2.1 Fraction as a Part of a Whole :

If a birthday cake is divided into four equal parts, each part is represented as 1 part out of 4 equal parts

and is written as  $\frac{1}{4}$ . The part that is considered (in this case, 1) is called the **numerator**. The number of parts into which the whole is divided (in this case, 4) is called the **denominator**.

$\frac{5}{12}$  is a fraction. We read it as “five-twelfths”. Here 12 stands for the number of equal parts into which the whole has been divided and 5 stands for the number of equal parts which have been taken out. Here 5 is called the numerator and 12 is called the denominator.

### EXAMPLES

**Example 1:** What fraction of a day is 9 hours?

**Solution:** One day = 24 hours

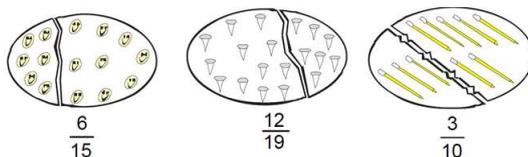
$$\therefore 9 \text{ hours out of } = \frac{9}{24} \text{ i.e.,}$$

9 hours out of 24 hours.

Hence, 9 hours is  $\frac{9}{24}$  parts of a day.

**2.2 Fraction as a Part of a Collection :**

Now study the following collections of similar things. Some things in each collection are separated. The given fraction of the whole collection represented the things separated the left in the collection.



The fraction  $\frac{6}{15}$  indicates that the collection has 15 objects of which 6 are separated

**2.3 Fraction as a Division :**

A fraction can be used to represent a division sum. For example, if one pastry has to be shared equally between two friends, the corresponding division sum would be  $1 \div 2$ . We can represent

this in fraction as  $\frac{1}{2}$ . Hence, we would say that pastry shared by each friend is  $\frac{1}{2}$  of the pastry.

While expressing a division sum as a fraction, the dividend is written as the numerator and the divisor is written as the denominator. Similarly, a fraction can be represented as a division sum. In that case, the numerator is written as the dividend and the denominator as the divisor.

**2.4 Fraction in Lowest Form :**

A fraction is said to be in its lowest term if the only common factor between the numerator and the denominator of the fraction is 1, i.e., when the numerator and denominator are coprime. It is also known as the simplest form or the standard form of a fraction.

Example,  $\frac{3}{5}$  is a fraction in its lowest term.

A fraction can be reduced to its lowest term by following the steps given below.

- (i) Find the HCF of the numerator and the denominator.
- (ii) Then divide both the numbers by the HCF.
- (iii) The resultant fraction will be in its lowest term.

**EXAMPLES**

**Example 2:** Show that  $\frac{7}{10}$  is in simplest form

**Solution:** Here, numerator = 7 and denominator = 10.  
 Factors of 7 are 1, 7.  
 Factors of 10 are 1, 2, 5, 10.  
 Common factors of 7 and 10 is 1 only.  
 $\therefore$  HCF of 7 and 10 is 1.

Hence,  $\frac{7}{10}$  is in the simplest form.

**Example 3:** Reduce  $\frac{24}{72}$  to its lowest term.

**Solution:** The HCF of 24 and 72 is 24. Divide both 24 and 72 by 24

$$\frac{24}{72} = \frac{24 \div 24}{72 \div 24} = \frac{1}{3}$$

**Example 4:** Reduce  $\frac{27}{72}$  to its lowest terms.

**Solution:** In  $\frac{27}{72}$  numerator = 27, denominator = 72.

Prime factors of each of them  $27 = 3 \times 3 \times 3$   
 $72 = 3 \times 3 \times 2 \times 2 \times 2$

$$\therefore \text{HCF} = 3 \times 3 = 9 \quad \therefore \frac{27}{72} = \frac{27 \div 9}{27 \div 9} = \frac{3}{8}$$

Hence  $\frac{27}{72}$  in its lowest term

### 3. FRACTION ON THE NUMBER LINE

#### 3.1 Representation of a Proper Fraction on a Number Line :

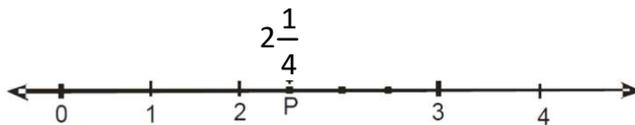
Draw a number line and mark points at equal intervals. Let these points represent the numbers 0, 1, 2,....

let us find a point on the number line corresponding to the fraction  $\frac{2}{7}$ . The denominator 7 suggests that the unit distance is to be divided into seven equal parts and 2 of these parts are to be taken. Thus the point P on the following number line represents the fraction  $\frac{2}{7}$ .



#### 3.2 Representation of an Improper Fraction on a Number Line :

Let us represent  $2\frac{1}{4}$  on a number line. Draw a number line and mark points at equal intervals. Let these points represent the numbers 0, 1, 2, 3, .....



We have learnt that  $2\frac{1}{4} = 2 + \frac{1}{4}$  which shows that the number is greater than 2 but less than 3. So

divide the distance between 2 and 3 in 4 equal parts (4 is the denominator of  $\frac{1}{4}$ ). Each part represents  $\frac{1}{4}$ . The point P in the above figure represents the fraction  $2\frac{1}{4}$ .

#### ➤ Like and Unlike Fractions

Two or more fractions with the same denominators are called like fractions, whereas fractions with different denominators are called unlike fractions.

**For Example,**

$\frac{7}{20}, \frac{13}{20}, \frac{9}{20}, \frac{11}{20}$  are all like fractions as their denominators are all equal.

$\frac{3}{7}, \frac{8}{9}, \frac{3}{8}, \frac{6}{13}$  are all unlike fractions as their denominators are not equal.

**(i) Conversion of unlike fractions into like fractions**

It is easy to compare, add, and subtract like fractions, so, we must learn to convert unlike fractions to like fractions.


**EXAMPLES**


**Example 5:** Convert into like fractions  $\frac{3}{8}, \frac{5}{6}, \frac{7}{12}$

**Solution:** Find the LCM of the denominators 8, 6 and 12.

$$\text{LCM} = 2 \times 2 \times 2 \times 3 = 24$$

Now the above fractions can be converted into equivalent fractions with 24 as the denominator.

$$\begin{array}{r} 2 \overline{)8, 6, 12} \\ 2 \overline{)4, 3, 6} \\ 3 \overline{)2, 3, 3} \\ 2, 1, 1 \end{array}$$

$$\frac{3}{8} = \frac{3 \times 3}{8 \times 3} = \frac{9}{24}, \frac{5}{6} = \frac{5 \times 4}{6 \times 4} = \frac{20}{24} \text{ and } \frac{7}{12} = \frac{7 \times 2}{12 \times 2} = \frac{14}{24}$$

So,  $\frac{9}{24}, \frac{20}{24}$ , and  $\frac{14}{24}$  are like fractions representing  $\frac{3}{8}, \frac{5}{6}$  and  $\frac{7}{12}$ , respectively.

➤ **Conversion**

**(i) Conversion of Mixed Fractions into Improper Fractions**

$$\text{Improper fraction} = \frac{(\text{Whole no.} \times \text{denominator}) + N}{\text{Denominator}}$$

Where N = Numerator

**(ii) Conversion of Improper Fractions into Mixed Fractions**

Consider the improper fraction  $\frac{28}{9}$ .

On dividing 28 by 9, we get the quotient = 3 and the remainder = 5.

$$\therefore \frac{28}{9} = 3 + \frac{5}{9} = 3\frac{5}{9}$$


**EXAMPLES**


**Example 6:** Convert each of the following into an improper fraction :

(i)  $3\frac{4}{5}$

(ii)  $6\frac{5}{8}$

(iii)  $5\frac{7}{9}$

**Solution:** We have:

(i)  $3\frac{4}{5} = \frac{(3 \times 5) + 4}{5} = \frac{19}{5}$

(ii)  $6\frac{5}{8} = \frac{(6 \times 8) + 5}{8} = \frac{53}{8}$

(iii)  $5\frac{7}{9} = \frac{(5 \times 9) + 7}{9} = \frac{52}{9}$

**Example 7:** Convert each of the following into a mixed fraction

(i)  $\frac{23}{5}$

(ii)  $\frac{37}{6}$

(iii)  $\frac{45}{8}$

**Solution:** (i)  $\frac{23}{5} = 4 + \frac{3}{5} = 4\frac{3}{5}$

(ii)  $\frac{37}{6} = 6\frac{1}{6} = 6\frac{1}{6}$

(iii)  $\frac{45}{8} = 5 + \frac{5}{8} = 5\frac{5}{8}$

#### 4. TYPES OF FRACTIONS

**4.1 Proper Fractions :** A proper fraction is a fraction in which the numerator is smaller than the denominator.

Examples of proper fractions are  $\frac{3}{4}, \frac{1}{2}, \frac{9}{10}, \frac{0}{3}, \dots$ , etc.

**4.2 Improper Fractions :** An improper fraction is a fraction in which the numerator is greater than the denominator.

$\frac{7}{2}, \frac{8}{5}, \frac{17}{12}$  are all improper fractions.

**4.3 Mixed fraction :** Fractions such as  $1\frac{1}{4}$  and  $2\frac{1}{2}$  are called Mixed Fractions. A mixed fraction has a combination of a whole and a part.

**Ex.** Express the following as mixed fraction :

(a)  $\frac{17}{4}$       (b)  $\frac{11}{3}$

**Sol.** (a)  $\frac{17}{4}$       
$$\begin{array}{r} 4 \overline{)17} \\ \underline{-16} \\ 1 \end{array}$$
      i.e. 4 whole and  $\frac{1}{4}$  more or  $4\frac{1}{4}$

(b)  $\frac{11}{3}$       
$$\begin{array}{r} 3 \overline{)11} \\ \underline{-9} \\ 2 \end{array}$$
      i.e. 3 whole and  $\frac{2}{3}$  more or  $3\frac{2}{3}$

**4.4 Unit fractions :** Any fraction with 1 as the numerator is called a unit fraction, Thus,  $\frac{1}{3}$  is called a unit fraction.

#### 5. CONVERSION OF MIXED FRACTIONS INTO IMPROPER FRACTIONS

Improper fraction =  $\frac{(\text{Whole no.} \times \text{denominator}) + N}{\text{Denominator}}$  where N = Numerator

**Ex.** Express the following mixed fractions as improper fractions :

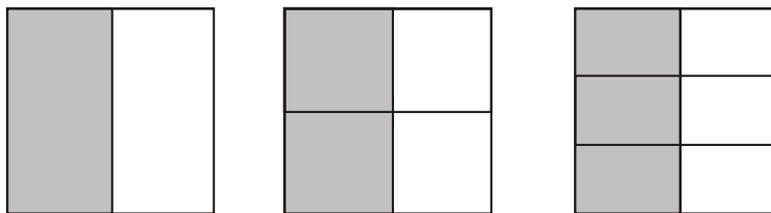
(a)  $2\frac{3}{4}$       (b)  $7\frac{1}{9}$       (c)  $5\frac{3}{7}$

**Sol.** (a)  $2\frac{3}{4} = 2 + \frac{3}{4} = \frac{2 \times 4}{4} + \frac{3}{4} = \frac{11}{4}$

(b)  $7\frac{1}{9} = \frac{(7 \times 9) + 1}{9} = \frac{64}{9}$       (c)  $5\frac{3}{7} = \frac{(5 \times 7) + 3}{7} = \frac{38}{7}$

**6. EQUIVALENT FRACTIONS :**

Let us take some pictorial representation of fraction.



These fractions are  $\frac{1}{2}, \frac{2}{4}, \frac{3}{6}$  representing the parts taken from the total number of parts. If we place the pictorial representation of one over the other they are found to be equal. These fractions are called equivalent fractions.

**Understanding equivalent fractions**

$\frac{1}{2}, \frac{2}{4}, \frac{3}{6}, \dots, \frac{36}{72}, \dots$ , are all equivalent fractions. They represent the same part of a whole.

There are two ways of obtaining equivalent fractions.

(a) By multiplying its numerator and denominator by the same number.

$$\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4}, \quad \frac{1}{2} = \frac{1 \times 3}{2 \times 3} = \frac{3}{6}, \quad \frac{1}{2} = \frac{1 \times 4}{2 \times 4} = \frac{4}{8}$$

$\therefore \frac{1}{2}, \frac{2}{4}, \frac{3}{6}, \frac{4}{8}$  are all equivalent fractions.

(b) By dividing its numerator and denominator by the same number.

$$\frac{2}{4} = \frac{2 \div 2}{4 \div 2} = \frac{1}{2}, \quad \frac{3}{6} = \frac{3 \div 3}{6 \div 3} = \frac{1}{2}, \quad \frac{4}{8} = \frac{4 \div 4}{8 \div 4} = \frac{1}{2}$$

**Ex.:** Find the equivalent fraction of  $\frac{2}{5}$  with numerator 6.

**Sol.:** We know  $2 \times 3 = 6$ . This means we need to multiply both the numerator and the denominator by 3 to get the equivalent fraction.

**Ex.:** Find the equivalent fraction of  $\frac{2}{9}$  with denominator 63.

**Sol.:** We have  $\frac{2}{9} = \frac{\square}{63}$

For this, we should have,  $9 \times \square = 2 \times 63$

But  $63 = 7 \times 9$ , so  $9 \times \square = 2 \times 7 \times 9 = 14 \times 9 = 9 \times 14$

or  $9 \times \square = 9 \times 14$

But comparison,  $\square = 14$

Therefore,  $\frac{2}{9} = \frac{14}{63}$

**7. SIMPLEST FORM OF A FRACTION**

A fraction is said to be in the simplest (or lowest) form if its numerator and denominator have no common factor except 1.

**The shortest way**

The shortest way to find the equivalent fraction in the simplest form is to find the HCF of the numerator and denominator, and then divide both of them by the HCF.

Consider  $\frac{36}{24}$

The HCF of 36 and 24 is 12.

Therefore,  $\frac{36}{24} = \frac{36 \div 12}{24 \div 12} = \frac{3}{2}$ . The fraction  $\frac{3}{2}$  is in the lowest form. Thus, HCF helps us to reduce a fraction to its lowest form.

**Ex.** Reduce  $\frac{24}{72}$  to its lowest term.

**Sol.** The HCF of 24 and 72 is 24. Divide both 24 and 72 by 24.

$$\frac{24}{72} = \frac{24 \div 24}{72 \div 24} = \frac{1}{3}$$

## 8. LIKE AND UNLIKE FRACTIONS

Fractions with same denominators are called **like fractions**.

Thus,  $\frac{1}{15}, \frac{2}{15}, \frac{3}{15}, \frac{8}{15}$ , are all like fractions.

For an example  $\frac{7}{27}$  and  $\frac{7}{28}$ , their denominators are different. Therefore, they are not like fractions.

They are called **unlike fractions**.

### EXAMPLES

**Example 8:** Convert into like fractions.

$$\frac{3}{8}, \frac{5}{6}, \frac{7}{12}$$

**Solution :** Find the LCM of the denominators 8, 6, and 12.

$$\text{LCM} = 2 \times 2 \times 2 \times 3 = 24$$

Now the above fractions can be converted into equivalent fractions with 24 as the denominator.

$$\begin{array}{r} 2 \overline{) 8, 6, 12} \\ 2 \overline{) 4, 3, 6} \\ 3 \overline{) 2, 3, 3} \\ \underline{2, 1, 1} \end{array}$$

$$\frac{3}{8} = \frac{3 \times 3}{8 \times 3} = \frac{9}{24}, \quad \frac{5}{6} = \frac{5 \times 4}{6 \times 4} = \frac{20}{24}$$

$$\text{and} \quad \frac{7}{12} = \frac{7 \times 2}{12 \times 2} = \frac{14}{24}$$

So,  $\frac{9}{24}, \frac{20}{24}$ , and  $\frac{14}{24}$  are like fractions representing  $\frac{3}{8}, \frac{5}{6}$ , and  $\frac{7}{12}$ , respectively.

## 9. COMPARING FRACTIONS

For comparing two or more fractions, First we check their numerator and denominator with each other i.e. they are like or unlike.

### EXAMPLES

**Example 9:** Compare  $\frac{4}{5}$  and  $\frac{5}{6}$

**Solution :** The fractions are unlike fractions. Their numerators are different too. Let us write their equivalent fractions.

$$\frac{4}{5} = \frac{8}{10} = \frac{12}{15} = \frac{16}{20} = \frac{20}{25} = \frac{24}{30} = \frac{28}{35} = \dots\dots\dots$$

and  $\frac{5}{6} = \frac{10}{12} = \frac{15}{18} = \frac{20}{24} = \frac{25}{30} = \frac{30}{36} = \dots\dots\dots$

The equivalent fractions with the same denominator are

$$\frac{4}{5} = \frac{24}{30} \text{ and } \frac{5}{6} = \frac{25}{30}$$

Since,  $\frac{25}{30} > \frac{24}{30}$  so,  $\frac{5}{6} > \frac{4}{5}$

So, when we compare two unlike fractions, we first get their equivalent fractions with a denominator which is a common multiple of the denominators of both the fractions.

**Example 10:** Compare  $\frac{5}{6}$  and  $\frac{13}{15}$ .

**Solution :** The fractions are unlike. We should first get their equivalent fractions with a denominator which is a common multiple of 6 and 15.

Now,  $\frac{5 \times 5}{6 \times 5} = \frac{25}{30}$ ,  $\frac{13 \times 2}{15 \times 2} = \frac{26}{30}$

Since,  $\frac{26}{30} > \frac{25}{30}$  we have  $\frac{13}{15} > \frac{5}{6}$ .



## TRY YOURSELF

**Q.1** Which of the following are like fractions?

(A)  $\frac{3}{5}, \frac{3}{7}, \frac{3}{11}, \frac{3}{16}$       (B)  $\frac{5}{11}, \frac{5}{11}, \frac{15}{11}, \frac{2}{11}$       (C)  $\frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{6}{7}$       (D) None of these

**Q.2** The correct fraction in the box  $\square$  is  $\square - \frac{5}{8} = \frac{1}{4}$

(A)  $\frac{6}{8}$       (B)  $\frac{7}{8}$       (C)  $\frac{1}{2}$       (D) None of these

**Q.3** What fraction of an hour is 20 minute ?

(A)  $\frac{1}{3}$       (B)  $\frac{1}{2}$       (C)  $\frac{1}{4}$       (D)  $\frac{1}{5}$

**Q.4** Which of the following is the smallest fraction ?

(A)  $\frac{3}{12}$       (B)  $\frac{5}{9}$       (C)  $\frac{1}{3}$       (D)  $\frac{4}{15}$

**Q.5** The mixed fraction  $5\frac{4}{7}$ , can be expressed as

(A)  $\frac{33}{7}$       (B)  $\frac{39}{7}$       (C)  $\frac{33}{4}$       (D)  $\frac{39}{4}$

**Q.6** The equivalent fraction of  $\frac{5}{7}$  with numerator 25 is:

(A)  $\frac{25}{35}$       (B)  $\frac{25}{7}$       (C)  $\frac{5}{35}$       (D) None of these

**Q.7** Which pair of fractions are equivalent ?

- (A)  $\frac{9}{15}, \frac{3}{10}$       (B)  $\frac{3}{11}, \frac{15}{33}$       (C)  $\frac{14}{21}, \frac{12}{18}$       (D)  $\frac{2}{5}, \frac{6}{20}$

**Q.8** Which of the following fraction is the greatest ?

- (A)  $\frac{5}{7}$       (B)  $\frac{5}{6}$       (C)  $\frac{5}{9}$       (D)  $\frac{5}{8}$

### ANSWER KEY

<b>Q.1</b>	B	<b>Q.2</b>	B	<b>Q.3</b>	A	<b>Q.4</b>	A	<b>Q.5</b>	B
<b>Q.6</b>	A	<b>Q.7</b>	C	<b>Q.8</b>	B				

## 10. ADDING AND SUBTRACTING FRACTIONS

Addition and subtraction is performed in like fractions. It is also not very difficult to add fractions that do not have the same denominator. When we have to add or subtract fractions we first find equivalent fractions with the same denominator and then proceed.

$\frac{1}{5}$  and  $\frac{1}{2}$  are unlike fractions, in order to subtract them, we first find their equivalent fractions with the

same denominator. These are  $\frac{2}{10}$  and  $\frac{5}{10}$  respectively.

This is because  $\frac{1}{2} = \frac{1 \times 5}{2 \times 5} = \frac{5}{10}$  and  $\frac{1}{5} = \frac{1 \times 2}{5 \times 2} = \frac{2}{10}$

Note that 10 is the least common multiple (LCM) of 2 and 5.

### EXAMPLES

**Example 11:** Subtract  $\frac{3}{4}$  from  $\frac{5}{6}$

**Solution :** We need to find equivalent fractions of  $\frac{3}{4}$  from  $\frac{5}{6}$ , which have the same denominator. This denominator is given by the LCM of 4 and 6. The required LCM is 12.

$$\text{Therefore, } \frac{5}{6} - \frac{3}{4} = \frac{5 \times 2}{6 \times 2} - \frac{3 \times 3}{4 \times 3} = \frac{10}{12} - \frac{9}{12} = \frac{1}{12}$$

**Example 12:** Add  $\frac{2}{5}$  to  $\frac{1}{3}$

**Solution :** The LCM of 5 and 3 is 15.

$$\text{Therefore } \frac{2}{5} + \frac{1}{3} = \frac{2 \times 3}{5 \times 3} + \frac{1 \times 5}{3 \times 5} = \frac{6}{15} + \frac{5}{15} = \frac{11}{15}$$

## 11. ADDITION AND SUBTRACTION WITH MIXED FRACTIONS

Mixed fractions can be written either as a whole part plus a proper fraction or entirely as an improper fraction. One way to add (or subtract) mixed fractions is to do the operation separately for the whole parts and the other way is to write the mixed fractions as improper fractions and then directly add (or subtract) them.


**EXAMPLES**


**Example 13:** Add  $2\frac{4}{5}$  and  $3\frac{5}{6}$

**Solution :**  $2\frac{4}{5} + 3\frac{5}{6} = 2 + \frac{4}{5} + 3 + \frac{5}{6} = 5 + \frac{4}{5} + \frac{5}{6}$

$$\begin{aligned} \text{Now } \frac{4}{5} + \frac{5}{6} &= \frac{4 \times 6}{5 \times 6} + \frac{5 \times 5}{6 \times 5} \quad (\text{Since LCM of 5 and 6} = 30) \\ &= \frac{24}{30} + \frac{25}{30} = \frac{49}{30} = \frac{30+19}{30} = 1 + \frac{19}{30} \end{aligned}$$

$$\text{Thus, } 5 + \frac{4}{5} + \frac{5}{6} = 5 + 1 + \frac{19}{30} = 6 + \frac{19}{30} = 6\frac{19}{30}$$

$$\text{And therefore, } 2\frac{4}{5} + 3\frac{5}{6} = 6\frac{19}{30}$$

**Example 14:** Simplify:  $8\frac{1}{4} - 2\frac{5}{6}$

**Solution :** Here  $8 > 2$  but  $\frac{1}{4} < \frac{5}{6}$ . We proceed as follows :

$$8\frac{1}{4} = \frac{(8 \times 4) + 1}{4} = \frac{33}{4} \quad \text{and} \quad 2\frac{5}{6} = \frac{(2 \times 6) + 5}{6} = \frac{17}{6}$$

$$\begin{aligned} \text{Now, } \frac{33}{4} - \frac{17}{6} &= \frac{33 \times 3}{12} - \frac{17 \times 2}{12} \quad (\text{Since LCM of 4 and 6} = 12) \\ &= \frac{99 - 34}{12} = \frac{65}{12} = 5\frac{5}{12} \end{aligned}$$

**Example 15:** Arrange in ascending order  $\frac{5}{8}, \frac{5}{6}, \frac{7}{4}, \frac{3}{5}$

**Solution :** LCM of 8, 6, 4, 5

$$\text{LCM} = 2 \times 2 \times 2 \times 3 \times 5 = 120$$

$$\frac{5}{8} = \frac{5 \times 15}{8 \times 15} = \frac{75}{120} \quad (120 \div 8 = 15)$$

$$\frac{5}{6} = \frac{5 \times 20}{6 \times 20} = \frac{100}{120} \quad (120 \div 6 = 20)$$

$$\frac{7}{4} = \frac{7 \times 30}{4 \times 30} = \frac{210}{120} \quad (120 \div 4 = 30)$$

$$\frac{3}{5} = \frac{3 \times 24}{5 \times 24} = \frac{72}{120} \quad (120 \div 5 = 24)$$

Since  $72 < 75 < 100 < 210$

$$\frac{72}{120} < \frac{75}{120} < \frac{100}{120} < \frac{210}{120} \quad \therefore \quad \frac{3}{5} < \frac{5}{8} < \frac{5}{6} < \frac{7}{4}$$

## 12. Brahmagupta's Method for Adding Fractions

Brahmagupta explained a systematic way to add fractions by first making their parts comparable and then combining them.

### Step 1: Make the Fractions Comparable

Convert all given fractions into **equivalent fractions with the same denominator**.

This common denominator can be obtained by finding a **common multiple** of the denominators, such as:

- their **product**, or
- their **least common multiple (LCM)**.

### Step 2: Add the Fractions

Once all fractions have the same denominator, **add their numerators** while keeping the denominator unchanged.

### Step 3: Simplify the Answer

If possible, reduce the resulting fraction to its **simplest (lowest) form** by dividing the numerator and denominator by a common factor.

**Example 16:** Find the sum of  $\frac{2}{3}$  and  $\frac{1}{5}$ .

**Solution :** The denominators of the given fractions are 3 and 5. The lowest common multiple of 3 and 5 is 15. Then we see that

$$\frac{2}{3} = \frac{2 \times 5}{3 \times 5} = \frac{10}{15}, \quad \frac{1}{5} = \frac{1 \times 3}{5 \times 3} = \frac{3}{15}$$

**EXERCISE-I**

**NCERT Essentials**

**Figure it Out (Page No. 152 & 153)**

Fill in the blanks with fractions.

- Q.1 Three guavas together weigh 1 kg. If they are roughly of the same size, each guava will roughly weigh \_\_\_\_ kg.
- Q.2 A wholesale merchant packed 1 kg of rice in four packets of equal weight. The weight of each packet is \_\_\_\_ kg.
- Q.3 Four friends ordered 3 glasses of sugarcane juice and shared it equally among themselves. Each one drank \_\_\_\_ glass of sugarcane juice.
- Q.4 The big fish weighs  $\frac{1}{2}$  kg. The small one weighs  $\frac{1}{4}$  kg. Together they weigh \_\_\_\_ kg.
- Q.5 Arrange these fraction words in order of size from the smallest to the biggest in the empty box below:  
One and a half, three quarters, one and a quarter, half, quarter, two and a half.

**Figure it Out (Page No. 155)**

The figures below show different fractional units of a whole *chikki*. How much of a whole *chikki* is each piece?

a.

b.

c.

d.

e.

f.

g.

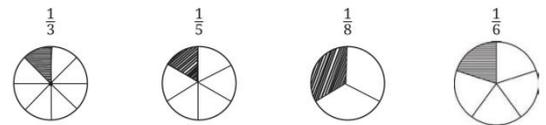
h.

**Figure it Out (Page No. 158)**

Let Represents a full *roti* (whole)

$\frac{1}{2}$ = 1 times half	$\frac{1}{2} + \frac{1}{2}$ = 2 times half	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ = 3 times half	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ = 4 times half	$\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ = 5 times half

- Q.1 Continue this table of  $\frac{1}{2}$  for 2 more steps.
- Q.2 Can you create a similar table for  $\frac{1}{4}$ ?
- Q.3 Make  $\frac{1}{3}$  using a paper strip. Can you use this to also make  $\frac{1}{6}$ ?
- Q.4 Draw a picture and write an addition statement as above to show:
  - a. 5 times  $\frac{1}{4}$  of a *roti*
  - b. 9 times  $\frac{1}{4}$  of a *roti*
- Q.5 Match each fractional unit with the correct picture:

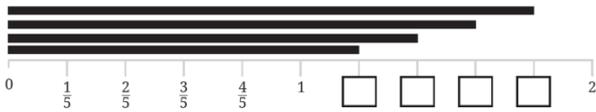


**Figure it Out (Page No. 160)**

- Q.1 On a number line, draw lines of lengths  $\frac{1}{10}$ ,  $\frac{3}{10}$ , and  $\frac{4}{5}$ .
- Q.2 Write five more fractions of your choice and mark them on the number line.
- Q.3 How many fractions lie between 0 and 1? Think, discuss with your classmates, and write your answer.
- Q.4 What is the length of the blue line and black line shown below? The distance between 0 and 1 is 1 unit long, and it is divided into two equal parts. The length of each part is 12. So the blue line is 12 units long. Write the fraction that gives the length of the black line in the box.



**Q.5** Write the fraction that gives the lengths of the black lines in the respective boxes.



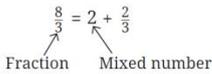
**Figure it Out (Page No. 162)**

- Q.1** How many whole units are there in  $\frac{7}{2}$ ?
- Q.2** How many whole units are there in  $\frac{4}{3}$  and in  $\frac{7}{3}$ ?

**Figure it Out (Page No. 162)**

- Q.1** Figure out the number of whole units in each of the following fractions:
  - a.  $\frac{8}{3}$
  - b.  $\frac{11}{5}$
  - c.  $\frac{9}{4}$

We saw that



This number is thus also called 'two and two thirds'. We also write it as  $2\frac{2}{3}$ .

**Q.2** Can all fractions greater than 1 be written as such mixed numbers?

A **mixed number or mixed fraction** contains a whole number (called the whole part) and a fraction that is less than 1 (called the fractional part)

**Q.3** Write the following fractions as mixed fractions (e.g.,  $\frac{9}{2} = 4\frac{1}{2}$ ):

- a.  $\frac{9}{2}$
- b.  $\frac{9}{5}$
- c.  $\frac{21}{19}$
- d.  $\frac{47}{9}$
- e.  $\frac{12}{11}$
- f.  $\frac{19}{6}$

**Figure it Out (Page No. 163)**

Write the following mixed numbers as fractions:

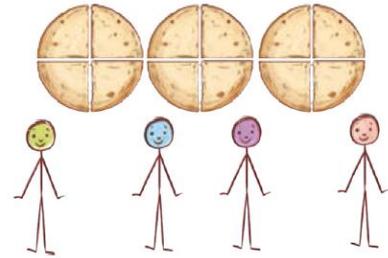
- a.  $3\frac{1}{4}$
- b.  $7\frac{2}{3}$
- c.  $9\frac{4}{9}$
- d.  $3\frac{1}{6}$
- e.  $2\frac{3}{11}$
- f.  $3\frac{9}{10}$

**Figure it Out (Page No. 165)**

- Q.1** Are  $\frac{3}{6}$ ,  $\frac{4}{8}$ ,  $\frac{5}{10}$  equivalent fractions? Why?
- Q.2** Write two equivalent fractions for  $\frac{2}{6}$ .
- Q.3**  $\frac{4}{6} = \frac{\square}{\square} = \frac{\square}{\square} = \frac{\square}{\square} = \dots\dots\dots$  (Write as many as you can)

**Figure it Out (Page No. 166)**

**Q.1** Three rotis are shared equally by four children. Show the division in the picture and write a fraction for how much each child gets. Also, write the corresponding division facts, addition facts, and, multiplication facts.



Fraction of *roti* each child gets is  $\frac{1}{4}$ . Division fact:

Addition fact:

Multiplication fact:

Compare your picture and answers with your classmates!

**Q.2** Draw a picture to show how much each child gets when 2 rotis are shared equally by 4 children. Also, write the corresponding division facts, addition facts, and multiplication facts.

**Q.3** Anil was in a group where 2 cakes were divided equally among 5 children. How much cake would Anil get?

**Figure it Out (Page No. 168 & 169)**

**Find the missing numbers:**

a. 5 glasses of juice shared equally among 4 friends is the same as  $\square$  glasses of juice shared equally among 8 friends.

So,  $\frac{5}{4} = \frac{\square}{8}$

b. 4 kg of potatoes divided equally in 3 bags is the same as 12 kgs of potatoes divided equally in  $\square$  bags.

So,  $\frac{4}{3} = \frac{12}{\square}$

- c. 7 rotis divided among 5 children is the same as \_\_\_\_\_ rotis divided among \_\_\_\_\_ children.

$$\text{So, } \frac{7}{5} = \frac{\square}{\square}$$

**Figure it Out** (Page No. 173)

Express the following fractions in lowest terms:

- a.  $\frac{17}{51}$                       b.  $\frac{64}{144}$   
 c.  $\frac{126}{147}$                       d.  $\frac{525}{112}$

**Figure it Out** (Page No. 174)

Q.1 Compare the following fractions and justify your answers:

- a.  $\frac{8}{3}, \frac{5}{2}$                       b.  $\frac{4}{9}, \frac{3}{7}$   
 c.  $\frac{7}{10}, \frac{9}{14}$                       d.  $\frac{12}{5}, \frac{8}{5}$   
 e.  $\frac{9}{4}, \frac{5}{2}$

Q.2 Write the following fractions in ascending order.

- a.  $\frac{7}{10}, \frac{11}{5}, \frac{2}{5}$                       b.  $\frac{19}{24}, \frac{5}{6}, \frac{7}{12}$

Q.3 Write the following fractions in descending order.

- a.  $\frac{25}{16}, \frac{7}{8}, \frac{13}{4}, \frac{17}{32}$   
 b.  $\frac{3}{4}, \frac{12}{5}, \frac{7}{12}, \frac{5}{4}$

**Figure it Out** (Page No. 179)

Q.1 Add the following fractions using Brahmagupta's method:

- a.  $\frac{2}{7} + \frac{5}{7} + \frac{6}{7}$                       b.  $\frac{3}{4} + \frac{1}{3}$   
 c.  $\frac{2}{3} + \frac{5}{6}$                       d.  $\frac{2}{3} + \frac{2}{7}$   
 e.  $\frac{3}{4} + \frac{1}{3} + \frac{1}{5}$                       f.  $\frac{2}{3} + \frac{4}{5}$   
 g.  $\frac{4}{5} + \frac{2}{3}$                       h.  $\frac{3}{5} + \frac{5}{8}$   
 i.  $\frac{9}{2} + \frac{5}{4}$                       j.  $\frac{8}{3} + \frac{2}{7}$   
 k.  $\frac{3}{4} + \frac{1}{3} + \frac{1}{5}$                       l.  $\frac{2}{3} + \frac{4}{5} + \frac{3}{7}$   
 m.  $\frac{9}{2} + \frac{5}{4} + \frac{7}{6}$

Q.2 Rahim mixes  $\frac{2}{3}$  litres of yellow paint with  $\frac{3}{4}$  litres of blue paint to make green paint. What is the volume of green paint he has made?

Q.3 Geeta bought  $\frac{2}{5}$  meter of lace and Shamim bought  $\frac{3}{4}$  meter of the same lace to put a complete border on a table cloth whose perimeter is 1 meter long. Find the total length of the lace they both have bought. Will the lace be sufficient to cover the whole border?

**Figure it Out** (Page No. 181)

Q.1  $\frac{5}{8} - \frac{3}{8}$

Q.2  $\frac{7}{9} - \frac{5}{9}$

Q.3  $\frac{10}{27} - \frac{1}{27}$

**Figure it Out** (Page No. 182)

Q.1 Carry out the following subtractions using Brahmagupta's method:

- a.  $\frac{8}{15} - \frac{3}{15}$                       b.  $\frac{2}{5} - \frac{4}{15}$   
 c.  $\frac{5}{6} - \frac{4}{9}$                       d.  $\frac{2}{3} - \frac{1}{2}$

Q.2 Subtract as indicated:

- a.  $\frac{13}{4}$  from  $\frac{10}{3}$   
 b.  $\frac{18}{5}$  from  $\frac{23}{3}$   
 c.  $\frac{29}{7}$  from  $\frac{45}{7}$

Q.3 Solve the following problems:

- a. Jaya's school is  $\frac{7}{10}$  km from her home. She takes an auto for  $\frac{1}{2}$  km from her home daily, and then walks the remaining distance to reach her school. How much does she walk daily to reach the school?
- b. Jeevika takes  $\frac{10}{3}$  minutes to take a complete round of the park and her friend Namit takes  $\frac{13}{4}$  minutes to do the same. Who takes less time and by how much?

## EXERCISE-II

## Brain Booster MCQs

- Q.1** Four pizzas are to be equally shared among 5 children. What is each child's share ?  
 (A)  $\frac{5}{4}$  (B)  $\frac{1}{4}$   
 (C)  $\frac{1}{5}$  (D)  $\frac{4}{5}$
- Q.2** What fraction of numbers from 1 to 15 are prime numbers.  
 (A)  $\frac{8}{15}$  (B)  $\frac{7}{15}$   
 (C)  $\frac{6}{15}$  (D)  $\frac{9}{15}$
- Q.3** Which denominator makes the fraction  $\frac{2}{9}$  and  $\frac{6}{\quad}$  equivalent ?  
 (A) 27 (B) 3  
 (C) 54 (D) 81
- Q.4** Which pair of fractions are equivalent ?  
 (A)  $\frac{9}{15}, \frac{3}{10}$  (B)  $\frac{3}{11}, \frac{15}{33}$   
 (C)  $\frac{14}{21}, \frac{12}{18}$  (D)  $\frac{2}{5}, \frac{6}{20}$
- Q.5** Reena has  $\frac{6}{8}$  of a chocolate bar and Sarika has  $\frac{3}{4}$  of an identical bar. Which of the following statements is true ?  
 (A) Reena has more chocolate than Sarika.  
 (B) Sarika has more chocolate than Reena.  
 (C) Sarika has twice the amount of chocolate as Reena.  
 (D) Reena has smaller pieces of chocolate, but the same amount as Sarika.
- Q.6** In the fraction  $\frac{3}{7}$ , the numerator is:  
 (A) 7 (B) 3  
 (C) 10 (D) 4
- Q.7** The fraction  $\frac{2}{5}$  means:  
 (A) 2 divided by 5 (B) 5 divided by 2  
 (C) 2 plus 5 (D) 5 minus 2
- Q.8** The equivalent fraction of  $\frac{2}{3}$  with denominator 9 is:  
 (A)  $\frac{6}{9}$  (B)  $\frac{4}{9}$   
 (C)  $\frac{3}{9}$  (D)  $\frac{8}{9}$
- Q.9** When one roti is divided equally among 4 children, each child gets:  
 (A)  $\frac{1}{2}$  roti (B)  $\frac{1}{3}$  roti  
 (C)  $\frac{1}{4}$  roti (D) 4 rotis
- Q.10** Which fraction lies between  $\frac{1}{2}$  and 1?  
 (A)  $\frac{1}{3}$  (B)  $\frac{1}{4}$   
 (C)  $\frac{3}{4}$  (D)  $\frac{1}{5}$
- Q.11** Which is the largest fraction?  
 (A)  $\frac{2}{3}$  (B)  $\frac{3}{4}$   
 (C)  $\frac{5}{6}$  (D)  $\frac{7}{8}$
- Q.12** The fraction  $\frac{15}{20}$  in lowest terms is:  
 (A)  $\frac{3}{4}$  (B)  $\frac{5}{10}$   
 (C)  $\frac{15}{20}$  (D)  $\frac{30}{40}$
- Q.13**  $\frac{2}{7} \times 3$  equals:  
 (A)  $\frac{6}{7}$  (B)  $\frac{2}{21}$   
 (C)  $\frac{6}{21}$  (D)  $\frac{5}{7}$
- Q.14** On a number line,  $\frac{3}{4}$  lies between:  
 (A) 0 and  $\frac{1}{2}$  (B)  $\frac{1}{2}$  and 1  
 (C) 1 and 2 (D) 0 and  $\frac{1}{4}$

- Q.15** The sum of  $\frac{1}{4} + \frac{1}{4} + \frac{1}{4}$  is:  
 (A)  $\frac{3}{4}$  (B)  $\frac{3}{12}$   
 (C)  $\frac{1}{4}$  (D) 1
- Q.16** The fraction form of "three and one-half" is:  
 (A)  $\frac{3}{2}$  (B)  $\frac{7}{2}$   
 (C)  $\frac{4}{2}$  (D)  $\frac{1}{2}$
- Q.17** Which is smaller:  $\frac{2}{5}$  or  $\frac{3}{7}$ ?  
 (A)  $\frac{2}{5}$  (B)  $\frac{3}{7}$   
 (C) Both equal  
 (D) Cannot compare
- Q.18** The sum  $\frac{1}{6} + \frac{1}{6} + \frac{1}{6}$  equals:  
 (A)  $\frac{3}{18}$  (B)  $\frac{1}{2}$   
 (C)  $\frac{3}{6}$  (D)  $\frac{1}{6}$
- Q.19**  $\frac{4}{5} + \frac{1}{10}$  equals:  
 (A)  $\frac{5}{15}$  (B)  $\frac{9}{10}$   
 (C)  $\frac{5}{10}$  (D)  $\frac{1}{2}$
- Q.20**  $2\frac{1}{3}$  as an improper fraction is:  
 (A)  $\frac{5}{3}$  (B)  $\frac{7}{3}$   
 (C)  $\frac{3}{3}$  (D)  $\frac{8}{3}$
- Q.21** A fraction represents:  
 (A) A whole number  
 (B) A part of a whole  
 (C) A decimal number  
 (D) An integer
- Q.22**  $\frac{7}{8} - \frac{3}{8}$  equals:  
 (A)  $\frac{4}{8}$  (B)  $\frac{1}{2}$   
 (C)  $\frac{4}{0}$  (D)  $\frac{10}{8}$
- Q.23** The common denominator for  $\frac{1}{3}$  and  $\frac{1}{4}$  is:  
 (A) 7 (B) 12  
 (C) 6 (D) 24
- Q.24**  $\frac{1}{2} + \frac{1}{3}$  equals:  
 (A)  $\frac{2}{5}$  (B)  $\frac{5}{6}$   
 (C)  $\frac{1}{6}$  (D)  $\frac{3}{6}$
- Q.25** If a chocolate bar is divided into 8 equal pieces and Ravi eats 3 pieces, the fraction eaten is:  
 (A)  $\frac{3}{8}$  (B)  $\frac{5}{8}$   
 (C)  $\frac{3}{5}$  (D)  $\frac{8}{3}$
- Q.26** The length of Femur, the longest bone in the human body is  $\frac{101}{2}$  cm. Write this as a mixed number.  
 (A)  $5\frac{1}{2}$  (B)  $2\frac{1}{50}$   
 (C)  $50\frac{1}{2}$  (D)  $100\frac{1}{2}$
- Q.27** Which operations are used to change a mixed number to an improper fraction?  
 (A) division and subtraction  
 (B) multiplication and addition  
 (C) multiplication and subtraction  
 (D) division and addition
- Q.28** If one-third of a tank holds 80 litres of water, then the quantity of water that half of the tank holds is:  
 (A)  $\frac{80}{3}$  litres (B) 100 litres  
 (C) 120 litres (D) 240 litres
- Q.29** A fraction whose numerator is less than its denominator is called :  
 (A) a proper fraction  
 (B) an improper fraction  
 (C) a mixed fraction  
 (D) none of these
- Q.30** Fractions having equal denominators are called :  
 (A) like fractions  
 (B) unit fractions  
 (C) proper fractions  
 (D) improper fractions

## EXERCISE-III

## Concept Check

## TRUE/FALSE QUESTIONS

- Q.1** In any fraction, the numerator is always smaller than the denominator. **T/F**
- Q.2** All unit fractions have 1 as the numerator. **T/F**
- Q.3** Equivalent fractions represent the same value. **T/F**
- Q.4** A mixed number contains both a whole number and a fraction. **T/F**
- Q.5** When adding fractions with the same denominator, we add both numerators and denominators. **T/F**
- Q.6** The simplest form of  $\frac{12}{16}$  is  $\frac{3}{4}$ . **T/F**
- Q.7** The denominator tells us into how many equal parts the whole is divided. **T/F**
- Q.8** Egyptian fractions only used unit fractions. **T/F**

## FILL IN THE BLANKS

- Q.1** Three guavas weighing 1 kg in total means each guava weighs \_\_\_\_\_ kg.
- Q.2** The simplest form of  $\frac{15}{25}$  is \_\_\_\_\_.
- Q.3** The equivalent fraction of  $\frac{3}{5}$  with denominator 15 is \_\_\_\_\_.
- Q.4** When one unit is divided into 8 equal parts, each part is \_\_\_\_\_ of the whole.
- Q.5** The fraction  $\frac{24}{36}$  in lowest terms is \_\_\_\_\_.
- Q.6** The largest unit fraction is \_\_\_\_\_.
- Q.7** The sum of all unit fractions from  $\frac{1}{2}$  to  $\frac{1}{10}$  is \_\_\_\_\_.
- Q.8** If a rope of length  $\frac{5}{6}$  meter is cut into 5 equal pieces, each piece is \_\_\_\_\_ meter long.

## ASSERTION &amp; REASON

**Instructions:** Each question contains an Assertion (A) and a Reason (R). Choose the correct option:

- (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

**Q.1 Assertion (A):**  $\frac{4}{6}$  and  $\frac{2}{3}$  are equivalent fractions

**Reason (R):** Equivalent fractions represent the same part of a whole

**Q.2 Assertion (A):**  $\frac{3}{7} + \frac{2}{7} = \frac{5}{7}$

**Reason (R):** When adding fractions with same denominator, we add only numerators

**Q.3 Assertion (A):**  $2\frac{1}{3} = \frac{7}{3}$

**Reason (R):** Mixed numbers can be converted to improper fractions

**Q.4 Assertion (A):** The fraction wall helps in comparing fractions

**Reason (R):** Visual representation makes fraction comparison easier

**Q.5 Assertion (A):** Every whole number can be written as a fraction

**Reason (R):** Any whole number n can be written as  $\frac{n}{1}$

**Q.6 Assertion (A):** Brahmagupta's method is used for fraction arithmetic

**Reason (R):** Ancient Indian mathematicians developed fraction operations

## CASE STUDY

## Case Study 1: Garden Plot

Farmer Ramesh has a rectangular plot. He used  $\frac{2}{5}$  of the plot for growing wheat,  $\frac{1}{4}$  for vegetables, and  $\frac{1}{10}$  for flowers.

- Q.1** What fraction of the total plot is used for farming?
- Q.2** What fraction of land remains unused?
- Q.3** If the plot area is 100 square meters, how much area is used for wheat?
- Q.4** Which crop occupies the maximum area?

**Q.5** If vegetables need  $\frac{1}{8}$  more area, what total fraction would be needed for vegetables?

**MATCH THE COLUMNS**

**Q.1** Match the mixed numbers with improper fractions:

Column A		Column B	
(a)	$2\frac{1}{2}$	(i)	$\frac{7}{3}$
(b)	$1\frac{3}{4}$	(ii)	$\frac{5}{2}$
(c)	$2\frac{1}{3}$	(iii)	$\frac{7}{4}$
(d)	$3\frac{1}{5}$	(iv)	$\frac{16}{5}$

- (A) a-ii, b-iii, c-i, d-iv
- (B) a-i, b-ii, c-iv, d-iii
- (C) a-iii, b-ii, c-i, d-iv
- (D) a-ii, b-i, c-iii, d-iv

**Q.2** Match equivalent fractions:

Column A		Column B	
(a)	$\frac{2}{3}$	(i)	$\frac{4}{6}$
(b)	$\frac{3}{5}$	(ii)	$\frac{9}{15}$
(c)	$\frac{1}{4}$	(iii)	$\frac{3}{12}$
(d)	$\frac{5}{8}$	(iv)	$\frac{10}{16}$

- (A) a-ii, b-iii, c-i, d-iv
- (B) a-i, b-ii, c-iii, d-iv
- (C) a-ii, b-i, c-iii, d-iv
- (D) a-iv, b-i, c-ii, d-iii

**Q.3** Match operations with results:

Column A		Column B	
(a)	$\frac{1}{2} + \frac{1}{3}$	(i)	$\frac{1}{6}$
(b)	$\frac{2}{3} - \frac{1}{2}$	(ii)	$\frac{5}{6}$
(c)	$\frac{3}{4} - \frac{1}{2}$	(iii)	$\frac{1}{4}$
(d)	$\frac{1}{4} + \frac{1}{4}$	(iv)	$\frac{1}{2}$

- (A) a-i, b-ii, c-iv, d-iii
- (B) a-ii, b-i, c-iii, d-iv
- (C) a-ii, b-iii, c-i, d-iv
- (D) a-iv, b-i, c-iii, d-ii

**Q.4** Match historical facts:

Column A		Column B	
(a)	Brahmagupta	(i)	Ancient Egypt
(b)	Unit fractions	(ii)	628 CE
(c)	Fraction bar	(iii)	Al-Hassar
(d)	Modern notation	(iv)	India

- (A) a-iv, b-ii, c-iii, d-i
- (B) a-ii, b-iv, c-i, d-iii
- (C) a-iii, b-i, c-ii, d-iv
- (D) a-ii, b-i, c-iii, d-iv

**Q.5** Match fractions with word forms

Column A		Column B	
(a)	$\frac{3}{4}$	(i)	One-eighth
(b)	$\frac{2}{3}$	(ii)	Five-sixths
(c)	$\frac{1}{8}$	(iii)	Two-thirds
(d)	$\frac{5}{6}$	(iv)	Three-quarters

- (A) a-iv, b-iii, c-i, d-ii
- (B) a-iii, b-iv, c-ii, d-i
- (C) a-iv, b-ii, c-i, d-iii
- (D) a-i, b-iii, c-iv, d-ii

**CORRECT THE ERROR**

**Q.1** What's wrong?  $\frac{4}{6}$  simplified is  $\frac{2}{4}$

**Q.2** What's wrong:  $\frac{1}{0} = 0$

**Q.3** Correct error:  $\frac{4}{5} \times 0 = \frac{4}{5}$

**Q.4** Correct: On number line,  $\frac{2}{3}$  comes after  $\frac{3}{4}$

**Q.5** Find mistake:  $\frac{3}{8} + \frac{1}{4} = \frac{4}{12}$

## EXERCISE-IV

## Subjective Assessment

## SHORT QUESTION

- Q.1** What are equivalent fractions? Give an example.
- Q.2** What does the denominator of a fraction tell us?
- Q.3** Compare:  $\frac{3}{7}$  and  $\frac{4}{9}$
- Q.4** Find the sum:  $\frac{1}{4} + \frac{1}{6} + \frac{1}{12}$
- Q.5** Find the missing numerator:  $\frac{3}{4} = ?/16$
- Q.6** Find:  $\frac{2}{3}$  of  $\frac{1}{4}$
- Q.7** What is  $\frac{3}{5} \div 2$ ?
- Q.8** What is 150% of  $\frac{2}{3}$ ?
- Q.9** If  $\frac{3}{8}$  of a journey is completed, what fraction remains?
- Q.10** Solve:  $\frac{1}{2} + \frac{1}{3} + \frac{1}{6}$

## LONG ANSWER

- Q.1** Describe the historical development of fractions in ancient India. Mention at least three mathematicians and their contributions.
- Q.2** Explain how fractions are represented on a number line. Mark and label  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and  $\frac{5}{4}$  on a number line.
- Q.3** Explain the concept of equivalent fractions using the fraction wall method. Create a fraction wall showing equivalents for  $\frac{1}{2}$ ,  $\frac{1}{3}$ , and  $\frac{1}{4}$ .
- Q.4** Compare and contrast proper fractions, improper fractions, and mixed numbers. Give two examples of each and show how to convert between them.
- Q.5** A farmer has a rectangular field. He plants wheat on  $\frac{3}{8}$  of the field, rice on

$\frac{1}{4}$  of the field, and vegetables on  $\frac{1}{6}$  of the field. What fraction of the field is still unused? If the total area is 240 square meters, find the area used for each crop.

- Q.6** Three friends ordered pizzas. Ram ate  $\frac{2}{3}$  of his pizza, Shyam ate  $\frac{3}{4}$  of his pizza, and Gita ate  $\frac{5}{6}$  of her pizza. Who ate the most? If each pizza was cut into 12 slices, how many slices did each person eat?

- Q.7** A water tank was  $\frac{3}{4}$  full. After using  $\frac{1}{6}$  of its capacity, more water was added to make it  $\frac{5}{6}$  full. What fraction of the tank's capacity was added?

- Q.8** Create a real-life scenario involving a shopkeeper who sells different fractions of his stock on different days. Include at least three different fractions and solve to find what fraction remains.

- Q.9** A construction project is divided into phases. Foundation work takes  $\frac{1}{4}$  of total time, structural work takes  $\frac{2}{5}$  of total time, and finishing work takes  $\frac{1}{3}$  of total time. Is this possible? If not, suggest a realistic distribution.

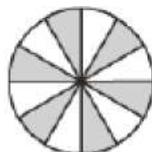
- Q.10** Explain the concept of reciprocals using fractions. How are reciprocals useful in division of fractions? Demonstrate with examples.

- Q.11** A student's day is divided as follows:  $\frac{1}{3}$  for school,  $\frac{1}{8}$  for homework,  $\frac{1}{6}$  for play,  $\frac{1}{4}$  for meals, and the rest for sleep. What fraction of the day is spent sleeping? Convert this to hours and minutes.

**EXERCISE-V**

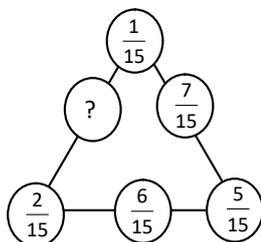
**Competition Edge**

- Q.1** Which of the following decimals represents the shaded part in the given figure?  
(IMO 2012)



- (A) 0.1                      (B) 0.5  
(C) 0.2                      (D) 0.7

- Q.2** What should be placed in place of ? So that the sum of fractions on each side of the triangle is same?  
(IMO 2012)



- (A)  $\frac{7}{15}$     (B)  $\frac{9}{15}$     (C)  $\frac{6}{15}$     (D)  $\frac{10}{15}$

- Q.3** Four families went on a picnic. Each family carried a cake for picnic. 3 of each cake was eaten. How much cake was eaten in all?  
(IMO 2012)

- (A)  $\frac{3}{8}$     (B) 3    (C)  $\frac{9}{12}$     (D) 1

- Q.4** Pranay spend  $\frac{1}{8}$  th of his money on food. He spend 3 times as much as what he spent on food on a pair of shoes and  $\frac{1}{3}$  rd of its on transport. What fraction of his money was left?  
(NSTSE 2013)

- (A)  $\frac{7}{8}$                       (B)  $\frac{1}{4}$   
(C)  $\frac{1}{2}$                       (D)  $\frac{1}{6}$

- Q.5** What is the missing number in the box ?  
(NSTSE 2013)

$$\boxed{1\frac{2}{5} + 1\frac{2}{5} + 1\frac{2}{5} + 1\frac{2}{5} = ? \times \frac{7}{5} + 1\frac{2}{5}}$$

- (A) 21                      (B) 2  
(C) 3                      (D) 4

- Q.6** What must be added to the product of  $2\frac{4}{7}$  and 3 to make  $21\frac{5}{14}$                       (IMO 2013)

- (A)  $13\frac{9}{12}$                       (B)  $12\frac{9}{14}$   
(C)  $13\frac{9}{14}$                       (D)  $15\frac{11}{14}$

- Q.7**  $\frac{2}{3}$  of the books in a box are English books,  $\frac{1}{4}$  are Maths books and the rest are Science books. What fraction of the books are science books ?  
(IMO 2013)

- (A)  $\frac{2}{3} - \frac{1}{4}$                       (B)  $\frac{2}{3} \times \frac{1}{4}$   
(C)  $1 - \left(\frac{2}{3} + \frac{1}{4}\right)$                       (D)  $1 - \left(\frac{2}{3} - \frac{1}{4}\right)$

- Q.8** Mayank is  $1\frac{2}{5}$  times as tall as Vansh. If Mayank is 38 cm taller than Vansh, what is Mayank's height?  
(IMO 2013)

- (A) 133 cm                      (B) 123 cm  
(C) 95 cm                      (D) 129 cm

- Q.9** Which of the following is true? (IMO 2013)  
**Statement I :** A fraction is said to be in the simple (or lowest) form if its numerator and denominator have no common factor except 1.

- Statement II :** Simplest form of  $\frac{686}{1715}$  is  $\frac{3}{5}$ .  
(A) Statement I and statement II both are true.  
(B) Statement I is false and statement II is true.  
(C) Statement I is true and statement II is false.  
(D) Statement I and statement II both are false.

- Q.10** Select the correct match of fractions of the unshaded part.  
(IMO 2013)

- (A)  $1\frac{1}{5}$   
(B)  $1\frac{2}{3}$   
(C)  $\frac{4}{7}$   
(D)  $\frac{4}{9}$

**Q.11** A shopkeeper bought 50 kg of sugar. He sold  $\frac{1}{4}$  of the sugar. Find the weight of sugar that was left. **(IMO 2013)**  
 (A) 37.5 kg (B) 37500 g  
 (C)  $50 \times \frac{3}{4}$  kg (D) All of these

**Q.12** Vineet measured the lengths of two bugs he found. The cricket was three-fourths of a unit long. The ant was one-eighth of a unit long. How much longer was the cricket than the ant? **(IMO 2013)**  
 (A)  $\frac{3}{8}$  (B)  $\frac{5}{8}$   
 (C)  $\frac{2}{7}$  (D)  $\frac{11}{7}$

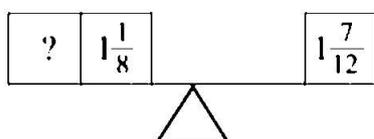
**Q.13** If  $\frac{7}{9}$  of a number is 63, then  $\frac{1}{3}$  of the number is **(IMO 2014)**  
 (A) 21 (B) 27  
 (C) 49 (D) 42

**Q.14** Find the missing number  
 $14\frac{3}{4} \times 4\frac{1}{2} - 3\frac{1}{4} \times 4\frac{1}{2} + 11\frac{1}{2} \times 5\frac{1}{2} = ? - 4.$  **(IMO 2014)**  
 (A)  $32\frac{3}{8}$  (B) 111 (C) 115 (D) 119

**Q.15** A bottle is  $\frac{3}{4}$  full of water. The water in the bottle can fill 5 glasses. If the water in the bottle is poured out to fill 3 glasses. Find the fraction of the water left in bottle. **(IMO 2014)**  
 (A)  $\frac{9}{10}$  (B)  $\frac{3}{5}$   
 (C)  $\frac{9}{20}$  (D)  $\frac{3}{10}$

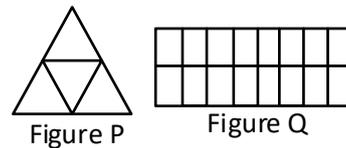
**Q.16** The weight of three boys are  $11\frac{3}{4}$  kg,  $14\frac{1}{5}$  kg and  $16\frac{1}{2}$  kg **(IMO 2014)**  
 (A)  $41\frac{9}{20}$  kg (B)  $43\frac{9}{20}$  kg  
 (C)  $42\frac{9}{20}$  kg (D)  $44\frac{9}{20}$  kg

**Q.17** To balance the scale, write the missing fraction. **(IMO 2014)**



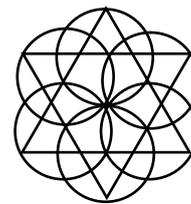
- (A)  $\frac{11}{24}$  (B)  $\frac{10}{24}$   
 (C)  $\frac{5}{24}$  (D)  $\frac{1}{24}$

**Q.18** How many parts should be shaded in the figure Q to make it the same fraction as the unshaded part in the figure? **(IMO 2014)**



- (A) 3 (B) 4 (C) 8 (D) 12

**Q.19** Find the fraction of curved lines to the total number of lines in the given figure **(IMO 2014)**



- (A)  $\frac{6}{13}$  (B)  $\frac{8}{13}$  (C)  $\frac{7}{13}$  (D)  $\frac{5}{13}$

**Q.20** A wheel barrow can hold \_\_\_\_\_ kg. If four rocks weighs  $6\frac{1}{8}$  kg,  $8\frac{1}{2}$  kg,  $4\frac{3}{4}$  kg and  $7\frac{1}{2}$  kg are to be loaded into the wheel barrow. **(IMO 2014)**

- (A)  $26\frac{7}{8}$  (B)  $24\frac{3}{8}$   
 (C)  $26\frac{1}{8}$  (D)  $24\frac{7}{8}$

**Q.21** A man spends  $\frac{4}{15}$  of his monthly income on

house rent,  $\frac{1}{2}$  on food and  $\frac{1}{5}$  on other items.

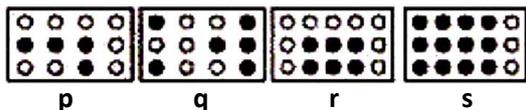
He saves Rs. 800 in the end. What was his monthly income? **(IMO 2014)**

- (A) Rs. 24,000 (B) Rs. 22,000  
 (C) Rs. 25,000 (D) Rs. 20,000

**Q.22** The capacity of a drum is 50 L and that of a bucket is  $8\frac{3}{4}$  L. If 5 buckets of water is poured into the drum. What fraction of the drum remains empty? **(IMO 2014)**

- (A)  $\frac{1}{4}$  (B)  $\frac{1}{2}$   
 (C)  $\frac{3}{4}$  (D)  $\frac{1}{8}$

**Q.23** Arrange the shaded fractions of the following figures in ascending order. **(IMO- 2015)**



- (A) s, q, r, p (B) p, r, s, q  
 (C) s, p, q, r (D) p, r, q, s

**Q.24** sidak bought  $13\frac{5}{8}$  m of cloth and Sanchi bought  $13\frac{3}{4}$  m of cloth. Who bought more cloth and by how much ? **[IMO-2015]**

- (A) Sanchi,  $\frac{7}{8}$  m (B) Sidak,  $\frac{1}{8}$  m  
 (C) Sanchi,  $\frac{1}{8}$  m (D) Sidak,  $\frac{7}{8}$  m

**Q.25** Raj, Gaurav and Amit are fast friends. They started painting a wall. Raj paints  $\frac{2}{15}$  of the wall. Gaurav paints  $\frac{1}{24}$  of the wall and Amit paints  $\frac{3}{10}$  of the wall. Read the statements related to above situation and answer the question given below **[IMO- 2015]**

**Statement 1 :** Gaurav painted least portion of the wall

**Statement 2 :**  $\frac{1}{8}$  portion of wall is unpainted

- (A) Both Statement 1 and Statement 2 are true.  
 (B) Both Statement 1 and Statement 2 are false  
 (C) Statement 1 is true but Statement 2 is false.  
 (D) Statement 1 is false and Statement 2 Is true.

**Q.26** If  $\frac{1872}{3276} = \frac{A}{259} = \frac{828}{B}$ , then find the value of A + B **(IMO - 2016)**  
 (A) 1589 (B) 1597  
 (C) 1379 (D) 1277

**Q.27** If  $\frac{1}{18} = \frac{x}{162} = \frac{24}{y}$ , then the value of  $\frac{x+y}{21}$  is: **[IMO - 2017]**  
 (A) 23 (B) 21 (C) 24 (D) 27

**Q.28** The sum  $\left(17\frac{1}{5} + 17\frac{1}{5} + 17\frac{1}{5} + 17\frac{1}{5} + 17\frac{1}{5}\right)$  is same as: **[IMO - 2017]**

- (A)  $(17 \times 5)$  (B)  $\left(17\frac{1}{5}\right) + 1$   
 (C)  $(17 \times 5) + 1$  (D)  $(17 \times 5) + \frac{1}{5}$

**Q.29** If  $\frac{1}{3} \times -1\frac{1}{3} = 2\frac{1}{3}$ , then the value of  $x^3$  is: **[IMO - 2017]**  
 (A) 1331 (B) 2197  
 (C) 1728 (D) 729

**Q.30** In the figure given below, if the fraction represented by shaded parts in Figure (2) is added to the fraction represented by shaded parts of Figure (1), the result in its simplest form is: **[IMO - 2017]**

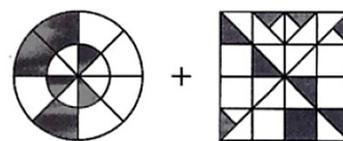


Figure (1)                      Figure (2)

- (A)  $\frac{7}{8}$  (B)  $\frac{9}{16}$   
 (C)  $\frac{5}{8}$  (D)  $\frac{11}{16}$

**Q.31** Mohit travelled half of his journey by Train,  $\frac{1}{4}$  by a Taxi,  $\frac{1}{8}$  by Bus and the remaining 2 km on Foot, What is the length of his journey covered by Bus and Taxi altogether? **[IMO - 2017]**  
 (A) 2 km (B) 8 km (C) 3 km (D) 6 km

**Q.32** When a rational number  $\frac{p}{q}$  is divided by  $\frac{5}{6}$ , the result is  $\frac{-12}{25}$  the rational number  $\frac{p}{q}$  must be: **[IOM - 2019]**

- (A)  $\frac{2}{5}$  (B)  $\frac{-2}{5}$   
 (C)  $\frac{5}{2}$  (D)  $\frac{-5}{2}$

**Q.33** For what value of the natural number n, the given product will be equal to 10, when simplified? **[IOM-2019]**

$$\left(1 + \frac{1}{2}\right)\left(1 + \frac{1}{3}\right)\left(1 + \frac{1}{4}\right)\left(1 + \frac{1}{5}\right) \dots \left(1 + \frac{1}{n}\right)$$

(A) 18 (B) 19 (C) 20 (D) 21

**Q.34** If  $\frac{63}{105} = \frac{a}{5} = \frac{24}{b}$ , then the fraction  $\frac{b-a}{ab}$  is equal to: **[IOM-2019]**

- (A)  $\frac{13}{105}$  (B)  $\frac{11}{210}$   
 (C)  $\frac{37}{120}$  (D)  $\frac{43}{120}$

**Q.35** Some triangles are shaded inside the circle shown below. Now many more such triangles should be shaded so that the fraction represented by the shaded parts of the whole circle is equivalent to 0.5? **[IOM - 2019]**



- (A) 4 (B) 7 (C) 6 (D) 12

**Q.36** If  $x + \frac{1}{2}x + \frac{1}{3} = \frac{1}{6}x + 2$ , then the value of x is **[IOM - 2019]**

(A) 2 (B) 3  
 (C) 6 (D) none of these

**Q.37** Manasa used  $\frac{1}{4}$  of a bag of sugar for a recipe. Identify the decimal form of that fraction. **[NSTSE - 2021]**

(A) 7.5 (B) 0.75  
 (C) 0.34 (D) 0.25

**Q.38** Which fraction is closest to 0? **[NSTSE - 2022]**

- (A)  $\frac{5}{12}$  (B)  $-\frac{2}{3}$   
 (C)  $\frac{3}{11}$  (D)  $\frac{3}{4}$

**Q.39** Choose the correct descending order option. **[NSTSE - 2022]**

- (A)  $-\frac{5}{6}, -\frac{19}{24}, -\frac{3}{4}, -\frac{2}{3}, -\frac{7}{12}$   
 (B)  $-\frac{7}{12}, -\frac{2}{3}, -\frac{3}{4}, -\frac{19}{24}, -\frac{5}{6}$   
 (C)  $-\frac{5}{6}, -\frac{19}{24}, -\frac{2}{3}, -\frac{3}{4}, -\frac{7}{12}$   
 (D)  $-\frac{7}{12}, -\frac{2}{3}, -\frac{19}{24}, -\frac{3}{4}, -\frac{5}{6}$

## ANSWER KEY

## EXERCISE-II

Q.1	D	Q.7	A	Q.13	A	Q.19	B	Q.25	A
Q.2	C	Q.8	A	Q.14	B	Q.20	B	Q.26	C
Q.3	A	Q.9	C	Q.15	A	Q.21	B	Q.27	D
Q.4	C	Q.10	C	Q.16	B	Q.22	A	Q.28	C
Q.5	D	Q.11	D	Q.17	A	Q.23	B	Q.29	A
Q.6	B	Q.12	A	Q.18	B	Q.24	B	Q.30	A

## EXERCISE-III

## TRUE/FALSE QUESTIONS

Q.1	False	Q.3	True	Q.5	False	Q.7	True
Q.2	True	Q.4	True	Q.6	True	Q.8	True

## FILL IN THE BLANKS

Q.1	$\frac{1}{3}$ kg	Q.4	$\frac{1}{8}$	Q.7	$\frac{4861}{2520}$ (sum of $\frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{10}$ )
Q.2	$\frac{3}{5}$	Q.5	$\frac{2}{3}$	Q.8	$\frac{1}{6}$ m
Q.3	$\frac{9}{15}$	Q.6	$\frac{1}{2}$		

## ASSERTION &amp; REASON

Q.1	(A)	Q.3	(A)	Q.5	(A)
Q.2	(A)	Q.4	(A)	Q.6	(A)

## CASE STUDY

Q.1 Fraction used =  $\frac{2}{5} + \frac{1}{4} + \frac{1}{10} = \frac{8}{20} + \frac{5}{20} + \frac{2}{20} = \frac{15}{20} = \frac{3}{4}$ .  
 $\frac{3}{4} \cdot \frac{2}{5} + \frac{1}{4} + \frac{1}{10} = \frac{8}{20} + \frac{5}{20} + \frac{2}{20} = \frac{15}{20} = \frac{3}{4} \rightarrow \frac{3}{4}$

Q.2 Fraction unused =  $\frac{1}{4}$

Q.3 Wheat area (of 100 m<sup>2</sup>) = 40 m<sup>2</sup>

Q.4 Wheat occupies maximum (40 m<sup>2</sup> vs vegetables 25 m<sup>2</sup> vs flowers 10 m<sup>2</sup>).

Q.5 Vegetables need additional  $\frac{1}{8}$ : total veg fraction =  $\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$ .  $\frac{3}{8} \cdot \frac{1}{4} + \frac{1}{8} = \frac{3}{8} \cdot \frac{1}{4} + \frac{1}{8} = \frac{3}{32} + \frac{4}{32} = \frac{7}{32}$ .

## MATCH THE COLUMNS

Q.1	(A)	Q.2	(C)	Q.3	(B)	Q.4	(D)	Q.5	(A)
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

## CORRECT THE ERROR

Q.1  $\frac{4}{6}$  simplified =  $\frac{2}{3}$  (not  $\frac{2}{4}$ ). Q.4 On the number line  $\frac{2}{3}$  comes **before**  $\frac{3}{4}$

Q.2  $\frac{1}{0}$  is **undefined** (not 0). ( $\frac{2}{3} < \frac{3}{4}$ ).

Q.3  $\frac{4}{5} \times 0 = 0$  (not  $\frac{4}{5}$ ). Q.5  $\frac{3}{8} + \frac{1}{4} = \frac{3}{8} + \frac{2}{8} = \frac{5}{8}$  (not  $\frac{4}{12}$ ).

## EXERCISE-V

Q.1	B	Q.2	D	Q.3	B	Q.4	B	Q.5	C	Q.6	C	Q.7	C
Q.8	A	Q.9	C	Q.10	D	Q.11	D	Q.12	B	Q.13	B	Q.14	D
Q.15	D	Q.16	C	Q.17	A	Q.18	D	Q.19	C	Q.20	A	Q.21	A
Q.22	D	Q.23	D	Q.24	C	Q.25	C	Q.26	B	Q.27	B	Q.28	C
Q.29	A	Q.30	C	Q.31	D	Q.32	B	Q.33	B	Q.34	C	Q.35	C
Q.36	D	Q.37	D	Q.38	C	Q.39	B						

# 1

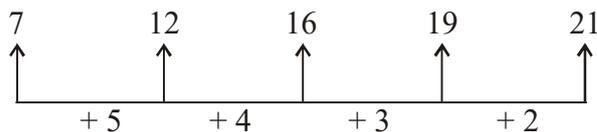
# Series completion

## NUMBER SERIES

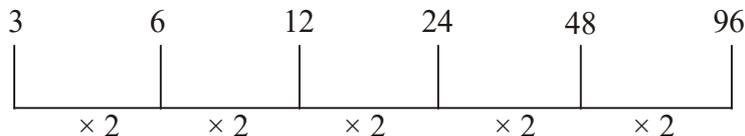
A number series is a collection of numbers which follow a particular pattern or rule. The pattern followed by the number in the series remains the same throughout. Each number in a number series is called a term.

## TYPES OF SERIES

- Difference series** : The difference series can be further, classified as follows:
  - Number series with a constant difference : Here the difference between two consecutive numbers is always constant. For example, the numbers of the series 1, 4, 7, 10, 13 ..... are such that the difference between two consecutive terms is constant. Here this difference is 3.
  - Number series with increasing /decreasing difference : Here the difference between consecutive terms is not constant. It either decreases or increases, e.g. the series 7, 12, 16, 19, 21 ....

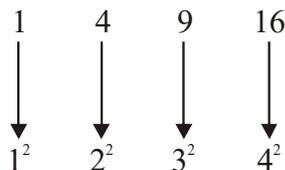


- Product series** : Consider the series 3, 6, 12, 24, 48, 96.



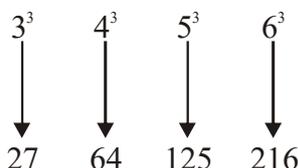
- Squares/Cubes series** :

**Ex.1 Squares series** :



Here the term that follows 16 will be square of 5, i.e. 25.

**Ex.2 Cubes series** :



- Combination series** : This is a type of series where more than one arithmetic operation is performed. Let us take an example. 2, 1, 4, 4, 6, 9, 8, 16  
Here two series are being followed alternatively first is even number series (2, 4, 6, 8) and the second is square series (1, 4, 9, 16)
- Triangular Pattern Series** : Sometimes, the differences between the consecutive terms of a series, again form a series. The differences between the consecutive terms of the new series so formed, again form a series. This pattern continues till we attain a uniform difference between the consecutive terms of the series.

**FINDING THE WRONG TERMS IN THE GIVEN SERIES (NUMBER ODD MAN OUT)**

Let us consider some examples to understand the concept of odd man.

1      4      9      16      25      36      63      81

(a) On observing the terms of the above number series carefully, we notice that all the terms except 63 are perfect squares of natural numbers. 63 is not a square of a natural number. Hence, 63 is the odd man.

(b) 235    354    424    541    613

This problem is somewhat tricky. The sum of digits of each term except 354 is 10. The sum of digits of 354 is  $3 + 5 + 4 = 12$ . Hence 354 is the odd man.

**ALPHABET SERIES**

In this type of questions, a series of single, pairs or groups of letters or combinations of letters and numerals is given. The terms of the series form a certain pattern as regards the position of the letters in the English alphabet. Identity this pattern and accordingly find the missing term or the wrong term in the given series.

**ALPHA NUMERIC SERIES**

This type of question is just a jumbled form of questions of Type 1 and Type 2, which you have just read. Here, the terms of the given series are a combination of letters and numerals, which move according to a set pattern. Study the following illustrations.

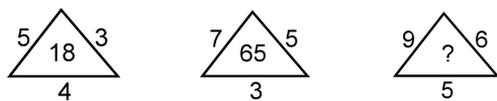
**CONTINUOUS PATTERN SERIES**

This type of questions usually consists of a series of small letters which follow a certain pattern. However, some letters are missing from the series. These missing letters are then given in a proper sequence as one of the alternatives. Choose this alternative as the answer.

**MISSING CHARACTER**

In such type of question, a figure, a set of figures, an arrangement or a matrix is given, each of which bears certain characters, be it numbers, letters or a group/combination of letters/numbers, following a certain pattern. The candidate is required to decipher this pattern and accordingly find the missing character in the figure.

**Illustration 1 :**



(A) 112

(B) 92

(C) 82

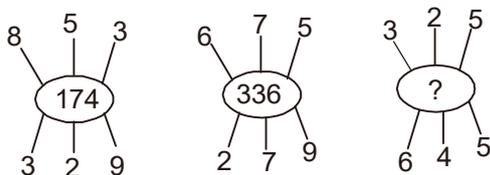
(D) 102

**Sol.** In figure I,  $5^2 - 4^2 + 3^2 = 18$

In figure II,  $7^2 - 3^2 + 5^2 = 65$

$\therefore$  In figure III,  $9^2 - 5^2 + 6^2 = 92$  **Ans.**

**Illustration 2 :**



(A) 140

(B) 150

(C) 200

(D) 180

**Sol.** In figure first ]

$$8 \times 5 \times 3 + 3 \times 2 \times 9 = 120 + 54 = 174$$

In figure second]

$$6 \times 7 \times 5 + 2 \times 7 \times 9 = 210 + 126 = 336$$

$\therefore$  missing number in figure]

$$3 \times 2 \times 5 + 6 \times 4 \times 5 = 30 + 120 = 150$$
 **Ans.**

## EXERCISE

**Directions (Q.1 to 32): Find the missing numbers.**

- Q.1 1, 4, 9, 16, 25, ?  
 (A) 35 (B) 49  
 (C) 36 (D) 64
- Q.2 6, 12, 7, 11, 8, 10, 9, ?  
 (A) 8 (B) 15  
 (C) 9 (D) 14
- Q.3 5, 9, 16, 29, 54, \_  
 (A) 92 (B) 89  
 (C) 79 (D) 103
- Q.4 1, 3, 7, 13, \_  
 (A) 19 (B) 23  
 (C) 21 (D) 25
- Q.5 16, 33, 67, 135, \_  
 (A) 371 (B) 175  
 (C) 271 (D) 287
- Q.6 1, 10, 17, 22, 25, ?  
 (A) 26 (B) 25  
 (C) 27 (D) 29
- Q.7 0.5, 1.5, 3, 5, 7.5, 10.5,.....  
 (A) 21 (B) 13.5  
 (C) 14 (D) 15
- Q.8 2, 9, 28, 65 .....  
 (A) 121 (B) 195  
 (C) 126 (D) 103
- Q.9 1,4,2,8,6,24,22,88, ?  
 (A) 86 (B) 90  
 (C) 154 (D) 352
- Q.10 1, 2, 3, 6, 12, ?  
 (A) 18 (B) 24  
 (C) 36 (D) 48
- Q.11 240, ?, 120, 40, 10, 2  
 (A) 120 (B) 240  
 (C) 40 (D) 10
- Q.12  $\frac{1}{5}, \frac{3}{7}, \frac{6}{11}, \frac{10}{19}, ?$   
 (A)  $\frac{11}{13}$  (B)  $\frac{12}{25}$   
 (C)  $\frac{3}{7}$  (D)  $\frac{15}{38}$
- Q.13 4, 9, 20, 43, .....  
 (A) 133 (B) 84  
 (C) 96 (D) None of these
- Q.14 6, 24, 60, 120, 210, 336, \_\_, 720  
 (A) 496 (B) 502  
 (C) 504 (D) 498
- Q.15 0, 3, 8, 15, 24, ?  
 (A) 30 (B) 35  
 (C) 48 (D) 63
- Q.16 3, 10, 29, 66, 127, ?  
 (A) 164 (B) 187  
 (C) 216 (D) 218
- Q.17 77, 78, 77, 81, 73, ... 55  
 (A) 69 (B) 71  
 (C) 82 (D) 89
- Q.18 5, 7, ....., 9, 7, 11, 8, 13  
 (A) 8 (B) 6  
 (C) 19 (D) 7
- Q.19 4, 8, 12, 24, 36, 72, ....  
 (A) 108 (B) 98  
 (C) 92 (D) 96
- Q.20 7776, 1296, 216,.....  
 (A) 16 (B) 36  
 (C) 108 (D) 21
- Q.21 -15, 2, 21, 42,.....  
 (A) 62 (B) 84  
 (C) 65 (D) 66
- Q.22 4, 16, 36, ?, 100, 144  
 (A) 72 (B) 68  
 (C) 81 (D) 64

**Directions (Q.23 to 36): Find the missing term**

- Q.23 V, T, R, ?, N, ?  
 (A) P, M (B) O, L  
 (C) P, L (D) O, M
- Q.24 AB, BA, ABD, DBA, PQRS, ?  
 (A) SRQP (B) SRPQ  
 (C) SQRP (D) RSQP
- Q.25 2B, 4C, 8E, 14H, ?  
 (A) 22L (B) 24L  
 (C) 22K (D) 22M
- Q.26 5X9, 8U12, 11R15, 14O18, ?  
 (A) 17L21 (B) 17K21  
 (C) 17M21 (D) 17L23
- Q.27 6C7, 8F10, 11J14, 15O19, ?  
 (A) 19U24 (B) 20U25  
 (C) 19U25 (D) 20U24
- Q.28 A, H, N, S, W, ?  
 (A) A (B) Y  
 (C) B (D) Z
- Q.29 AF, EJ, IN, OT, ?  
 (A) UX (B) UY  
 (C) UN (D) UZ
- Q.30 KTE, SBM, AJU, IRC, ?  
 (A) KZQ (B) ZRL  
 (C) QZK (D) LYJ
- Q.31  $C_3, H_8, O_{15}, \dots$   
 (A)  $X_{24}$  (B)  $I_{35}$   
 (C)  $T_{26}$  (D)  $J_{35}$
- Q.32 BE, FI, JM, ?, RU  
 (A) UW (B) NO  
 (C) NQ (D) PN
- Q.33 A, C, F, J, ?, U  
 (A) M (B) N  
 (C) O (D) P
- Q.34 A, Y, D, W, G, U, J, ?  
 (A) R (B) T  
 (C) S (D) P
- Q.35 F3X, H7U, J15R, L31O, ?  
 (A) M63L (B) N63L  
 (C) N61L (D) N65K

- Q.36 AH, DL, GP, JT, ?  
 (A) MY (B) NX  
 (C) MX (D) NY

**Directions (Q.37 to 47): Find the wrong term(s).**

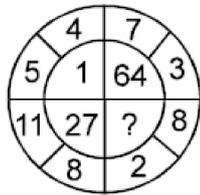
- Q.37 ECA, JHF, OMK, TQP, YWU  
 (A) ECA (B) JHF  
 (C) TQP (D) YWU
- Q.38 ABD, DGK, HMS, NTB, SBL, ZKW  
 (A) NTB (B) DGK  
 (C) SBL (D) ZKW
- Q.39 0, 0, 1, 3, 5, 10, 15, 21  
 (A) 0 (B) 1  
 (C) 5 (D) 21
- Q.40 5, 10, 12, 24, 26, 48, 54  
 (A) 10 (B) 24  
 (C) 26 (D) 48
- Q.41 2, 6, 11, 17, 23, 32, 41  
 (A) 6 (B) 17  
 (C) 23 (D) 32
- Q.42 1 2 6 21 84 445 2676  
 (A) 2 (B) 6  
 (C) 21 (D) 84
- Q.43 2 5 11 20 30 47  
 65  
 (A) 5 (B) 20  
 (C) 30 (D) 47
- Q.44 3 7 15 27 63 127 255  
 (A) 15 (B) 27  
 (C) 63 (D) 127
- Q.45 7 8 18 57 228 1165 6996  
 (A) 18 (B) 228  
 (C) 1165 (D) 6996
- Q.46 2880 480 92 24 8 4 4  
 (A) 92 (B) 96  
 (C) 106 (D) 89
- Q.47 9, 13, 21, 37, 69, 132, 261  
 (A) 21 (B) 37  
 (C) 69 (D) 132

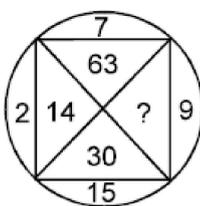
**Directions (Q.48 to 60): Which sequence of letters when placed at the blanks one after the other will complete the given letter series ?**

- Q.48 a a – b a a – b b b – a  
 (A) baa (B) abb  
 (C) bab (D) aab
- Q.49 cc – ccdd – d – cc – ccdd – dd  
 (A) dcdcc (B) dcdde  
 (C) dccdd (D) None of these
- Q.50 a – b a a – a a – – a b  
 (A) a a a a (B) b a a a  
 (C) b b a a (D) a b b a
- Q.51 – a a b b – a – a b – b  
 (A) b b a a (B) b a b a  
 (C) b a a b (D) a b a b
- Q.52 a – bbc – aab – cca – bbcc  
 (A) bacb (B) acba  
 (C) abba (D) caba
- Q.53 – b c c – ac – a a b b – a b – c c  
 (A) aabca (B) abaca  
 (C) bacab (D) bcaca
- Q.54 – a a b b – a b b a – b  
 (A) b a b (B) a b a  
 (C) b b a (D) b a a
- Q.55 ab \_ bc \_ c \_ ba \_ c  
 (A) bbca (B) bcbc  
 (C) caba (D) caab
- Q.56 a \_ bccb \_ ca \_ cca \_ baab \_ c  
 (A) ababc (B) abcaa  
 (C) accab (D) bacca
- Q.57 bc \_ b \_ c \_ b \_ ccb  
 (A) cbc b (B) b b c b  
 (C) c b b c (D) b c b c
- Q.58 cb \_ ab \_ cb \_ a \_ cc \_ a  
 (A) aacbb (B) acabb  
 (C) abacb (D) ababc
- Q.59 – ca – c – bc – b – a  
 (A) abcba (B) bbaac  
 (C) ccbab (D) cbaca

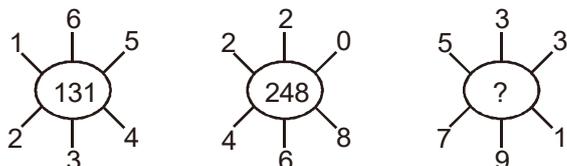
- Q.60 1 \_ 0100 \_ 11001000 \_ 1001 \_ 001  
 (A) 0010 (B) 0001  
 (C) 0000 (D) 1111

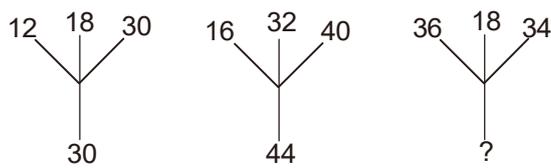
**Directions (Q.61 to 69): Find the missing number(s):**

Q.61   
 (A) 125 (B) 216  
 (C) 121 (D) 225

Q.62   
 (A) 33 (B) 145  
 (C) 135 (D) 18

Q.63   
 (A) Z (B) C  
 (C) E (D) F

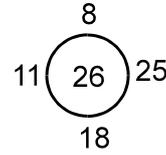
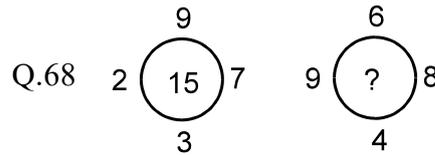
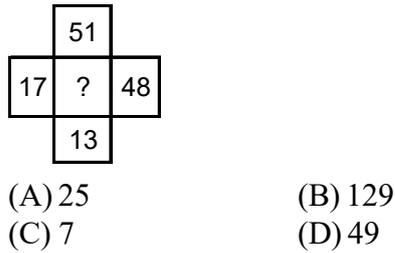
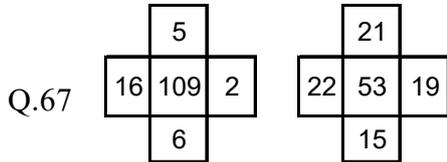
Q.64   
 (A) 262 (B) 274  
 (C) 320 (D) 132

Q.65   
 (A) 48 (B) 9  
 (C) 44 (D) 64

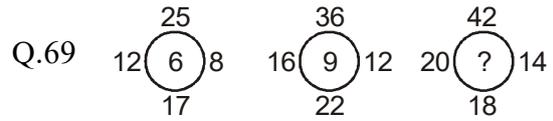
Q.66

10	54	?
7	45	32
24	144	68

- (A) 42 (B) 36  
(C) 6 (D) 4



- (A) 72 (B) 18  
(C) 9 (D) 19



- (A) 6 (B) 15  
(C) 30 (D) 47

**ANSWER KEY**

Q.1	C	Q.2	C	Q.3	D	Q.4	C	Q.5	C	Q.6	A	Q.7	C
Q.8	C	Q.9	A	Q.10	B	Q.11	B	Q.12	C	Q.13	D	Q.14	C
Q.15	B	Q.16	D	Q.17	C	Q.18	B	Q.19	A	Q.20	B	Q.21	C
Q.22	D	Q.23	C	Q.24	A	Q.25	A	Q.26	A	Q.27	B	Q.28	D
Q.29	D	Q.30	C	Q.31	A	Q.32	C	Q.33	C	Q.34	C	Q.35	B
Q.36	C	Q.37	C	Q.38	A	Q.39	C	Q.40	D	Q.41	C	Q.42	D
Q.43	C	Q.44	B	Q.45	B	Q.46	A	Q.47	D	Q.48	A	Q.49	B
Q.50	D	Q.51	D	Q.52	B	Q.53	C	Q.54	D	Q.55	D	Q.56	A
Q.57	A	Q.58	B	Q.59	B	Q.60	A	Q.61	B	Q.62	C	Q.63	C
Q.64	A	Q.65	C	Q.66	D	Q.67	A	Q.68	D	Q.69	B		