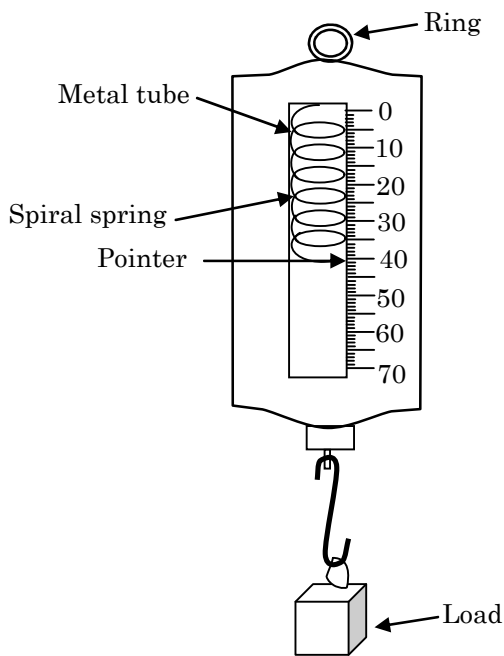
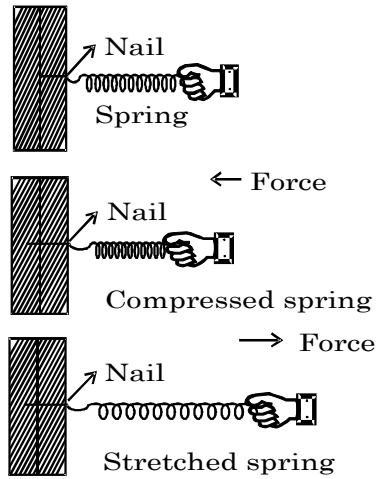


Chapter Outline

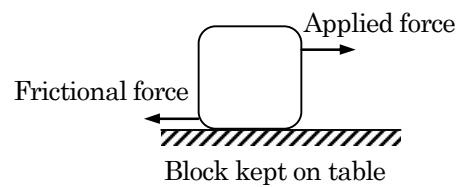
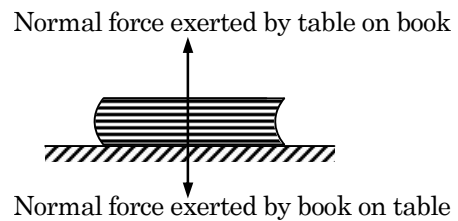
- ❖ Force
- ❖ Balanced and Unbalanced force
- ❖ Types of Force



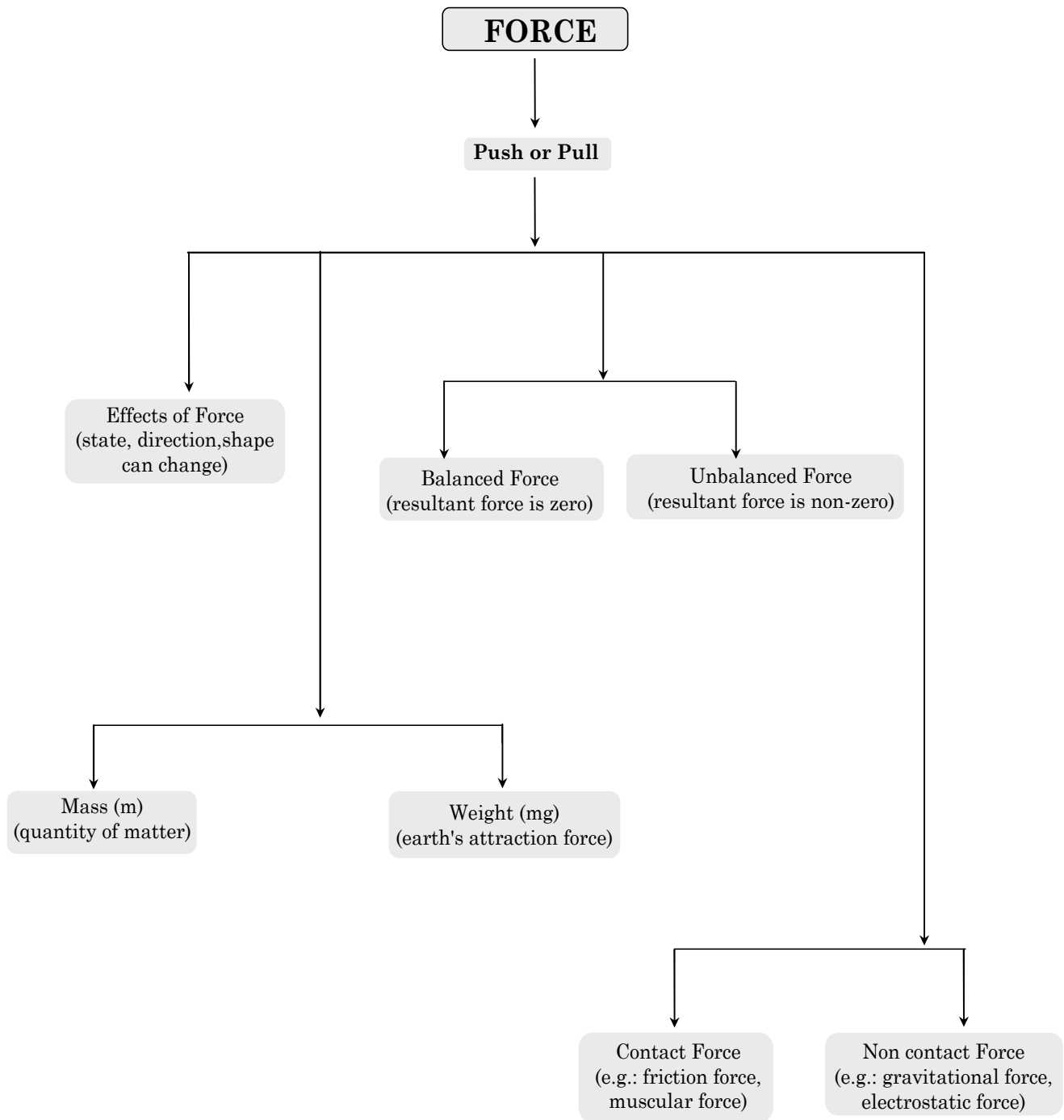
Spring balance



Force changes the shape of objects



MIND MAP



FORCE

Force

To define force first of all one has to see the effects of force. By 'effects of force' we mean what force can do or what changes a force can bring about.

◆ Effects of Force

- **Force can set a stationary object in motion:** When force is applied to a stationary object, it can make it move. For example, if you push a book placed on a table, it starts moving. When you pull a chair, it starts moving. When you push a handcart, it starts moving. However, it is not necessary that force always makes a stationary body move. For example, if you try to push the wall of your classroom, it will not move. For that matter even if all the boys in your class push the wall, it will not move. The reason is that the force applied by all of you is not sufficient to move the wall.
- **Force can stop the moving objects or slow them down:** Imagine your friend is riding a bicycle. If you pull his bicycle from behind, it is going to slow down. It means that if you apply a force in the direction opposite to the direction of the moving body, the body slows down.

Similarly, if we apply brakes to a moving bicycle, it first slows down and then stops. We ourselves have to apply force to stop our bodies while running. A cricket ball is stopped by a player by applying a force in the direction opposite to that of the ball.

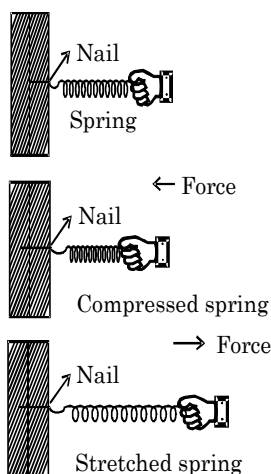
From the above examples, it is clear that a force may stop a moving body or may reduce the speed of the moving body.

- **Force can change the direction of moving objects:** When a cricket player hits the ball with a bat, his force changes the speed as well as the direction of the ball. Similarly, a football player changes the direction of a moving ball by angling his foot. You change the direction of your moving bicycle by applying force on its handle in the desired direction.



Force can change the direction of a ball

- **Force can change the shape of objects:** Imagine a spring fixed in a wall with a nail. When we pull the spring, it gets stretched and hence, its shape changes, similarly, when we crumple a paper, its shape changes. Thus by applying force, we can change the shape of object.



Force changes the shape of objects

◆ Definition of Force

Based on the effects of force, it may be defined as:

Force is a pull or push, which changes or tends to change the state of rest or of uniform motion of a body or changes its direction or shape.

COMPETITIVE LEVEL

◆ Mathematical Representation of Force

Mathematically, force F is equal to the product of mass ' m ' of a body and acceleration ' a ' produced in the body due to that force.

i.e. $F = ma$

Where $a = (\text{final velocity} - \text{initial velocity})/\text{time}$

• Units of Force:

(i) In C.G.S. system:

$$F = ma \rightarrow \text{gram} \times \text{cm/s}^2 = \text{dyne}$$

If $m = 1$ gram and $a = 1 \text{ cm/s}^2$ then by $F = ma$,

$$F = 1 \times 1 = 1 \text{ g} \times \text{cm/s}^2 = 1 \text{ dyne}$$

When a force is applied on a 1 gram body and the acceleration produced in the body is 1 cm/s^2 then the force acting on the body will be one dyne.

(ii) In S.I. system:

$$F = ma \rightarrow \text{kg} \times \text{m/s}^2 = \text{Newton}$$

If $m = 1$ kg and $a = 1 \text{ m/s}^2$ then by $F = ma$

$$F = 1 \times 1 = 1 \text{ kg} \times \text{m/s}^2 = 1 \text{ Newton.}$$

If a force is applied on a body of mass 1 kg and acceleration produced in the body is 1 m/s^2 then the force acting on the body will be one Newton.

• Relationship between the Newton and dyne:

$$1 \text{ N} = 1 \text{ kg} \times 1 \text{ m s}^{-2}$$

$$= 1000 \text{ g} \times 100 \text{ cm s}^{-2}$$

$$= 100000 \text{ g cm s}^{-2} = 10^5 \text{ dyne}$$

$$\text{Thus } 1 \text{ N} = 10^5 \text{ dyne}$$

Ex.1 Calculate the force required to produce an acceleration of 5 m/s^2 in a body of mass 2.4 kg .

Sol. We know that force = mass \times acceleration

$$= 2.4 \text{ kg} \times 5 \text{ m/s}^2 = 12.0 \text{ N}$$

Ex.2 A force acts for 0.2 s on a body of mass 2.5 kg initially at rest. The force then ceases to act and the body moves through 4 m in the next one second. Calculate the magnitude of force.

Sol. When the force ceases to act, the body will move with a constant velocity. Since it moves a distance of 4 m in 1 s , therefore, its uniform velocity = 4 m/s .

Now, initial velocity, $u = 0$

Final velocity, $v = 4 \text{ m/s}$

Time interval, $\Delta t = 0.2 \text{ s}$

$$\therefore \text{Acceleration, } a = \frac{v - u}{\Delta t} = \frac{4 - 0}{0.2} = 20 \text{ m/s}^2$$

From the relation,

$F = ma$, we get

$$\text{Force, } F = 2.5 \times 20 = 50 \text{ N}$$

Ex.3 A ball of mass 20 gm is initially moving with a velocity of 100 m/s . On applying a constant force on the ball for 0.5 s , it acquires a velocity of 150 m/s . Calculate the following:

(i) Acceleration of the ball

(ii) Magnitude of the force applied

Sol. Given, $m = 20 \text{ gm} = 0.02 \text{ kg}$

Initial velocity, $u = 100 \text{ m/s}$

Time interval, $t = 0.5 \text{ s}$

Final velocity, $v = 150 \text{ m/s}$

$$(i) \text{ Acceleration, } a = \frac{v - u}{t} = \frac{150 - 100}{0.5} = 100 \text{ ms}^{-2}$$

$$(ii) \text{ Force, } F = \text{mass} \times \text{acceleration} \\ = 0.02 \times 100 = 2.0 \text{ N}$$

Ex.4 A cricket ball of mass 200 gm moving with a speed of 40 m/s is brought to rest by a player in 0.04 s . Calculate the average force applied by the player.

Sol. Mass, $m = 200 \text{ gm} = \frac{200}{1000} \text{ kg} = 0.2 \text{ kg}$

Initial velocity, $u = 40 \text{ m/s}$

Final velocity, $v = 0$

Time, $t = 0.04 \text{ s}$

$$\text{Average force} = \frac{\text{Change in momentum}}{\text{Time}} = \frac{-8.0}{0.04} = -200 \text{ N}$$

(The negative sign shows that the force is applied in a direction opposite to the direction of motion of the ball).

Ex.5 A motorcycle is moving with a velocity of 108 km/hr and it takes 5 s to stop it after the brakes are applied. Calculate the force exerted by the brakes on the motorcycle if its mass along with the rider is 250 kg.

Sol. Given that initial velocity of the motorcycle

$$= 108 \text{ km/hr} = 30 \text{ m/s}$$

$$\text{Final velocity} = 0 \text{ m/s}$$

Time taken to stop = 5s, the mass of the motorcycle with rider = 250 kg.

The change in the velocity of the motorcycle in 5s = $0 - 30 = -30 \text{ m/s}$

$$\text{Therefore, the acceleration of the motorcycle, } a = \frac{-30}{5} = -6 \text{ m/s}^2$$

The magnitude of the force applied by the brakes is given by the equation,

$$F = \text{mass} \times \text{acceleration}$$

$$= 250 \text{ kg} \times (6) \text{ m/s}^2 = 1500 \text{ N}$$

Ex.6 A force produces an acceleration of 5.0 cm/s^2 in a body of mass 20g. Then find out the force acting on the body in Newton.

Sol. Acceleration of the body,

$$a = 5 \text{ cm/s}^2 = 0.05 \text{ m/s}^2$$

Mass of the body, $m = 20 \text{ g} = 0.02 \text{ kg}$

$$F = ma$$

$$\Rightarrow F = 0.05 \times 0.02 = 10^{-3} \text{ N}$$

Ex.7 A force of 15 N acts on a body of mass 5 kg for 2s. What is the change in velocity of the body?

Sol. Given: $F = 15 \text{ N}$, $t = 2\text{s}$, $m = 5 \text{ kg}$

$$F = ma$$

$$a = \frac{F}{m} = \frac{15}{5} = 3 \text{ m/s}^2$$

$$a = \frac{v - u}{t}$$

$$\Rightarrow v - u = at = 3 \times 2 = 6 \text{ m/s}$$

Balanced and Unbalanced Forces

A number of forces acting on an object may either be balanced or unbalanced.

◆ Balanced Forces

If a number of forces acting on an object does not produce any change in its state of rest or uniform motion or direction of motion then they are known as balanced forces.

For example

- (i) A person holding a briefcase in hand.
- (ii) A book resting on a table.
- (iii) Squeezing a lemon, etc.

◆ Unbalanced Forces

If a number of forces acting on an object produce a change in its state of rest or uniform motion or direction of motion, then they are termed as unbalanced forces:

For example:

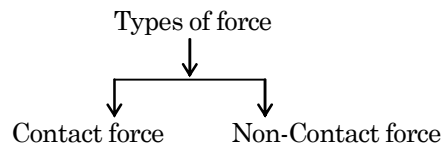
- (i) A briefcase released from a persons hand.
- (ii) A stone dropped, etc.

◆ Resultant Force

If a number of forces act on an object then a single force that produces same change in the state of rest or motion is called resultant force. For example, if a number of people push a large almirah and the same almirah can also be pushed by a single person then the force of this single person is the resultant force of all these people. If two forces act on an object in the same direction then the resultant force is obtain by adding them. If two forces act on an object in the opposite direction then the resultant force is obtain by subtracting them.

Note: If resultant force is zero it means either object is at rest or in uniform motion.

Types of Force



◆ Contact Force

Force which acts on a body only when the body is in contact with another body (exerting force), the force is known as contact force.

- **Types of contact force**

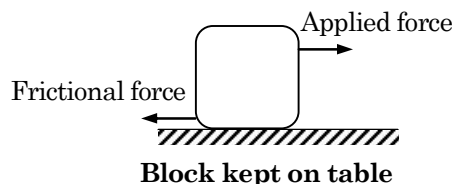
COMPETITIVE LEVEL

(i) **Normal force:** If contact forces between the bodies are perpendicular to the surfaces in contact, then the forces are known as normal forces.

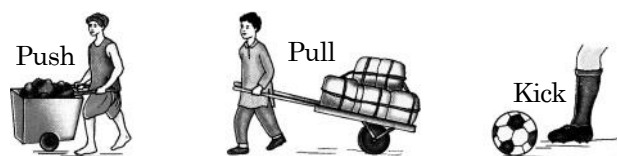
e.g.: Consider a book on a table. The table pushes the book upwards and book pushes the table downwards, these forces are perpendicular to the surfaces of book and table. Thus, the table applies a normal force on book in the upward direction and book applies a normal force on table in downward direction.

```
graph TD; A[Normal force exerted by table on book] --> B[Book]; B --> C[Normal force exerted by book on table]
```

(ii) **Force of friction:** Two bodies placed in contact can also exert forces parallel to the surfaces in contact; such a force is called force of friction or simply friction. It always opposes relative motion of object.



(iii) **Muscular force:** This is the force we can exert with our bodies by using our muscles, e.g. pull, push, kick, etc. Such forces are also called mechanical forces. These are contact forces.



Muscular or mechanical forces

◆ **Non-Contact force**

Force which acts on a body when the body is not in contact with any other body (exerting force), is known as non-contact force.

• **Types of non-contact force:**

(i) **Gravitational force:** Newton said that every object in this universe attracts every other object with a certain force. The force with which two objects attract each other is called the force of gravitation. The force of gravitation acts even if the two objects are not connected by any means. If, however, the masses of the objects are small, the force of gravitation between them is small and cannot be detected easily. The force of attraction between any two particles in the universe is called gravitation or gravitational force.

COMPETITIVE LEVEL

(a) **Force of gravity:** The earth attracts all the bodies towards its centre. The force exerted by the earth on the body is known as weight of the body or force of gravity. It acts in vertically downward direction. If mass of the body is m and acceleration due to gravity is g . Then, force of gravity or weight = mg .

The value of g is 9.8 m/s^2 . For a body moving downward, g is taken as positive while for a body moving upward, g is taken as negative.

(b) **Gravitational units of force:** The force due to gravity on a body of mass m at a place where acceleration due to gravity is g , is given as

$$F = mg$$

The above relation can be used to define the gravitational units of force.

In M.K.S. system, the unit of force is the kilogram force (kgf). One kilogram force is the force due to gravity on a mass of 1 kilogram.

Thus, 1 kgf = force due to gravity on a mass of 1 kg

$$1 \text{ kgf} = 1 \text{ kg mass} \times \text{acceleration due to gravity } g \text{ (ms}^{-2}\text{)} = g \text{ Newton.}$$

Since, the average value of g is 9.8 m s^{-2} ,

$$1 \text{ kgf} = 9.8 \text{ newton (or } 9.8\text{N).}$$

In C.G.S. system, the gravitational unit of force is the gram force (gf). One gram force is the force due to gravity on a mass of 1 gram.

Thus, 1 gf = force due to gravity on a mass of 1 g

$$1 \text{ gf} = 1 \text{ g mass} \times \text{acceleration due to gravity } g \text{ (cms}^{-2}\text{)} = g \text{ dyne.}$$

Since, the average value of g is 980 cms^{-2} , 1 gf = 980 dyne.

Further, 1 kgf = 1000 gf.

To an approximation 1 kgf can be treated to be nearly equal to 10 N.

Then, 1 N = 0.1 kgf or 1 N = 100 gf.

Difference between Mass and Weight

Mass		Weight	
(i)	It is the quantity of matter possessed by a body. It is represented by m .	(i)	It is the force with which a body is attracted towards the centre of the earth. It is represented by $W = mg$.
(ii)	A mass is a constant quantity and is same (for a body) everywhere.	(ii)	It varies from place to place due to variation in value of g .
(iii)	Mass is never zero.	(iii)	A body has zero weight at the centre ($g = 0$) of the earth .
(iv)	Its unit is kg.	(iv)	Its unit is Newton.
(v)	It is a scalar quantity.	(v)	It is a vector quantity.

Ex.8 Find out the weight of an object of mass 25kg in Newton, dyne, kgf and gf. ($g=10 \text{ m/s}^2$).

Sol. Mass = 25 kg

Weight = mg

$$W = 25 \times 10 = 250 \text{ N}$$

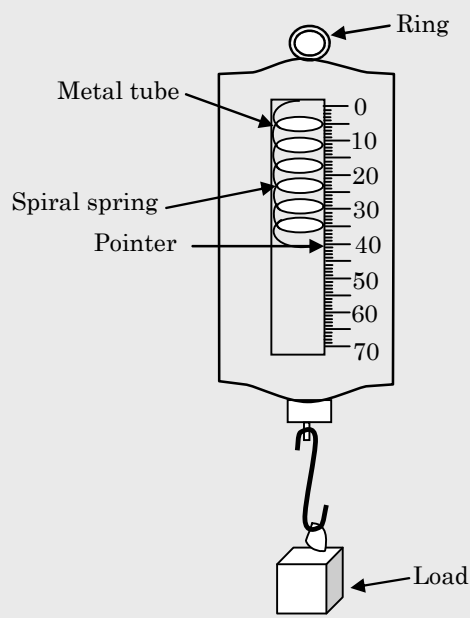
$$= 250 \times 10^5 \text{ dyne} \quad (1\text{N} = 10^5 \text{ dyne})$$

$$= 250/10 = 25 \text{ kgf} \quad (1\text{kgf} = 10 \text{ N})$$

$$= 25 \times 1000 = 25000 \text{ gf} \quad (1\text{kgf} = 1000 \text{ gf})$$

◆ Spring Balance

Spring balance is a device used for measuring the force acting on an object. It consists of a coiled spring which gets stretched when a force is applied to it. Stretching of the spring is measured by a pointer moving on a graduated scale. The reading on the scale gives the magnitude of the force.

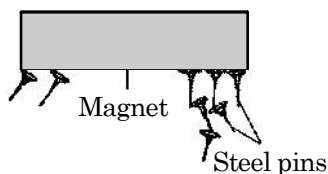


(ii) Electrostatic force: The force exerted by a charged body on another charged or uncharged body is known as electrostatic force. When a plastic comb is rubbed with silk, it can pick up small bits of paper. This is because the comb acquires an electric charge because of which it can exert a force called electrostatic force. Electrostatic force can also act from a distance and is therefore a non contact force. A body with electrostatic charge can either attract or repel another charged body. Electrostatic force is used to separate solid pollutant particles from smoke given out from factories.



Electrostatic force

(iii) Magnetic force: A magnet attracts iron filings, nails and other objects made of iron, steel, nickel and cobalt. Magnets exert forces of attraction or repulsion on other magnets. An important feature of magnetic force is that it can act from a distance and is therefore a non–contact force.



Magnetic force

Note: So far, we know only four fundamental forces in the universe. They are gravitational force, electromagnetic force, weak force and strong interactions. We are familiar with the first two. Weak forces come into play during radioactivity. Strong interactions are responsible for holding the nucleus of an atom together. All other forces are manifestations of these fundamental forces. For example, forces such as friction between bodies, muscular action, etc. viewed on an atomic scale arise chiefly from electrical attraction and repulsion of the electrons and nuclei making up the atoms of the material.

EXERCISE-1

Very Short Answer Type Questions

- Q.1** How many minimum number of objects should be present for a force to come into play?
- Q.2** What happens to the speed of a body when a force is applied?
- Q.3** Is it possible that a force changes the direction of motion but not the speed of an object?
- Q.4** What do you mean by resultant force.
- Q.5** In a tug of war, side A applies 10 Newton force and side B applies 8 Newton force. Which side will the rope move?

Short Answer Type Questions

- Q.6** What do you mean by the direction of force? What is the standard unit of force?
- Q.7** If the force is applied opposite to the motion, what will happen to the speed of the object?
- Q.8** What is meant by contact force? Name the different types of contact forces.
- Q.9** What is meant by non-contact forces? Name the different types of non contact forces.
- Q.10** State the two factors, which describe the state of motion of an object.

Long Answer Type Questions

- Q.11** Force can change the direction of a moving body. Explain with the help of some examples.
- Q.12** Differentiate between contact and non-contact forces.

- Q.13** Name the forces acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.
- Q.14** Name the type of force in the following cases.
(a) Raindrops falling on the earth.
(b) Holding a book on your hand.
(c) Running a comb through your dry hair.
(d) A bar magnet suspended freely.
(e) Bullocks ploughing the field.
- Q.15** How do the mud particles fly off the wheel of a vehicle moving on the wet road?

Fill in the Blanks

- Q.16** (i) To draw water from a well we have to the rope.
(ii) A charged body.....an uncharged body towards it.
(iii) To move a loaded trolley we have to it.
(iv) The north pole of a magnet the north pole of another magnet.
(v) S.I. unit of force is

True or False

- Q.17** (i) Gravitational force is a type of contact force.
(ii) A force cannot be seen but the effect of the force can be felt.
(iii) When we lift a bucket of water, we use gravitational force.
(iv) Newton and kgm/s^2 both are the units of force
(v) Only the earth exerts gravitational force on all objects.

➤ Match the Column

Q.18

Column-A		Column-B	
(a)	Falling object	(i)	friction force
(b)	Magnet	(ii)	non-contact force
(c)	Muscular force	(iii)	Steel pins
(d)	Force which opposes the relative motion	(iv)	gravitational force
(e)	Electrostatic force	(v)	contact force

EXERCISE-2

- Q.1** A force applied on a moving body may:
(A) bring it to rest
(B) increase its speed
(C) decrease the speed
(D) all of the above
- Q.2** A hockey player uses his hockey stick:
(A) to push the ball
(B) to pull the ball
(C) to change its direction
(D) all of these
- Q.3** C.G.S unit of force is:
(A) Dyne (B) Newton
(C) gf (D) can't say
- Q.4** How many dynes are equal to 1N?
(A) 10^6 (B) 10^4 (C) 10^5 (D) 10^3
- Q.5** When an object undergoes acceleration:
(A) its speed always increases
(B) its velocity always increases
(C) it always falls towards the earth
(D) a force always acts on it
- Q.6** The net force acting on a body of mass 1 kg moving with a uniform velocity of 5 ms^{-1} is:
(A) 5 N (B) 0.2 N (C) 0 N (D) None
- Q.7** A body is moving with certain velocity towards right. A force of 5N is applied on it towards right and a force of 6N is applied on it towards left then:
(A) speed of body increases towards right
(B) speed of body increases towards left
(C) speed of body remains the same
(D) speed of body decreases
- Q.8** A contact force cannot act through
(A) empty space
(B) touching
(C) touching with a metal rod
(D) touching with a wooden rod
- Q.9** If you press an inflated balloon, it deforms due to a type of:
(A) contact force
(B) non-contact force
(C) gravitational force
(D) none of these
- Q.10** Which of the following is the action-at-distance force?
(A) muscular force (B) frictional force
(C) magnetic force (D) mechanical force
- Q.11** The force exerted by one object on another by virtue of their masses is:
(A) magnetic force
(B) electrostatic force
(C) gravitational force
(D) frictional force
- Q.12** Earth always pull everything towards it due to:
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force
- Q.13** A cart being carried by a horse is an example of:
(A) muscular force
(B) mechanical force
(C) gravitational force
(D) electrostatic force
- Q.14** Force exerted by the muscles is known as:
(A) mechanical force
(B) gravitational force
(C) electrostatic force
(D) muscular force
- Q.15** The force you will use to collect the iron nails scattered on a sandy ground is:
(A) frictional force
(B) gravitational force
(C) magnetic force
(D) none of these

- Q.16** The force you use to stretch a rubber band is:
(A) frictional force
(B) gravitational force
(C) magnetic force
(D) muscular force
- Q.17** Which of the following is weakest force in nature?
(A) gravitational force
(B) electrostatic force
(C) magnetic force
(D) all of these
- Q.18** If a rock is brought from the surface of the moon:
(A) its mass will change
(B) its weight will change, but not mass
(C) both mass and weight will change
(D) its mass and weight will remain the same
- Q.19** How much force is required to lift a mass of 100g:
(A) 10 N (B) 1 N
(C) 100 N (D) 1000 N
- Q.20** A spring balance is used for measuring:
(A) weight
(B) speed
(C) acceleration
(D) mass

EXERCISE-3

(Previous Year Questions – NSO)

Q.1 Match Column-I with Column-II and select the correct option from the codes given below.

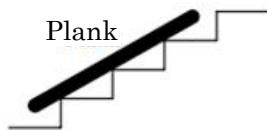
	Column-I		Column-II
(a)	A child running to catch the school bus	(i)	Force can make a stationary object to move
(b)	A man blowing a balloon	(ii)	Force can stop a moving object
(c)	A woman pushing a table	(iii)	Force can change the shape of an object
(d)	A cricketer catching a ball	(iv)	Force can make an object move faster

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

Q.2 A ball is dropped from a spacecraft revolving the earth at a height of 100 km. What will happen to the ball?

- (A) It will continue to move with the same speed along the original orbit of spacecraft
 (B) It will move with the same speed, tangentially to the spacecraft
 (C) It will go very far in the space
 (D) It will fall down to earth gradually.

Q.3 A plank is supported on the steps of a staircase as shown in the figure. How many forces are acting on the plank?



- (A) 4 (B) 5 (C) 6 (D) 7

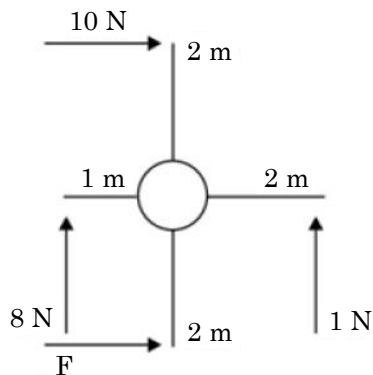
Q.4 When a constant force acts on a mass, and the mass starts moving from rest, then the
 (i) Acceleration is constant
 (ii) Velocity increases at a constant rate
 (iii) Distance traveled is directly proportional to the time.

- (A) (i) only (B) (i) and (ii) only
 (C) (i) and (iii) only (D) (ii) and (iii) only

Q.5 Which of the following objects experience balanced forces?

- (A) A ball dropping vertically
 (B) A car accelerating uniformly from rest
 (C) A trolley moving at a constant velocity down an inclined plane
 (D) A plane flying in a circle with constant speed

Q.6 A windmill s pushed by four external forces as shown in the given figure. The force F required to make the windmill stand still is



- (A) 10 N (B) 13 N
 (C) 15 N (D) 18 N

ANSWER KEY

EXERCISE - 1

➤ Fill in the Blanks :

16. (i) pull
(ii) attracts
(iii) push
(iv) repels
(v) newton

➤ True & False :

17. (i) False
(ii) True
(iii) False
(iv) True
(v) False

➤ Match the Column :

18. a → (iv) ; b → (iii) ; c → (v) ; d → (i) ; e → (ii)

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	A	C	D	C	D	A	A	C	C	C	A	D	C
Ques.	16	17	18	19	20										
Ans.	D	A	B	B	A										

EXERCISE - 3

Ques.	1	2	3	4	5	6
Ans.	A	A	D	B	C	B

SYNTHETIC FIBRES & PLASTICS

Chapter Outline

- ❖1 Synthetic Polymers
- ❖1 Fibres
- ❖1 Synthetic Fibres
- ❖1 Advantages & Disadvantages of Synthetic Fibre
- ❖1 Plastics
- ❖1 Types of Plastic
- ❖1 Characteristics of Plastic
- ❖1 Uses of Plastic
- ❖1 Plastics and the Environment
- ❖1 Solution of problem associated with disposal of plastic



Natural & Synthetic Fibres

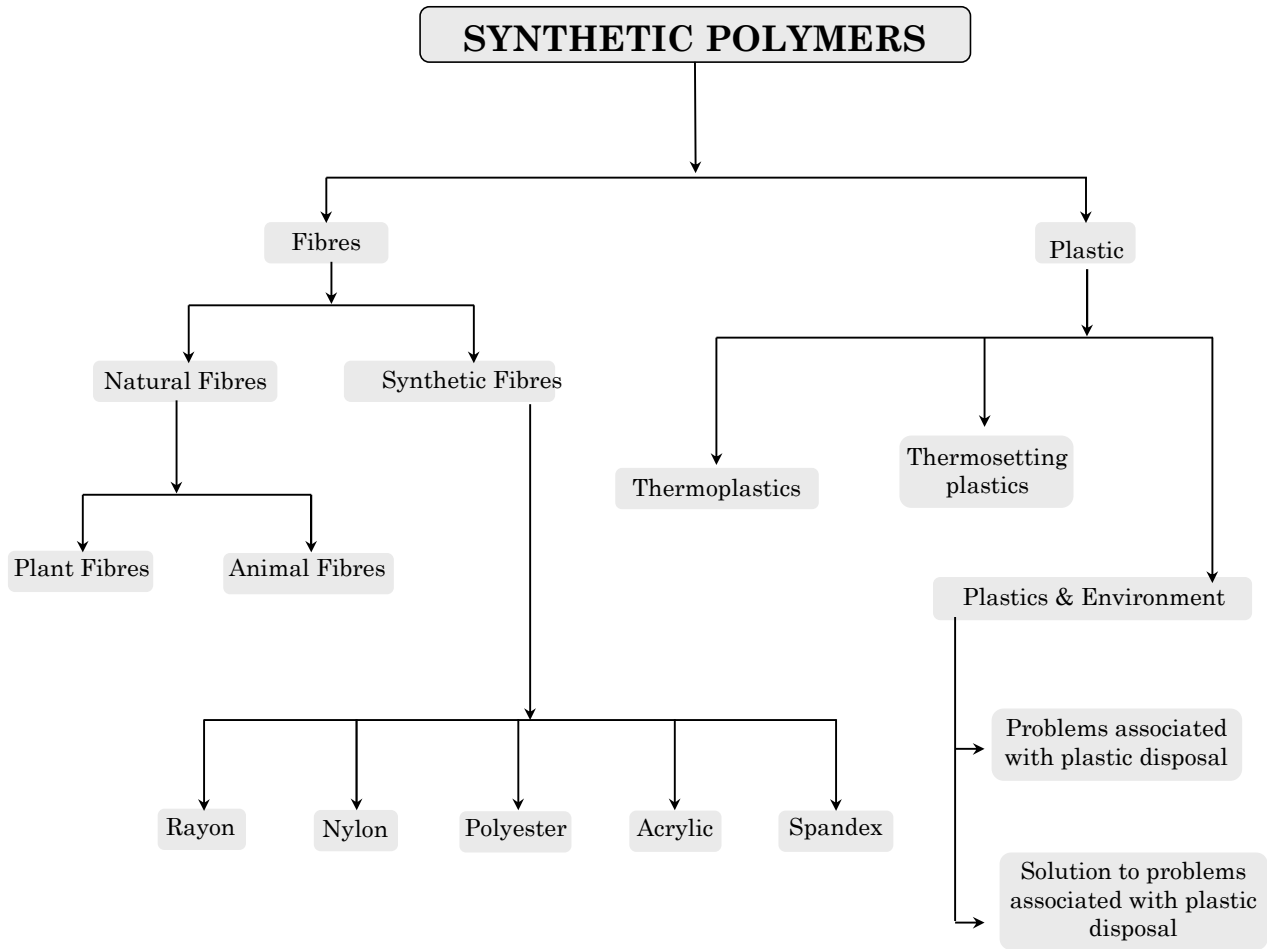


Plastic Materials



Synthetic Fibres

MIND MAP



SYNTHETIC FIBRES & PLASTICS

Introduction

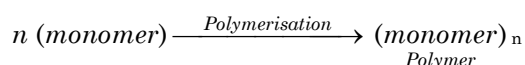
Through scientific knowledge and development of technology man has been able to develop new materials from the materials already existing.

Scarcity and drawbacks of traditional natural materials has spurred development of new man made materials.

Synthetic Polymers

A polymer is a compound of high molecular mass formed by combination of a large number of small molecules.

The small molecules which constitute the repeating units in a polymer are called monomer units. The process by which monomers are transformed into a polymer is called polymerization.



Where n is an integer.

◆1 On the basis of structure of polymers, these can be classified as

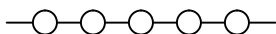
- 1. Linear polymers:** These are polymers in which monomeric units are linked together to form linear chains. These linear polymers are well packed and therefore, have high densities, high tensile (pulling) strength and high melting points. Some common examples of linear polymers are: polyethylene, nylons, polyesters, etc
- 2. Branched chain polymers:** These are polymers in which the monomers are joined to form long chains with side chains or branches of different lengths. These branched chain polymers are irregularly packed and therefore, they have low tensile strength and melting points than linear polymers. Some common examples are: low density polythene, glycogen starch, etc.
- 3. Cross-linked polymers:** These are polymers in which monomer units are cross-linked together to form a three-dimensional network. These are also called three-dimensional network polymers. These polymers are hard, rigid, and brittle because of network structure. For example, bakelite, melamine formaldehyde resin, etc

In this section, we will study common synthetic polymers -

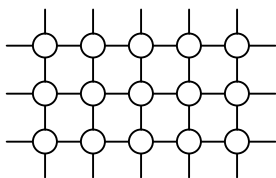
(i) Fibres

(ii) Plastics

Plastics and synthetic fibres are categorized as a class of substance known as polymers. This is because they consist of many repeating molecular units or monomers.



(a) Linear monomer



(b) Cross-linked monomer

Linkage of monomers

Note: The word *polymer* is derived from two greek word *poly* means many and *mer* means part / unit.

Fibres

In daily life we use different things like shirt, socks etc. These things are made up of different kinds of fabrics made of different types of fibres. A thread or filament from which a cloth is made is called a fibre.

Fibres may be of three types:

- (1) Natural fibres
- (2) Synthetic fibres

(1) Natural fibres: Fibres obtained from plants and animals are known as natural fibres. These are usually short fibres.

e.g.: Wool, cotton, silk (it can be obtained up to 1 km length)

Natural fibres are also of two types:

(i) Animal Fibre: These fibres are obtained from animals, for example, wool and silk.

(ii) Plant Fibre: These fibres are obtained from plants, for example, cotton, jute, flax and hemp.

(2) Synthetic fibres: Fibres synthesized by human being are known as synthetic fibres. *All synthetic fibres are prepared from raw materials of petroleum origin called 'petrochemicals'*. Synthetic fibres are continuous filament fibres.

e.g.:Nylon, polyester, Acrylic, spandex etc.

COMPETITIVE LEVEL

Fleece: Thick covering of wool on a sheep, used to make a piece of clothing.

Hair: The mass of thin thread like structure that grows out of the skin.

Wool has several qualities that distinguish it from hair or fur. It is crimped (tight curls), it has a different texture, it is elastic and grows in staples (clusters).

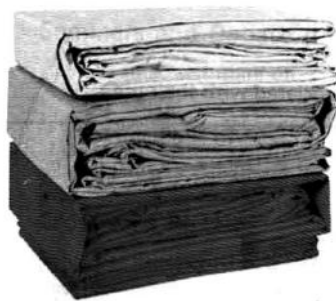
Synthetic Fibres

- ¶ A synthetic fibres is a chain of small units joined together. Each small unit is actually a chemical substance.
- ¶ Most synthetic fabrics can be used as clothing material, Nylon, rayon, polyester, acrylic and spandex are some commonly used synthetic clothing fabrics.
- ¶ Synthetic fabrics find varied applications depending upon their properties and climatic conditions. For example, stocking and socks are generally made up of nylon because of the ability of nylon fibres to retain their original shape even after repeated use.

Properties and uses of some commonly used synthetic fibres

◆ Rayon

Rayon is made from cellulose obtained from wood pulp. Rayon is a reformed cellulose. Cellulose is an organic compound and is basic component of cotton. The characteristics of clothes formed by rayon or viscose are different from those of cotton clothes. It is prepared by modifying cotton chemically. It is known as artificial silk. Rayon fibres are available in three different varieties – viscose, cupro, acetate rayon.



Bedsheets Made of Rayon Fibre

- ◆ **Preparation of rayon:** Cellulose is soaked in a 20% sodium hydroxide solution for about 3 hours. The purified cellulose is then treated with carbon disulphide (CS_2) to get a pale-yellow syrup-like liquid called viscose.

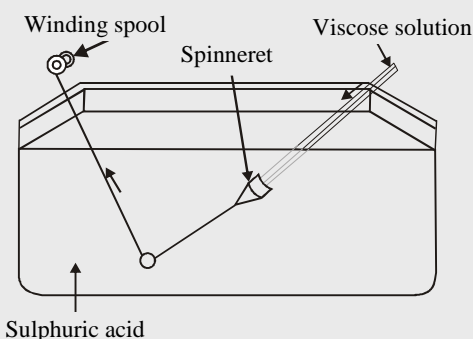


Fig. : Production of Viscose Rayon Yarn

This viscose solution is forced through fine pores in a metal cylinder kept inside a dilute sulphuric acid bath.

Here, cellulose is regenerated in the form of lustrous continuous fibre, called rayon.

- ◆ **Properties:**

- 1 (i) It has tendency to absorb moisture. So it absorb sweat. Therefore, it is generally preferred over other synthetic fabrics in summer.
- (ii) It is shiny and lustrous and resembles to silk in appearance. So, it is also called artificial silk.

- ◆ **Uses:**

- (i) Shirts, ties, linings etc. are made up of rayon fabric.
- (ii) It is used in home furnishing materials (bed sheets, curtains, table clothes, sofa covers etc.) and bandages.

- ◆ **Nylon**

It is the first fully synthetic fibres. It was prepared in 1931 using coal, water and air. It's monomer units are adipic acid and hexamethylene diamine.

- ◆ **Preparation of Nylon:** Nylon is prepared on heating the coal with water vapour in the presence of oxygen.

- ◆ **Properties:**

- (i) Nylon is a high strength fibre.
- (ii) It does not lose strength even after repeated use.
- (iii) It is one of the most elastic and light synthetic fabrics available.

◆ **Uses:**

- (i) It is used in making sarees, socks, stockings etc.
- (ii) It is blended with wool to increase the strength.
- (iii) It is used for making tents, umbrellas, parachutes.
- (iv) Its fibres are used for making tooth brush bristles.
- (v) Due to their high strength and elasticity, nylon threads are used to make fishing nets, climbing ropes and strings in badminton and tennis racquets.

Note: ¶1 Nylon is an acronym obtained from the name of the cities New York (NY) and London (LON).

¶1 Kevlar is the synthetic fibre bounded tightly to form net-like structure to be used as Bulletproof material

◆ **Polyester**

It is made of repeating units of a chemical called ester which has fruit like smell. Most polyester fabrics have excellent wash and wear characteristics and therefore, require very less care.

◆1 **Properties:**

- (i) It absorbs very little water and hence dry quickly after washing.
- (ii) It is a strong, lightweight and elastic fabric.
- (iii) It resists wrinkling and springs back into shape when creased.

◆1 **Uses:**

- (i) Polyester fibres are widely used in textile industry for making a variety of textiles such as sarees, dress materials, curtains etc.
- (ii) Terrywool, a blend of Terylene (a type of polyester) and wool, is used for making suits.
Terylene is also called Dacron or Mylar.
- (iii) Terrycot, a blend of Terylene and cotton is commonly used for making skirts, shirts and other dress materials.
- (iv) It is light weight and strong. This property makes it suitable for making light weight sails.
- (v) Terylene is used for making conveyor belts as it is very elastic.
- (vi) Polyester films (commonly known as mylar) are also used for making magnetic recording types in audio cassettes, video cassettes and floppy discs.

Note: ¶ The term 'spinneret' originated from the spinning organ of a spider. Most spiders have six spinnerets, but some may have four or even two. The spinnerets are usually present at the lower side of spider's abdomen and they work in coordination to build the web.

¶ An ester in a sweet smelling organic compound formed when an alcohol combine and release water

1 1 ¶ Fabrics are sold by names like polycot, polywool, terrycot, etc. As the name suggests, these are made by mixing two types of fibres. Polycot is a mixture of polyester and cotton; polywool is a mixture of polyester and wool 1

◆ Acrylic

Acrylic fabrics are also known as Orlon or Acrilan fabrics. Acrylic fabric closely resembles to wool in its properties.

◆1 Properties:

- (i) It is warm, soft, light and flexible fibre.
- (ii) Acrylic yarn can be easily knitted.
- (iii) It is cheaper than natural wool and is available in a variety of colours.

◆1 Uses:

- (i) Acrylic fabric is used for making sweaters, socks and shawls.
- (ii) It is used for making carpets and blankets.

◆ Spandex

Spandex is also known as Lycra.

◆1 Properties:

- (i) These fabrics have excellent elasticity. The high elasticity of these fabrics make them suitable for use in clothes that require snug fitting, for example swimming costumes.
- (ii) Spandex is mixed with other fabrics, such as cotton, to get stretch fabrics, which are used for making T-shirts and caps.

◆1 Uses: It is used in the making of costumes, caps, T-shirts etc.

Properties and uses of some commonly used synthetic fibres

S.No.	Name of the synthetic fibre	Characteristics	Uses
1.	Rayon	Resembles silk in appearance and texture and absorbs moisture	Shirts, dress material, bed linen, carpets, etc.
2.	Nylon	Elastic, lightweight, lustrous and easy to wash	Clothes, ropes, socks and parachutes
3.	Polyester	Wrinkle-resistant, lightweight and elastic	Mixed with natural fibres like wool, silk and cotton to make fabrics
4.	Acrylic	Resembles wool and not affected by moisture, chemicals or bacteria.	Socks, shawls and sweaters
5.	Spandex (also known as lycra)	Soft, rubbery and highly elastic.	Swimming costumes, shirts, etc.

Advantages and Disadvantages of Synthetic Fibres

Different properties of synthetic fabrics like moisture absorbing capacity, tensile strength, elasticity etc. make synthetic fabrics very advantageous but they also need great care.

◆ Advantages

- (i) **Most synthetic fabrics can handle heavy loads without breaking:** The ability to withstand loads is called tensile strength.
- (ii) **Most synthetic fabrics are elastic:** Elasticity refers to the ability of a material to regain its original shape, after it has been stretched or compressed.
- (iii) **Most synthetic fabrics do not wrinkle easily:** If wrinkled and released, they retain their original shape. Hence, people find them convenient to wash and wear.

In addition to these properties, synthetic fibres drawn from the spinneret can be made very fine and thin. Thus, the texture of the synthetic fabrics produced is generally soft.

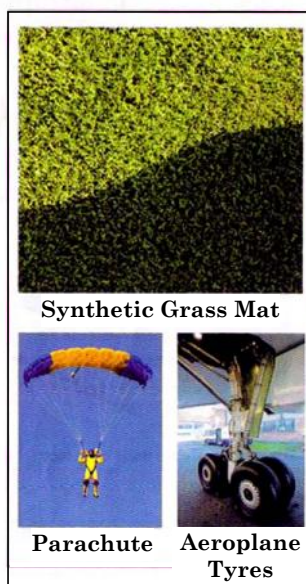
- (iv) **They are less expensive and readily available:** Synthetic fibres are cheaper than natural fibre.

◆ Disadvantages

- (i) Most synthetic fabrics can absorb very little moisture. They become sticky when the body sweat. On the other hand, most natural fabrics absorb moisture readily. As a result when we sweat, the sweat is not trapped between the fabric and the skin. It keeps on evaporating from the fabric and we feel that our skin can breathe.
- (ii) Most synthetic fabrics melt very easily thus they should not be worn while working in the kitchen and in laboratory. They require very careful ironing.
- (iii) Most synthetic fibres accumulate electric charge on them so they cling together and stick to the skin.

◆ Other Uses of Synthetic Fibres

- Synthetic fibres are not only used for making clothes, but they have diverse uses ranging from making of curtains, upholstery, furniture, mops, mats, parachutes, aeroplane tyres and many other things.
- The textile industry is one of the major users of synthetic fibres. The synthetic fibre is blended with natural fibres in different proportions to enhance its properties. For example, terylene is blended with cotton, silk and wool to form terrycot, terrysilk and terrywool, respectively. The blended material has:
 - (i) The ability to absorb sweat, so it is more comfortable.
 - (ii) More durability and less electrical charge.
 - (iii) Better heat setting properties.
 - (iv) Less lustrous and more resemblance to natural fibre.



Plastics

Plastics are polymers like synthetic fibres. The only difference between the two is in the nature of monomer units they are made of. For example, polyethylene, a plastic used to make polyethene bags, is a polymer of monomer called ethene.

- (i) They are easily mouldable, i.e., they can be shaped in different forms.
- (ii) They can be melted, coloured, recycled, reused, rolled into sheet and drawn into wires.



Articles Made of Plastics

Note: *Plasticity: The property of plastics which make them mouldable.*

◆ Types of Plastics

Different types of plastics may be classified as thermosetting plastics and thermoplastics on the basis of their reaction to heat.

(1) Thermoplastics: Thermoplastics can be melted by heating and then moulded into desired shapes and sizes. These plastics soften on heating and harden when cooled. They retain their plasticity even after repeated heating and cooling.

Examples of thermoplastics are polythene (polyethylene), polyvinylchloride (PVC), polystyrene etc., used to make bags, toys etc.

(2) Thermosetting plastics:

- ↳ Thermosetting plastics are harder and stronger than thermoplastics and can retain their shape and size even at high temperature.
- 1 1 ↳ These polymers once set in a given shape on heating cannot be softened or melted on being reheated. These polymers undergo a permanent change upon melting and set to a solid which cannot be remelted.
For example bakelite, melamine.
- ↳ Bakelite is an insulator and used to make electrical switches and handles of various utensils.
- ↳ Melamine has fire resistant and heat resistant properties and is used to make floor tiles, kitchenware and fire resistant fabrics.

Note: *Bakelite, the first completely synthetic substance, is a thermosetting plastic. It was created by Leo Baekeland in 1907.*

Characteristic Properties of Plastics

Although different types of plastics differ in some physical and chemical properties, the following properties are common to most of them.

- (1) **Thermal conductivity:** 'Thermal' means 'heat'. Plastic (like bakelite etc.) are poor conductors of heat. This is why they are used -
- (i) For making handles of cooking containers.
 - (ii) In the thermal innerwear that people wear in extreme winters.
 - (iii) For making containers and films used in microwaves ovens.

Activity

Aim: To show that plastics are bad conductors of heat.



Comparison of Thermal Conductivity of Steel and Plastic

Procedure:

- (i) Take a pan containing boiling hot water.
- (ii) Now place a metal spoon and plastic spoon into it. You can use a plastic scale also in place of a plastic spoon.
- (iii) Keep them in boiling hot water for some time.
- (iv) Touch the other ends of the spoons, which are not dipped in water.

What do you observe? Has the other end of the metal spoon become hot? Is the other end of the plastic spoon also equally hot? No, but why?

Conclusion: Metals are good conductors whereas plastics are bad conductors of heat.

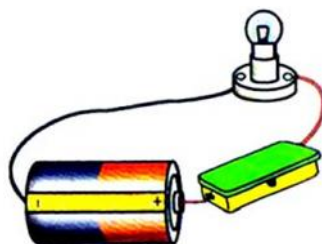
- (2) **Electrical conductivity:** Plastics are poor conductors of electricity. This explains why they are used as covering materials in electrical appliances, cords, electrical outlets and wiring.
- (3) **Solubility in water:** Plastics are insoluble in water and for this reason bottles, buckets and containers made of plastic are used for storing water and plastic tumblers and cups used for drinking water.
- (4) **Effect of flame:** Plastic polybags melting on accidentally coming in contact with a hot pan. This happens because plastics are inflammable.
- (5) **Non-reactivity:** Plastics do not react with air and water. Unlike metals they are not corroded and thus are used as storage containers in which a variety of materials, including chemicals, can be stored.
- (6) Plastics are light, strong, durable and can be moulded in any desired shape and size.

Activity

Aim: To observe electrical conductivity of plastic.

1 1 Procedure:

- (i) Set a circuit with the help of a battery, bulb and conducting wires as shown in the figure.



A Plastic Object does not Conduct Electric Current

- (ii) Connect metal, rubber and plastic objects in the circuit and observe in which case the bulb glows.

Does the bulb glow when a plastic object is used as test materials?

Conclusion: Plastic is a bad conductor of electricity and does not allow current to pass through it.

Uses of Plastics

Plastics can be recycled, reused, coloured, melted, rolled into thin sheets or made into wires. Thus, they find a variety of uses, some of which are listed below:

COMPETITIVE LEVEL

PET (Poly Ethylene terephthalate)	Containers for microwave cooking, carbonated beverage bottles and other food containers.
HDPE (High Density PolyEthylene)	For packaging strong and corrosive household and industrial chemicals like bleaches, acids and liquid detergents.
PVC (PolyVinyl Chloride)	PVC pipes for sanitary fittings (such as water pipes).
LDPE (Low Density PolyEthylene)	Polybags, grocery bags and packages of frozen foods and bread.
PP (PolyPropylene)	Ketchup bottles, yoghurt containers, medicine bottles, automobile battery casings.
PS (Polystyrene)	Thermocol, a form of PS, is used for making disposable cups and packaging material for fragile items like computers and televisions.

- (iii) When wastes are dumped in water, they result in water pollution. They also pose a threat to aquatic life, as toxic substances present in plastics can cause death or reproductive failure in fish and other aquatic animals.
- (iv) When plastics are burned, they produce toxic gases and smoke that cause air pollution.
- (v) The polybags carelessly thrown here and there are responsible for the deaths of many animals, especially cows. The animals, in the process of eating food waste, swallow materials like plastic bags and wrappers of food which choke their respiratory system or form a lining in their stomach leading to their death.

Solutions of Problems Associated with Plastic Disposal

1. Recycling of plastic involves collecting, sorting and processing. To support this, the municipal corporation has made available green and blue bins for collection of biodegradable and non-biodegradable wastes respectively.
2. To identify what type of plastic a particular product belongs to, numbers have been allotted to the different types of plastics. The principle followed is, the smaller the number, the easier it is to recycle. It is the duty of every responsible citizen to help the local bodies to keep public places clean and free of plastic.
3. As a responsible citizen remember the 4R principle. Reduce, Reuse, Recycle and recover. Develop habits which are environment friendly.

Note: *Scientists all over the world are trying to produce plastic which is biodegradable. They are also trying to produce photodegradable plastic which can be decomposed by sunlight.*

EXERCISE-1

➤ Very Short Answer Type Questions

- Q.1** Name the fibres that are obtained from natural sources.
- Q.2** Name the fibres which are synthesized in the laboratory with the help of chemicals.
- Q.3** Name the fibres which are not attacked by moths and are wrinkle resistant.
- Q.4** Write the brand name of polytetrafluoroethylene.
- Q.5** Name the first man made fibre from natural base material.

➤ Short Answer Type Questions

- Q.6** What are monomers and polymers?
- Q.7** What are the disadvantage of plastics?
- Q.8** What is biodegradable plastics?
- Q.9** What is spinneret?
- Q.10** What is 4R principle?

➤ Long Answer Type Questions

- Q.11** Write short notes on
(a) Polycot
(b) Terrywool
(c) Cotswool
- Q.12** Say no to polythene bags and say yes for paper bags. Comment
- Q.13** What are the main advantages of synthetic fibres?
- Q.14** Why are synthetic materials widely used now-a-days?
- Q.15** Give two properties & uses of each of the following-
(i) Polyester
(ii) Spandex
(iii) LDPE
(iv) PS
(v) PP

D. Fill in the Blanks

- Q.16** (i) The unit of polymer is called
- (ii) All synthetic fibres are prepared from raw materials of petroleum origin called
- (iii) is a mixture of polyester and cotton.
- (iv) Artificial wool is prepared from another type of synthetic fibre called
- (v) resists fire and can tolerate heat better than other plastics.

E. True & False

- Q.17** (i) Teflon is a scratch proof and corrosion resistant plastic.
- (ii) Plastics are poor conductors of heat & electricity.
- (iii) Bakelite is a poor conductor of electricity.
- (iv) Cellulose is a monomer made up of large number of glucose units.
- (v) The material similar to silk in appearance is terylene.

F. Match the Column

Q.18

	Column-A		Column-B
(a)	It burns very slowly with smell of burning hair	(i)	Petroleum
(b)	Used to give non-stick coating to kitchen ware	(ii)	Wool
(c)	The source for all the synthetic polymer, like fibres and plastics	(iii)	Polyvinyl chloride
(d)	Used to make shoe soles	(iv)	Polythene
(e)	Made by polymerization of ethene molecules	(v)	Teflon

EXERCISE-2

- Q.1** Nylon is obtained by -
(A) Treating wood pulp
(B) Solidifying water
(C) Mixing coal, air & water
(D) Mixing chemicals
- Q.2** is stronger than steel wire -
(A) Cotton fibre (B) Silk thread
(C) Plastic thread (D) Nylon fibre
- Q.3** is polyester used for making bottles, utensils, films -
(A) Leather (B) Nylon
(C) PET (D) Plastic
- Q.4** Polyester is repeating units of
(A) Ether (B) Beads
(C) Carbon (D) Ester
- Q.5** You must not wear synthetic fibres while working with fire because
(A) They make you feel cold and so you may get a frost bite.
(B) They are lustrous and so they shine under the flame.
(C) They melt on heating and stick to your body when they catch fire.
(D) None of the above
- Q.6** Synthetic fibres are made using as raw materials -
(A) Woolen products
(B) Polymers
(C) Cotton
(D) Petrochemicals
- Q.7** Plastics and synthetic fibres are made of large units called as -
(A) Nylon (B) Rayon
(C) Monomers (D) Polymers
- Q.8** Polycot is obtained by mixing -
(A) Nylon and wool
(B) Polyester and wool
(C) Nylon and cotton
(D) Polyester and cotton
- Q.9** Which of the following groups contain all synthetic substances -
(A) Nylon, Terylene, Wool
(B) Cotton, Polycot, Rayon
(C) PVC, Polythene, Bakelite
(D) Acrylic, Silk, Wool
- Q.10** The fibres that are obtained from cotton, jute and silk are known as -
(A) Man made or synthetic fibres
(B) Natural fibres
(C) Artificial fibres
(D) Plastics
- Q.11** Which fibre is also known as regenerated fibre?
(A) Plastic (B) Polymer
(C) Rayon (D) Acrylon
- Q.12** What is PET?
(A) Polyester
(B) Polyester & Terylene
(C) Polyethylene Tetraphthalate
(D) Polyethene Terylene
- Q.13** The polymer in which monomers are arranged in a straight chain are known as -
(A) Polythene (B) Melamine
(C) Bakelite (D) None of these
- Q.14** Bakelite and Melamine are examples of -
(A) Thermosetting plastics
(B) Silk
(C) Nylon
(D) Rayon
- Q.15** Nylon absorbs very little water hence it is most suitable for making -
(A) Fishing net (B) Tyre cords
(C) Parachute (D) All of these
- Q.16** We should never dispose of polythene in the sewage system because -
(A) chokes drains and soil
(B) makes sewage non-biodegradable
(C) release toxic fumes and gases
(D) all of them

- Q.17** Bakelite do not melt on heating because such -
- (A) Polymers are poor conductor of heat
 - (B) Polymers are attached by strong linear chains
 - (C) Polymers are joined by strong cross links
 - (D) Polymers are strong and inexpensive

- Q.18** Which of the following represents the correct match for items in column I with those in column II.

Column - I	Column-II
(I) Nylon	(i) Thermoplastic
(II) PVC	(ii) Thermosetting plastic
(III) Bakelite	(iii) Fibre

- (A) I – (ii), II-(iii), III-(i)
- (B) I – (iii), II-(i), III-(ii)
- (C) I – (ii), II-(i), III-(iii)
- (D) I – (iii), II-(ii), III-(i)

- Q.19** Which properties of plastic are not make them as materials of choice –
- (A) plastic is non reactive and non corrosive
 - (B) plastic is light strong and durable
 - (C) plastics are poor conductors of heat and electricity
 - (D) None of these

- Q.20** Which of the following is not a common property of plastics?
- (A) Non-reactive
 - (B) Light in weight
 - (C) Durable
 - (D) Good conductor of electricity

EXERCISE-3

(Previous Year Questions – NSO)

Q.1 The characteristics of different fibres are listed as

W: I am strong, elastic, light and hard beads

I shrink on heating and form hard beads with smell of burning hair.

X: I burn completely leaving no residue.


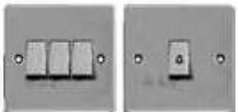


Y: I can be woven like silk fibres and dyed in a wide variety of colours. I burn quickly with a smell of burning paper

Z: I do not get wrinkled easily. I burn slowly and produce black smoke.

W, X, Y and Z are respectively

- (A) Terylene, rayon, cotton and nylon
- (B) Bakelite, nylon, rayon and cotton
- (C) melamine, PVC, nylon and rayon
- (D) Nylon, cotton, rayon and polyester

Q.2 Match the items given in column A with the synthetic fibres from which they are obtained in column B and mark the correct option.

Column A	Column B
 <p>(P)</p>	(i) Bakelite
 <p>(Q)</p>	(ii) Nylon
 <p>(R)</p>	(iii) PET
 <p>(S)</p>	(iv) PVC

- (A) (P)-(ii); (Q)-(i); (R)-(iv); (S)-(iii)
- (B) (P)-(iv); (Q)-(ii); (R)-(i); (S)-(iii)
- (C) (P)-(iii); (Q)-(ii); (R)-(i); (S)-(iv)
- (D) (P)-(i); (Q)-(iii); (R)-(ii); (S)-(iv)

Q.3 We should not wear polyester clothes while working in kitchen because ____.

- (A) It produces heat and we feel hot.
- (B) It feels uncomfortable, as it does not allow air to pass through.
- (C) Its fabric melts and sticks to the body, in case of fire.
- (D) It is not hygienic to wear synthetic fibre clothes.

Q.4 Which of the following describes moulting?

- (A) The resting stage in the life cycle of a silkworm
- (B) Change in appearance during the different stages in the life cycle of a silkworm
- (C) Spinning of cocoon
- (D) Casting off old skin.

Q.5 Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I		Column-II
(p)	A synthetic fibre obtained from cellulose	(i)	Acrylic
(q)	A synthetic fibre used for making woolen clothes	(ii)	Nylon
(r)	A thermosetting plastic	(iii)	Rayon
(s)	This polymer is used for making ropes and fishing nets	(iv)	Bakelite

- (A) (i)-(p); (ii)-(q); (iii)-(r); (iv)-(s)
- (B) (i)-(r); (ii)-(p); (iii)-(s); (iv)-(q)
- (C) (i)-(s); (ii)-(r); (iii)-(q); (iv)-(p)
- (D) (i)-(p); (ii)-(r); (iii)-(q); (iv)-(s)

Q.6 Sakshi wants to test the quality of her dupatta. She pulled a small strand of yarn from the dupatta and burned it. Smelled like a burning plastic. She inferred that the dupatta is made of ____.

- (A) Pure wool
- (B) Nylon
- (C) Pure silk
- (D) Cotton

Q.7 Solve the following riddles by identifying X, Y and Z.

X: Your mother loves to cook in the utensils which are coated with me because I make them non-stick.

Y: I protect the firemen by coating their uniforms to make them fire resistant.

Z: I am a very familiar form of polyester and used for making bottles, utensils, films, etc.

X	Y	Z
(A) Acrylic	Rayon,	Bakelite
(B) PET.	Polythene,	Teflon
(C) Rayon,	Bakelite,	Melamine
(D) Teflon,	Malamine,	PET

Q.8 Match the articles given in Column-I with the fibres/plastics from which they are made in Column-II.

Column I	Column II
(a) Toothbrush bristles	(i) Melamine
(b) Carpet	(ii) PVC
(c) Bottle	(iii) Nylon
(d) Toy	(iv) Rayon
(e) Fire resistant fabric	(v) PET

(A) (a)-(i); (b)-(iv); (c)-(ii); (d)-(v), (e)-(iii)

(B) (a)-(iv); (b)-(ii); (c)-(iii); (d)-(i), (e)-(v)

(C) (a)-(iii); (b)-(iv); (c)-(v); (d)-(ii), (e)-(i)

(D) (a)-(iii); (b)-(v); (c)-(iv); (d)-(i), (e)-(ii)

ANSWER KEY

EXERCISE - 1

➤ **Fill in the Blanks:**

16. (i). Monomer
(ii). petrochemicals
(iii). polycot
(iv). acrylic
(v). melamine

➤ **True & False:**

17. (i). True
(ii). True
(iii). True
(iv). True
(v). False

➤ **Match the Column:**

18. [a→(ii); b→(v); c→(i); d→(iii); e→(iv)]

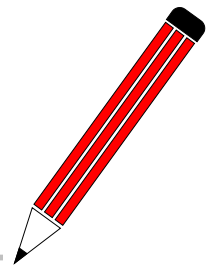
EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	D	C	D	C	D	D	D	C	B	C	C	A	A	D
Ques.	16	17	18	19	20										
Ans.	D	C	B	D	D										

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8
Ans.	D	A	C	D	B	B	D	C

NOTES



CROP PRODUCTION & MANAGEMENT

Chapter Outline

- ❖1 Agriculture
- ❖1 Crop Season
- ❖1 Basic Practices of Crop Production
- ❖1 Preparation of Soil
- ❖1 Sowing
- ❖1 Addition of Manure and Fertilizers
- ❖1 Irrigation
- ❖1 Crop Protection
- ❖1 Harvesting
- ❖1 Storage
- ❖1 Animal Husbandry
- ❖1 White Revolution and Green Revolution

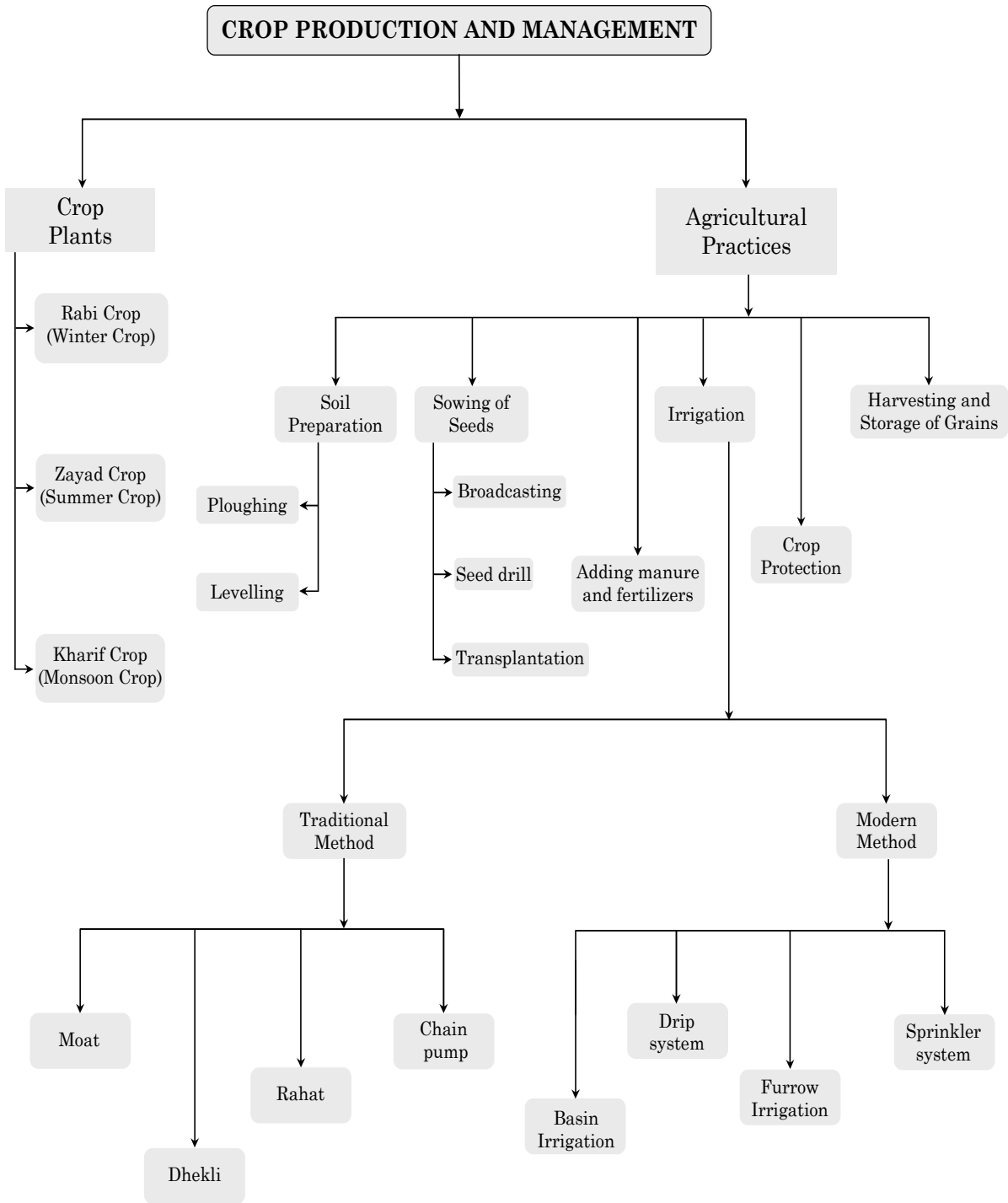


Moat System



Crop Production

MIND MAP



CROP PRODUCTION & MANAGEMENT

Agriculture

The process of growing crops on a large scale is called agriculture.

OR

(Ager means field : cultura means cultivation). It is the applied biological science which deals with the production of plants and raising of animals useful to man, involving soil cultivation, breeding and management of crops and livestock.

◆ Horticulture

It is the process of growing fruits, vegetables & ornamental plants.

Crop Plants And Crop Seasons

The plants which are grown by man in large numbers to get useful products are known as crops.

1. The land where plants are cultivated on a large scale is called field.
2. Earthworms help to turn and loosen the soil. Earthworms and microbes help in adding humus (dead organic matter) to the soil. The organisms are, therefore, **friends of the farmer**.

TABLE : CLASSIFICATION OF CROP PLANTS

S.No.	Type of Crop Plant	Examples	Importance
1.	Cereals	Wheat, Rice, Maize, Minor millets, Sorghum	Rich in carbohydrates for energy requirements.
2.	Pulses	Gram (Chana), Pea (Matar), Black gram (Moong), Pigeon pea (Arhar), etc.	Rich in proteins that are body builders.
3.	Oil seed crops	Soyabean, Groundnut, Sunflower, Niger, Sesame, Castor, Mustard, Linseed, etc.	Rich in oils and fatty acid.
4.	Root Crops	Turnip, Carrot, Sweet potato.	It is utilized as the vegetables & medicines.
5.	Sugar Crops	Sugarcane and Beet.	Important for wine Industry.
6.	Fibre Crops	Jute & Cotton.	Important for jute & cotton industry.
7.	Plantation Crops	Tea, Coffee, Coconut and Rubber.	Increases cash and also called as cash crops.
8.	Fodder Crops	Berseem, Maize, Sorghum and Elephant grass.	Provide fodder for animals.
9.	Horticulture Crops (fruits & vegetables)	Apple, Banana, Guava, Pomegranate, Pear, Chilies, Dhania, Jira, Carrot, Raddish, Cabbage, Cauliflower, Spinach, Cucurbit.	Provide vitamins, Minerals alongwith small quantities of carbohydrate, proteins and oils.

In India there are two main crop seasons for cultivating crops. These are known as **rabi seasons** and **Kharif season**.

◆ Rabi Crops

These crops are sown in the beginning of winter i.e. between October and November, and harvested by March or April. These crops do not depend on monsoon rains.

Examples : Wheat, barley, gram, potato, mustard.

◆ Kharif Crops :

These crops are sown at the beginning of the monsoon seasons between June and July, and harvested by September or October. These crops depend on monsoon rains for growth.

S.No.	Kharif Crop/Rainy Season Crop	Rabi Crop/Winter Season Crop	Zaid/Zayad Crop/Summer Season
1.	Are grown during monsoon/rainy season.	Are grown during winter season.	Are grown during mainly in the summer season.
2.	They require warm & wet weather.	They require cold & dry weather.	They require warm day weather.
3.	They are sown in June/July & harvested in September/October	They are sown in October/November & harvested in March/April.	They are sown in march & harvested in june.
4.	e.g. - Rice, Jowar, Bajra, Cotton, Groundnut, Urad, Moong, etc.	e.g. - Wheat, Barley, Gram, Mustard, Potato, etc.	e.g. - Seasonal fruits and vegetables.

Basic Practices of Crop Productions

All the activities which are involved in cultivation of crops, from sowing to harvesting, are known as **agricultural practices**. Cultivation of crops involves several activities undertaken by a farmers over period of time.

- These activities are listed below :

- (i) Preparation of soil
- (ii) Sowing
- (iii) Adding manure and fertilizers
- (iv) Irrigation
- (v) Protecting from weeds
- (vi) Harvesting
- (vii) Storage

(A) Preparation of soil :

This is the first essential stage for cultivating any crop plant. Preparation of soil involves the following step – ploughing and digging, levelling and manuring.

◆ Ploughing and Digging :

The process of loosening and turning up of the soil is called tilling or ploughing. This is done by using a wooden or iron plough.

- **Significance of Ploughing :**
 - (i) This practice loosens the soil.
 - (ii) The soil is overturned and properly aerated.
 - (iii) This allows the roots to penetrate deeper easily.



Fig. : Iron plough

◆ **Levelling :**

- Soil, if ploughed in dry season, breaks into big mud pieces called crumbs. It is necessary to break these crumbs with the help of a wooden plank or iron leveller. The field is levelled for sowing as well as for irrigation.
- This is the agricultural process to make the soil in level for sowing the seeds. This is done by leveller which is made of wood or iron. It is a flat 1.8 - 2 m long wooden plank with a log to put weight on it.
- **Significance of levelling :** This practice smoothens the soil surface.

◆ **Manuring :**

Mixing soil with manure is called manuring. Manure is usually added to the soil both before and after tilling. Adding manure before tilling helps in proper mixing of manure with the soil.

◆ **Agriculture Implements :**

The tools which are used in cultivation of plant are known as agricultural implements. A list of commonly used agricultural implements along with their uses are given below in the table.

Name of implement	Uses	Name of implement	Uses
Khurpa	For weeding	Seed drill	For sowing
Spade	For digging	Harrow	For weeding
Wooden plough	For tillage	Sickle	For harvesting
Iron plough	For tillage	Combines	For harvesting and threshing
Soil plank	For breaking crumbs	Sprayers	For spraying insecticides
Leveller	For leveling and Pressing the soil		

(B) Sowing : The process of putting seeds into the soil is called sowing.

◆ **Selection of Seeds :**

Good quality seeds are heavier than damaged seeds. Damaged seeds become hollow and are thus lighter. So they float on water.

Seeds should be high yielding varieties, free from insects and pests.

◆ **Methods of Sowing :**

Seeds are sown in the field by any of the three methods described below.

- (i) **Broadcasting :** Seeds are sown manually by directly scattering them into the soil. This process is called broadcasting.
- (ii) **Seed Drills :** The other method is to use a seed drill. A simple seed drill consists of an iron tube with a funnel at the top attached to the plough.

◆ **To find out seeds of good quality.**

¶ **Materials Required :** Wheat or bean seeds, beaker and water.

1 ¶ **Procedure :** Take some wheat or bean seeds. Put them in a beaker of water.

1 ¶ **Observation and conclusion :** Some seeds will sink and some seeds will float on water. The ones that float are not fit for sowing. The ones that sink are fit for sowing. Often, seeds that have been stored for a long time are eaten by insects. They may have tiny holes in them and thus float in water. These seeds are unfit for sowing.



Fig : Seed Drill

COMPETITIVE LEVEL

- 1 ¶ **Vegetative Propagation :** In this type of propagation vegetative parts of plants like leaf, stems and roots can give rise to new plant.
- 1 ¶ In crops like sugarcane, potato, ginger, onion, turmeric, etc, vegetative plant parts instead of seeds are used for growing the crop.
- 1 ¶ The uncultivated fields are known as fallow.

(iii) **Transplantation :** There are certain crops like paddy and some vegetables for which seeds are not directly sown in the field and then the seedlings are transferred to the main field. This process is known as transplantation.

◆ **Precautions during Sowing :**

- (i) Spacing should be proper.
- (ii) Seeds should be treated with pesticides.
- (iii) Depth should be proper.

(C) **Adding Manure and Fertilizers :** Crops absorb various nutrients from the soil through their roots. They are required for their growth and development. The replenishment is done by adding manures and fertilisers to the soil. This process is called manuring.

◆ Manures :

Manures are natural, organic substances obtained by the decomposition of animal wastes and plant residues. They supply essential nutrients and humus to the soil and make it fertile. Manures are of three kinds : farm yard manure, compost and green manure.

- (i) **Farm Yard Manure** : It consists of cattle dung, urine, straw, leaves and other farmyard wastes.
- (ii) **Compost** : It is the manure obtained by the decomposition of dead plants and animal wastes, sewage waste, etc. It is made by burying all available organic material in a pit with alternative layers of soil and leaving it to rot.
- (iii) **Green Manure** : Green manure is formed by the decomposition of fast growing leguminous plants like guar and sunhemp. These plants are grown and ploughed back into the soil.

• Advantages of Manure :

- (a) It enriches the soil with nutrients.
- (b) It adds organic matter to the soil which improves the quality of soil.
- (c) It increases water-holding capacity in sandy soil and drainage in clay soil.
- (d) It increases the population of useful microorganism in the soil
- (e) It improves and maintains the quality of the soil for a long time.

◆ Fertilisers :

- A fertiliser is a man-made inorganic compound which supplies specific nutrients to the soil.
- The most commonly used fertilisers are the NPK fertilisers which are rich in nitrogen, phosphorus and potassium.
- Chemical fertilisers have become popular in farmers because most of them are soluble in water and can be easily absorbed by plants. They are also easy to store and handle.
- Fertilisers are applied either by broadcasting in the field or by spraying or through irrigation channels mixed into water (fertigation). Some examples of commonly used fertilisers are urea, ammonium sulphate, superphosphate and potassium nitrate.

Note :

- Leguminous crops such as pea, bean, soya bean or groundnut are able to fix atmospheric nitrogen and convert it into usable nitrogen. The process is called **nitrogen fixation**.
- Nodules are formed in the roots of leguminous plants. Rhizobia are soil bacteria present in the root nodules. These bacteria fix the atmospheric nitrogen.

COMPETITIVE LEVEL

- Fertilizers are classified according to the element (N, P or K) which they supply to the soil.
 - (i) Nitrogenous fertilizers
 - (ii) Phosphatic fertilizers
 - (iii) Potash fertilizers
 - (iv) NPK fertilizers

(i) Nitrogenous Fertilizers :

- The important nitrogenous compounds used as fertilizers are :

Ammonium sulphate, $(\text{NH}_4)_2\text{SO}_4$

Calcium cyanamide, CaCN_2

Calcium ammonium nitrate, $\text{Ca}(\text{NO}_3)_2, \text{NH}_4\text{NO}_3$

Basic calcium nitrate, $\text{Ca}(\text{NO}_3)_2, \text{CaO}$

Urea, $(\text{NH}_2 - \text{CO} - \text{NH}_2)$

(ii) Phosphatic Fertilizers :

- The minerals of phosphorus such as phosphorite, $[\text{Ca}_3(\text{PO}_4)_2]$ and apatite, $[\text{3Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2]$ are sparingly soluble in water and thus do not serve as source of phosphorus for plants. These are, therefore, converted into soluble materials which can act as good fertilizers. The important phosphatic fertilizers are :

Calcium superphosphate

Nitrophosphate

Triple phosphate

Phosphatic slag

(iii) Potash Fertilizers :

- Potassium nitrate, potassium chloride and potassium sulphate are used as fertilizers.

(iv) NPK Fertilizers :

- Fertilizers containing N, P and K in suitable adjusted proportions are known as NPK fertilizers. These are obtained by mixing nitrogenous, phosphatic and potash fertilizers in suitable proportions.

Table : Differences Between Manures & Fertilisers

S.No.	MANURES	FERTILISERS
1.	Manures are organic natural substances derived from the decomposition of biological materials (Plants and animal residues).	Fertilisers are inorganic or organic substances.
2.	Manures contain organic matter in large quantities.	Organic matter is not present.
3.	Manures contain nutrients in small quantities & are needed in large quantities.	Fertilisers contain much higher amount of nutrients & are required in very small quantities.
4.	They are not nutrient - specific.	These are nutrient - specific.
5.	They are prepared in fields & villages.	These are manufactured in factories.
6.	Manures are bulky substances. So, these are inconvenient to store, use & transport.	These are available in concentrated form. So these are easy to store, use & transport.
7.	Manures do not cause pollution.	They cause pollution.

◆ Natural Methods of Replenishing the Soil with Nutrients

- (i) **Leaving the Field Fallow :** It is the process of leaving the field uncultivated (fallow) for one or more seasons. Fallow land will regenerate the lost nutrients. However, due to high demand of foodgrains this method is no longer followed.
- (ii) **Crop Rotation :** It is the method of growing different crops alternately on the same land. Earlier, farmers in northern India used to grow legumes (e.g. pea, gram) as fodder in one season and wheat or rice in the next season. This practice was helpful in the replenishment of the soil with nitrogen. Farmers should be encouraged to adopt this practice.
- (iii) **Mixed Cropping :** Sometimes two or more crops are grown together in the same field. This practice is called mixed cropping or multiple cropping. The crops are chosen in such a way that the products and waste materials from one crop help in the growth of the other. Cotton and groundnut crops are often grown together for this reason.

However, these methods alone are not enough to maintain soil fertility and farmers have to add manures and fertilisers from time to time.

(D) Irrigation : Plants need water for proper growth and development. Seeds need water for germination. Plants need water to draw nutrients from the soil and for making food by photosynthesis. Water helps the plant to translocate food from one part to other parts of the body. It also protects the crop from frost and extremely hot air currents. Thus water plays an important role in the life of plants right from the germination stage to the maturity stage.

◆ Purpose of Irrigation :

In agriculture, irrigation fulfills the following requirements and goals of crop plants :

- Irrigation supplies two essential macronutrients-hydrogen and oxygen to the crop plants.
- It provides moisture to the soil, which helps in the germination of seeds.
- It helps in growth and elongation of the roots of crop plants.
- It helps in the absorption of nutrients by the roots of crop plants from the soil.
- It helps in increasing the number of aerial branches.

◆ Water Resources in India and Judicious use of Water :

India has enormous surface water resources comprising 12 major river basins and 8 composite river basins. Ground water, which is replenished from rain fall, also contributes significantly to total water resources of our country. In fact more than 55 percent of our cropped area does not have irrigation facilities and depends on rainfall for crop production.

Water is a precious natural resource. It should be used in irrigation by exploiting proper techniques of soil and water management. The efficiency of existing irrigation system can be enhanced by **using water judiciously**. This can be achieved by adopting the following measures :

- (i) By proper selection of appropriate crop and cropping system.
- (ii) By applying only optimum quantity of water at appropriate time.
- (iii) By keeping weeds under control in the fields.
- (iv) By time scheduling during irrigation operations.

COMPETITIVE LEVEL

◆ Water Requirements or Irrigation of Crop Plants Depends on Two Factors

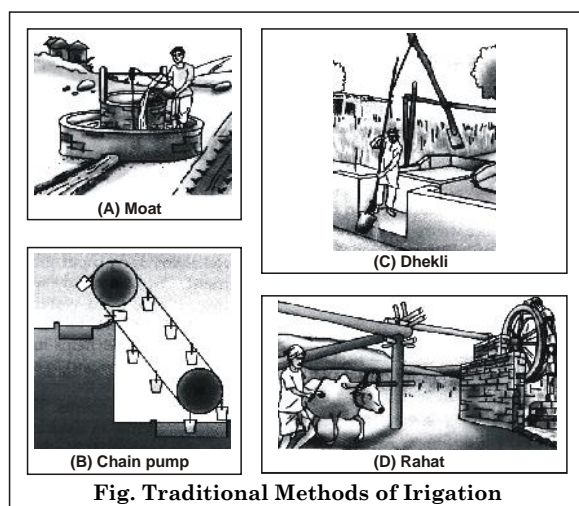
- (i) **Crop-Based Irrigation** : Water requirement of different crop plants varies at different stages of their growth & maturation e.g. paddy crop is transplanted in standing water and also requires continuous water supply whereas this is not so, for the crops of wheat, gram, cotton, maize, etc.
- (ii) **Soil-Based Irrigation** : Irrigation also depends on the nature of soil in which the crop is grown e.g. if two wheat crops are grown together one in sandy and another in clay soil, then in sandy soil more frequent irrigation is needed than clay soil.

◆ Sources of Irrigation

The main sources of irrigation in our country are rivers, lakes, ponds, wells, tubewells, dams and canals. Water from these sources is delivered by irrigation canals or pumped by using electric or diesel pumps.

◆ Traditional Methods of Irrigation

In our country traditional systems of irrigation like the pulley system (moat), chain pump, lever system (rahat) and dhekli have been in use for centuries to lift water from water reservoirs and supply it to the field for irrigation. These methods are cheaper but less efficient.



◆ Modern Methods of Irrigation :

There are four modern methods of irrigation commonly used in India :

- (i) **Sprinkler Irrigation** : This type of irrigation is used where the soil cannot retain water for a long time. Here the water is sprinkled by sprinklers.
- (ii) **Drip Irrigation** : Drip irrigation is also called trickle irrigation or micro-irrigation. In this system water falls drop by drop just at the root zone. The system minimises the use of water and fertilizers. Drip irrigation is used by farms, commercial greenhouses and residential gardens. 3

COMPETITIVE LEVEL

Modern Methods of Irrigation

- (i) **Furrow Irrigation** : In this method of irrigation, water is allowed to enter the field through channels or furrows made between two rows of crop.
- (ii) **Basin Irrigation** : In this method of irrigation, the field is just filled with water as in the case of paddy.
- (v) **Fertigation** is an innovative method for applying fertilizers through drip irrigation to maximize farm productivity with available water.

◆ Disadvantages of Excessive or Untimely Irrigation :

- All crop plants require water at different stages of their development. Plants require the right amount of water at the right time.
- Excess of water (waterlogging) in the soil inhibits the process of germination of the seeds as the seeds do not get sufficient air to respire.
- Roots do not grow well if there is waterlogging in the field.
- If the crop is irrigated when fully mature, it gets damaged. The excess water from the field then has to be drained of immediately.

Note :

- To protect plants from frost in winters, farmer water their field, especially at night. The water in the fields freezes earlier than water in the plant cells, thereby releasing a lot of heat. This heat keeps the air around the plants warmer and protects them from freezing.
- Chaff is the material consisting of seed coverings and small stem pieces that have been separated from the grains.

(E) Protection from Weeds : Weeds are the unwanted plants which grow alongwith the main crops. They are undesirable because they compete with the main crop for nutrients, space, air, light and water, etc. and reduce the crop yield. They also spread pests into crops and sometime produce poisonous substances which are harmful to animals and humans. The process of removing weeds from the field is called weeding.

◆ Time for Weeding :

The best time for the removal of weeds is before they produce flowers and seeds.

◆ Some Common Weeds :

Some of the most common weeds found in crop fields are :

- Wild oats (Javi)
- Grass
- Amaranthus (Chaulai)
- Chenopodium (Bathua)

◆ Methods of Weeding

- (i) **Manual Weeding** : Weeds may be removed manually either by uprooting them or by cutting them with the help of tools like handfork, khurpa and harrow.
- (ii) **By Using weedicides** : The chemical substances which destroy (kill) weeds but do not harm the crop are called weedicides or herbicides. Some common weedicides in use are : Dalapon, Metachlor, Siniazine and Butachlor. These weedicides are diluted in water and sprayed in the field with a sprayer. Using chemicals called herbicides or weedicides e.g. 2, 4 D, nitrofen, atrazine.

Weedicides must be used with care as they are poisonous and have side effects if consumed. Farmers should cover their nose and mouth with a piece of cloth during spraying.

COMPETITIVE LEVEL

◆ Method of Weeding :

- (i) **Biological Method** : Weeds can also be controlled by biological methods. For example, cochineal insects are used to control the growth of the weed called opuntia.

Biological method employs living organisms to destroy weeds. Cassia plant prevents the growth of parthenium weed. Herbivorous fish feed on aquatic weeds.

- **Advantages of biological methods** : It does not cause pollution. Organisms are harmless to the main crop.

◆ Protection of Crops :

Pests are organisms that attack and damage crops. They may be rodents (rats), insects (locusts, weevils, termites), stray animals and birds. It is estimated that 10% of our crop is destroyed every year by these pests.

Crops are also attacked by bacteria, fungi and viruses by causing several diseases which reduces the quality and quantity of the product. These diseases get transmitted through seeds, air, soil or through insects.

- **Pesticides** : The chemical substances which kill pests without harming the crops are called pesticides. These chemicals are sprayed by using a sprayer. The following chemicals are used to kill these pests.
- **Insecticides** : These are used to destroy insects. *Examples* : DDT, BHC, Malathion.
- **Fungicides** : These are used to destroy fungi. *Examples* : sulphur, lime sulphur.
- **Rodenticides** : These are used to kill rodents. *Examples* : zinc phosphide, warfarin.
- Insecticides, Fungicides and rodenticides are collectively called pesticides. Birds can be scared away by putting scarecrows in the fields as shown in Fig.

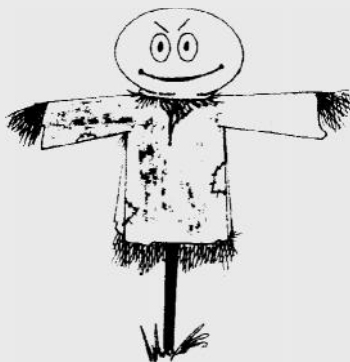


Fig. : Scarecrow to keep Birds Away from the Crop

(F) Harvesting : Once the crop has matured, it has to be gathered. The process of cutting and gathering a matured crop is known as harvesting.

All over the world, harvest season is celebrated with excitement. Baisakhi, Holi, Pongal, Diwali, Nabanya and Bihu are some of the harvest festivals celebrated in India.

◆ **Harvesting of Grain Crops**

Most of the grain crops are reaped close to the ground with the help of a sickle.

(i) Threshing : The process of separating the grain from the harvested stalks of hay is known as threshing. This is done by spreading the harvested crop on the ground and walking over them. Animals such as bullocks, buffaloes or camels are also used on a large scale for this purpose.

(ii) Winnowing : The process of separating the grain from the chaff is known as winnowing. Farmers hold the mixture of grains and chaff at a height and allow them to fall in a gentle stream. The wind blows away the chaff which is lighter. The heavier grains fall directly on the ground below and are thus separated.

Big farms use huge machines called combines which cut, thresh as well as separate the grain from the chaff.

(iv) Harvesting of other crops : Besides grain crops, all other crops like vegetable crops, cash crops, etc. are harvested through different processes and techniques. Plucking, gathering, packing, storing of crops, etc. are the different steps in the process of harvesting some specific crops.

Note :

◆ **Storage :** There are two types of food materials perishable and non-perishable.

¶ **Perishable food materials :** Perishable food materials are those which get spoiled easily when kept for sometime at room temperature, for example, vegetables, fruits, fish, meat and milk.

¶ **Non-perishable food materials :** Non-perishable food materials are those which do not get spoiled even when kept for a long time at room temperature, for example, wheat flour, food grains, spices and sugar.

◆ **Modes of Storage**

There are two different modes of storage : dry storage and cold storage.

(a) Dry storage : This method is used for storage of non-perishable food materials. Foodgrains are dried in the sun to bring down the moisture content should be below 14% of weight to prevent the attack by pests. The dried foodgrains are then weighed, packed in gunny bags and transferred to properly ventilated halls called godowns or granaries.

The gunny bags in the godown should be kept about 60 to 70 cm away from the walls and on wooden platforms about 10 to 15 cm above the ground. The godown must be kept free from pests by spraying various pesticides from time to time.

Grain silos are specially designed tall cylindrical structures for bulk storage of foodgrains. These silos can store different stocks of food grains at different levels. The required foodgrain can be taken out from the openings provided in the silos.

(b) Cold storage : This method is used for storage of perishable food materials. These food material have very short shelf-life so that these are usually stored at low temperature.

Icebox or refrigerator is used at home to store fruits, vegetables, milk, milk products, fish, etc. On commercial scale, the perishable food materials are stored in either a deep freezer or a cold storage.

◆ Advantages of Food Storage

- It prevents the food from being spoiled by the action of enzymes and microorganisms.
- It increases the storage period of food materials.
- It helps in the availability of season fruits and vegetables around the year
- It makes the transportation of food materials easier.
- It helps to maintain prices in the market.

Food From Animals

The keeping of animals for specific purpose is called **domestication**. All domesticated and useful animals constitute **livestock**. The breeding, feeding and carrying of livestock for food and other useful purpose is known as **animal husbandry**.

Note :

- Large-scale rearing of honeybees is called **apiculture**.
- Large-scale rearing of fish is called **pisciculture**.
- Cod liver oil obtained from fish is rich in Vitamin D.
- Milk, eggs and fish are rich in proteins.
- Meat is a rich source of fats and proteins.

COMPETITIVE LEVEL

◆ White revolution in India

Operation Flood, launched in 1966, was a project of India's National Dairy Development Board (NDDB), which was the world's biggest dairy development program. It transformed India from a milk-deficient nation into the world's largest milk producer, surpassing the USA in 1998, with about 17 percent of global output in 2010–11. In 30 years it doubled milk available per person, and made dairy farming India's largest self-sustainable rural employment generator.

The Anand pattern experiment at Amul, a single, cooperative dairy, was the engine behind the success of the program. Verghese Kurien, the chairman and founder of Amul, was named the chairman of NDDB by the then Prime Minister of India Lal Bahadur Shastri.

◆ Green Revolution in India

The Green Revolution in India refers to a period when agriculture in India improved due to the adoption of modern methods and technology in agriculture. The key leadership role played by the Indian agricultural scientist M. S. Swaminathan together with many others including GS Kalkat, earned him the popularly used title 'Father of Green Revolution of India'.

The Green Revolution allowed developing countries, like India, to overcome poor agricultural productivity. Within India, this started in the early 1960s and led to an increase in food grain production, especially in Punjab, Haryana and Uttar Pradesh during the early phase. The main development was higher-yielding varieties of wheat, for developing rust resistant strains of wheat.

EXERCISE-1

➤ Very Short Answer Type Questions

- Q.1 Which agriculture task has to be completed before sowing ?
- Q.2 What do you mean by the term agricultural practices ?
- Q.3 Name the implement used for sowing seeds.
- Q.4 Give two examples of rabi and Kharif crops.
- Q.5 Name two harvest festivals of India ?

➤ Short Answer Type Questions

- Q.6 Why weeds should be removed ?
- Q.7 Why seeds should be grown at proper distance ?
- Q.8 Why should the grains, fruits & vegetables be washed properly before use ?
- Q.9 What do you mean by transplantation ? Which crops are grown by this method ?
- Q.10 Define manure. What purpose is served by a manure ?

➤ Long Answer Type Questions

- Q.11 List in sequence the various agricultural practices which a farmer has to adopt for growing wheat crop.
- Q.12 State four differences between manures and fertilisers.
- Q.13 Write a short note on crop seasons.
- Q.14 Explain how soil gets affected by continuous plantation of crops in a field.
- Q.15 Why is storage of food materials needed ? Name the types of storage.

➤ Fill in the Blanks

- Q.16 _____ contain _____ matter in large quantities.
- Q.17 _____ is a phosphatic fertilizer.
- Q.18 Sowing of seeds by hands is called _____.
- Q.19 Soil crumbs are broken with the help of _____.
- Q.20 Crop rotation increases soil _____.

➤ True and False

- Q.21 Fertilisers are nutrient specific.
- Q.22 The plants grown in a field for food and fibres are called crop plants.
- Q.23 In India, special festivals are held commemorating the harvest.
- Q.24 Mustard, sunflower and groundnuts are all pulses.
- Q.25 The soil should be loosened before seeds are sown.

➤ Match the Column

- | Column - A | Column-B |
|----------------------------------|--------------------|
| Uses | Instruments |
| (i) weeding | (a) sickle |
| (ii) Digging and bunds formation | (b) seed drill |
| (iii) Tillage | (c) wooden plough |
| (iv) sowing | (d) spade |
| (v) Harvesting | (e) Khurpa |

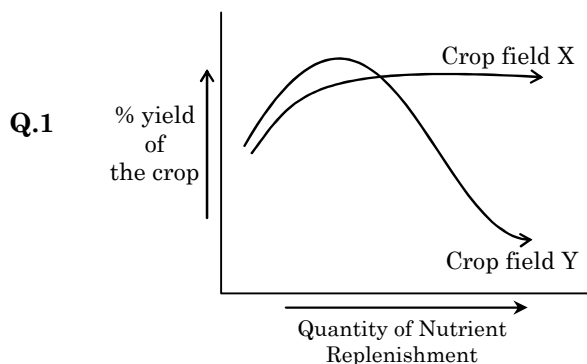
EXERCISE-2

- Q.1** The process of separating grains from the chaff is known as -
(A) Threshing (B) Winnowing
(C) Harvesting (D) Weeding
- Q.2** Transfer of seedlings from the nurseries to the main field is termed as -
(A) weeding
(B) sowing
(C) transplantation
(D) ploughing
- Q.3** The unwanted wild plants growing along with the crop plants are called -
(A) weeds (B) seedlings
(C) minor crops (D) grasses
- Q.4** Dalapon is used to kill -
(A) Weeds (B) Insects
(C) Pests (D) Rodents
- Q.5** Which one of the following does not cause plant diseases ?
(A) Viruses (B) Bacteria
(C) Algae (D) Fungi
- Q.6** Rahat and Dhekli are the -
(A) Names of two persons
(B) Names of two villages
(C) Traditional methods of irrigation
(D) None of these
- Q.7** Which one of the following is traditional method of Irrigation ?
(A) Moat (B) Chain pump
(C) Rahat (D) All of these
- Q.8** Chemicals which are used for removal of weeds are
(A) Insecticides (B) Pesticides
(C) Weedicides (D) None of these
- Q.9** Ditches made between the two rows of a crop are called as -
(A) Furrow (B) Canal
(C) Line (D) None
- Q.10** In which of the following storage structure food grains are stored ?
(A) Silos (B) Jute bags
(C) Granaries (D) All of the these
- Q.11** Fertilizers are harmful for soil because -
(A) they increase soil fertility.
(B) they cause the soil pollution.
(C) provides the nutrients.
(D) they are inorganic salt.
- Q.12** The crops that are harvested by March and April are -
(A) Rabi crops (B) Kharif crops
(C) Medicinal crop (D) Fibre crops
- Q.13** Which one of the following is kharif crop ?
(A) Wheat (B) Maize
(C) Barley (D) Mustard
- Q.14** Ploughing, levelling and manuring are the steps of -
(A) Preparation of soil
(B) Sowing
(C) Irrigation
(D) Weeding
- Q.15** Which one of the following is the advantage of soil preparation ?
(A) It increase soil fertility.
(B) It improves soil aeration.
(C) Soil become loose for roots to penetrate.
(D) All of these are correct.
- Q.16** Fertigation is a new method to apply :
(A) Manures
(B) Fertilizers
(C) Water
(D) Both (B) & (C)
- Q.17** Large scale rearing of fish is called -
(A) Apiculture
(B) Pisciculture
(C) Animal husbandry
(D) Agriculture

- Q.18** In _____ soil, frequent irrigation is required –
(A) Sandy (B) Clayey
(C) Loamy (D) All of these
- Q.19** An irrigation practice common in southern region of India is –
(A) Sprinkler system
(B) River valley system
(C) Fertigation
(D) Canal system
- Q.20** Combine is used for –
(A) Tilling
(B) Weeding
(C) Harvesting and Threshing
(D) Sowing
- Q.21** Which is the by-product of honeycomb ?
(A) Grease (B) Wax
(C) Vitamin (D) Sugar
- Q.22** Milch animals are given _____ to increase the quantity of milk.
(A) grass (B) straw
(C) ambon (D) horse gram
- Q.23** 'SILOS' are structures used for
(A) Storage of Milk
(B) Storage of Water
(C) Storage of Grains
(D) Release of Smoke
- Q.24** Which one of the following is a weed ?
(A) Wheat (B) Chenopodium
(C) Maize (D) Rice
- Q.25** The fertility of agricultural soil depends upon.
(A) Presence of Nitrogen in the soil.
(B) Presence of Carbon in the soil.
(C) Presence of both Nitrogen and Carbon in the soil.
(D) None of the above.

EXERCISE-3

(Previous Year Questions – NSO)



The given graph shows two crop fields (X and Y) that have been treated by different types of materials for nutrient replenishment, keeping other environmental factors same. Given are some assumptions regarding the crop fields and the materials used. Select the most correct one(s).

- I. Addition of chemical fertilizers in Y has resulted in sudden increase in yield due to increased release of N, P, K nutrients, but it gradually declined as continuous use of chemicals killed useful microbes that replenish the soil fertility.
- II. The difference in the two graphs indicates that the crop fields X and Y are treated with fertilizer and manure respectively, as fertilizer is beneficial for long time and gives durable yield whereas manure gives immediate yield but later causes problems.
- III. The highest peak in crop field X is slightly delayed because manure enriches soil fertility gradually.

- (A) I and II (B) II only
(C) III only (D) I and III

Q.2 Which of the following statements are correct ?

- (i) Water logging increases the amount of salt in the soil that reduces soil fertility.
 - (ii) 2,4-D, MCPA and butachlor are common weedicides.
 - (iii) Leguminous crops (like pea and beans) cannot be grouped in combination with cereals (like wheat and rice) under mixed cropping as both use large amount of nitrogen from the soil.
 - (iv) Manures provide specific nutrients to the soil.
 - (v) Paddy, maize, cotton and groundnut are examples of kharif crops while wheat, gram, pea and mustard are examples of rabi crops.
- (A) (i), (iv) and (v) only
(B) (ii), (iii), (iv) and (v) only
(C) (i),(ii) and (v) only
(D) (i), (ii), (iii) and (iv) only

Q.3 Read the given paragraph where few words have been italicised.

Preparation of soil in a field, before sowing of seeds involves tow steps : broadcasting and leveling. Soil in the crop field is enriched with nutrients by adding manures and fertilisers to it. Crop fields need to be irrigated water is allowed to fall drop by drop from a pipe just near the plant roots whereas in drop irrigation water escapes from a revolving nozzle. Weeding in crop fields can be done using thresher. After the crop is harvested, the grain in separated from cut crop using a machine called harvester.

Select the correct option regarding these.

- (A) Broadcasting should be replaced by winnowing.
- (B) Positions of sprinkler system and drip irrigation should be interchanged.
- (C) Thresher should not be replaced as it is correctly mentioned.
- (D) Harvester should be replaced by seed drill.

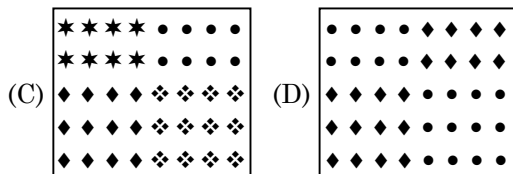
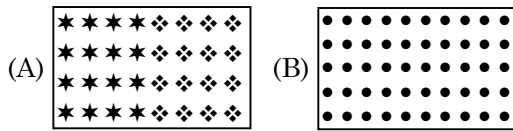
Q.4 In which of the following agricultural methods, the nutrient needs of one crop are fulfilled by the other crop ?

* = Ground nut

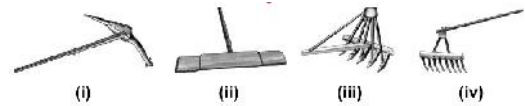
• = Rice

◆ = Wheat

❖ = Soyabean



Q.5 Which of the following agricultural tools is/are used in weeding ?



(A) (ii) & (iii)

(B) (iv) only

(C) (i), (iii) & (iv)

(D) (i) only

ANSWER KEY

EXERCISE - 1

➤ Fill in The Blanks :

16. Manure and organic
19. Leveller

17. Ammonium phosphate
20. Fertility

18. Broadcasting

➤ True and False :

21. True
24. False

22. True
25. True

23. True

➤ Match the Column :

26. i-(e) ; ii-(d) ; iii-(c) ; iv-(b) ; v-(a)

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	A	A	C	C	D	C	A	D	B	A	B	A	D
Ques.	16	17	18	19	20	21	22	23	24	25					
Ans.	D	B	A	B	C	B	C	C	B	A					

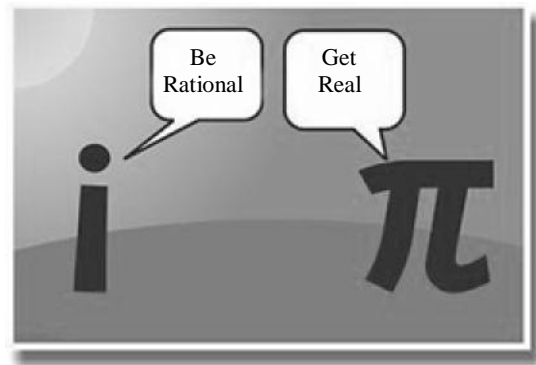
EXERCISE - 3

Ques.	1	2	3	4	5
Ans.	D	C	B	C	C

RATIONAL NUMBERS

Chapter Outline

- ❖1 Classification of Numbers
- ❖1 Rational Numbers
- ❖1 Standard Form of Rational Numbers
- ❖1 Representation of Rational Numbers on Number Line
- ❖1 Absolute Value of Rational Number
- ❖1 Comparison of Rational Number
- ❖1 Addition, Subtraction, Multiplication and Division of Rational Numbers
- ❖1 Rational Numbers between Two Rational Numbers

**Rational Numbers**

A number that can be expressed in the form $\frac{p}{q}$, where p, q are integers and $q \neq 0$ is called rational number.

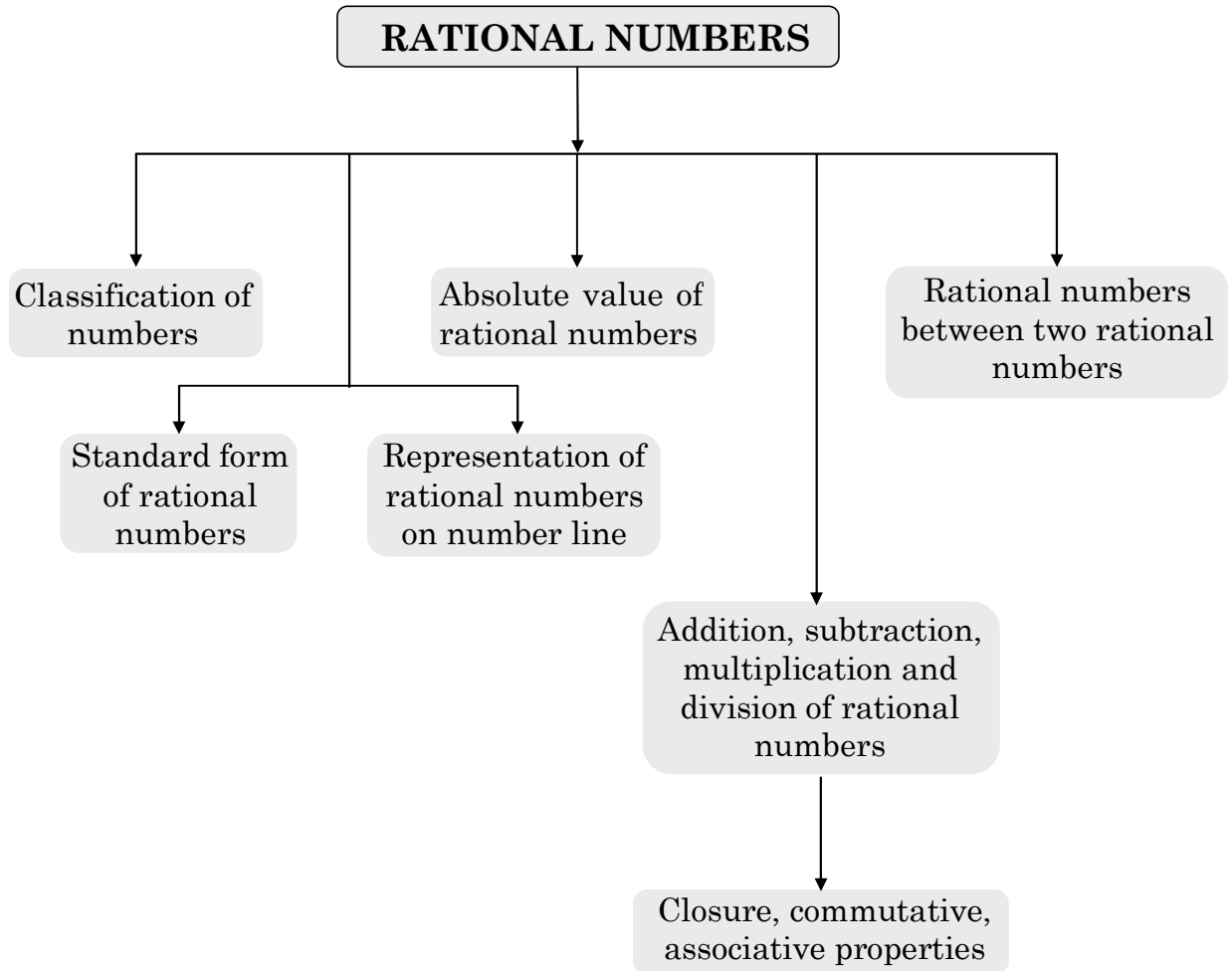
Between which two integers

does $\frac{10}{3}$ lie ?

- A. 0 and 1
- B. 1 and 2
- C. 2 and 3
- D. 3 and 4



MIND MAP



RATIONAL NUMBERS

Classification of numbers

ℕ **Natural Numbers : (N)** : The collection of counting numbers 1, 2, 3, 4..... are called natural numbers
 $N = \{1, 2, 3, \dots\}$

ℕ **Even Numbers** : All natural numbers which are divisible by 2 are called even numbers and denoted by $2n$ where $n \in N$.

Ex. 2, 4, 6, 8 etc.

ℕ **Odd Numbers** : All natural numbers which are not divisible by 2 are called odd numbers and denoted by $2n + 1$, where $n \in N$.

Ex. 1, 3, 5, 7 etc.

ℕ **Prime Numbers** : All natural numbers that have exactly two factors one & the number it self, as their factors are called prime numbers.

So $P = \{2, 3, 5, 7, 11, 13, 17, 19, 23, \dots\}$

Note : 2 is only even prime number & it is smallest prime number.

Identification of Prime Number :

Step (I) : Find approximate square root of given number.

Step (II) : Divide the given number by prime numbers less than approximate square root of number. If given number is not divisible by any of these prime numbers then the number is prime otherwise not.

Ex. 571 a prime number ?

Sol. Approximate square root = 24.

Prime number < 24 are 2,3,5,7,11,13,17,19 & 23.

But 571 is not divisible by any of these prime numbers. So, 571 is a prime number.

ℕ **Composite Numbers** : All natural numbers which are not prime called composite numbers.

So $C = \{4, 6, 8, 9, 10, 12, 14, \dots\}$

Note : 1 is neither prime nor composite number.

ℕ **Co-prime Numbers** : If the H.C.F. (or G.C.D.) of the given numbers is 1 then they are known as co-prime numbers.

Ex. 5, 8 are co-prime \because Their HCF is 1.

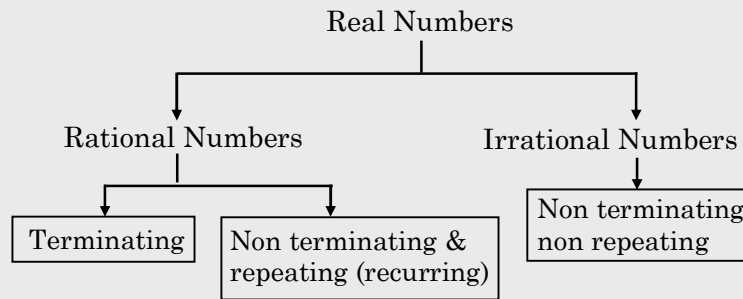
Note : Any Two consecutive numbers are always co-prime.

ℕ **Whole Numbers : (W)** : The collection of natural numbers with '0' is called set of whole numbers

$W = \{0, 1, 2, 3, \dots\}$

ℕ **Integers (I or Z)** : The collection of natural numbers, zero and negative of natural numbers together form a set of integers.

$Z = I = \{\dots -3, -2, -1, 0, 1, 2, 3, \dots\}$



Rational Numbers

The numbers which can be represented in form of $\frac{p}{q}$, where p and q are integers and $q \neq 0$

Ex. $\frac{5}{7}$, $\frac{-3}{8}$, $\frac{11}{1}$, 0, $\frac{2}{71}$ etc.

̄ **Positive Rational Number** : A rational number $\frac{p}{q}$ is positive, if p and q are either both positive or both negative.

Each of the rational numbers $\frac{2}{3}$, $\frac{-5}{-12}$, $\frac{-1}{-15}$ is a positive rational number.

̄ **Negative Rational Number** : A rational number $\frac{p}{q}$ is negative, if p and q are of opposite signs.

$\frac{-1}{8}$, $\frac{-11}{16}$, $\frac{3}{-4}$ these are negative rational numbers.

Note :

(i) All natural numbers, whole numbers and integers are rational number.

(ii) Rational numbers, includes all integers, terminating fractions (if the decimal parts are terminating like 0.2, 0.5, -3.5 etc) and non terminating recurring decimals like $0.\overline{6}$, -3.777 etc.

Standard form of Rational Number

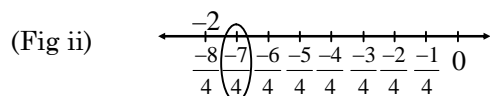
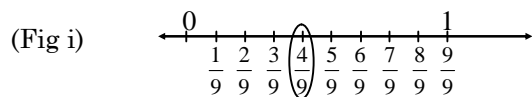
A rational number is said to be in the standard form if its denominator is a positive integer and the numerator and denominator have no common factor other than 1. If a rational number is not in the standard form, then it can be reduced to the standard form.

Ex. Standard form of $\frac{-5}{10}$ is $\frac{-1}{2}$ and standard form of $\frac{35}{-14}$ is $\frac{-5}{2}$

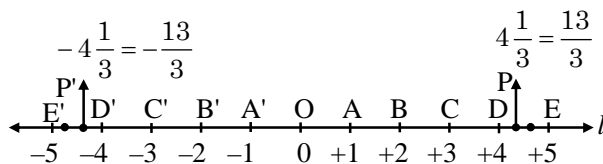
Representation of Rational Numbers on the Number Line

Any rational number can be represented on the number line in the following way. In a rational number, the denominator, tells the number of equal parts into which the first unit has been divided. The numeral above the bar i.e., the numerator, tells 'how many' of these parts are considered. So, a

rational number such as $\frac{4}{9}$ means four of nine equal parts on the right of 0 (Fig i) and for $\frac{-7}{4}$, we make 7 marking of distance $\frac{1}{4}$ each on the left of zero and starting from 0. The seventh marking is $\frac{-7}{4}$ (Fig ii).



Ex.1 Represent $\frac{13}{3}$ and $-\frac{13}{3}$ on number line.



Sol. Draw a line l , mark zero on it and name it as O

$$\frac{13}{3} = 4\frac{1}{3} = 4 + \frac{1}{3} \text{ and } -\frac{13}{3} = -\left(4 + \frac{1}{3}\right)$$

Therefore, from O mark OA, AB, BC, CD and DE to the right of O . Such that $OA = AB = BC = CD = DE = 1$ unit.

Clearly,

Point A represents the Rational number = 1

Point B represents the Rational number = 2

Point C represents the Rational number = 3

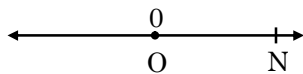
Point D represents the Rational number = 4

Point E represents the Rational number = 5

Since we have to consider 4 complete units and a part of the fifth unit, therefore divide the fifth unit DE into 3 equal parts. Take 1 part out of these 3 parts. Then point P is the representation of number $\frac{13}{3}$ on the number line. Similarly, take 4 full unit lengths to the left of 0 and divide the fifth unit $D'E'$ into 3 equal parts. Take 1 part out of these three equal parts. Thus, P' represents the rational number $-\frac{13}{3}$.

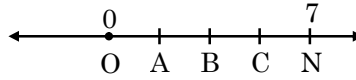
Ex.2 Represent the rational number $\frac{7}{4}$ on the number line.

Sol. In order to represent $\frac{7}{4}$ on the number line, we first draw a number line and mark a point O on it which represent '0' as shown in the figure.



Now we have to find a point, say, N on the number line which represents the numerator 7 of the rational number $\frac{7}{4}$.

So, N is the point that represents the integer 7 on the number line and is on the right hand side of the point O. Divide the segment ON into four (Denominator of $\frac{7}{4}$) equal parts (with the help of a ruler). Let A, B, C be the points of division as shown in the figure.



Then $OA = AB = BC = CN$.

By construction, each segment OA, AB, BC and CN represents $\frac{1}{4}$ th of segment ON. Therefore, the point A represents the rational number $\frac{7}{4}$.

Absolute Value of Rational Number

We have learned in earlier class that the absolute value of a rational number is its numerical value (value without signs).

For example : $\left| -\frac{3}{5} \right| = \frac{3}{5}$ and $\left| \frac{7}{9} \right| = \frac{7}{9}$.

Ex.3 Verify that $|x + y| \leq |x| + |y|$ by taking $x = \frac{3}{5}$, $y = \frac{-4}{15}$

Sol. If $x = \frac{3}{5}$, $y = \frac{-4}{15}$, then

$$|x + y| = \left| \frac{3}{5} + \left(\frac{-4}{15} \right) \right| = \left| \frac{9-4}{15} \right| = \left| \frac{5}{15} \right| = \frac{|5|}{|15|} = \frac{5}{15}$$

$$\begin{aligned} |x| + |y| &= \left| \frac{3}{5} \right| + \left| \frac{-4}{15} \right| = \frac{|3|}{|5|} + \frac{|-4|}{|15|} \\ &= \frac{3}{5} + \frac{4}{15} = \frac{9+4}{15} = \frac{13}{15} \end{aligned}$$

But $\frac{5}{15} < \frac{13}{15}$

Hence $|x + y| \leq |x| + |y|$ is true in this case.

Comparison of Rational Numbers

Ex.4 Arrange the following rational numbers in ascending order.

$$\frac{3}{8}, \frac{4}{12}, \frac{-7}{16}, \frac{-2}{3}$$

Sol. LCM of denominators 8, 12, 16, and 3 = $2 \times 2 \times 2 \times 2 \times 3 = 48$.

Then $\frac{3}{8} = \frac{3 \times 6}{8 \times 6} = \frac{18}{48}$;

$$\frac{4}{12} = \frac{4 \times 4}{12 \times 4} = \frac{16}{48}$$
 ;

$$\frac{-7}{16} = \frac{-7 \times 3}{16 \times 3} = \frac{-21}{48};$$

$$-\frac{2}{3} = \frac{-2 \times 16}{3 \times 16} = \frac{-32}{48}$$

The equivalent rational numbers are

$$\frac{18}{48}, \frac{16}{48}, \frac{-21}{48} \text{ and } \frac{-32}{48}$$

Therefore, the smallest rational number is $\frac{-32}{48}$, then comes, $\frac{-21}{48}$, then comes $\frac{16}{48}$, and the greatest rational number is $\frac{18}{48}$. Hence, their ascending order is $\frac{-2}{3}, \frac{-7}{16}, \frac{4}{12}, \frac{3}{8}$.

Addition of Rational Numbers

When denominators are equal :

Ex.5 Add $\frac{5}{6}$ and $\frac{7}{6}$.

Sol. $\frac{5}{6} + \frac{7}{6} = \frac{5+7}{6} = \frac{12}{6}$

Ex.6 Add $\frac{7}{5}$ and $\frac{-13}{5}$.

Sol. $\frac{7}{5} + \left(\frac{-13}{5}\right) = \frac{7-13}{5} = \frac{-6}{5}$

When one denominator is a multiple of the other denominator :

Ex.7 Solve $\frac{4}{3}$ and $\frac{5}{6}$.

Sol. We know that $\frac{4}{3} = \frac{4 \times 2}{3 \times 2} = \frac{8}{6}$

($\frac{8}{6}$ is equivalent rational number of $\frac{4}{3}$)

So, $\frac{4}{3} + \frac{5}{6} = \frac{8}{6} + \frac{5}{6} = \frac{13}{6}$

Ex.8 Solve $\frac{-3}{7} + \left(\frac{-5}{21}\right)$.

Sol. We know that

$$\frac{-3}{7} = \frac{3 \times 3}{7 \times 3} = \frac{-9}{21}$$

$$\begin{aligned} \text{So, } \frac{-3}{7} + \left(\frac{-5}{21}\right) &= \frac{-9}{21} - \frac{5}{21} \\ &= \frac{-9-5}{21} = \frac{-14}{21} \end{aligned}$$

When denominator are co-prime :

Ex.9 Find the sum of $\frac{4}{5}$ and $\frac{-6}{7}$.

Sol. $\frac{4}{5} + \left(\frac{-6}{7}\right) = \frac{4 \times 7}{5 \times 7} - \frac{6 \times 5}{7 \times 5}$

(Multiplying and dividing each fraction by the denominator of the other fraction)

$$= \frac{28}{35} - \frac{30}{35} = \frac{28-30}{35} = \frac{-2}{35}$$

When denominator have a common factor :

Ex.10 Solve $\frac{5}{12} + \frac{7}{8}$.

Sol. Since 12 and 8 have common factors, we will proceed by finding the LCM of 12 and 8. LCM of 12 and 8 is $2 \times 2 \times 2 \times 3 = 24$

Now we will find equivalent fractions of the given numbers having 24 in the denominator.

Hence, $\frac{5}{12} = \frac{5 \times 2}{12 \times 2} = \frac{10}{24}$

and $\frac{7}{8} = \frac{7 \times 3}{8 \times 3} = \frac{21}{24}$

So, $\frac{5}{12} + \frac{7}{8} = \frac{10}{24} + \frac{21}{24} = \frac{10+21}{24} = \frac{31}{24}$

◆ **Properties of Addition of Rational Number**

Ñ **Closure property :**

When two rational numbers are added, the result is always a rational number, i.e., if $\frac{a}{b}$ and $\frac{c}{d}$ is added then the resultant is always a rational number.

For example, $\frac{2}{5} + \frac{3}{6} = \frac{12+15}{30} = \frac{27}{30}$, which is also a rational number.

Ñ **Commutative property :**

When two rational numbers are added, the order of addition does not matter, i.e., if $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then

$$\frac{a}{b} + \frac{c}{d} = \frac{c}{d} + \frac{a}{b}$$

For example, $\frac{3}{4} + \frac{4}{5} = \frac{15+16}{20} = \frac{31}{20}$ and

$\frac{4}{5} + \frac{3}{4} = \frac{16+15}{20} = \frac{31}{20}$. Both results are equal.

Ñ **Associative property**

If $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$ three rational numbers, then $\left(\frac{a}{b} + \frac{c}{d}\right) + \frac{e}{f} = \frac{a}{b} + \left(\frac{c}{d} + \frac{e}{f}\right)$

Consider the fractions $\frac{2}{5}$, $\frac{1}{4}$ and $\frac{2}{3}$.

$$\begin{array}{l}
1 \quad \left(\frac{2}{5} + \frac{1}{4} \right) + \frac{2}{3} \quad \left| \quad \frac{2}{5} + \left(\frac{1}{4} + \frac{2}{3} \right) \right. \\
= \left(\frac{8+5}{20} \right) + \frac{2}{3} \quad = \frac{2}{5} + \left(\frac{3+8}{12} \right) \\
= \frac{13}{20} + \frac{2}{3} \quad = \frac{2}{5} + \frac{11}{12} \\
= \frac{39+40}{60} \quad = \frac{24+55}{60} \\
= \frac{79}{60} \quad = \frac{79}{60}
\end{array}$$

¶1 Additive identity

If $\frac{a}{b}$ is a rational number, then there exists a rational number zero such that $\frac{a}{b} + 0 = \frac{a}{b} = 0 + \frac{a}{b}$. Zero is called the identity element of addition. Addition of zero does not change the value of the rational number.

¶1 Additive inverse

If $\frac{a}{b}$ is a rational number, then there exists a rational number $\left(\frac{-a}{b} \right)$, called the additive inverse, such

$$\text{that } \frac{a}{b} + \left(\frac{-a}{b} \right) = 0 = \left(\frac{-a}{b} \right) + \frac{a}{b}$$

The additive inverse is also referred to as ‘negative’ of the given number.

$$\text{Ex. } \frac{3}{4} + \left(\frac{-3}{4} \right) = 0.$$

$$\therefore \left(\frac{-3}{4} \right) \text{ is the additive inverse of } \frac{3}{4}.$$

$$\text{Ex. } \frac{-5}{6} + \frac{5}{6} = 0.$$

$$\therefore \frac{5}{6} \text{ is the additive inverse of } \left(\frac{-5}{6} \right).$$

Subtraction of Rational Numbers

For rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, we define:

$$\left(\frac{a}{b} - \frac{c}{d} \right) = \frac{a}{b} + \left(\frac{-c}{d} \right) = \frac{a}{b} + \left(\text{additive inverse of } \frac{c}{d} \right)$$

When we have to subtract a rational number, say $\frac{5}{9}$ from $\frac{8}{9}$, we add the additive inverse of $\frac{5}{9}$, i.e.,

$$\frac{-5}{9} \text{ to } \frac{8}{9}. \text{ Thus, } \frac{8}{9} - \frac{5}{9} = \frac{8}{9} + \left(\frac{-5}{9} \right) = \frac{8-5}{9} = \frac{3}{9} = \frac{1}{3}$$

Ex. Subtract $\frac{3}{-7}$ from $\frac{4}{11}$.

$$\begin{aligned}\text{Here, } \frac{4}{11} - \left(\frac{-3}{7}\right) &= \frac{4}{11} + \left(\frac{+3}{7}\right) \\ &= \frac{4 \times 7}{11 \times 7} + \frac{3 \times 11}{7 \times 11} = \frac{28}{77} + \frac{33}{77} = \frac{61}{77}\end{aligned}$$

Multiplication of Rational Numbers

When we multiply two rational numbers, we multiply the numerator with the numerator and the denominator with the denominator.

$$\text{Thus, } -5 \times (-7) = \frac{-5}{1} \times \left(\frac{-7}{1}\right) = \frac{(-5)(-7)}{1 \times 1} = 35$$

$$\text{And, } \frac{-2}{11} \times \frac{3}{5} = \frac{-2 \times 3}{11 \times 5} = \frac{-6}{55}$$

◆ Properties of Multiplication of Rational Number

¶ Closure property :

The rational number are closed under multiplication. It means that the product of two rational numbers is always a rational number, i.e., if $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers,

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd} \text{ is always a rational number.}$$

For example, $\frac{-3}{7} \times \frac{5}{8} = -\frac{15}{56}$ which is rational number.

¶ Commutative property :

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then

$$\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}, \text{ i.e., } \frac{ac}{bd} = \frac{ca}{db}$$

$$\begin{aligned}\text{Ex. } \frac{4}{5} \times \left(\frac{-3}{7}\right) &= \left(\frac{-3}{7}\right) \times \frac{4}{5} \\ &= \frac{4 \times (-3)}{5 \times 7} = \frac{(-3) \times 4}{7 \times 5} \\ &= \frac{-12}{35} = \frac{-12}{35} \\ \frac{4}{5} \times \left(\frac{-3}{7}\right) &= \left(\frac{-3}{7}\right) \times \frac{4}{5}\end{aligned}$$

¶ Associative property :

If $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$ are three rational numbers, then $\left(\frac{a}{b} \times \frac{c}{d}\right) \times \frac{e}{f} = \frac{a}{b} \times \left(\frac{c}{d} \times \frac{e}{f}\right)$

$$\text{i.e., } \frac{ac}{bd} \times \frac{e}{f} = \frac{a}{b} \times \frac{ce}{df} \text{ or } \frac{ace}{bdf} = \frac{ace}{bdf}$$

Thus, rational numbers can be multiplied in any order.

$$\text{Ex. } \left(\frac{-3}{7} \times \frac{4}{5}\right) \times \left(\frac{-5}{8}\right) = \left(\frac{-3}{7}\right) \times \left(\frac{4}{5} \times \frac{-5}{8}\right)$$

$$\frac{(-3) \times 4}{7 \times 5} \times \left(\frac{-5}{8}\right) = \left(\frac{-3}{7}\right) \times \frac{4 \times (-5)}{5 \times 8}$$

$$\frac{-12}{35} \times \left(\frac{-5}{8}\right) = \left(\frac{-3}{7}\right) \times \left(\frac{-20}{40}\right)$$

$$\frac{60}{280} = \frac{60}{280}$$

$$\frac{3}{14} = \frac{3}{14}$$

¶ Multiplicative identity :

When any rational number, say $\frac{a}{b}$, is multiplied by the rational number 1, the product is always $\frac{a}{b}$.

$$\frac{a}{b} \times 1 = \frac{a \times 1}{b} = \frac{a}{b}$$

$$\text{or, } 1 \times \frac{a}{b} = \frac{1 \times a}{b} = \frac{a}{b}$$

$$\text{Ex. } \frac{21}{35} \times 1 = \frac{21}{35} \times \frac{1}{1} = \frac{21 \times 1}{35 \times 1} = \frac{21}{35}$$

$$\text{Ex. } \frac{-3}{7} \times 1 = \frac{-3}{7} \times \frac{1}{1} = \frac{(-3) \times 1}{7 \times 1} = \frac{-3}{7}$$

‘One’ is called the multiplicative identity or identity element of multiplication for rational numbers.

¶ Multiplicative inverse, or reciprocal :

Every nonzero rational number $\frac{a}{b}$ has its multiplicative inverse $\frac{b}{a}$.

$$\text{Thus, } \left(\frac{a}{b} \times \frac{b}{a}\right) = \left(\frac{b}{a} \times \frac{a}{b}\right) = 1.$$

$\frac{b}{a}$ is called the reciprocal of $\frac{a}{b}$. Clearly, zero has no reciprocal.

Reciprocal of 1 is 1 and the reciprocal of (-1) is (-1).

$$\text{Ex. } \frac{2}{3} \times \frac{3}{2} = \frac{2 \times 3}{3 \times 2} = \frac{6}{6} = 1. \text{ So } \frac{3}{2} \text{ is the multiplicative inverse of } \frac{2}{3} \text{ and } \frac{2}{3} \text{ is the multiplicative inverse of } \frac{3}{2}.$$

$$\text{Ex. } \left(-\frac{4}{7}\right) \times \left(-\frac{7}{4}\right) = \frac{(-4)(-7)}{7 \times 4} = \frac{28}{28} = 1. \text{ So } -\frac{7}{4} \text{ is the multiplicative inverse of } -\frac{4}{7} \text{ and vice versa.}$$

¶ Distributive property :

If $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$ are three rational numbers, then $\frac{a}{b} \times \left(\frac{c}{d} + \frac{e}{f}\right) = \frac{a}{b} \times \frac{c}{d} + \frac{a}{b} \times \frac{e}{f} = \left(\frac{c}{d} + \frac{e}{f}\right) \times \frac{a}{b}$

$$\begin{aligned} \text{Ex. } \frac{-3}{5} \left(\frac{3}{4} + \frac{-8}{9} \right) &= \left(\frac{-3}{5} \right) \times \frac{3}{4} + \left(\frac{-3}{5} \right) \times \left(\frac{-8}{9} \right) \\ \frac{-3}{5} \left(\frac{27-32}{36} \right) &= \frac{-9}{20} + \frac{24}{45} \\ \frac{-3}{5} \times \frac{-5}{36} &= \frac{-81+96}{180} \\ \frac{15}{180} &= \frac{15}{180} \end{aligned}$$

Note : When any rational number $\frac{a}{b}$ is multiplied by 0, the product is always zero. i.e. $\frac{a}{b} \times 0 = \frac{a \times 0}{b} = \frac{0}{b} = 0$

Division of Rational Numbers

Division is the inverse process of multiplication.

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers and $\frac{c}{d} \neq 0$, then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$.

$$\text{Ex. } \frac{3}{8} \div \frac{-4}{9} = \frac{3}{8} \times \left(\frac{-9}{4} \right) = \frac{-27}{32}$$

◆ Properties of Division of Rational Number

ℕ Closure property :

When a rational number is divided by another non zero rational number, the quotient is always a rational number.

Thus, if $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$, which is again a rational number since b, c, d are non-zero integers.

$$\text{Ex. } \frac{3}{4} \div \left(\frac{-1}{3} \right) = \frac{3}{4} \times \left(\frac{-3}{1} \right) = \frac{-9}{4}$$

ℕ Division is not commutative :

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers in which b, c and d $\neq 0$, then

$$\frac{a}{b} \div \frac{c}{d} \neq \frac{c}{d} \div \frac{a}{b} \text{ because,}$$

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc} \text{ and } \frac{c}{d} \div \frac{a}{b} = \frac{c}{d} \times \frac{b}{a} = \frac{cb}{da}$$

$$\text{So, } \frac{a}{b} \div \frac{c}{d} \neq \frac{c}{d} \div \frac{a}{b}$$

$$\text{Ex. } \frac{4}{7} \div \frac{1}{3} \text{ is not equal to } (\neq) \frac{1}{3} \div \frac{4}{7}$$

$$\frac{4}{7} \div \frac{1}{3} = \frac{4}{7} \times \frac{3}{1} = \frac{12}{7},$$

$$\text{whereas } \frac{1}{3} \div \frac{4}{7} = \frac{1}{3} \times \frac{7}{4} = \frac{7}{12}$$

$$\text{So, } \frac{4}{7} \div \frac{1}{3} \neq \frac{1}{3} \div \frac{4}{7}$$

Ex.11 Find $\frac{3}{7} + \left(\frac{-6}{11}\right) + \left(\frac{-8}{21}\right) + \left(\frac{5}{22}\right)$.

Sol. $\frac{3}{7} + \left(\frac{-6}{11}\right) + \left(\frac{-8}{21}\right) + \left(\frac{5}{22}\right)$
 $= \frac{198}{462} + \left(\frac{-252}{462}\right) + \left(\frac{-176}{462}\right) + \left(\frac{105}{462}\right)$

(Note that 462 is the LCM of 7, 11, 21 and 22)

$$= \frac{198 - 252 - 176 + 105}{462} = \frac{-125}{462}$$

We can also solve it as.

$$\frac{3}{7} + \left(\frac{-6}{11}\right) + \left(\frac{-8}{21}\right) + \frac{5}{22}$$
$$= \left[\frac{3}{7} + \left(\frac{-8}{21}\right)\right] + \left[\frac{-6}{11} + \frac{5}{22}\right]$$

(by using commutative and associativity)

$$= \left[\frac{9 + (-8)}{21}\right] + \left[\frac{-12 + 5}{22}\right]$$

(LCM of 7 and 21 is 21; LCM of 11 and 22 is 22)

$$= \frac{1}{21} + \left(\frac{-7}{22}\right) = \frac{22 - 147}{462} = \frac{-125}{462}$$

Ex.12 Find $\frac{-4}{5} \times \frac{3}{7} \times \frac{15}{16} \times \left(\frac{-14}{9}\right)$

Sol. We have $\frac{-4}{5} \times \frac{3}{7} \times \frac{15}{16} \times \left(\frac{-14}{9}\right)$
 $= \left(\frac{-4 \times 3}{5 \times 7}\right) \times \left(\frac{15 \times (-14)}{16 \times 9}\right)$

$$= \frac{-12}{35} \times \left(\frac{-35}{24}\right) = \frac{-12 \times (-35)}{35 \times 24} = \frac{1}{2}$$

We can also do it as.

$$\frac{-4}{5} \times \frac{3}{7} \times \frac{15}{16} \times \left(\frac{-14}{9}\right) = \left(\frac{-4}{5} \times \frac{15}{16}\right) \times \left[\frac{3}{7} \times \left(\frac{-14}{9}\right)\right] \text{ (Using commutativity and associativity)}$$

$$= \frac{-3}{4} \times \left(\frac{-2}{3}\right) = \frac{1}{2}$$

Rational Numbers Between Two Rational Numbers

If a and b are two rational numbers, then $\frac{a+b}{2}$ is a rational number between a and b such that $a < \frac{a+b}{2} < b$.

This shows that there are countless number of rational numbers between any two given rational numbers.

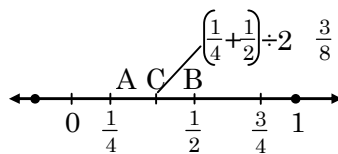
Ex.13 Find a rational number between $\frac{1}{4}$ and $\frac{1}{2}$.

Sol. We find the mean of the given rational numbers.

$$\left(\frac{1}{4} + \frac{1}{2}\right) \div 2 = \left(\frac{1+2}{4}\right) \div 2 = \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$$

$\frac{3}{8}$ lies between $\frac{1}{4}$ and $\frac{1}{2}$.

This can be seen on the number line also.



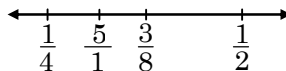
We find mid point of AB which is C, represented by $\left(\frac{1}{4} + \frac{1}{2}\right) \div 2 = \frac{3}{8}$.

We find that $\frac{1}{4} < \frac{3}{8} < \frac{1}{2}$.

Now we find another rational number between $\frac{1}{4}$ and $\frac{3}{8}$. For this, we again find the mean of $\frac{1}{4}$ and $\frac{3}{8}$. That is,

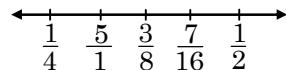
$$\left(\frac{1}{4} + \frac{3}{8}\right) \div 2 = \frac{5}{8} \times \frac{1}{2} = \frac{5}{16}$$

$\frac{1}{4} < \frac{5}{16} < \frac{3}{8} < \frac{1}{2}$

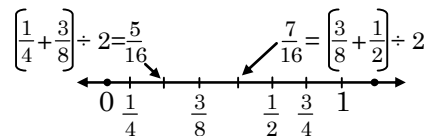


Now find the mean of $\frac{3}{8}$ and $\frac{1}{2}$. We have, $\left(\frac{3}{8} + \frac{1}{2}\right) \div 2 = \frac{7}{8} \times \frac{1}{2} = \frac{7}{16}$

Thus we get $\frac{1}{4} < \frac{5}{16} < \frac{3}{8} < \frac{7}{16} < \frac{1}{2}$.



Thus, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$ are the three rational numbers between $\frac{1}{4}$ and $\frac{1}{2}$. This can clearly be shown on the number line as follows :



In the same way we can obtain as many rational numbers as we want between two given rational numbers. You have noticed that there are countless rational numbers between any two given rational numbers.

Ex.14 Write any 3 rational numbers between -2 and 0 .

Sol. -2 can be written as $\frac{-20}{10}$ and 0 as $\frac{0}{10}$.

Thus we have $\frac{-19}{10}$, $\frac{-18}{10}$, $\frac{-17}{10}$, $\frac{-16}{10}$, $\frac{-15}{10}$, $\frac{-1}{10}$ between -2 and 0 and we can write any 3 rational numbers out of these.

Ex.15 Find any ten rational numbers between $\frac{-5}{6}$ and $\frac{5}{8}$.

Sol. We first convert $\frac{-5}{6}$ and $\frac{5}{8}$ to rational numbers with the same denominators.

$$\frac{-5 \times 4}{6 \times 4} = \frac{-20}{24} \quad \text{and} \quad \frac{5 \times 3}{8 \times 3} = \frac{15}{24}.$$

Thus we have, $\frac{-19}{24}$, $\frac{-18}{24}$, $\frac{-17}{24}$, $\frac{14}{24}$ as the rational numbers between $\frac{-20}{24}$ and $\frac{15}{24}$.

So $\frac{-19}{24}$, $\frac{-18}{24}$, $\frac{-17}{24}$, $\frac{-10}{24}$ are the ten rational numbers.

EXERCISE-1

Very Short Answer Type Questions

Direction : (Q.1 to Q.3) Find the value of following expressions

Q.1 $-\frac{2}{3} \times \frac{3}{5} + \frac{5}{2} - \frac{3}{5} \times \frac{1}{6}$

Q.2 $\frac{2}{5} \times \left(-\frac{3}{7}\right) - \frac{1}{6} \times \frac{3}{2} + \frac{1}{14} \times \frac{2}{5}$

Q.3 $\frac{5}{7} + \frac{1}{3} + \frac{8}{9} + \frac{1}{14}$

Q.4 The sum of the two numbers is $\frac{5}{9}$. If one of the numbers is $\frac{1}{3}$, find the other.

Q.5 The sum of two rational numbers is -8 . If one of the numbers is $\frac{-15}{7}$, find the other.

Short Answer Type Questions – Type I

Q.6 What should be added to $\frac{-7}{8}$ so as to get $\frac{5}{9}$?

Q.7 What number should be subtracted from $\frac{-5}{3}$ to get $\frac{5}{6}$?

Q.8 What should be added to $\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{5}\right)$ to get 3?

Q.9 What should be subtracted from $\left(\frac{3}{4} - \frac{2}{3}\right)$ to get $\frac{-1}{6}$?

Q.10 Represent these numbers on the number line.

(i) $\frac{7}{4}$ (ii) $\frac{-5}{6}$ (iii) $\frac{-2}{11}$

Short Answer Type Questions – Type II

Q.11 Find five rational numbers between.

(i) $\frac{2}{3}$ and $\frac{4}{5}$ (ii) $\frac{-3}{2}$ and $\frac{5}{3}$

(iii) $\frac{1}{4}$ and $\frac{1}{2}$

Q.12 Simplify each of the following and write as a rational number of the form $\frac{p}{q}$:

(i) $\frac{-9}{10} + \frac{22}{15} + \frac{13}{-20}$

(ii) $\frac{5}{3} + \frac{3}{-2} + \frac{-7}{3} + 3$

(iii) $\frac{-7}{4} + 0 + \frac{-9}{5} + \frac{19}{10} + \frac{11}{14}$

(iv) $\frac{-7}{4} + \frac{5}{3} + \frac{-1}{2} + \frac{-5}{6} + 2$

(v) $\frac{5}{6} + \frac{-2}{5} - \frac{-2}{15}$

(vi) $\frac{3}{8} - \frac{-2}{9} + \frac{-5}{36}$

Q.13 Simplify each of the following and express the result as a rational number in standard form:

(i) $\frac{-19}{36} \times 16$ (ii) $\frac{-13}{9} \times \frac{27}{-26}$

(iii) $\frac{-50}{7} \times \frac{14}{3}$ (iv) $\frac{-11}{9} \times \frac{-81}{-88}$

(v) $\frac{-5}{9} \times \frac{72}{-25}$

Q.14 Simplify:

(i) $\left(\frac{13}{5} \times \frac{8}{3}\right) - \left(\frac{-5}{2} \times \frac{11}{3}\right)$

(ii) $\left(\frac{13}{7} \times \frac{11}{26}\right) - \left(\frac{-4}{3} \times \frac{5}{6}\right)$

(iii) $\left(\frac{8}{5} \times \frac{-3}{2}\right) + \left(\frac{-3}{10} \times \frac{11}{16}\right)$

- Q.15** Find ten rational numbers between $\frac{3}{5}$ and $\frac{3}{4}$.

➤ Long Answer Type Questions

- Q.16** By what number should $\left(\frac{1}{-15}\right)$ be divided so that the quotient equal to $\left(\frac{1}{-5}\right)$.

- Q.17** By what number should $(-4)^{-2}$ be multiplied so that the product may be equal to 10^{-2} ?

- Q.18** By what number should $(-12)^{-1}$ be divided so that the quotient may be $\left(\frac{2}{3}\right)^{-1}$?

- Q.19** (i) Verify that $|x + y| \leq |x| + |y|$ by taking $x = \frac{-5}{12}$, $y = \frac{-7}{18}$
 (ii) Verify that $|x \times y| = |x| \times |y|$ by taking $x = \frac{-2}{3}$, $y = \frac{-9}{8}$.

Q.20 Simplify : $5 - \left[\frac{3}{4} + \left\{ 2\frac{1}{2} - \left(0.5 + \frac{1}{6} - \frac{1}{7} \right) \right\} \right]$

➤ Fill in the Blanks

- Q.21** (i) The numbers and are their own reciprocals
 (ii) The product of two rational numbers is always a
 (iii) $\frac{7}{-8}$, expressed as a rational number with denominator 24 as
 (iv) The absolute value of $\frac{-16}{-19}$ is
 (v) The rational number which is neither positive nor negative is

➤ True or False

- Q.22** (i) Every fraction is a rational number.
 (ii) $|x| = -x$ if $x < 0$.
 (iii) $\frac{10}{21} \div \frac{8}{9} = \frac{8}{9} \div \frac{10}{21}$
 (iv) $0 \times \frac{4}{5} = \frac{4}{5} \times 0$ implies that 0 is the multiplicative identity for rational numbers.
 (v) Reciprocal of $\frac{1}{x}$, where $x \neq 0$ is x

➤ Match the Column

- | Q.23 | Column-I | Column-II |
|-------------|--|--------------------|
| (i) | A rational number between $\frac{1}{2}$ and $\frac{1}{3}$ | (a) $\frac{4}{19}$ |
| (ii) | A rational number between $\frac{-1}{3}$ and $\frac{-11}{5}$ | (b) $\frac{5}{12}$ |
| (iii) | $\frac{11}{12} \times \frac{14}{19} \times \frac{16}{84} \times \frac{18}{11}$ | (c) -2 |
| (iv) | $\frac{2}{3} \times \frac{6}{4} \times \frac{5}{11} \div \frac{10}{11}$ | (d) $\frac{-2}{3}$ |
| | | (e) $\frac{1}{2}$ |

EXERCISE-2

- Q.1** Which of the following numbers is the additive inverse of $\frac{7}{29}$?
- (A) $\frac{29}{7}$ (B) $-\frac{29}{7}$
 (C) $-\frac{7}{29}$ (D) $\frac{7}{29}$
- Q.2** Which of the following is (are) greater than x when $x = \frac{9}{11}$?
- I. $\frac{1}{x}$ II. $\frac{x+1}{x}$ III. $\frac{x+1}{x-1}$
- (A) I only (B) I and II only
 (C) I and III only (D) II and III only
- Q.3** How many rational numbers exist between any two distinct rational numbers ?
- (A) 2 (B) 3
 (C) 11 (D) Infinite
- Q.4** Which of the following numbers is the product of $\frac{6}{13}$ & $\frac{-26}{3}$?
- (A) 1 (B) -4
 (C) $\frac{-266}{133}$ (D) $\frac{266}{133}$
- Q.5** The product of $\frac{-2}{5}$ with $\frac{-5}{2}$ is :
- (A) 1 (B) 0
 (C) -1 (D) None of these
- Q.6** Which of the following numbers is the decimal form of $\frac{1}{4}$?
- (A) -0.25 (B) 2.5
 (C) 0.25 (D) -2.5
- Q.7** Which of the following numbers lies in the middle of $\frac{3}{4}$ & $\frac{7}{4}$?
- (A) 5.0 (B) 3.0
 (C) 2.5 (D) 1.25
- Q.8** Which pair of following numbers are respectively the additive & multiplicative identities .
- (A) 2 & 0 (B) 1 & -1
 (C) -1 & 0 (D) 0 & 1
- Q.9** Which of the following numbers is the simplest form of $\frac{3}{4} + \left(-\frac{1}{4}\right) + \left(-\frac{5}{4}\right)$
- (A) $\frac{9}{4}$ (B) $-\frac{3}{4}$
 (C) $-\frac{9}{4}$ (D) $\frac{7}{4}$
- Q.10** Which of the following properties indicates the given operation
- $$\left[\left(-\frac{1}{5}\right) + \left(-\frac{3}{5}\right)\right] + \left(\frac{1}{7}\right) = \left(-\frac{1}{5}\right) + \left[\left(-\frac{3}{5}\right) + \left(\frac{1}{7}\right)\right]$$
- (A) commutative (B) associative
 (C) distributive (D) none of these
- Q.11** Which of the following set of rational numbers is arranged in ascending order ?
- (A) $-\frac{1}{2}, -\frac{3}{7}, -\frac{5}{14}, -\frac{25}{28}$
 (B) $-\frac{25}{28}, -\frac{1}{2}, -\frac{3}{7}, -\frac{5}{14}$
 (C) $-\frac{25}{28}, -\frac{5}{14}, -\frac{3}{7}, -\frac{1}{2}$
 (D) $-\frac{5}{14}, -\frac{25}{28}, -\frac{3}{7}, -\frac{1}{2}$
- Q.12** $-\frac{1}{5}, -\frac{3}{10}, -\frac{11}{15}$ and $\frac{13}{20}$ arranged in descending order are :
- (A) $\frac{13}{20}, -\frac{3}{10}, -\frac{11}{15}, \frac{1}{5}$ (B) $\frac{13}{20}, -\frac{11}{15}, -\frac{3}{10}, \frac{1}{5}$
 (C) $\frac{13}{20}, -\frac{1}{5}, -\frac{3}{10}, -\frac{11}{15}$ (D) $\frac{13}{20}, -\frac{1}{5}, -\frac{11}{15}, -\frac{3}{10}$

Q.13 What number should be added to $\frac{-5}{16}$ to get $\frac{7}{24}$?

- (A) $\frac{-29}{48}$ (B) $\frac{15}{48}$ (C) $\frac{29}{48}$ (D) $\frac{21}{28}$

Q.14 $\frac{-5}{7} + \frac{1}{12} + \frac{3}{4} + \frac{-1}{3} + \frac{10}{7} + \frac{-1}{6}$ equals :

- (A) 0 (B) 1
(C) $1\frac{1}{21}$ (D) -1

Q.15 $(-36) \times \left(\frac{-35}{76}\right) \times \left(\frac{19}{15}\right) \times \left(\frac{3}{-2}\right)^{-1}$ equals :

- (A) -64 (B) -14
(C) 14 (D) 64

Q.16 Which of the following statement is true ?

- (A) $\frac{16}{21} \div \left(\frac{-4}{9} \div \frac{8}{9}\right) = \left(\frac{16}{21} \div \frac{-4}{5}\right) \div \frac{8}{9}$
(B) $\left(\frac{9}{20} - \frac{17}{40}\right) \div \frac{10}{3} = \left(\frac{9}{20} \div \frac{10}{3}\right) - \left(\frac{17}{40} \div \frac{10}{3}\right)$
(C) $0 \div -\frac{13}{14} = 0$
(D) $\frac{-15}{22} \div \frac{22}{-15} = 1$

Q.17 By what rational number should $\frac{-7}{85}$ be multiplied to obtain $\frac{1}{17}$?

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

Q.18 If a triangle has a base of $10\frac{3}{4}$ cm and a height of $15\frac{3}{4}$ cm, what is its area ?

- (A) $150\frac{9}{16}$ cm² (B) $75\frac{9}{32}$ cm²
(C) $84\frac{21}{32}$ cm² (D) $150\frac{9}{32}$ cm²

Q.19 In the last three months Mr. Sharma lost $5\frac{1}{2}$ kg, gained $2\frac{1}{4}$ kg, and then lost $3\frac{3}{4}$ kg. If he now weight 95 kg, how much did Mr. Sharma weight to begin with ?

- (A) 100 kg (B) 102 kg
(C) 106.5 kg (D) 104 kg

Q.20 Which of the following is not true ?

- (A) $\frac{-5}{6} + \frac{-7}{12} = \frac{-7}{12} + \frac{-5}{6}$
(B) $\frac{8}{9} + \left(\frac{11}{3} + \frac{-2}{5}\right) = \left(\frac{8}{9} + \frac{11}{3}\right) + \frac{-2}{5}$
(C) $\frac{8}{9} - \frac{7}{11} = \frac{7}{11} - \frac{8}{9}$
(D) $\frac{-4}{-5} + 0 = \frac{4}{5}$

EXERCISE-3

(Previous Year Questions – NSO)

Q.1 Which of the following statements is always true ?

- 1 (A) $\frac{x-y}{2}$ is a rational number between x and y
- (B) $\frac{x+y}{2}$ is a rational number between x and y
- (C) $\frac{x \times y}{2}$ is a rational number between x and y
- (D) $\frac{x \div y}{2}$ is a rational number between x and y

Q.2 The numerical expression $\frac{3}{8} + \frac{(-5)}{7} = \frac{-19}{56}$

shows that

- (A) Rational numbers are closed under addition
- (B) Rational numbers are not closed under addition
- (C) Rational numbers are closed under Multiplication
- (D) Addition of rational numbers are not commutative

Q.3 The number 34 is divided into two parts such that $\frac{4}{7}$ th of the first part is equal to

$\frac{2}{5}$ th of the second part. The numbers are

respectively

- (A) 20, 14 (B) 21, 13
(C) 13, 21 (D) 14, 20

Q.4 To reduce a rational number in its standard form, we divide its numerator and denominator by their ____.

- (A) L.C.M (B) H.C.F
(C) Product (D) Multiple

Q.5 Which of the following shows distributive property of multiplication over addition for rational numbers?

(A) $-\frac{3}{4} \times \left\{ \frac{1}{3} + \left(-\frac{5}{7} \right) \right\} = \left[-\frac{3}{4} \times \frac{1}{3} \right] + \left[-\frac{3}{4} \times \left(-\frac{5}{7} \right) \right]$

(B) $-\frac{3}{4} \times \left\{ \frac{1}{3} + \left(-\frac{5}{7} \right) \right\} = \left[-\frac{3}{4} \times \frac{1}{3} \right] + \left[-\frac{5}{7} \right]$

(C) $-\frac{3}{4} \times \left\{ \frac{1}{3} + \left(-\frac{5}{7} \right) \right\} = \frac{1}{3} \left[-\frac{3}{4} \right] \times \left(-\frac{5}{7} \right)$

(D) $-\frac{3}{4} \times \left\{ \frac{1}{3} + \left(-\frac{5}{7} \right) \right\} = \left[\frac{1}{3} + \left(-\frac{5}{7} \right) \right] - \frac{3}{4}$

Q.6 One fruit salad recipe requires $\frac{1}{2}$ cup of

sugar. Another recipe for the same fruit salad requires 2 tablespoons of sugar. If 1 tablespoon is equivalent to $\frac{1}{16}$ cup, how much more sugar does the first recipe require?

(A) $\frac{4}{5}$ cup (B) $\frac{6}{5}$ cup

(C) $\frac{3}{8}$ cup (D) $\frac{5}{8}$ cup

Q.7 Fill in the blanks:

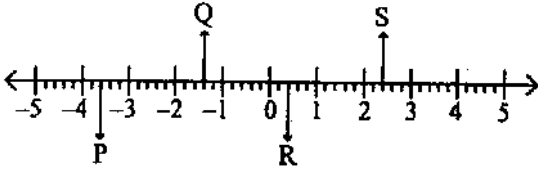
(i) ___P___ is the multiplicative identity of rational numbers.

(ii) There are ___Q___ rational numbers between two given rational numbers.

(iii) Rational numbers are not associative for ___R___.

- | | P | Q | R |
|-----|---|----------|-------------|
| (A) | 0 | infinite | division |
| (B) | 1 | infinite | division |
| (C) | 1 | finite | subtraction |
| (D) | 0 | infinite | addition |

- Q.8** Observe the given number line and find the value of $P + Q + R + S$.



- (A) 0 (B) 2.2
(C) -2.2 (D) 5.0

- Q.9** How many digits are required for numbering the pages of a book having 300 pages?

- (A) 299 (B) 492
(C) 789 (D) 792

- Q.10** Which of the following statements is correct?

- (A) There are finite rational numbers between any two rational numbers.
(B) The additive inverse of the rational number $\frac{x}{y}$ is -1 and vice-versa.
(C) The rational number 1 is additive identity of rational numbers.
(D) Rational numbers are closed under the operations of addition, subtraction and multiplication.

- Q.11** The smallest fraction which should be subtracted from the sum of $1\frac{3}{4}$, $2\frac{1}{2}$, $5\frac{7}{12}$, $3\frac{1}{3}$ and $2\frac{1}{4}$ to make the result a greatest one digit number, is -

- (A) $\frac{5}{12}$ (B) $\frac{7}{12}$ (C) $\frac{1}{2}$ (D) $6\frac{5}{12}$

- Q.12** Which greatest number will divide 3026 and 5053 leaving remainders 11 and 13 respectively?

- (A) 15 (B) 30 (C) 45 (D) 60

- Q.13** Which of the following statements is INCORRECT?

- (A) If a and b are consecutive rational numbers where $a < b$, then $\frac{a+b}{2} < b$.
(B) $\frac{x+y}{2}$ is a rational number which lies between x and y.
(C) Rational numbers are associative under subtraction.
(D) The rational numbers $\frac{5}{3}$ and $\frac{-1}{3}$ are lying on the opposite sides of '0' on the number line.

ANSWER KEY

EXERCISE - 1

1. 2 2. $-\frac{11}{28}$ 3. $\frac{253}{126}$ 4. $\frac{2}{9}$ 5. $-\frac{41}{7}$ 6. $\frac{103}{72}$ 7. $\frac{-5}{2}$ 8. $\frac{59}{30}$ 9. $\frac{1}{4}$
11. (i) $\frac{41}{60}, \frac{42}{60}, \frac{43}{60}, \frac{44}{60}, \frac{45}{60}$ (ii) $\frac{-8}{6}, \frac{-7}{6}, 0, \frac{1}{6}, \frac{2}{6}$ (iii) $\frac{9}{32}, \frac{10}{32}, \frac{11}{32}, \frac{12}{32}, \frac{13}{32}$
12. (i) $\frac{-1}{12}$ (ii) $\frac{5}{6}$ (iii) $\frac{-121}{140}$ (iv) $\frac{7}{12}$ (v) $\frac{17}{30}$ (vi) $\frac{11}{24}$ 13. (i) $\frac{-76}{9}$ (ii) $\frac{3}{2}$ (iii) $\frac{-100}{3}$ (iv) $\frac{-9}{8}$ (v) $\frac{8}{5}$
14. (i) $\frac{161}{10}$ (ii) $\frac{239}{126}$ (iii) $\frac{-417}{160}$
15. $\frac{97}{160}, \frac{98}{160}, \frac{99}{160}, \frac{100}{160}, \frac{101}{160}, \frac{102}{160}, \frac{103}{160}, \frac{104}{160}, \frac{105}{160}, \frac{106}{160}$
16. $\frac{1}{3}$ 17. $\frac{4}{25}$ 18. $\frac{-1}{18}$ 20. $\frac{191}{84}$
21. (i) 1, -1 (ii) Rational number (iii) $\frac{-21}{24}$ (iv) $\frac{16}{19}$ (v) 0
22. (i) True (ii) True (iii) False (iv) False (v) True
23. (i) \rightarrow (b); (ii) \rightarrow (c, d); (iii) \rightarrow (a); (iv) \rightarrow (e)

EXERCISE - 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	D	B	A	C	D	D	B	B	B	C	C	C	B
Ques.	16	17	18	19	20										
Ans.	C	D	C	B	C										

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13
Ans.	B	A	D	B	A	C	B	C	D	D	D	C	C

ALGEBRAIC EXPRESSIONS

Chapter Outline

1

- ✧ Algebraic Expression
- ✧ Addition and Subtraction of Algebraic Expression
- ✧ Multiplication of Algebraic Expression
- ✧ Division of Algebraic Expression
- ✧ Remainder Theorem
- ✧ Factor Theorem

Coefficients

$$2x + 4y - 9$$

Variables**Constant****Terms** — $2x, 4y, 9$ **Expansions**

- 1) $a^2 - b^2 = (a + b)(a - b)$
- 2) $(a + b)^2 = a^2 + 2ab + b^2$
- 3) $(a - b)^2 = a^2 - 2ab + b^2$
- 4) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
- 5) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

Algebraic Expression:

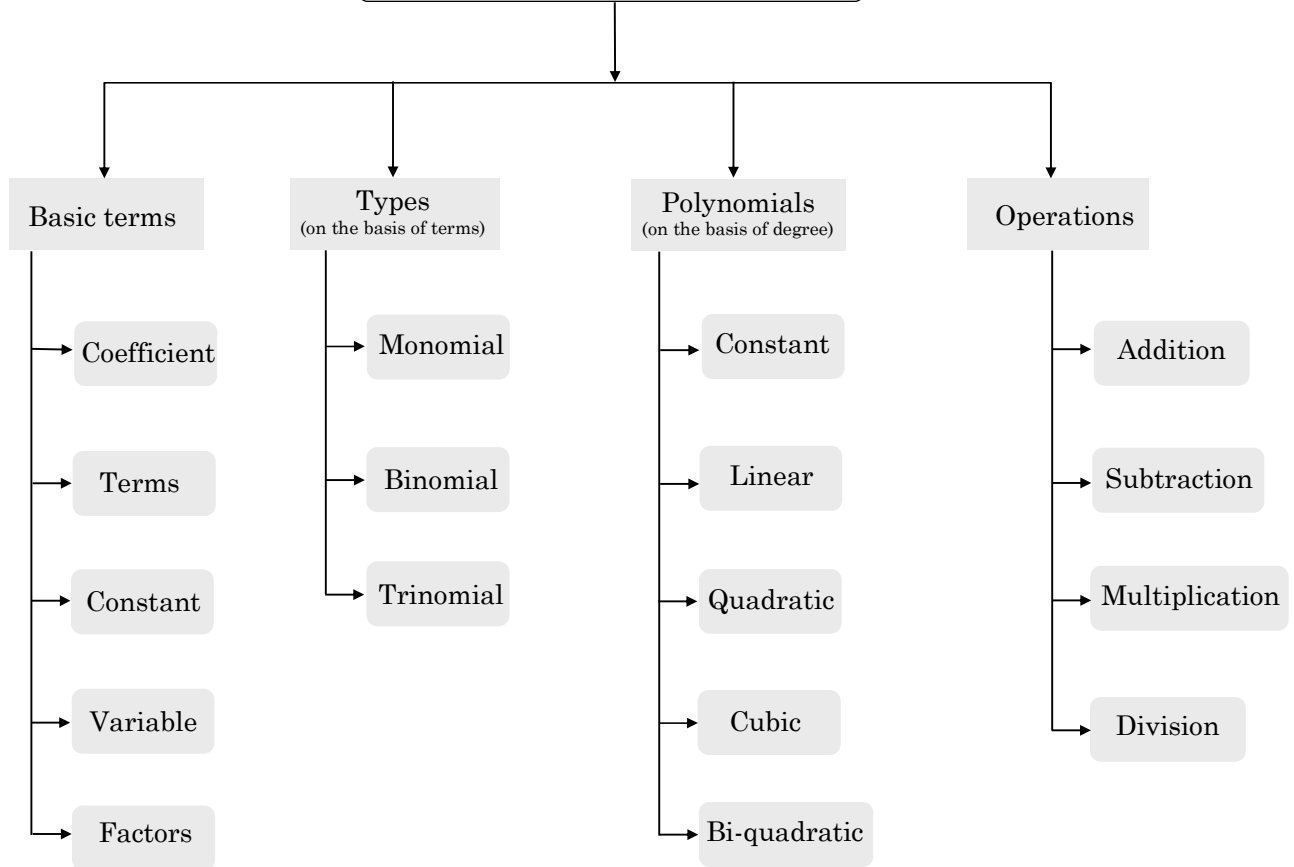
A number or group of numbers with an operation symbol (+, -, ×, ÷) and a variable

Example:)

$$4p-2$$

MIND MAP

ALGEBRAIC EXPRESSIONS



ALGEBRAIC EXPRESSIONS

Constant & Variable

Ñ **Constant** : A symbol having a fixed numerical value is called a constant.

Ñ **Variable** : A symbol which takes various numerical values is called a variable.

e.g. We know that the perimeter P of a square of side s is given by $P = 4 \times s$. Here, 4 is a constant and P and s are variables.

e.g. The perimeter P of a rectangle of sides l and b is given by $P = 2(l + b)$. Here, 2 is a constant and l and b are variables.

Algebraic Expressions

A combination of constants and variables connected by the signs of fundamental operation of addition, subtraction, multiplication and division is called an algebraic expression.

Ñ **Terms** : Various parts of an algebraic expression which are separated by the signs of $+$ or $-$ are called the 'terms' of the expression.

e.g. (i) $2x^2 - 3xy + 5y^2$ is an algebraic expression consisting of three terms, namely, $2x^2$, $-3xy$ and $5y^2$.

(ii) The expression $2x^3 - 3x^2 + 4x - 7$ is an algebraic expression consisting of four terms, namely, $2x^3$, $-3x^2$, $4x$ and -7 .

Ñ **Monomial** : An algebraic expression containing only one term is called a monomial.

e.g. $-5, 3y, 7xy, \frac{2}{3}x^2yz, \frac{5}{3}a^2bc^3$ etc. are all monomials.

Ñ **Binomial** : An algebraic expression containing two terms is called a binomial.

e.g. The expression $2x - 3, 3x + 2y, xyz - 5$ etc. are all binomials.

Ñ **Trinomial** : An algebraic expression containing three terms is called a trinomial.

e.g. The expressions $a - b + 2, x^2 + y^2 - xy, x^3 - 2y^3 - 3x^2y^2z$ etc. are trinomial.

Ñ **Multinomial** : An algebraic expression having two or more terms is called a multinomial.

Ñ **Factors** : Each terms in an algebraic expression is a product of one or more number(s) and / or literal(s). These number(s) and literal(s) are known as the factors of that terms.

A constant factor is called a numerical factor, while a variable factor is known as a literal factor.

Ñ **Coefficient** : In a term of an algebraic expression any of the factors with the sign of the term is called the coefficient of the other factors.

e.g. (i) In $-5xy$, the coefficient of x is $-5y$; the coefficient of y is $-5x$ and the coefficient of xy is -5 .

(ii) In $-x$, the coefficient of x is -1 .

Ñ **Constant Term** : A term of the expression having no literal factor is called a constant term.

e.g. In the algebraic expression $x^2 - xy + yz - 4$, the constant term is -4 .

Ñ **Like and Unlike Terms** : The terms having the same literal factors are called like or similar terms, otherwise they are called unlike terms.

e.g. In the algebraic expression $2a^2b + 3ab^2 - 7ab - 4ba^2$, we have $2a^2b$ and $-4ba^2$ as like terms, whereas $3ab^2$ and $-7ab$ are unlike terms.

Note : An algebraic expression in x is said to be in **standard form** when the terms are written either in increasing order or decreasing order of the powers of x in various terms.

For addition of two algebraic expression, first we arrange both the algebraic expression in standard form and then we add the coefficients of like powers of variable.

Ex.1 Add : $7x^2 - 4x + 5$, $-3x^2 + 2x - 1$ and $5x^2 - x + 9$.

Sol. We have, Required sum

$$\begin{aligned} &= (7x^2 - 4x + 5) + (-3x^2 + 2x - 1) + (5x^2 - x + 9) \\ &= 7x^2 - 3x^2 + 5x^2 - 4x + 2x - x + 5 - 1 + 9 && \text{[Collecting like terms]} \\ &= (7 - 3 + 5)x^2 + (-4 + 2 - 1)x + (5 - 1 + 9) && \text{[Adding like terms]} \\ &= 9x^2 - 3x + 13 \end{aligned}$$

Ex.2 Add : $5x^2 - \frac{1}{3}x + \frac{5}{2}$, $-\frac{1}{2}x^2 + \frac{1}{2}x - \frac{1}{3}$ and $-2x^2 + \frac{1}{5}x - \frac{1}{6}$.

Sol. Required sum

$$\begin{aligned} &= \left(5x^2 - \frac{1}{3}x + \frac{5}{2}\right) + \left(-\frac{1}{2}x^2 + \frac{1}{2}x - \frac{1}{3}\right) + \left(-2x^2 + \frac{1}{5}x - \frac{1}{6}\right) \\ &= 5x^2 - \frac{1}{2}x^2 - 2x^2 - \frac{1}{3}x + \frac{1}{2}x + \frac{1}{5}x + \frac{5}{2} - \frac{1}{3} - \frac{1}{6} && \text{[Collecting like terms]} \\ &= \left(5 - \frac{1}{2} - 2\right)x^2 + \left(-\frac{1}{3} + \frac{1}{2} + \frac{1}{5}\right)x + \left(\frac{5}{2} - \frac{1}{3} - \frac{1}{6}\right) && \text{[Adding like term]} \\ &= \left(\frac{10-1-4}{2}\right)x^2 + \left(\frac{-10+15+6}{30}\right)x + \left(\frac{15-2-1}{6}\right) = \frac{5}{2}x^2 + \frac{11}{30}x + 2 \end{aligned}$$

Ex.3 Find the sum of $f(x)$ & $g(x)$ where, $f(x) = 4x^5 + 3x^3 + 4x^2 + x + 1$ & $g(x) = 5x^4 + x^5 + x^3 + 3$.

Sol. Arrange in standard form

$$f(x) = 4x^5 + 3x^3 + 4x^2 + x + 1$$

$$\text{or } f(x) = 4x^5 + 0.x^4 + 3x^3 + 4x^2 + x + 1$$

$$\text{and } g(x) = x^5 + 5x^4 + x^3 + 3$$

$$\text{or } g(x) = x^5 + 5x^4 + x^3 + 0.x^2 + 0.x + 3$$

$$f(x) + g(x) = (4x^5 + 0.x^4 + 3x^3 + 4x^2 + x + 1) + (x^5 + 5x^4 + x^3 + 0.x^2 + 0.x + 3)$$

$$f(x) + g(x) = (4 + 1)x^5 + (0 + 5)x^4 + (3 + 1)x^3 + (4 + 0)x^2 + (1 + 0)x + (1 + 3)$$

$$= (5x^5 + 5x^4 + 4x^3 + 4x^2 + x + 4).$$

Ex.4 Subtract $g(x)$ from $f(x)$ where $f(x) = 2 + x^2 + 4x^3$, $g(x) = x^4 + x^2 + 3x + 5$.

Sol. $f(x) = 4x^3 + x^2 + 0.x + 2 = 0.x^4 + 4x^3 + x^2 + 0.x + 2$

$$g(x) = x^4 + 0.x^3 + x^2 + 3x + 5$$

$$f(x) - g(x) = (0.x^4 + 4x^3 + x^2 + 0.x + 2) - (x^4 + 0x^3 + x^2 + 3x + 5)$$

$$f(x) - g(x) = (0 - 1)x^4 + (4 - 0)x^3 + (1 - 1)x^2 + (0 - 3)x + (2 - 5)$$

$$= -x^4 + 4x^3 + 0.x^2 - 3x - 3$$

$$= -x^4 + 4x^3 - 3x - 3.$$

Ex.5 Subtract $h(x)$ from the sum of $f(x)$ & $g(x)$ where $f(x) = x^3 + x^2 + x + 1$, $g(x) = 2x^3 - 3x^2 + 1$,
 $h(x) = 3x^2 - 4x^3 + 5x + 7$.

Sol. $f(x) = x^3 + x^2 + x + 1$; $g(x) = 2x^3 - 3x^2 + 0.x + 1$

$$h(x) = -4x^3 + 3x^2 + 5x + 7$$

$$f(x) + g(x) - h(x) = (x^3 + x^2 + x + 1) + (2x^3 - 3x^2 + 0.x + 1) - (-4x^3 + 3x^2 + 5x + 7)$$

$$f(x) + g(x) - h(x) = (1 + 2 + 4) x^3 + (1 - 3 - 3) x^2 + (1 + 0 - 5) x + (1 + 1 - 7) = 7x^3 - 5x^2 - 4x - 5$$

Multiplication of Algebraic Expressions

◆ Multiplication Of Algebraic Expressions

(i) The product of two factors with like signs is positive and the product of two factors with unlike signs is negative

i.e., (a) $(+) \times (+) = +$

(b) $(+) \times (-) = -$

(c) $(-) \times (+) = -$

and, (d) $(-) \times (-) = +$

(ii) If a is any variable and m, n are positive integers, then

$$a^m \times a^n = a^{m+n}$$

For example , $a^3 \times a^5 = a^{3+5} = a^8$,

$$y^4 \times y = y^{4+1} = y^5 \text{ etc.}$$

◆ Multiplication of monomial by monomial

Ex.6 Find the product of the following pairs of polynomials :

(i) $4, 7x$

(ii) $-4a, 7a$

(iii) $-4x, 7xy$

(iv) $4x^3, -3xy$

(v) $4x, 0$

Sol. We have,

(i) $4 \times 7x = (4 \times 7) \times x = 28 \times x = 28x$

(ii) $(-4a) \times (7a) = (-4 \times 7) \times (a \times a) = -28a^2$

(iii) $(-4x) \times (7xy) = (-4 \times 7) \times (x \times xy) = -28x^{1+1}y = -28x^2y$

(iv) $(4x^3) \times (-3xy) = (4 \times -3) \times (x^3 \times xy) = -12(x^{3+1}y) = -12x^4y$

(v) $4x \times 0 = (4 \times 0) \times x = 0 \times x = 0$

Ex.7 Multiply each of the following monomials :

(i) $3xyz, 5x, 0$

(ii) $\frac{6}{5}ab, \frac{5}{6}bc, \frac{12}{9}abc$

(iii) $\frac{3}{4}x^2yz^2, 0.5xy^2z^2, 1.16x^2yz^3, 2xyz$

(iv) $20x^{10}y^{20}z^{30}, (10xyz)^2$

(v) $(-3x^2y), (4xy^2z), (-xy^2z^2)$ and $\left(\frac{4}{5}z\right)$

Sol. (i) We have,

$$(3xyz) \times (5x) \times 0$$

$$= (3 \times 5 \times 0) \times (x \times x \times y \times z) = 0 \times x^2yz = 0$$

(ii) We have,

$$\begin{aligned} & \left(\frac{6}{5}ab\right) \times \left(\frac{5}{6}bc\right) \times \left(\frac{12}{9}abc\right) \\ & \left(\frac{6}{5} \times \frac{5}{6} \times \frac{12}{9}\right) \times (a \times a \times b \times b \times b \times c \times c) \\ & = \frac{12}{9} a^{(1+1)}b^{(1+1+1)}c^{(1+1)} = \frac{4}{3} a^2b^3c^2 \end{aligned}$$

(iii) We have,

$$\begin{aligned} & \left(\frac{3}{4}x^2yz^2\right) \times (0.5xy^2z^2) \times (1.16x^2yz^3) \times (2xyz) \\ & = \left(\frac{3}{4} \times 0.5 \times 1.16 \times 2\right) \times (x^2 \times x \times x \times x \times \\ & \quad y \times y^2 \times y \times y \times z^2 \times z^2 \times z^3 \times z) \\ & = \left(\frac{3}{4} \times \frac{5}{10} \times \frac{116}{100} \times 2\right) \times [x^{(2+1+2+1)} \times y^{(1+2+1+1)} \times z^{(2+2+3+1)}] \\ & = \frac{87}{100} x^6y^5z^8 \end{aligned}$$

(iv) We have,

$$\begin{aligned} & (20x^{10}y^{20}z^{30}) \times (10xyz)^2 \\ & = (20x^{10}y^{20}z^{30}) \times (10xyz) \times (10xyz) \\ & = (20 \times 10 \times 10) \times (x^{10} \times x \times x \times y^{20} \times y \times y \times z^{30} \times z \times z) \\ & = 2000x^{(10+1+1)}y^{(20+1+1)}z^{(30+1+1)} \\ & = 2000x^{12}y^{22}z^{32} \end{aligned}$$

(v) We have,

$$\begin{aligned} & (-3x^2y) \times (4xy^2z) \times (-xy^2z^2) \times \left(\frac{4}{5}z\right) \\ & = \left(-3 \times 4 \times -1 \times \frac{4}{5}\right) \times (x^2 \times x \times x \times y \times y^2 \times y^2 \times z \times z^2 \times z) \\ & = \frac{48}{5} x^{(2+1+1)}y^{(1+2+2)}z^{(1+2+1)} = \frac{48}{5} x^4y^5z^4 \end{aligned}$$

Ex.8 Find the value of $(5a^6) \times (-10ab^2) \times (-2.1a^2b^3)$ for $a = 1$ and $b = \frac{1}{2}$

Sol. We have, $(5a^6) \times (-10ab^2) \times (-2.1a^2b^3)$

$$\begin{aligned} & = (5 \times -10 \times -2.1) \times (a^6 \times a \times a^2 \times b^2 \times b^3) \\ & = \left(5 \times -10 \times -\frac{21}{10}\right) \times (a^6 \times a \times a^2 \times b^2 \times b^3) \\ & = 105 a^{6+1+2}b^{2+3} = 105a^9b^5 \end{aligned}$$

Putting $a = 1$ and $b = \frac{1}{2}$, we have

$$105a^9b^5 = 105 \times (1)^9 \times \left(\frac{1}{2}\right)^5 = 105 \times 1 \times \frac{1}{32} = \frac{105}{32}$$

◆ Multiplication of a Monomial & a Binomial

Ex.9 Multiply : $2x$ by $(3x + 5y)$

Sol. We have, $2x \times (3x + 5y) = 2x \times 3x + 2x \times 5y = 6x^2 + 10xy$

Ex.10 Multiply : $(7xy + 5y)$ by $3xy$

Sol. We have, $(7xy + 5y) \times 3xy = 7xy \times 3xy + 5y \times 3xy$
 $= 21x^{1+1}y^{1+1} + 15xy^{1+1} = 21x^2y^2 + 15xy^2$

Ex.11 Multiply : $-\frac{3ab^2}{5}$ by $\left(\frac{2a}{3} - b\right)$

Sol. We have, $\left(-\frac{3ab^2}{5}\right) \times \left(\frac{2a}{3} - b\right) = \left(-\frac{3ab^2}{5}\right) \times \frac{2a}{3} - \left(-\frac{3ab^2}{5}\right) \times b$
 $= -\frac{3}{5} \times \frac{2}{3} a^{1+1}b^2 + \frac{3}{5} ab^{2+1} = -\frac{2}{5} a^2b^2 + \frac{3}{5} ab^3$

Ex.12 Multiply : $\left(3x - \frac{4}{5}y^2x\right)$ by $\frac{1}{2}xy$.

Sol. Horizontal method

We have, $\left(3x - \frac{4}{5}y^2x\right) \times \frac{1}{2}xy = 3x \times \frac{1}{2}xy - \frac{4}{5}y^2x \times \frac{1}{2}xy$
 $= \left(3 \times \frac{1}{2}\right) \times x \times x \times y - \left(\frac{4}{5} \times \frac{1}{2}\right) \times y^2 \times y \times x \times x$
 $= \frac{3}{2}x^2y - \frac{2}{5}y^3x^2 = \frac{3}{2}x^2y - \frac{2}{5}x^2y^3$

Ex.13 Simplify the expression and evaluate them as directed :

(i) $x(x - 3) + 2$ for $x = 1$

(ii) $3y(2y - 7) - 3(y - 4) - 63$ for $y = -2$

Sol. (i) We have, $x(x - 3) + 2 = x^2 - 3x + 2$

For $x = 1$, we have

$$\begin{aligned} x^2 - 3x + 2 &= (1)^2 - 3 \times 1 + 2 = 1 - 3 + 2 \\ &= 3 - 3 = 0 \end{aligned}$$

(ii) We have, $3y(2y - 7) - 3(y - 4) - 63$

$$\begin{aligned} &= (6y^2 - 21y) - (3y - 12) - 63 \\ &= 6y^2 - 21y - 3y + 12 - 63 \\ &= 6y^2 - 24y - 51 \end{aligned}$$

For $y = -2$, we have

$$\begin{aligned} 6y^2 - 24y - 51 &= 6 \times (-2)^2 - 24(-2) - 51 \\ &= 6 \times 4 + 24 \times 2 - 51 = 24 + 48 - 51 \\ &= 72 - 51 = 21 \end{aligned}$$

Ex.14 Simplify each of the following expressions :

- (i) $15a^2 - 6a(a - 2) + a(3 + 7a)$
 (ii) $x^2(1 - 3y^2) + x(xy^2 - 2x) - 3y(y - 4x^2y)$
 (iii) $4st(s - t) - 6s^2(t - t^2) - 3t^2(2s^2 - s) + 2st(s - t)$

Sol. (i) We have, $15a^2 - 6a(a - 2) + a(3 + 7a)$
 $= 15a^2 - 6a^2 + 12a + 3a + 7a^2$
 $= 15a^2 - 6a^2 + 7a^2 + 12a + 3a = 16a^2 + 15a$

(ii) We have, $x^2(1 - 3y^2) + x(xy^2 - 2x) - 3y(y - 4x^2y)$
 $= x^2 \times 1 - 3y^2 \times x^2 + x \times xy^2 - x \times 2x - 3y \times y + 3y \times 4x^2y$
 $= x^2 - 3x^2y^2 + x^2y^2 - 2x^2 - 3y^2 + 12x^2y^2$
 $= (x^2 - 2x^2) + (-3x^2y^2 + x^2y^2 + 12x^2y^2) - 3y^2$
 $= -x^2 + 10x^2y^2 - 3y^2$

(iii) $4st(s - t) - 6s^2(t - t^2) - 3t^2(2s^2 - s) + 2st(s - t)$
 $= 4st \times s - 4st \times t - 6s^2 \times t + 6s^2 \times t^2 - 3t^2 \times 2s^2 + 3t^2 \times s + 2st \times s - 2st \times t$
 $= 4s^2t - 4st^2 - 6s^2t + 6s^2t^2 - 6s^2t^2 + 3st^2 + 2s^2t - 2st^2$
 $= (4s^2t - 6s^2t + 2s^2t) + (-4st^2 + 3st^2 - 2st^2) + (6s^2t^2 - 6s^2t^2)$
 $= -3st^2$

◆ Multiplication of Two Binomials

Ex.15 Multiply $(3x + 2y)$ and $(5x + 3y)$.

Sol. We have, $(3x + 2y) \times (5x + 3y)$
 $= 3x \times (5x + 3y) + 2y \times (5x + 3y)$
 $= (3x \times 5x + 3x \times 3y) + (2y \times 5x + 2y \times 3y)$
 $= (15x^2 + 9xy) + (10xy + 6y^2)$
 $= 15x^2 + 9xy + 10xy + 6y^2$
 $= 15x^2 + 19xy + 6y^2$

Ex.16 Multiply $(2x + 3y)$ and $(4x - 5y)$

Sol. We have, $(2x + 3y) \times (4x - 5y)$
 $= 2x \times (4x - 5y) + 3y \times (4x - 5y)$
 $= (2x \times 4x - 2x \times 5y) + (3y \times 4x - 3y \times 5y)$
 $= (8x^2 - 10xy) + (12xy - 15y^2)$
 $= 8x^2 - 10xy + 12xy - 15y^2$
 $= 8x^2 + 2xy - 15y^2$

Ex.17 Multiply $(7a + 3b)$ and $(2a + 3b)$ by column method.

Sol. We have,

$$\begin{array}{r}
 7a + 3b \\
 \times 2a + 3b \\
 \hline
 14a^2 + 6ab \quad \text{Multiplying } 7a + 3b \text{ by } 2a \\
 \quad + 21ab + 9b^2 \quad \text{Multiplying } 7a + 3b \text{ by } 3b \\
 \hline
 14a^2 + 27ab + 9b^2 \quad \text{Adding the like term}
 \end{array}$$

Ex.18 Multiply $(7x - 3y)$ by $(4x - 5y)$ by column method.

Sol. We have,

$$\begin{array}{r}
 7x - 3y \\
 \times 4x - 5y \\
 \hline
 28x^2 - 12xy \qquad \text{Multiplying } 7x - 3y \text{ by } 4x \\
 \underline{- 35xy + 15y^2} \qquad \text{Multiplying } 7x - 3y \text{ by } -5y \\
 28x^2 - 47xy + 15y^2 \qquad \text{Adding the like terms}
 \end{array}$$

Ex.19 Simplify the following :

(i) $(2x + 5)(3x - 2) + (x + 2)(2x - 3)$

(ii) $(3x + 2)(2x + 3) - (4x - 3)(2x - 1)$

(iii) $(2x + 3y)(3x + 4y) - (7x + 3y)(x + 2y)$

Sol. (i) We have, $(2x + 5)(3x - 2) + (x + 2)(2x - 3)$
 $= 2x(3x - 2) + 5(3x - 2) + x(2x - 3) + 2(2x - 3)$
 $= 6x^2 - 4x + 15x - 10 + 2x^2 - 3x + 4x - 6$
 $= (6x^2 + 2x^2) + (-4x + 15x - 3x + 4x) + (-10 - 6)$
 $= 8x^2 + 12x - 16$

(ii) We have, $(3x + 2)(2x + 3) - (4x - 3)(2x - 1)$
 $= \{3x(2x+3) + 2(2x+3)\} - \{4x(2x-1) - 3(2x-1)\}$
 $= (6x^2 + 9x + 4x + 6) - (8x^2 - 4x - 6x + 3)$
 $= (6x^2 + 13x + 6) - (8x^2 - 10x + 3)$
 $= 6x^2 + 13x + 6 - 8x^2 + 10x - 3$
 $= -2x^2 + 23x + 3$

(iii) We have, $(2x + 3y)(3x + 4y) - (7x + 3y)(x + 2y)$
 $= \{2x(3x + 4y) + 3y(3x + 4y) - 7x(x + 2y) + 3y(x + 2y)\}$
 $= (6x^2 + 8xy + 9xy + 12y^2) - (7x^2 + 14xy + 3xy + 6y^2)$
 $= (6x^2 + 17xy + 12y^2) - (7x^2 + 17xy + 6y^2)$
 $= 6x^2 + 17xy + 12y^2 - 7x^2 - 17xy - 6y^2$
 $= 6x^2 - 7x^2 + 17xy - 17xy + 12y^2 - 6y^2 = -x^2 + 6y^2.$

Ex.20 Multiply : $(2x^2 - 3x + 5)$ by $(5x + 2)$.

Sol. Horizontal method: We have, $(2x^2 - 3x + 5) \times (5x + 2)$
 $= (2x^2 - 3x + 5) \times 5x + (2x^2 - 3x + 5) \times 2$
 $= (10x^3 - 15x^2 + 25x) + (4x^2 - 6x + 10)$
 $= 10x^3 - 11x^2 + 19x + 10$

Column Method:

We have,

$$\begin{array}{r}
 2x^2 - 3x + 5 \\
 \times \quad 5x + 2 \\
 \hline
 10x^3 - 15x^2 + 25x \qquad \text{Multiplying } 2x^2 - 3x + 5 \text{ by } 5x \\
 \underline{\quad + 4x^2 - 6x + 10} \qquad \text{Multiplying } 2x^2 - 3x + 5 \text{ by } 2 \\
 10x^3 - 11x^2 + 19x + 10 \qquad \text{Adding the like terms}
 \end{array}$$

Ex.21 Simplify :

(i) $(3x - 2)(x - 1)(3x + 5)$

(ii) $(5 - x)(3 - 2x)(4 - 3x)$

Sol.

(i) We have, $(3x - 2)(x - 1)(3x + 5)$

$$= \{(3x - 2)(x - 1)\} \times (3x + 5) \quad [\text{By Associativity of Multiplication}]$$

$$= \{3x(x - 1) - 2(x - 1)\} \times (3x + 5)$$

$$= (3x^2 - 3x - 2x + 2) \times (3x + 5)$$

$$= (3x^2 - 5x + 2) \times (3x + 5)$$

$$= 3x^2 \times (3x + 5) - 5x(3x + 5) + 2 \times (3x + 5)$$

$$= (9x^3 + 15x^2) + (-15x^2 - 25x) + (6x + 10)$$

$$= 9x^3 + 15x^2 - 15x^2 - 25x + 6x + 10 = 9x^3 - 19x + 10$$

(ii) We have, $(5 - x)(3 - 2x)(4 - 3x)$

$$= \{(5 - x)(3 - 2x)\} \times (4 - 3x)$$

$$= \{5(3 - 2x) - x(3 - 2x)\} \times (4 - 3x)$$

$$= (15 - 10x - 3x + 2x^2) \times (4 - 3x)$$

$$= (2x^2 - 13x + 15) \times (4 - 3x)$$

$$= 2x^2 \times (4 - 3x) - 13x \times (4 - 3x) + 15 \times (4 - 3x)$$

$$= 8x^2 - 6x^3 - 52x + 39x^2 + 60 - 45x$$

$$= -6x^3 + 47x^2 - 97x + 60$$

Polynomials

1 ¶1 **Polynomials** : An algebraic expression in which the variables involved have only non-negative integer powers, is called a polynomial.

1 ¶1 **Degree of a polynomial in one variable**: In a polynomial in one variable, the highest power of the variable is called degree.

1 ¶1 **Degree of a polynomial in two variable**: In a polynomial in more than one variable the sum of the powers of the variables in each term is computed and the highest sum so obtained is called the degree of the polynomial.

1 ¶1 **Constant Polynomial** : A polynomial consisting of a constant term only is called a constant polynomial. The degree of a constant polynomial is zero.

1 ¶1 **Linear Polynomial** : A polynomial of degree 1 is called a linear polynomial.

1 ¶1 **Quadratic Polynomial** : A polynomial of degree 2 is called a quadratic polynomial.

1 ¶1 **Cubic Polynomial** : A polynomial of degree 3 is called a cubic polynomial.

1 ¶1 **Biquadratic Polynomials** : A polynomial of degree 4 is called a biquadratic polynomial.

e.g. : $\frac{2}{3}x^2 - \frac{3}{2}x^2 + x - 5$ is a polynomial in variable x whereas $\frac{1}{2}x^3 - 3x^2 + 5x^{1/2} + x - 1$ is not a polynomial, because it contains a term $5x^{1/2}$ which contains $\frac{1}{2}$ as the power of variable x , which is not a non-negative integer.

e.g. : $3 - 2x^2 + 4x^2y + 8y - \frac{5}{3}xy^2$ is a polynomial in two variables x and y .

e.g. : (i) $2x + 3$ is a polynomial in x of degree 1.

(ii) $2x^2 - 3x + \frac{7}{5}$ is polynomial in x of degree 2.

(iii) $\frac{2}{3}a^2 - \frac{7}{2}a^2 + 4$ is a polynomial in a of degree 2.

e.g. : $3x^4 - 2x^3y^2 + 7xy^3 - 9x + 5y + 4$ is a polynomial in x and y of degree 5,

whereas $\frac{1}{2} - 3x + 7x^2y - \frac{3}{4}x^2y^2$ is a polynomial of degree 4 in x and y .

e.g. : $2 - \frac{3}{4}x, \frac{1}{2} + \frac{3}{5}y,$

$2 + 3a$ etc. are linear polynomials.

e.g. : $2x^2 - 3x + 4, 2 - x + x^2,$

$2y^2 - \frac{3}{2}y + \frac{1}{4}$ are quadratic polynomials.

e.g. : $x^3 - 7x + 2x - 3,$

$2 + \frac{1}{2}y - \frac{3}{2}y^2 + 4y^3$ are cubic polynomials.

e.g. : $3x^4 - 7x^3 + x^2 - x + 9,$

$4 - \frac{2}{3}x^2 + \frac{3}{5}x^4$ are biquadratic polynomials.

Division of Algebraic Expression

◆ Division of a monomial by a monomial

While dividing a monomial by a monomial, we follow the following two rules:

Rule-1 : Coefficient of the quotient of two monomial is equal to the quotient of their coefficients.

Rule-2 : The variable part in the quotient of two monomials is equal to the quotient of the variables in the given monomials.

Ex.22 Divide : (i) $12x^3y^2$ by $3x^2y$ (ii) $-15a^2bc^3$ by $3ab$

Sol. (i) We have,

$$\frac{12x^3y^2}{3x^2y} = \frac{12 \times x \times x \times x \times y \times y}{3 \times x \times x \times y} = 4 \times x \times y = 4xy$$

(ii) We have,

$$\frac{-15a^2bc^3}{3ab} = \frac{-15 \times a \times a \times b \times c \times c \times c}{3 \times a \times b} = -5ac^3$$

◆ Division of a Polynomial by a Monomial

Step I : Obtain the polynomial (dividend) and the monomial (divisor).

Step II : Arrange the terms of the dividend in descending order of their degrees. For example, write

$$7x^2 + 4x - 3 + 5x^3 \text{ as } 5x^3 + 7x^2 + 4x - 3.$$

Step III: Divided each term of the polynomial by the given monomial by using the rules of division of a monomial by a monomial.

Ex.23 Divide : (i) $9m^5 + 12m^4 - 6m^2$ by $3m^2$ (ii) $24x^3y + 20x^2y^2 - 4xy$ by $2xy$

Sol. (i) We have,
$$\frac{9m^5 + 12m^4 - 6m^2}{3m^2} = \frac{9m^5}{3m^2} + \frac{12m^4}{3m^2} - \frac{6m^2}{3m^2} = 3m^3 + 4m^2 - 2$$

(ii) We have,
$$\frac{24x^3y + 20x^2y^2 - 4xy}{2xy} = \frac{24x^3y}{2xy} + \frac{20x^2y^2}{2xy} - \frac{4xy}{2xy} = 12x^2 + 10xy - 2$$

◆ **Division of a Polynomial by a Binomial by using long division**

Step I : Arrange the terms of the dividend and divisor in descending order of their degrees.

Step II : Divide the first term of the dividend by the first term of the divisor to obtain the first term of the quotient.

Step III : Multiply the divisor by the first term of the quotient and subtract the result from the dividend to obtain the remainder.

Step IV : Consider the remainder (if any) as dividend and repeat step II to obtain the second term of the quotient.

Step V : Repeat the above process till we obtain a remainder which is either zero or a polynomial of degree less than that of the divisor.

Ex.24 Divide $6 + x - 4x^2 + x^3$ by $x - 3$.

Sol. We go through the following steps to perform the division:

Step I : We write the terms of the dividend as well as of divisor in descending order of their degrees. Thus, we write

$$= 6 + x - 4x^2 + x^3 \text{ as } x^3 - 4x^2 + x + 6 \text{ and } x - 3 \text{ as } x - 3$$

Step II : We divide the first term x^3 of the dividend by the first term x of the divisor and obtain $\frac{x^3}{x} = x^2$ as the first term of the quotient.

Step III : We multiply the divisor $x - 3$ by the first term x of the quotient and subtract the result from the dividend $x^3 - 4x^2 + x + 6$. We obtain $-x^2 + x + 6$ as the remainder.

$$\begin{array}{r}
 x^2 - x - 2 \\
 x - 3 \overline{) \begin{array}{l} x^3 - 4x^2 + x + 6 \\ x^3 - 3x^2 \\ \hline -x^2 + x + 6 \\ -x^2 + 3x \\ \hline + - \\ -2x + 6 \\ -2x + 6 \\ \hline + - \\ 0 \end{array} }
 \end{array}$$

Step IV : We take $-x^2 + x + 6$ as the new dividend and repeat step II to obtain the second term $\left(\frac{x^2}{x} = x\right) - x$ of the quotient.

Step V : We multiply the divisor $x - 3$ by the second term $-x$ of the quotient and subtract the result $-x^2 + 3x$ from the new dividend. We obtain $-2x + 6$ as the remainder.

Step VI : Now we treat $-2x + 6$ as the new dividend and divide its first term $-2x$ by the first term x of the divisor to obtain $\frac{-2x}{x} = -2$ as the third term of the quotient.

Step VII : We multiply the divisor $x - 3$ and the third term -2 of the quotient and subtract the result $-2x + 6$ from the new dividend. We obtain 0 as the remainder.

Thus, we can say that

$$(6 + x - 4x^2 + x^3) \div (x - 3) = x^2 - x - 2$$

$$\text{or, } \frac{6 + x - 4x^2 + x^3}{x - 3} = x^2 - x - 2$$

Note : In the above example, the remainder is zero. So, we can say that $(x - 3)$ is a factor of $6 + x - 4x^2 + x^3$.

Ex.25 Divide : $x^3 - 6x^2 + 11x - 6$ by $x^2 - 4x + 3$

Sol. On dividing, we get

$$\begin{array}{r} x^2 - 4x + 3 \overline{) x^3 - 6x^2 + 11x - 6} \\ \underline{x^3 - 4x^2 + 3x} \\ -2x^2 + 8x - 6 \\ \underline{-2x^2 + 8x - 6} \\ + + \\ 0 \end{array}$$

$$\therefore x^3 - 6x^2 + 11x - 6 = (x - 2)(x^2 - 4x + 3)$$

Ex.26 Using division show that $3y^2 + 5$ is factor of $6y^5 + 15y^4 + 16y^3 + 4y^2 + 10y - 35$.

Sol. On dividing $6y^5 + 15y^4 + 16y^3 + 4y^2 + 10y - 35$ by $3y^2 + 5$, we obtain

$$\begin{array}{r} 2y^3 + 5y^2 + 2y - 7 \\ 3y^2 + 5 \overline{) 6y^5 + 15y^4 + 16y^3 + 4y^2 + 10y - 35} \\ \underline{6y^5 + 10y^3} \\ 15y^4 + 6y^3 + 4y^2 + 10y - 35 \\ \underline{15y^4 + 25y^2} \\ 6y^3 - 21y^2 + 10y - 35 \\ \underline{6y^3 + 10y} \\ -21y^2 - 35 \\ \underline{-21y^2 - 35} \\ + + \\ 0 \end{array}$$

Since the remainder is zero. Therefore, $3y^2 + 5$ is a factor of $6y^5 + 15y^4 + 16y^3 + 4y^2 + 10y - 35$.

◆ **Division Algorithm:**

If a polynomial is divided by another polynomial, then

$$\text{Dividend} = \text{Divisor} \times \text{Quotient} + \text{Remainder}$$

This is generally known as the division algorithm.

Ex.27 What must be subtracted from $8x^4 + 14x^3 - 2x^2 + 7x - 8$ so that the resulting polynomial is exactly divisible by $4x^2 + 3x - 2$.

Sol. We know that

$$\text{Dividend} = \text{Quotient} \times \text{Divisor} + \text{Remainder}$$

$$\Rightarrow \text{Dividend} - \text{Remainder} = \text{Quotient} \times \text{Divisor}$$

Clearly, R.H.S of the above result is divisible by the divisor. Therefore, L.H.S. is also divisible by the divisor. Thus, if we subtract remainder from the dividend, then it will be exactly divisible by the divisor.

Dividing $8x^4 + 14x^3 - 2x^2 + 7x - 8$ by $4x^2 + 3x - 2$, we get

$$\begin{array}{r}
 2x^2 + 2x - 1 \\
 4x^2 + 3x - 2 \overline{) 8x^4 + 14x^3 - 2x^2 + 7x - 8} \\
 \underline{8x^4 + 6x^3 - 4x^2} \\
 - - + - 2x^2 + 7x - 8 \\
 \underline{8x^3 + 2x^2 + 7x - 8} \\
 8x^3 + 6x^2 - 4x \\
 \underline{- - + } \\
 -4x^2 + 11x - 8 \\
 \underline{-4x^2 - 3x + 2} \\
 + + - - 10 \\
 \hline
 14x - 10
 \end{array}$$

\therefore Quotient = $2x^2 + 2x - 1$ and,

Remainder = $14x - 10$

Thus, if we subtract the remainder $14x - 10$ from $8x^4 + 14x^3 - 2x^2 + 7x - 8$, it will be divisible by $4x^2 + 3x - 2$

Ex.28 Find the values of a and b so that $x^4 + x^3 + 8x^2 + ax + b$ is divisible by $x^2 + 1$.

Sol. If $x^4 + x^3 + 8x^2 + ax + b$ is exactly divisible by $x^2 + 1$, then the remainder should be zero.

On dividing, we get

$$\begin{array}{r}
 x^2 + x + 7 \\
 x^2 + 1 \overline{) x^4 + x^3 + 8x^2 + ax + b} \\
 \underline{x^4 + x^2} \\
 - - - 7x^2 + ax + b \\
 \underline{x^3 + 7x^2 + ax + b} \\
 x^3 + x \\
 \underline{- - } \\
 7x^2 + x(a-1) + b \\
 \underline{7x^2 + 7} \\
 - - \\
 x(a-1) + b - 7
 \end{array}$$

\therefore Quotient = $x^2 + x + 7$ and,

Remainder = $x(a - 1) + b - 7$

Now, Remainder = 0

$$\Rightarrow x(a-1) + (b-7) = 0$$

$$\Rightarrow x(a-1) + (b-7) = 0x + 0$$

$$\Rightarrow a-1 = 0 \text{ and } b-7 = 0 \quad [\text{Comparing coefficients of } x \text{ and constant terms}]$$

$$\Rightarrow a = 1 \text{ and } b = 7$$

Ex.29 Divide $x^4 - x^3 + x^2 + 5$ by $(x + 1)$ and write the quotient and remainder.

Sol. We have, $x^4 - x^3 + x^2 + 5 = x^3(x+1) - 2x^2(x+1) + 3x(x+1) - 3(x+1) + 8$
 $= (x+1)(x^3 - 2x^2 + 3x - 3) + 8$

Hence, Quotient = $x^3 - 2x^2 + 3x - 3$ and, Remainder = 8.

Ex.30 Divide $12x^3 - 8x^2 - 6x + 10$ by $(3x - 2)$. Also, write the quotient and the remainder.

Sol. We have, $12x^3 - 8x^2 - 6x + 10 = 4x^2(3x-2) - 2(3x-2) + 6$
 $= \{4x^2(3x-2) - 2(3x-2)\} + 6$
 $= (3x-2)(4x^2-2) + 6$

Hence, Quotient = $4x^2 - 2$ and, Remainder = 6.

COMPETITIVE LEVEL

Remainder Theorem

Remainder Theorem : Let $p(x)$ be any polynomial of degree greater than or equal to one and let a be any real number. If $p(x)$ is divided by the linear polynomial $x - a$, then the remainder is $p(a)$.

Ex.31 Find the remainder when $x^4 + x^3 - 2x^2 + x + 1$ is divided by $x - 1$.

Sol. Here, $p(x) = x^4 + x^3 - 2x^2 + x + 1$, and the zero of $x - 1$ is 1.

$$\text{So, } p(1) = (1)^4 + (1)^3 - 2(1)^2 + 1 + 1 = 2$$

So, by the Remainder Theorem, 2 is the remainder when $x^4 + x^3 - 2x^2 + x + 1$ is divided by $x - 1$.

Factor Theorem

If $p(x)$ is a polynomial of degree $n \geq 1$ and a is any real number, then (i) $x - a$ is a factor of $p(x)$, if $p(a) = 0$, and (ii) $p(a) = 0$, if $x - a$ is a factor of $p(x)$.

Ex.32 Examine whether $x + 2$ is a factor of $x^3 + 3x^2 + 5x + 6$ and of $2x + 4$.

Sol. The zero of $x + 2$ is -2 . Let $p(x) = x^3 + 3x^2 + 5x + 6$ and $s(x) = 2x + 4$

$$\text{Then, } p(-2) = (-2)^3 + 3(-2)^2 + 5(-2) + 6 \\ = -8 + 12 - 10 + 6 = 0$$

So, by the Factor Theorem, $x + 2$ is a factor of $x^3 + 3x^2 + 5x + 6$.

$$\text{Again, } s(-2) = 2(-2) + 4 = 0$$

So, $x + 2$ is a factor of $2x + 4$.

Note : $(x - a)(x - b)$ is a factor of a polynomial $p(x)$ if $p(a) = 0$ and $p(b) = 0$.

EXERCISE-1

Very Short Answer Type Questions

Q.1 Find each of the following products:

(i) $(-2x^2) \times (7a^2x^7) \times (6a^5x^5)$

(ii) $(4s^2t) \times (3s^3t^3) \times (2st^4) \times (-2)$

Q.2 Add:

(i) $5m(3 - m)$ and $6m^2 - 13m$

(ii) $4y(3y^2 + 5y - 7)$ and $2(y^3 - 4y^2 + 5)$

Q.3 Add the following algebraic expressions:

$$2, \frac{2y}{3} - \frac{5y^2}{3} + \frac{5y^3}{2}, -\frac{4}{3} + \frac{2y^2}{3} - \frac{y}{2},$$

$$\frac{5y^3}{3} + 3y^2 + 3y + \frac{6}{5}$$

Q.4 Subtract: $\left(-2y^2 + \frac{1}{2}y - 3\right)$ from

$7y^2 - 2y + 10$.

Q.5 Subtract: $\frac{3}{2}x^2y + \frac{4}{5}y - \frac{1}{3}x^2yz$ from

$\frac{12}{5}x^2yz - \frac{3}{5}xyz + \frac{2}{3}x^2y$.

Short Answer Type Questions – Type I

Q.6 (i) Subtract: $3l(l - 4m + 5n)$ from $4l(10n - 3m + 2l)$

(ii) Subtract: $3a(a + b + c) - 2b(a + b + c)$ from $4c(-a + b + c)$

Q.7 Simplify the following:

(i) $\frac{1}{3}(6x^2 + 15y^2)(6x^2 - 15y^2)$

(ii) $9x^4(2x^3 - 5x^4) \times 5x^6(x^4 - 3x^2)$

Q.8 Multiply: $(2x^2 - 4x + 5)$ by $(x^2 + 3x - 7)$

Q.9 Simplify the following products:

(i) $(x^2 + x + 1)(x^2 - x + 1)$

(ii) $(x^2 + 2x + 2)(x^2 - 2x + 2)$

Q.10 Divide:

(i) $6x^4yz - 3xy^3z + 8x^2yz^4$ by $2xyz$

(ii) $\frac{2}{3}a^2b^2c^2 + \frac{4}{3}ab^2c^3 - \frac{1}{5}ab^3c^2$ by $\frac{1}{2}abc$

Short Answer Type Questions – Type II

Q.11 Divide the polynomial

$2x^4 + 8x^3 + 7x^2 + 4x + 3$ by $x + 3$.

Q.12 Divide $10x^4 + 17x^3 - 62x^2 + 30x - 3$ by $2x^2 + 7x - 1$

Q.13 Divide $3y^5 + 6y^4 + 6y^3 + 7y^2 + 8y + 9$ by $3y^3 + 1$ and verify that
Dividend = Divisor \times Quotient + Remainder

Q.14 Show that $(x - 1)$ is the factor of $(x^3 - 1)$.

Q.15 If $(x + 5)$ is a factor of $x^3 + 2x^2 - 14x + k$, then find the value of k .

Long Answer Type Questions

Q.16 Find the remainder when $f(x) = x^3 - 6x^2 + 2x - 4$ is divided by $g(x) = 1 - 2x$.

Q.17 Find the value of K so that $(x - 3)$ is a factor of $3x^2 - 11x + K$.

Q.18 Show that $(x - 2)$ is a factor of $2x^3 + x^2 - 7x - 6$

Q.19 If $x = -2$, $y = 1$ then find the value of $(4y^2 - 9x^2)(16y^4 + 36x^2y^2 + 81x^4)$.

Q.20 Divide $12x^3 - 8x^2 - 6x + 10$ by $(3x - 2)$
Also, write the quotient and the remainder.

➤ **Fill in the Blanks**

- Q.21** (i) The product of two terms with like signs is a _____ term.
(ii) The product of two terms with unlike signs is a _____ term.
(iii) $a(b + c) = \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$.
(iv) Number of terms in the expression $a^2 + bc \times d$ is _____.
(v) The sum of areas of two squares with sides $4a$ and $4b$ is _____.

➤ **True or False**

- Q.22** (i) The numerical coefficient of the term $-6x^2y^2$ is -6 .
(ii) $p^2q + q^2r + r^2q$ is a binomial.
(iii) $abc + bca + cab$ is a monomial.
(iv) Common factor of $11pq^2$, $121p^2q^3$, $1331p^2q$ is $11p^2q^2$.
(v) On dividing $\frac{p}{3}$ by $\frac{3}{p}$, the quotient is 9 .

➤ **Match the Column**

- Q.23** Column II gives the degree of polynomials given in column I match them correctly :

Column I	Column II
(i) $2 - y^2 - y^3 + 2y^8$	(a) 2
(ii) 2	(b) 1
(iii) $5x - \sqrt{7}$	(c) 0
(iv) $4 - x^2$	(d) 8

EXERCISE-2

- Q.1** For what value of a for which the polynomial $(x^4 - x^3 - 11x^2 - x + a)$ is divisible by $x + 3$.
 (A) -12 (B) 12
 (C) 13 (D) -14
- Q.2** What must be added to $\frac{1}{x}$ to make it equal to x ?
 (A) $\frac{x-1}{x+1}$ (B) $\frac{x+1}{x-1}$
 (C) $\frac{x^2+1}{x}$ (D) $\frac{x^2-1}{x}$
- Q.3** The product of a monomial and a binomial is a :
 (A) monomial (B) binomial
 (C) trinomial (D) none of these
- Q.4** In a polynomial, the exponents of the variables are always :
 (A) integers
 (B) positive integers
 (C) non-negative integers
 (D) non-positive integers
- Q.5** The sum of $-7pq$ and $2pq$ is :
 (A) $-9pq$ (B) $9pq$
 (C) $5pq$ (D) $-5pq$
- Q.6** If we subtract $-3x^2y^2$ from x^2y^2 , then we get :
 (A) $-4x^2y^2$ (B) $-2x^2y^2$
 (C) $2x^2y^2$ (D) $4x^2y^2$
- Q.7** The value of $(3x^3 + 9x^2 + 27x) \div 3x$ is :
 (A) $x^2 + 9 + 27x$ (B) $3x^3 + 3x^2 + 27x$
 (C) $3x^3 + 9x^2 + 9$ (D) $x^2 + 3x + 9$
- Q.8** Which of the following is a binomial?
 (A) $7 \times a + a$ (B) $6a^2 + 7b + 2c$
 (C) $4a \times 3b \times 2c$ (D) $6(a^2 + b)$
- Q.9** Sum of $a - b + ab$, $b + c - bc$ and $c - a - ac$ is :
 (A) $2c + ab - ac - bc$
 (B) $2c - ab - ac - bc$
 (C) $2c + ab + ac + bc$
 (D) $2c - ab + ac + bc$
- Q.10** Product of the following monomials $4p$, $-7q^3$, $-7pq$ is :
 (A) $196 p^2q^4$ (B) $196 pq^4$
 (C) $-196 p^2q^4$ (D) $196 p^2q^3$
- Q.11** The value of $25x^3y^2z$ for $x = 1$, $y = 2$ and $z = 3$ is :
 (A) 600 (B) 500
 (C) 300 (D) None of these
- Q.12** If $x = 1$, $y = -2$ then the value of $4xy + 4y^2$ is :
 (A) 8 (B) 16
 (C) 4 (D) None of these
- Q.13** What must be added to $x^2 + 5x - 6$ to $x^3 - x^2 + 3x - 2$?
 (A) $x^3 - 2x^2 - 2x - 4$ (B) $x^3 + 2x^2 - 2x + 4$
 (C) $x^3 - 2x^2 - 2x + 4$ (D) None of these
- Q.14** What must be subtracted from $x^3 - 3x^2 + 5x - 1$ to get $2x^3 + x^2 - 4x + 2$?
 (A) $-x^3 + 4x^2 - 9x + 3$ (B) $x^3 + 4x^2 - 9x + 3$
 (C) $x^3 - 4x^2 + 9x - 3$ (D) $-x^3 - 4x^2 + 9x - 3$
- Q.15** Which of the following is the same as $(x + 3)(2x - 5)$?
 (A) $2x^2 + x + 15$ (B) $-2x^2 + x + 15$
 (C) $2x^2 + x - 15$ (D) $2x^2 - x + 145$
- Q.16** The product of x^2y and x/y is equal to the quotient obtained when x^2 is divided by :
 (A) 0 (B) 1
 (C) x (D) $\frac{1}{x}$

- Q.17** In its simplest form $2x(1 - 3y) - x(y - 3)$ is :
- (A) $7x - 5xy$ (B) $5x - 7xy$
(C) $5x + 7xy$ (D) None of these

- Q.18** The value of $(0.1)x^2 \times 10x^3$ is :
- (A) x^5 (B) x^2
(C) x^3 (D) None of these

- Q.19** The degree of the polynomial $15z^3 + 10y^2z^2 - 7z^2 + 21$ is :
- (A) 3 (B) 4
(C) 2 (D) 5

- Q.20** Which one is not a polynomial :
- (A) $x^2 + 5x + 7$ (B) $9x^3 + \frac{5}{4}x^2 + 4$
(C) $\frac{3}{x} + \frac{5}{x^2}$ (D) $8x^4 - 5x = + 6$

EXERCISE-3

(Previous Year Questions – NSO)

- Q.1** What must be subtracted from $x^4 + 2x^2 - 3x + 7$ to get $x^3 + x^2 + x - 1$?
- (A) $x^4 - x^3 + x^2 - 4x + 8$
(B) $x^3 + x^2 - 4x + 8$
(C) $x^4 - x^3 + x^2 + 4x - 8$
(D) $x^4 - x^3 - x^2 + 4x - 8$

- Q.3** If we divide $15(y + 3)(y^2 - 16)$ by $5(y^2 - y - 12)$ and multiply the result by $3(y + 4)$, we get ____.
- (A) $8y^2 + 15y + 124$ (B) $9y^2 + 72y + 144$
(C) $72y^2 + 9y + 144$ (D) $18y^2 + 4y + 164$

- Q.2** Solve :

$$54 \left[(3a + 8)(9a - 7) + 2 \left(2a + \frac{1}{3a} \right) (4a + 1) - \frac{2a}{3} \left(\frac{1}{a^2} + \frac{165}{2} \right) \right]$$

$$= 31 \left[(5 + 3a) \left(a - \frac{1}{a} \right) + \left(\frac{5}{a} + 2 \right) (1 - 4a) + 3a \right]$$

- (A) $a = 1$ (B) $a = 0$
(C) $a = 2$ (D) $a = -2$

ANSWER KEY

EXERCISE - 1

1. (i) $-84x^{14}a^7$ (ii) $-48s^6t^8$ 2. (i) $2m + m^2$ (ii) $14y^3 + 12y^2 - 28y + 10$
3. $\frac{28}{15} + \frac{19}{6}y + 2y^2 + \frac{25}{6}y^3$ 4. $9y^2 - \frac{5}{2}y + 13$
5. $\frac{41}{15}x^2yz - \frac{5}{6}x^2y - \frac{3}{5}xyz - \frac{4}{5}y$ 6. (i) $25ln + 5l^2$ (ii) $-7ac + 6bc + 4c^2 - 3a^2 - ab + 2b^2$
7. (i) $12x^4 - 75y^4$ (ii) $-225x^{18} + 90x^{17} + 675x^{16} - 270x^{15}$
8. $2x^4 + 2x^3 - 21x^2 + 43x - 35$ 9. (i) $x^4 + x^2 + 1$, (ii) $x^4 + 4$
10. (i) $3x^3 - \frac{3}{2}y^2 + 4xz^3$ (ii) $\frac{4}{3}abc + \frac{8}{3}bc^2 - \frac{2}{5}b^2c$
11. $(x + 3)(2x^3 + 2x^2 + x + 1)$ 12. $(2x^2 + 7x - 1)(5x^2 - 9x + 3)$
13. Quotient $(y^2 + 2y + 2)$ Remainder $(6y^2 + 6y + 7)$ 15. 5
16. $-\frac{35}{8}$ 17. 6 19. -46592 20. Quotient = $4x^2 - 2$, Remainder = 6
21. (i) positive (ii) negative (iii) ab, ac (iv) 2 (v) $16(a^2 + b^2)$
22. (i) True (ii) False (iii) True (iv) False (v) False
23. (i) \rightarrow (d) ; (ii) \rightarrow (c); (iii) \rightarrow (b) ; (iv) \rightarrow (a)

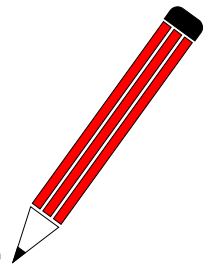
EXERCISE - 2

Ques	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A	B	C	D	D	D	D	A	A	C	A	C	D	C	D	B	A	B	C

EXERCISE - 3

Ques	1	2	3
Ans.	A	A	B

NOTES



NUMBER SERIES

Mental ability is the ability of mind to observe and understand things or patterns in a logical way and reach to a conclusion or judgment based on that logic.

It is the ability to distinguish between important, less important and more important.

Number Series problems deal with numbers. While attempting to solve the question, you have to check the pattern of the series. Series moves with certain mathematical operations like :

- Consecutive odd/even numbers.
- Consecutive prime / composite numbers.
- Squares/cubes of some numbers with/without variation of addition or subtraction of some number.
- Sum/product/difference of preceding number(s) .
- Addition/subtraction/multiplication/division by some number.
- Many more combinations of the relationship given above.

Type of questions asked in the examination:

- Find the missing term(s).
- Find the wrong term(s).

◆ **FIND THE MISSING TERM**

Ex.1 3, 5, 7, 9, 11, 13, 15, 17, ?

- (A) 14 (B) 19
(C) 15 (D) 21

Sol. (B) Each term has a common difference = + 2.
Hence, next term = $17 + 2 = 19$.

Ex.2 11, 15, 21, 29, ?

- (A) 40 (B) 41
(C) 37 (D) 39

Sol. (D) This series consists of increasing numbers.
The pattern is +4, +6, +8,.....

Ex.3 2, 3, 5, 7, 11, ?, 17

- (A) 14 (B) 13
(C) 10 (D) 12

Sol. (B) The series is made up of consecutive prime numbers. Therefore, the missing term is 13.

Ex.4 1, 4, 9, 16, 25, ?

- (A) 35 (B) 36
(C) 37 (D) 49

Sol. (B) Each term is a square of 1, 2, 3, 4 and so on
 $1^2 = 1, 2^2 = 4, 3^2 = 9, 4^2 = 16, 5^2 = 25$.
Hence, next term = $6^2 = 36$.

Ex.5 2, 3, 10, 15, 26, 35, ?

- (A) 48 (B) 51
(C) 49 (D) 50

Sol. (D) The series exhibits the pattern of $n^2 + 1$, $n^2 - 1$, alternately, n taking values 1, 2,

Ex.6 Which is the number that comes next in the sequence : 0, 6, 24, 60, 120, 210 ?

- (A) 240 (B) 290 (C) 336 (D) 504

Sol. (C) Clearly, the given series is

$$1^3 - 1, 2^3 - 2, 3^3 - 3, 4^3 - 4, 5^3 - 5, 6^3 - 6.$$

$$\therefore \text{Next number} = 7^3 - 7 = 343 - 7 = 336$$

Ex.7 1, 8, 9, 64, 25, 216, ?, ?

- (A) 49, 64 (B) 343, 64
(C) 49, 512 (D) 343, 512

Sol. (C) Odd positioned digits are squares of 1, 3, 5 and so on, i.e. $1^2 = 1, 3^2 = 9, 5^2 = 25$ and so on. Similarly, even positioned digits are cubes of 2, 4, 6, etc., i.e. $2^3 = 8, 4^3 = 64, 6^3 = 216$. Therefore, the next term would be 7^2 i.e. 49 and $8^3 = 512$ respectively.

Ex.8 94, 166, 258, ?, 4912

- (A) 3610 (B) 2490
(C) 789 (D) 810

Sol. (A) Each number is in two parts. The first part is square of consecutive number 3, 4, 5,

$$\begin{array}{ccccccccc} (3)^2 & (4)^2 & (5)^2 & (6)^2 & (7)^2 & & & & \\ 9 & 4 & 16 & 6 & 25 & 8 & 36 & 10 & 49 & 12 \\ & & 4 & 6 & 8 & 10 & & & & \end{array}$$

The second part is the sequence of number with difference +2, like 4, 6, 8,

Hence, the required number is 3610.

Ex.9 Which is the number that comes next in the following sequence ?

4, 6, 12, 14, 28, 30, ?

- (A) 32 (B) 60 (C) 62 (D) 64

Sol. (B) The given sequence is a combination of two series

(I) 4, 12, 28, ? and (II) 6, 14, 30.

Now, the pattern followed in each of the above two series is : +8, +16, +32

So, missing number = (28 + 32) = 60

Ex.10 Find out the missing number in the following sequence : 1, 3, 3, 6, 7, 9, ?, 12, 21.

- (A) 10 (B) 11 (C) 12 (D) 13

Sol. (D) Clearly, the given sequence is a combination of two series :

(I) 1, 3, 7, ?, 21 and (II) 3, 6, 9, 12

The pattern followed in I is + 2, + 4, ...; and the pattern followed in II is +3. Thus, missing number = 7 + 6 = 13.

Ex.11 3, 4, 10, 33, 136, ?

- (A) 240 (B) 430
(C) 685 (D) 820

Sol. (C) The terms of the series are, previous term $\times 1 + 1$, previous term $\times 2 + 2$, previous term $\times 3 + 3$ and so on. Hence, the next term will be $136 \times 5 + 5 = 680 + 5 = 685$.

Ex.12 3, 6, 18, 72, 360, ?

- (A) 720 (B) 1080
(C) 1600 (D) 2160

Sol. (D) The sequence in the given series is $\times 2, \times 3, \times 4, \times 5, \times 6$.

Hence, the missing number is $360 \times 6 = 2160$.

Ex.13 Which fraction comes next in the sequence

$$\frac{1}{2}, \frac{3}{4}, \frac{5}{8}, \frac{7}{16}, ?$$

- (A) $\frac{9}{32}$ (B) $\frac{10}{17}$ (C) $\frac{11}{34}$ (D) $\frac{12}{35}$

Sol. (A) Clearly, the numerators of the fractions in the given sequence form the series 1, 3, 5, 7, in which each term is obtained by adding 2 to the previous term. The denominators of the fractions form the series 2, 4, 8, 16,

i.e. $2^1, 2^2, 2^3, 2^4$.

So, the numerator of the next fraction will be (7 + 2) i.e., 9 and the denominator will be 2^5 i.e. 32.

\therefore The next term is $\frac{9}{32}$

Ex.14 20, 19, 17, ?, 10, 5

- (A) 12 (B) 13 (C) 14 (D) 15

Sol. (C) The pattern is -1, -2, ...

\therefore Missing number = $17 - 3 = 14$

Ex.15 1, 9, 17, 33, 49, 73, ?

- (A) 97 (B) 98 (C) 99 (D) 100

Sol. (A) The pattern is +8, +8, +16, +16, +24, ...

\therefore Missing number = $73 + 24 = 97$

◆ FIND THE WRONG TERM

Ex.16 2, 5, 9, 11, 14

- (A) 2 (B) 5 (C) 9 (D) 11

Sol. (C) Series : + 3, + 3, + 3,

The next term is got by adding 3 in preceding term.

$\therefore 2 + 3 = 5, 5 + 3 = 8$

Hence, 9 is wrong term.

Ex.17 10, 100, 1100, 11000, 111000, 1210000.

- (A) 1210000 (B) 11000
(C) 100 (D) 111000

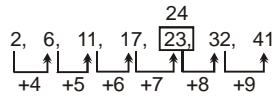
Sol. (D) Given series is :

$$\begin{array}{ccccccc} 10 & 100 & 1100 & 11000 & 121000 & 1210000 \\ \underbrace{\hspace{1cm}}_{\times 10} & \underbrace{\hspace{1cm}}_{\times 11} & \underbrace{\hspace{1cm}}_{\times 10} & \underbrace{\hspace{1cm}}_{\times 11} & \underbrace{\hspace{1cm}}_{\times 10} & \end{array}$$

Hence, the wrong term is 111000.

Ex.18 2, 6, 11, 17, 23, 32, 41
 (A) 6 (B) 17 (C) 23 (D) 32

Sol. (C) Given series is :



Hence, the wrong term is 23.

Ex.19 61, 52, 63, 95, 46, 18
 (A) 95 (B) 63 (C) 46 (D) 52

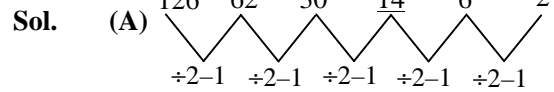
Sol. (A) On interchanging the digits of each term, we get a number which is a perfect square of a natural number.

$$4^2 = 16 \Rightarrow 61, 5^2 = 25 \Rightarrow 52, 6^2 = 36 \Rightarrow 63,$$

$$7^2 = 49 \Rightarrow 94,$$

Hence, the wrong term is 95.

Ex.20 126, 62, 30, 15, 6, 2
 (A) 15 (B) 30 (C) 6 (D) 62



Hence, the wrong term is 15.

EXERCISE

Direction : (Q.1 to Q.20) Find the missing term

- Q.1** 9, 7, 14, 11, 33, 28, ?, 133, 931
(A) 64 (B) 46
(C) 140 (D) 123
- Q.2** 6, 12, 23, 44, 85, ?
(A) 166 (B) 174
(C) 165 (D) 168
- Q.3** 1, 1, 2, 2, 3, 4, 4, 8, 5, 16, ?
(A) 6 (B) 32
(C) 8 (D) 7
- Q.4** 92, 23, 27, 9, 12, 6, ?
(A) 20 (B) 16
(C) 8 (D) 10
- Q.5** 0, 5, 8, 17, 24, 37, 48, ?
(A) 65 (B) 67
(C) 56 (D) 71
- Q.6** 31, 29, 24, 22, 17, ?, ?
(A) 15, 13 (B) 10, 8
(C) 14, 12 (D) 15, 10
- Q.7** 999, 730, 510, 345, 213, ?
(A) 122 (B) 126
(C) 68 (D) 128
- Q.8** 912, 303, 102, 33, ?, 3, 2
(A) 12 (B) 10
(C) 8 (D) 6
- Q.9** 3, 7, 35, 47, ?, 119
(A) 99 (B) 98
(C) 64 (D) 89
- Q.10** 2, 5, 4, 10, 7, 15, 11, 20, ?, ?
(A) 12, 21 (B) 16, 25
(C) 13, 25 (D) 17, 30
- Q.11** 23, 27, 43, 79, 143, ?
(A) 242 (B) 241
(C) 190 (D) 243
- Q.12** 55, 168, 57, 120, 60, 80, 62, 48, 65, 24, ?, ?
(A) 69, 11 (B) 67, 8
(C) 8, 71 (D) 6, 72
- Q.13** 9, 19, 35, 75, 143, ?
(A) 287 (B) 285
(C) 196 (D) 295
- Q.14** 57, 54, 58, 55, 59, 56, 60, ?
(A) 64 (B) 63
(C) 58 (D) 57
- Q.15** 256, 125, 60, ? 12.5
(A) 26 (B) 40
(C) 28 (D) 25
- Q.16** 6, 15, 35, 77, 143, 221, 323, ?
(A) 437 (B) 427
(C) 384 (D) 365
- Q.17** 3, 8, 22, 63, 185, ?
(A) 550 (B) 310
(C) 295 (D) 285
- Q.18** 2, 10, 19, 29, 40, 52, 65, 79, 94, ?
(A) 110 (B) 109
(C) 108 (D) None of these
- Q.19** 1, 2, 5, 12, 27, 58, 121, ?
(A) 246 (B) 247
(C) 248 (D) 249
- Q.20** 0.5, 0.55, 0.65, 0.8, ?
(A) 0.9 (B) 0.82
(C) 1 (D) 0.95

Direction : (Q.21 to Q.30) Find the wrong term

Q.21 10, 26, 74, 218, 654, 1946, 5834

- (A) 26 (B) 74
(C) 218 (D) 654

Q.22 3, 7, 9, 21, 27, 66, 81, 189, 243

- (A) 27 (B) 66
(C) 243 (D) 21

Q.23 3, 7, 15, 39, 63, 127, 255, 511

- (A) 15 (B) 39
(C) 63 (D) 127

Q.24 27, 34, 40, 45, 49, 53, 54, 55

- (A) 53 (B) 45
(C) 56 (D) 34

Q.25 445, 221, 109, 46, 25, 11, 4

- (A) 25 (B) 46
(C) 109 (D) 221

Q.26 0, 2, 3, 6, 6, 20, 9, 54, 12

- (A) 3 (B) 6
(C) 20 (D) 54

Q.27 5, 9, 17, 35, 65, 129

- (A) 65 (B) 35
(C) 17 (D) 9

Q.28 1236, 2346, 3456, 4566, 5686

- (A) 1236 (B) 3456
(C) 4566 (D) 5686

Q.29 1, 5, 6, 11, 17, 27, 45, 73

- (A) 27 (B) 45
(C) 17 (D) 11

Q.30 10, 15, 26, 35, 48, 63, 82

- (A) 48 (B) 26
(C) 63 (D) 82

ALPHABET AND LETTER REPEATING SERIES

◆ ALPHABET SERIES

In the alphabet series we have to find the relation or the order in which the letters have been arranged or grouped together, then find the missing letter or group of letters from the choice given below.

Type of questions asked in the examination :

- (i) Find the missing term(s).
 (ii) Find the wrong term(s).

Position of Alphabet :

(i) Alphabet in order

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

(ii) Alphabet in reverse order

Z	Y	X	W	V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

Ex.1 R, T, ?, X, Z

- (A) V (B) W
 (C) S (D) Y

Sol. (A) Series consists of alternate letter in order .
 So, the missing term would be V.

Ex.2 What will be the next term in BDF, CFI, DHL?

- (A) CJM (B) EIM
 (C) EJO (D) EMI

Sol. (C) Clearly, the first, second and third letters of each term are respectively moved one, two and three steps forward to obtain the corresponding letters of the next term. So, the missing term is EJO.

Ex.3 KTE, SBM, AJU, IRC, ?

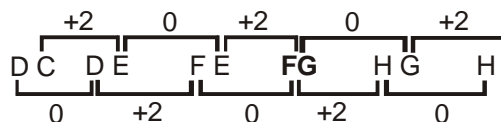
- (A) OZL (B) QYZ
 (C) QZL (D) QZK

Sol. (D) First letter of each group differ by 8 letters. Second letter of each group differ by 8 letters. Third letter of each group differ by 8 letters. Therefore, the missing term would be QZK.

Ex.4 DC, DE, FE, ?, HG, HI

- (A) FE (B) FG
 (C) GF (D) GH

Sol. (B) Hint



Direction : (Ex.5 & Ex.6) Find the wrong term (s) :

Ex.5 DOU, EPV, FQW, GRX, HTY, ITZ

- (A) EPV (B) FQW
 (C) GRX (D) HTY

Sol. (D) In every term first, second and third letter is in alphabetical order to its next term respectively. Fourth term is not following the same rule. Hence, HTY is the wrong term and should be replaced by HSY.

Ex.6 ABC, DGJ, HMR, NTA, SBK, ZKV

- (A) DGJ (B) HMR
 (C) NTA (D) SBK

Sol. (C) First letter of first, second, third,.....terms is moved three, four, five,steps forward respectively. Similarly, second letter is moved five, six, seven,.....steps forward respectively and third letter is moved seven, eight, nine,.....steps forward respectively. Hence, NTA is the wrong term and should be replaced by MTA.

◆ **ALPHA-NUMERIC SERIES**

A series in which both alphabets and number are used.

Ex.7 Choose the term which will continue the following series :

P3C, R5F, T8I, V12L ?

- (A) Y 17 O (B) X 17 M
(C) X 17 O (D) X 16 O

Sol. (C) Clearly, the first letters of the terms are alternate. The sequence followed by the numbers is +2, +3, +4, The last letter of each term is three steps ahead of the last letter of the preceding term. Thus, the next term would be X 17 O.

Ex.8 Find the missing term :

F3X, H7U, J15R, L31O, ?

- (A) M46L (B) N44L
(C) N63L (D) N44M

Sol. (C) The first letter of each term is moved two steps forward and the last letter is moved three steps backward to obtain the corresponding letters of the next term. The numbers form the sequence
 $3 \times 2 + 1 = 7, 7 \times 2 + 1 = 15, 15 \times 2 + 1 = 31,$
 $31 \times 2 + 1 = 63.$ So, the missing term would be N63L.

Ex.9 Find the wrong term :

D4V, G10T, J20R, M43P, P90N

- (A) G10T (B) J20R
(C) M43P (D) P90N

Sol. (A) First letter of every term is moved three steps forward in each next term. Second number of every term of the pattern $\Rightarrow \times 2 + 1, \times 2 + 2, \times 2 + 3, \dots$ and third letter of every term is moved two steps backward. Hence, G10T is the wrong term and should be replaced by G9T.

◆ **LETTER REPEATING SERIES**

It 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 and we have to choose that alternative.

Pattern of such questions is that some letters in sequence are missing :

- (i) The letters may be in cyclic order (clockwise or anti-clockwise).
 (ii) To solve a problem, we have to select one of the alternative from the given alternatives. The alternative which gives a sequence form of letters is the choice.

Ex.10 aab ___ aaa ___ bba___

- (A) baa (B) abb (C) bab (D) aab

Sol. (A) pattern is aabb/aaabbb/aa. Thus our answer is 'bba'.

Ex.11 ___ aba___ ba ___ ab

- (A) abbba (B) abbab
(C) baabb (D) bbaba

Sol. (B) The series is ab/ab/ab/ab/ab/ab thus the pattern ab is repeated

Ex.12 abca___ bcaab___ ca ___ bbc ___ a

- (A) ccaa (B) bbaa
(C) abac (D) abba

Sol. (C) The series is abc/aabc/aabbbc/aabccc/a

Ex.13 a___ bccb___ ca ___ cca ___ baab ___ c

- (A) ababc (B) abcaa
(C) accab (D) bacaa

Sol. (A) The series is aabcc/bbcaa/ccabb/aabcc the letters move in a cyclic order and in each group, the first and third letters occur twice.

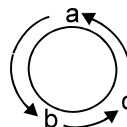
Ex.14 mnonopqopqrs___

- (A) mnopqr (B) oqrstu
(C) pqrstu (D) qrstuv

Sol. (C) The series is mno/nopq/opqrs/pqrstu

Ex. 15 a _ cab _ a _ c _ b c

- (A) bbac (B) abab
(C) abba (D) bcba



Sol. (D)

Series is abc/ abc/ abc/ abc. So, pattern abc is repeated.

EXERCISE

Direction : (Q.1 to Q.14) Find the missing term

- Q.1** TYU, NSO, HMI, ?
 (A) AGC (B) CGC
 (C) GBC (D) BGC
- Q.2** Y, W, U, S, Q, ?, ?
 (A) N, J (B) M, L
 (C) J, R (D) O, M
- Q.3** A, C, F, H, ?, M
 (A) L (B) K
 (C) J (D) I
- Q.4** MAAL, AALM, ALMA, LMAA, ?
 (A) AMLA (B) MAAL
 (C) AAML (D) LAAM
- Q.5** A, Z, X, B, V, T, C, R, ?, ?
 (A) P, D (B) E, O
 (C) Q, E (D) O, Q
- Q.6** A3P, C5N, E8K, G12G, ?
 (A) I16D (B) I17B
 (C) I17D (D) J16B
- Q.7** V, T, R, ?, N, ?
 (A) P, M (B) O, L
 (C) P, L (D) O, M
- Q.8** 2Z5, 7Y7, 14X9, 23W11, 34V13, ?
 (A) 27U24 (B) 47U15
 (C) 45U15 (D) 47V14
- Q.9** CE, GI, KM, OQ, ?
 (A) TW (B) TV
 (C) SU (D) RT
- Q.10** AB, DEF, HIJK, ?, STUVWX
 (A) MNOPQ (B) LMNOP
 (C) LMNO (D) QRSTU
- Q.11** B3M, E7J, H15G, K31D, ?
 (A) N65A (B) O63A
 (C) N63A (D) N63Z

- Q.12** U, O, I, ?, A
 (A) E (B) C
 (C) S (D) G
- Q.13** BEH, KNQ, TWZ, ?
 (A) IJL (B) CFI
 (C) BDF (D) ADG
- Q.14** AB, BA, ABD, DBA, PQRS, ?
 (A) SRQP (B) SRPQ
 (C) SQRP (D) RSQP

Direction : (Q.15 to Q.19) There is a wrong term in the following numbers / letters series. Find the wrong term of the series.

- Q.15** ABC, BCD, CDE, DEF, FEG
 (A) BCD (B) CDE
 (C) DEF (D) FEG
- Q.16** AACC, BBED, CCHE, DDMF, EEQG
 (A) AACC (B) DDMF
 (C) BBED (D) EEQG
- Q.17** ECA, JHF, OMK, TQP, YWU
 (A) ECA (B) JHF
 (C) TQP (D) YWU
- Q.18** EPV, FQW, GRX, HTY, ITZ
 (A) FQW (B) GRX
 (C) HTY (D) ITZ
- Q.19** PON, RQP, TSR, VVT, XWV, ZYX
 (A) VVT (B) TSR
 (C) XWV (D) RQP

Direction : (Q.20 to Q.26) Which sequence of letters when placed at the blanks one after the other will complete the given letter series ?

- Q.20** abc _ c _ c _ ba _ _ bca
 (A) abacb (B) babac
 (C) baabc (D) bacba
- Q.21** abb _ baa _ a _ bab _ ab
 (A) abba (B) abab
 (C) ccac (D) aabb

Q.22 babbb _ b_b_bb
 (A) bba (B) baa
 (C) aba (D) aaa

Q.23 _ ha _ hach _ c _ _
 (A) ccaha (B) achac
 (C) chaaa (D) aaach

Q.24 m _ l _ ml _ m _ llm
 (A) lmmm (B) lmlm
 (C) lmml (D) mllm

Q.25 _ bc _ _ bb _ aabc
 (A) acac (B) babc
 (C) abab (D) aacc

Q.26 gfe _ ig _ eii_fei _ gf _ ii
 (A) eifgi (B) figie
 (C) ifgie (D) ifige

Direction : (Q.27& Q.28) The series given below are based on the letter series, In each of these series, some letters are missing. Select the correct alternative. If more than five letters are missing, select the last five letters of the series.

Q.27 abcd _ bc _ e _ _ de _ _ _ _ _
 (A) deabc (B) edcba
 (C) decba (D) edabc

Q.28 _ _ r _ tqrpstpqst _ _ _ _ _
 (A) pqrts (B) pqtrs
 (C) pqrst (D) qrpst

Direction : (Q.29 & Q.30) There is a letter series in the first row and a number series in the second row. Each number in the number series stands for a letter in the letter series. Since in each of that series some term are missing you have to find out as to what those terms are, and answer the questions based on these as given below in the series.

Q.29 n _ g f _ t _ f h t n _ _ t _ b _ f

1 3 _ 2 4 5 0 _ 4 _ _ 3 _ _ _ _ _

The last five terms of the number series are

(A) 50123 (B) 40321
 (C) 40231 (D) 51302

Q.30 _ m y e _ _ y l x _ y l m _ _ l _ _ _ _

4 6 _ 5 8 6 _ _ _ 5 7 _ 6 5 8 _ _ _ _ _

The last five terms of the number series are

(A) 46758 (B) 74658
 (C) 76485 (D) 46785

Definition

What is a noun?

A noun is a part of speech that is used to name a person, place, thing, quality, or idea. A noun can function as a subject, object, complement, appositive, or object of a preposition.

Classification of Nouns

◆ Proper Nouns

- Proper nouns are nouns that refer to specific entities.
- They refer to the name of a particular person, place, animal or thing.
- Writers of English capitalize proper nouns .
- Examples are *Nebraska, Steve, Harvard, White House* .

◆ Common Nouns

- Common nouns refer to general, unspecific categories of entities.
- Its a name given in common to every person or thing of the same class or kind.
- Whereas *Nebraska* is a proper noun because it signifies a specific state, the word *state* itself is a common noun because it can refer to any of the 50 states in the United States. *Harvard* refers to a particular institution of higher learning, while the common noun *university* can refer to any such institution.

◆ Material Nouns

- Material nouns refer to materials or substances from which things are made.
- While *cotton* is an adjective when used in *cotton dress*, *cotton* is a material noun when used to describe a crop being grown - The farm grew *cotton*.

◆ Collective Nouns

- A collective noun refers top a collection of people or things.
- A collective noun contains two or more persons, animals or things of a same kind joined together to make a single noun.
- Examples are :- a bouquet of flowers, a bunch of grapes, an army of soldiers etc.
- Consider the following sentences :-
Look at the *gaggle* of geese. There used to be *herds* of wild buffalo on the prairie. A *bevy* of swans is swimming in the pond. A *colony* of ants live in the anthill.
In the above examples, *gaggle, herds, bevy, and colony* are collective nouns.

◆ Abstract Nouns

- An abstract noun refers to a quality or state.
- Concepts like *freedom, love, power, and redemption* are all examples of abstract nouns.

They *hate* us for our *freedom*. All you need is *love*. We must fight the *power*.

In these sentences, the abstract nouns refer to concepts, ideas, philosophies, and other entities that cannot be concretely perceived.

Countable & Uncountable Nouns

Here we will learn about countable and uncountable nouns but before we continue the lesson, look at the following chart and study the nouns.

Countable	Uncountable
books	money
friends	meat
teachers	juice
tables	milk

◆ Countable nouns

Countable nouns have a singular and a plural form. In plural, these nouns can be used with a number- they can be counted. (That's why they are called "countable nouns").

Example:

1 friend, 2 friends, 3 friends...
1 book, 2 books, 3 books...

Countable nouns take *many*.

Example:

100 friends – *many* friends

◆ Uncountable nouns

Uncountable nouns can only be used in singular. These nouns cannot be used with a number- they can't be counted. (That's why they are called "uncountable nouns").

Examples:

I have a lot of money. (Not ~~1000~~ money)
You say I drink a lot of milk. (Not ~~5~~ milk)

◆ Uncountable nouns take *much*.

Example:

100 money – *much* money

Note: Of course we can count money, milk, meat; but then we would use the currency, liter, kilo, glass:

- 5 euros or dollars... (but not ~~5~~ money).
- 2 liters, pints, glasses... of milk (but not ~~2~~ milk)
- 3 kilos... of meat (but not ~~3~~ meat)
- 10 bottles of mineral water... (but not ~~10~~ mineral water)

Plurals

English plural nouns:

In order to change a singular noun to its plural form, we usually add "s". For example, the plural of *book* is *books*. The plural of *table* is *tables*. These are **regular plurals**.

But there are many nouns which don't follow this rule. For example the plural of *fish* is *fish*. The plural of *tooth* is *teeth*. These are **irregular plurals**.

Regular plurals:

Form:

Add "s" to the noun:

Noun + **S**

While many plural nouns follow this rule, the spelling sometimes differ.

Examples:

Singular	Plural
snake	snakes
window	windows
box	boxes
boy	boys
lorry	lorries
potato	potatoes
knife	knives

Spelling of plurals:

The plural form of most nouns is created simply by adding the letter "s".

- more than one snake = snakes
- more than one girl = girls
- more than one window = windows

Nouns that end in *-ch, x, s, z* or *s-like* sounds, however, will require an 'es' for the plural:

- more than one witch = witches
- more than one box = boxes
- more than one gas = gases
- more than one bus = buses
- more than one kiss = kisses

Nouns that end in a vowel + *y* take the letter **s**:

- more than one boy = boys
- more than one way = ways

Nouns that end in a consonant + *y* drop the *y* and take 'ies':

- more than one baby = babies
- more than one lorry = lorries

A lot of nouns that end in 'o' take 'es' in the plural:

- more than one potato = potatoes
- more than one hero = heroes

<i>o</i> becomes <i>oes</i>	
echo	echoes
embargo	embargoes
hero	heroes
potato	potatoes
tomato	tomatoes
torpedo	torpedoes
veto	vetoes

Some nouns ending in 'o' break the above rule and get 'os' in the plural form:

<i>o</i> becomes <i>os</i>	
auto	autos
kangaroo	kangaroos
kilo	kilos
memo	memos
photo	photos
piano	pianos
pimento	pimentos
pro	pros
solo	solos
soprano	sopranos
studio	studios
tattoo	tattoos
video	videos
zoo	zoos

Other nouns ending in 'o' get either 'os' or 'oes' in the plural forms:

<i>o</i> becomes <i>os</i> or <i>oes</i>	
buffalo	buffalos/buffaloes
cargo	cargos/cargoes
halo	halos/haloes
mosquito	mosquitos/mosquitoes
motto	mottos/mottoes
no	nos/noes
tornado	tornados/tornadoes
volcano	volcanos/volcanoes
zero	zeros/zeroes

Plurals of nouns that end in 'f' or 'fe' usually change the 'f' sound to a 'v' sound and add 's' or '-es.'

- more than one knife = knives
- more than one leaf = leaves
- more than one hoof = hooves

- more than one life = lives
- more than one self = selves
- more than one elf = elves

◆ **Irregular plurals**

There are several nouns that have irregular plural forms.

Singular	Plural
fish	fish
sheep	sheep
barracks	barracks
foot	feet
tooth	teeth
goose	geese
tooth	teeth
goose	geese
child	children
man	men
woman	women
person	people
mouse	mice

Plurals formed in this way are sometimes called *irregular plurals or mutated (or mutating) plurals*.

- more than one child = **children**
- more than one woman = **women**
- more than one man = **men**
- more than one person = **people**
- more than one goose = **geese**
- more than one mouse = **mice**
- more than one barracks = **barracks**
- more than one deer = **deer**

Other irregular plural forms include the following:

Some foreign nouns retain their plural. (Note that some of them adapted the 's' of the English plural form!)

	<i>Foreign plural</i>	<i>English plural</i>
alga	algae	
amoeba	amoebae	amoebas
antenna	antennae	antennas
formula	formulae	formulas
larva	larvae	
nebula	nebulae	nebulas
vertebra	vertebrae	

Nouns ending in 'us' get 'a', 'I' or the 's' of the English plural:

<i>Singular</i>	<i>Foreign plural</i>	<i>English plural</i>
corpus	corpora	
genus	genera	
alumnus	alumni	
bacillus	bacilli	
cactus	cacti	cactuses
focus	foci	
fungus	fungi	funguses
nucleus	nuclei	
octopus	octopi	octopuses
radius	radii	
stimulus	stimuli	
syllabus	syllabi	syllabuses
terminus	termini	

Nouns ending in 'um' get 'a', 'I' or the 's' of the English plural:

<i>Singular</i>	<i>Foreign plural</i>	<i>English plural</i>
addendum	addenda	
bacterium	bacteria	
curriculum	curricula	curriculumms
datum	data	
erratum	errata	
medium	media	
memorandum	memoranda	memorandums
ovum	ova	
stratum	strata	
symposium	symposia	symposiums

Nouns ending in 'ex' or 'ix' get 'ice's or get the 's' of the English plural:

<i>Singular</i>	<i>Foreign plural</i>	<i>English plural</i>
apex	apices	apexes
appendix	appendices	appendixes
cervix	cervices	cervixes
index	indices	indexes
matrix	matrices	matrixes
vortex	vortices	

Nouns ending in 'Is' becoming 'es' in plural:

<i>Singular</i>	<i>Plural form</i>
analysis	analyses
axis	axes
basis	bases
crisis	crises
diagnosis	diagnoses
emphasis	emphases
hypothesis	hypotheses
neurosis	neuroses
oasis	oases
parenthesis	parentheses
synopsis	synopses
thesis	theses

Nouns ending in 'on' becoming 'a' in plural :

singular	plural
criterion	criteria
phenomenon	phenomena
automaton	automata

Nouns that are always singular :

A handful of nouns appear to be plural in form but take a singular verb:

- The **news** is bad.
- **Gymnastics** is fun to watch.
- **Economics/mathematics/statistics** is said to be difficult.

Some nouns never take the 's' of the plural and are always singular:

- Your **luggage / baggage** is so heavy.
- I'd like to buy new **furniture** for the house.
- You can find more **information** in our website.

Masculine and Feminine Nouns

◆ **Grammatical gender**

Grammatical gender is a system of noun classification. A common gender classification includes masculine and feminine categories. Masculine nouns are words used for men, boys and male animals. Feminine nouns are words for women, girls and female animals.

Masculine and feminine nouns :

<i>Masculine</i>	<i>Feminine</i>
actor	actress
author	authoress
bachelor	spinster
boy	girl
bridegroom	bride
brother	sister
conductor	conductress
count	countess
czar	czarina
dad	mum
daddy	mummy
duke	duchess
man	woman
emperor	empress
father	mother
god	goddess
grandfather	grandmother
heir	heiress
hero	heroine
host	hostess
husband	wife
king	queen
man	woman
master	mistress
murderer	murderess
nephew	niece
poet	poetess
policeman	policewoman
prince	princess
sir	madam
son	daughter
uncle	aunt
wizard	witch
waiter	waitress

Common gender nouns :

Some nouns are used for both males and females. These nouns are referred to as *common gender nouns*.

Examples

- baby
- bird
- cat

- cattle
- child
- companion
- comrade
- cousin
- dancer
- deer
- friend
- guardian
- guest
- infant
- owner
- parent
- passenger
- pig
- president
- pupil
- relative
- sheep
- singer
- student
- swan
- teacher

Animals

There is one general word for the animal. There are however many species of animals, particularly those domesticated, have been given specific names for the male and the female.

<i>animal</i>	<i>masculine</i>	<i>feminine</i>
rabbit	buck	doe
horse	stallion	mare
sheep	ram	ewe
pig	boar	sow
chicken	rooster	hen
duck	drake	duck
cattle	bull	cow
goose	gander	goose
fox	fox	vixen
tiger	tiger	tigress
lion	lion	lioness

EXERCISE

I. Direction (1 to 10) : Say whether the italicized nouns are common, proper, collective or abstract. Put a tick mark against your answer.

1. The *jury* has announced its verdict.
(A) Common (B) Proper (C) Abstract (D) Collective
2. *Sharon* makes models from clay.
(A) Common (B) Proper (C) Abstract (D) Collective
3. Donald took out his *pen* and began to make notes.
(A) Common (B) Proper (C) Abstract (D) Collective
4. The crocodiles in the *river* snapped angrily at the boat.
(A) Common (B) Proper (C) Abstract (D) Collective
5. The boys on bicycles delivered *pamphlets*.
(A) Common (B) Proper (C) Abstract (D) Collective
6. Cleopatra was known for her *beauty*.
(A) Common (B) Proper (C) Abstract (D) Collective
7. Always speak the *truth*.
(A) Common (B) Proper (C) Abstract (D) Collective
8. *The Nile* overflows its banks every year.
(A) Common (B) Proper (C) Abstract (D) Collective
9. I believe in his *innocence*.
(A) Common (B) Proper (C) Abstract (D) Collective
10. The *elephant* has great strength.
(A) Common (B) Proper (C) Abstract (D) Collective

II. Direction (11 to 20) : Fill in the blanks with the correct forms of the given nouns for the following exercise. Use each noun only one time.

chair	job	experience	information	hair
luggage	progress	furniture	permission	work

11. I don't have much _____ . Just two small bags.
12. They are going to tell you all you want to know. They are going to give you a lot of _____.
13. There is room for everybody to sit down. There are a lot of _____.
14. We have no _____, not even a bed or a table.
15. 'What does Alan look like?' He's got a long beard and very short _____.
16. Carla's English is very bad. She must make _____.
17. George is unemployed. He's looking for a _____.

18. If you want to leave work early, you have to ask for _____.
19. I don't think Ann will get the job. She hasn't got enough _____.
20. Shakespeare's _____ are wonderful.

III. Direction (21 to 30) : Decide whether these nouns are countable (C) or uncountable (U)

21. The **children** are playing in the garden. _____
22. I don't like **milk**. _____
23. I prefer **tea**. _____
24. **Scientists** say that the environment is threatened by pollution. _____
25. My mother uses **butter** to prepare cakes. _____
26. There are a lot of **windows** in our classroom. _____
27. We need some **glue** to fix this vase. _____
28. The **waiters** in this restaurant are very professional. _____
29. My father drinks two big **glasses** of water every morning. _____
30. The **bread** my mother prepares is delicious. _____

(d) **Distributive Pronouns :**

It refers to a number of persons or things, one at a time. These pronouns are always singular and are always followed by a Verb in the singular.

- **Each, Either, Neither** are such pronouns.

e.g. **Each** student secured a reward. **Neither** of your answer is correct.

At **either** end of the road was a Park.

(e) **Interrogative Pronouns** are used for asking questions.

- **Who, Whom and Whose** are used for asking questions about things.

e.g. **Who** is calling you ? **Whom** do you want to meet ? **Whose** book is this ?

- **What** is used for asking questions about things.

e.g. **What** shall you do after graduation ?

- **Which** is used for asking a question about the particular person or thing.

e.g. **Which** is the most intelligent student in this class? (Person)

Which is the best book ? (Thing)

(f) **Reciprocal pronoun :**

They are pronouns that denote reciprocal or mutual action. They are :

- **Each other:** generally used when two persons or things are referred to.

e.g. Jack and Jill loved **each other**.

- **One another:** generally used when more than two persons or things are referred.

e.g. The people of India love **one another**.

(g) **Relative Pronoun :**

- The Pronouns 'Who, Whose, Whom, Which, That', which join two sentences and relate or refer to Nouns which have gone before are called Relative Pronouns.

- The Noun to which a Relative Pronoun refers or relates is called its Antecedent.

e.g. This is the boy **who** was punished.

In this example 'boy' is the Antecedent of 'who'.

Use of Relative Pronouns

(i) **Who :**

- Used for persons only.

e.g. The man **who** is honest succeeds in his life.

The students **who** were lazy were punished.

They **who** live in glass houses should not throw stones at others.

The children **who** work hard always succeed.

(ii) **Whose:**

- It is the possessive case of 'Who'. It refers to persons but may also refer to things.

e.g. This is the question **whose** solution baffles me.

The school building **whose** roof was damaged, has now been repaired.

(iii) **Which:**

- Used for animals and for things without life.

e.g. These are the books **which** we purchased yesterday.

The horse **which** won the race is John's.

The things **which** we lost have been found.

(iv) Whom :

- Is used in formal written English. It is common to use ‘Who’ in place of ‘Whom’ in ordinary conversation.

e.g. The man **who (m)** the police caught was a dreaded terrorist.

The students **who (m)** we praised were good in their studies.

Note: ‘**whom**’ is often replaced by ‘That’ except after a preposition. The preposition may be placed at the end and ‘**that**’ used for ‘whom’.

e.g. That is the man about **whom** we were speaking.

That is the man **that** we were speaking about.

(v) That : Used for persons, animals and things.

- It may refer to singular or plural.

e.g. These are the boys **that** can be trusted.

This is the book **that** I want to buy.

This is the ring **that** I lost yesterday.

These are the only horses **that** neigh.

Note : ‘That’ is preferred to ‘who’ or ‘which’ though ‘who’ or ‘which’ can be equally used.

e.g. a) After the superlative degree of adjectives:

Ashoka was the best king **that** (= who) ruled in India.

This is the best book **that** (= which) I have read.

b) After the words ‘all, none, nothing, any, only, same’ etc.

All **that** (= which) glitters is not gold.

It is only you **that** (= who) can speak in such a way.

Nothing **that** (= which) we can do now will save him.

Pronouns at a Glance

PERSON	Nominative or Subjective	Objective	Reflexive	Possessive & Vocative
FIRST	I We	Me Us	Myself Ourselves	My, Mine Our, Ours
SECOND	You	You	Yourself/ Yourselves	Your, Yours
THIRD	He She It They	Him Her It Them	Himself Herself Itself Themselves	His, His Her, Hers Its Their, Theirs

EXERCISE

I. Fill in the blanks with suitable pronouns.

One evening, a rich lady sent (a) _____ housemaid to the market to buy some vegetables for (b) _____. The rich lady sat by (c) _____ for some time. Then she saw her maid returning very quickly. "Madam" she said, " I have forgotten (d) _____ you had asked me to bring." The angry lady said, (e)" _____ can bear with such a fool? (f) _____ was such a simple task and you've come back empty-handed."

II. The following passage has not been edited. There is one error in each line. Write the incorrect word and the correction against the correct blank number. Underline the word that you have supplied.

	Incorrect	Correct
We are in very serious times, because they are free. In	(a)	
the old days ours task was only to fight, to wrest freedom	(b)	
enthuse each other and carry on the freedom struggle.	(c)	
Those was easy, as we know, but now that we have freedom	(d)	
the entire burden of the future structure of my country is	(e)	
on our own shoulders. You must be as true in our conduct	(f)	
and thoughts as a brick that supports a building is true.		

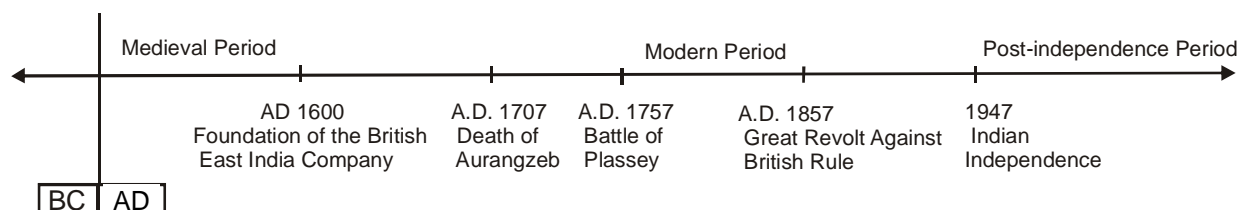
III. The following passage has not been edited. There is one error in each line. Write the incorrect word and the correction against the correct blank number. Underline the word that you have supplied.

	Incorrect	Correct
Jack and Michael were fast friends. They loved one another.	(a)	
Every tried to make the greatest sacrifice for	(b)	
the others. Their parents were equally friendly.	(c)	
But what knows the quirks or fate? It was just a	(d)	
Trifle that led to a misunderstanding between their.	(e)	
The two boys himself remained friendly as ever	(f)	
They tried there best to persuade their fathers.	(g)	
An ingenuous trick exposed the man which had created the	(h)	
bad blood. Jack's father was the one to greet his friend.	(i)	
The four stood together and embraced each other.	(j)	

HOW, WHEN AND WHERE

CONTENTS

- How Important Are Dates?
- Which Dates?
- How do we Periodise?
- What is Colonial?
- Sources of History
- What Official Records Do Not Tell?



HOW IMPORTANT ARE DATES?

History is about changes that occur over time. It is about finding out how things were in the past and how things have changed. Most of us have our moments of wonder, when we are curious, and we ask questions that actually are historical. Like when did people begin to drink tea or coffee? When were railways built and how did people travel long distances before the age of railways? How people got to hear about things before newspapers began to be printed? All such historical questions refer us back to notions of time. But time does not have to be always precisely dated in terms of a particular year or a month. All these things happened over a stretch of time. There was a time when history was an account of battles and big events. Historians now look at how people earned their livelihood, what they produced and ate, how cities developed and markets came up, how kingdoms were formed and new ideas spread, and how cultures and society changed.



Fig. - Advertisements help create taste

➤ WHICH DATES?

The dates we select, are not important on their own. They become vital because we focus on a particular set of events as important. For e.g. in the histories written by British historians in India, the rule of each Governor-General was important. All the dates in the history books were linked to the personalities and their activities, policies, achievements. If we have to focus on the activities of different groups and classes in Indian society we need another format for our history. This would mean that the old dates will no longer have the significance they earlier had. A new set of dates will become more important for us to know.



Fig. – Warren Hastings became the first Governor-General of India in 1773

➤ HOW DO WE PERIODISE?

- ◆ In 1817, James Mill, a Scottish economist and political philosopher, published a massive three volume work, 'A History of British India'. In this he divided Indian history into three periods – Hindu, Muslim and British. This periodisation came to be widely accepted.

Mill thought that all Asian societies were at a lower level of civilisation than Europe. According to his telling of history, before the British came to India, Hindu and Muslim despots ruled the country. Religious intolerance, caste taboos and

superstitious practices dominated social life. British ruler, Mill felt, could civilise India. To do this it was necessary to introduce European manners, arts, institutions and laws in India. James Mill, in fact, suggested that the British should conquer all the territories in India to ensure the enlightenment and happiness of the Indian people. For India was not capable of progress without British help. We cannot refer to any period of history as “Hindu” or “Muslim”. This division has problems -

- (1) Variety of faiths exist simultaneously in these periods.
 - (2) This division suggested that the lives and practices of the others do not really matter.
 - (3) Even rulers in ancient India did not share the same faith.
- ◆ Moving away from British classification, historians have usually divided Indian history into 'ancient', 'medieval' and 'modern'. This division too has its problems. It is a periodisation that is borrowed from the West where the modern period was associated with the growth of all the forces of modernity - science, reason, democracy, liberty and equality. Medieval was a term used to describe a society where these features of modern society did not exist. *Under* British rule people did not have equality, freedom or liberty. Nor was the period one of economic growth and progress.
 - ◆ Many historians, therefore, refer to this period as 'colonial'.

➤ WHAT IS COLONIAL?

- ◆ The British came to conquer the country and establish their rule, subjugating local nawabs and rajas. They established control over the economy and society, collected revenue to meet all their expenses, bought the goods they wanted at low prices, produced crops they needed for export. The British rule brought about many changes in values and tastes, customs and practices. When the subjugation of one country by another leads to these kinds of political, economic, social and cultural changes, we refer to the process as colonization.



SOURCES OF HISTORY

(i) Administration produces records :

One important source is the official records of the British administration. The British believed that the act of writing was important. Every instruction, plan, policy decision, agreement, investigation had to be clearly written up. Once this was done, things could be properly studied and debated. This conviction produced an administrative culture of memos, notings and reports.

Steps taken by the British :

- (1) The British also felt that all important documents and letters needed to be carefully preserved. So they set up record rooms attached to all administrative institutions. The village *tahsildar's* office, the collectorate, the commissioner's office, the provincial secretariats, the lawcourts - all had their record rooms
- (2) Specialised institutions like archives and museums were also established to preserve important records.
- (3) Letters and memos that moved from one branch of the administration to another in the early years of the nineteenth century can still be read in the archives. You can also study the notes and reports that district officials prepared, or the instructions and directives that were sent by officials at the top to provincial administrators.

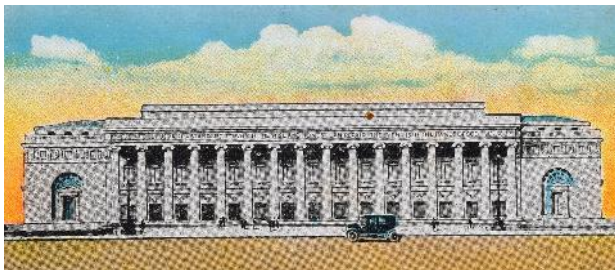


Fig. – The National Archives of India came up in the 1920s. When New Delhi was built, the National Museum and the National Archives were both located close to the Viceregal Place. This location reflects the importance these institutions had a British imagination.

(ii) Survey became important

The practice of surveying also became common under the colonial administration. The British believed that a country had to be properly known before it could be effectively administered.

By the early nineteenth century detailed surveys were being carried out to map the entire country. In the villages, revenue surveys were conducted. The effort was to know the topography, the soil quality, the flora, the fauna, the local histories, and the cropping pattern - all the facts seen as necessary to know about to administer the region. From the end of the nineteenth century, Census operations were held every ten years. These prepared detailed records of the number of people in all the provinces of India, noting information on castes, religions and occupation. There were many other surveys - botanical surveys, zoological surveys, archaeological surveys, anthropological surveys, forest surveys.



Fig. - Mapping and survey operations in progress in Bengal, a drawing by James Prinsep, 1832



WHAT OFFICIAL RECORDS DO NOT TELL

Official records tell us what the officials thought, what they were interested in, and what they wished to preserve for posterity. These records do not always help us understand what other people in the country felt, and what lay behind their actions. For that we have diaries of people, accounts of pilgrims and travellers, autobiographies of important personalities and popular booklets that were sold in the local bazars. As printing spread, newspapers were published and issues were debated in public. Leaders and reformers wrote to spread their ideas, poets and novelists wrote to express their feelings. To understand how history was experienced and lived by the tribals and the peasants, the workers in the mines or the poor on the streets, is a more difficult task.

GLOSSARY

- 1. Periodise :** Divide (a portion of time) into periods.
- 2. Colonial :** The policy or practice of a wealthy or powerful nation's maintaining or extending its control over other countries, especially in establishing settlements or exploiting resources.
- 3. Administration :** The process or activity of running a business, organization etc.
- 4. Archives :** A collection of historical documents or records providing information about a place, institution, or group of people.
- 5. Calligraphists :** Someone skilled in penmanship. Calligrapher, skilled worker, skilled workman, trained worker - a worker who has acquired special skills.
- 6. Survey :** Examine and record the area and features of (an area of land) so as to construct a map, plan, or description.
- 7. Botanical Survey :** An institution set up by the Government of India to survey the plant resource of Indian empire.
- 8. Zoological Survey :** A premier Indian organization promote the survey, exploration and research of the fauna in the region.
- 9. Archaeological Survey :** It is a type of field research by which search for archaeological sites and collect information about the location, distribution and organization of past human cultures across a large area.
- 10. Anthropological Survey :** Studies and field data research for human and cultural aspects.

EXERCISE-1

A Objective Type Questions

- Q.1** James Mill was a -
(A) Indian economist
(B) An Italian economist
(C) Scottish economist
(D) A Dutch economist
- Q.2** History is about -
(A) changes that occur over time
(B) finding out how things were in past
(C) how things have changed
(D) all of the above
- Q.3** Who wrote "History of British India"?
(A) Rippon (B) Liton
(C) James Mill (D) Irwin
- Q.4** Now a days history lays emphasis on
(A) dates
(B) periods
(C) other issues as compared to dates and periods
(D) None of the above
- Q.5** Who published the massive three-volume work "A history of British India"?
(A) Hindus (B) Muslims
(C) Warren Hastings (D) James Mill
- Q.6** What was important in the histories written by British historians in India?
(A) The role of Kings in making India a great country
(B) How the British defeated the French and captured India.
(C) The rule of each Governor-General
(D) The role of Indians who supported the British in establishing their rule over India
- Q.7** Warren Hasting became the first governor general of India in -
(A) 1773 (B) 1772
(C) 1774 (D) 1775
- Q.8** The idea that Asian societies were at a lower level of civilisation than Europe was proposed by -
(A) Montesquieu (B) Robert Lawrence
(C) James mill (D) Rousseau
- Q.9** Subjugation of one country by another country leading to political, economic, social and cultural changes is called -
(A) globalization (B) war
(C) colonization (D) imperialism

- Q.10** Those artists who specialise in the art of beautiful handwriting are called -
 (A) calligraphers (B) graphologists
 (C) writers (D) hieroglyphists

B Fill in the blanks

- Q.1** The British believed that country could be effectively if it is properly known.
Q.2 The name of a tea company featured as an advertisement dated 1922 is
Q.3 The National is established for keeping the records.
Q.4 The study of changes that occurred in the past is called
Q.5 The last British Governor General of India was

C True or False

- Q.1** During the British rule, census operations in India were held every ten years.
Q.2 Wellesley, Bentinck and Dalhousie were the British Governor Generals.
Q.3 In earlier times, History as a subject was synonymous with literature.
Q.4 The first period according to the periodization of Indian history by James Mill was the Hindu period.
Q.5 The last period as defined by the Periodisation of Indian history by the British historians Modern Period.

EXERCISE-2

A Very Short Answer Type Questions

- Q.1** What is history?
Q.2 How does history help us?
Q.3 Why do we connect history with dates?
Q.4 What is the title of the book written by James Mill?
Q.5 What is census?
Q.6 What is the importance of dates in history?
Q.7 What does 'Political history' refer to?
Q.8 What is an archive?
Q.9 Name three official documents of the British period.

B Short Answer Type Questions

- Q.1** What were the drawbacks of official records?
Q.2 Why do we divide history into different periods?
Q.3 What should be the base of selection of dates?
Q.4 What was the misconception of James Mills?

- Q.5** How various surveys helped the British administration?
Q.6 Why were the British interested in preserving official documents?
Q.7 What is periodisation?
Q.8 What are the characteristic of modern period?
Q.9 Who are calligraphists?
Q.10 Explain different types of surveys.

C Long Answer Type Questions

- Q.1** How the periodisation done by James Mill different from other Historians?
Q.2 What is colonial?
Q.3 How the various surveys conducted by British became a Important source of history?
Q.4 How did modernisation lead to colonization?
Q.5 How have historical buildings and paintings proved useful as a source of history (i.e., the history of modern India)?

FROM TRADE TO TERRITORY (THE COMPANY ESTABLISHES POWER)

CONTENTS

- Downfall of the Mughal Empire
- East India Company Comes East
- Company Rule Expands
- Setting up a new administration

▶ DOWNFALL OF THE MUGHAL EMPIRE

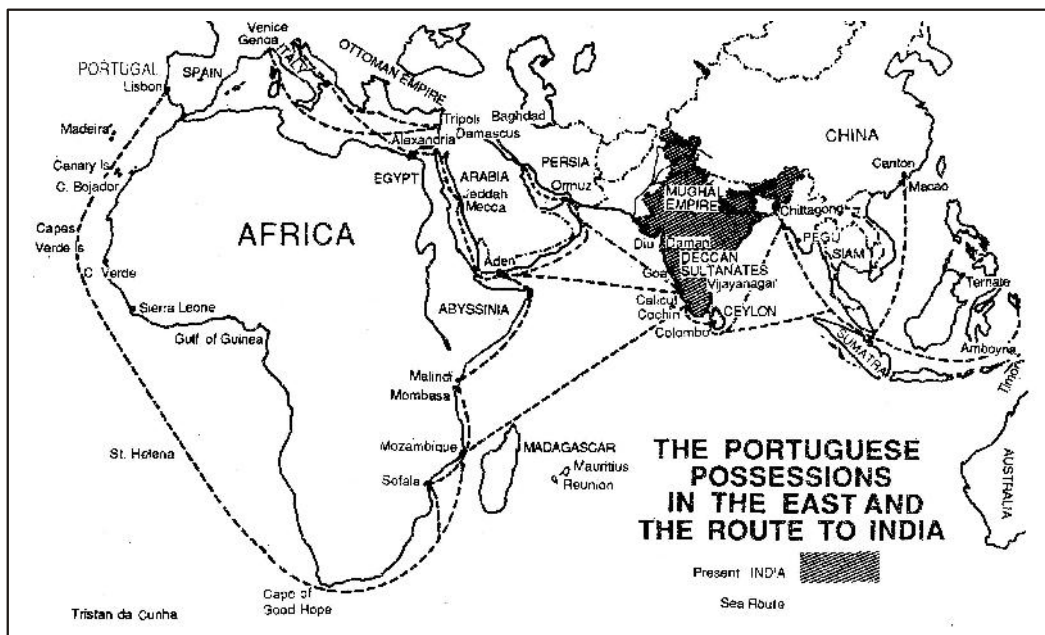
Aurangzeb was the last powerful Mughal emperor. After his death in 1707, many Mughal governors (subadars) and big zamindars began asserting their authority and establishing regional kingdoms. As powerful regional kingdoms emerged in various parts of India, Delhi could no longer function as an effective centre. By the second half of the eighteenth century, however a new power was emerging on the political horizon – the British.



Fig.: Bahadur Shah Zafar and his sons being arrested by Captain Hodson. After Aurangzeb there was no powerful Mughal ruler, but Mughal emperors continued to be symbolically important. In fact, when a massive rebellion against British rule broken out in 1857, Bahadur Shah Zafar, the Mughal emperor at the time, was seen as the natural leader. One the revolt was put down by the company, Bahadur Shah Zafar was forced to leave the kingdom, and his sons were shot in cold blood.

▶ EAST INDIA COMPANY COMES EAST

- (1) In 1600, the East India Company acquired a charter from the ruler of England, Queen Elizabeth, granting it the sole right to trade with the East. With this charter the Company could venture across the oceans, looking for new lands from which it could buy goods at a cheap prices, and carry them back to Europe to sell at higher prices. The Company did not have to fear competition from other English trading companies. Mercantile (A business enterprise that makes profit primarily through trade, buying goods cheap and selling them at higher prices) trading companies in those days made profit primarily by excluding competition, so that they could buy cheap and sell dear.
- (2) By the time the first English ship sailed down the west coast of Africa, round the Cape of Good Hope, and crossed the Indian Ocean, the Portuguese had already established their presence in the western coast of India, and had their base in Goa. Vasco da Gama, a Portuguese explorer, had discovered the sea route to India in 1498. The Dutch too were exploring the possibilities of trade in the Indian Ocean. Soon the French traders arrived on the scene.
- (3) The problem was that all the companies were interested in buying the same things. Competition amongst the European companies inevitably pushed up the prices at which these goods could be purchased, and this reduced the profits that could be earned. The only way the trading companies could flourish was by eliminating rival competitors. This led to fierce battles between the trading companies.



They regularly sank each other's ships, blockaded routes, and prevented rival ships from moving with supplies of goods. Trade was carried on with arms and trading posts were protected through fortification. This effort to fortify settlements and carry on profitable trade also led to intense conflict with local rulers.

(i) English East India Company begins trade in Bengal

- (1) The first English factory was set up on the bank of the river Hugli in 1651. This was the base from which the company's traders, known at that time as "factors" operated by 1696 Company began building a fort around the settlement two years later it bribed Mughal officials into giving the company zamindari right over three villages. It also persuaded the Mughal emperor Aurangzeb to issue a farman granting the company the right to trade duty free.
- (2) The Company tried continuously to press for more concessions and manipulate existing privileges. Aurangzeb's farman, for instance had granted only the Company the right to trade duty free. But officials of the company, who were carrying on private trade on the side were expected to pay duty refused to pay, thus causing an enormous loss of revenue for Bengal.

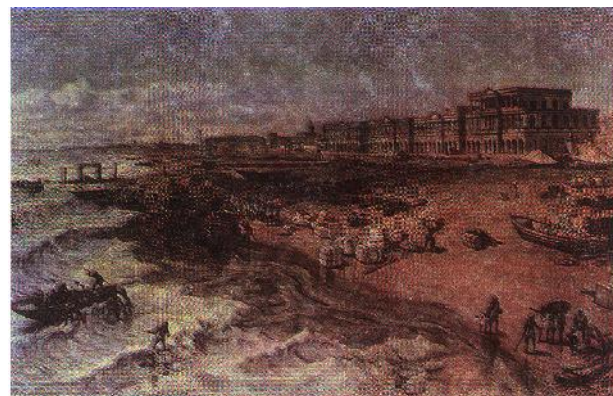


Fig. – Local boats bring goods from ships in Madras, painted by William Simpson, 1867

(ii) How trade led to battles

Through the early eighteenth century the conflict between the company and the Nawabs of Bengal intensified. The Nawab's of Bengal refused to grant the company concessions, demanded large tributes for the Company's right to trade, denied it any right to mint coins and stopped it from extending its fortifications. Accusing the Company of deceit, they claimed that the company was depriving the Bengal government of huge amounts of revenue and undermining the authority of the Nawab.

The company on its part declared that the unjust demands of the local officials were ruining the trade of the company. It was also convinced that to expand trade it had to enlarge its settlements, buy up villages, and rebuild its forts. The conflicts led to confrontations and finally culminated in the famous Battle of Plassey.

(iii) Battle of Plassey

- (1) The Company was worried about its power, started interfering in the political affairs of Bengal. An infuriated Sirajuddaulah asked the Company to stop meddling in the political affairs of his dominion, stop fortification and pay the revenues. After negotiations failed, the Nawab marched with 30,000 soldiers to the English factory at Kassim Bazar, captured the Company officials, locked the warehouse, disarmed all Englishmen and blocked English ships. Then he marched to Calcutta to establish control over the company's fort there.



Fig. - Robert Clive

- (2) On hearing the news of the fall of Calcutta, Company officials in Madras sent forces under the command of Robert Clive, reinforced by naval fleets. Prolonged negotiations with the Nawab followed. Finally, in 1757, Robert Clive led the Company's army against Sirajuddaulah at Plassey. One of the main reasons for the defeat of the Nawab was that the forces led by Mir Jafar, one of Sirajuddaulah's commanders, never fought the battle. Clive had managed to secure his support by promising to make him Nawab after crushing Sirajuddaulah. The Battle of Plassey became famous because it was the first major Victory the Company won in India. It was fought on 23 June 1757.



Fig.: The General Court Room, East India House, Leadenhall Street. The Court of Proprietors of the East India Company had their meetings in the East India House on Leadenhall Street in London. This is a picture of one of their meetings in progress.

- (3) After the defeat at Plassey, Mir Jafar was made the Nawab. Soon the Company discovered that the puppet Nawabs were not always as helpful as the Company wanted them to be. What could the Company do? When Mir Jafar protested, the Company deposed him and installed Mir Qasim in his place. When Mir Qasim complained, he in turn was defeated in battle fought at Buxar (1764), was driven out of Bengal, and Mir Jafar was reinstated. The Nawab had to pay Rs. 500,000 every month but the Company wanted more money to finance its wars, and meet the demands of trade and its other expenses. It wanted more territories and more revenue. Mir Jafar died in 1765. The victory of battle of Plassey turned the history of India and a mere trading company became a ruling force in Bengal. Having failed to work with puppet Nawabs, Clive declared "We must indeed become Nawabs ourselves."
- (4) Finally in 1765 the Mughal emperor appointed the Company as the Diwan of the provinces of Bengal. The Diwani allowed the Company to use the vast revenue resources of Bengal. This solved the major problem of purchasing the goods. Earlier the Company had to buy the goods with gold and silver imported from Britain. The outflow of gold from Britain slowed after the Battle of Plassey, and entirely stopped after the assumption of

Diwani. Now revenues from India could finance Company expenses. These revenues could be used to purchase cotton and silk textiles in India, maintain Company troops, and meet the cost of building the Company fort and offices at Calcutta.

(iv) Company officials become “nabobs”

- (1) The Company acquired more power and authority. Each company servant began to have visions of living like nawabs. After the Battle of Plassey the actual Nawabs of Bengal (real rulers before the Battle of Plassey) were forced to give land and vast sums of money as personal gifts to Company officials. Robert Clive himself amassed a fortune in India. When in 1767 he left India his Indian fortune was worth Pound 401, 102.
- (2) However, not all Company officials succeeded in making money like Clive. All of them were not corrupt and dishonest. Those who managed to return with wealth led flashy lives and flaunted their riches. They were called “Nabobs” an anglicised version of the Indian word nawab.

COMPANY RULE EXPANDS

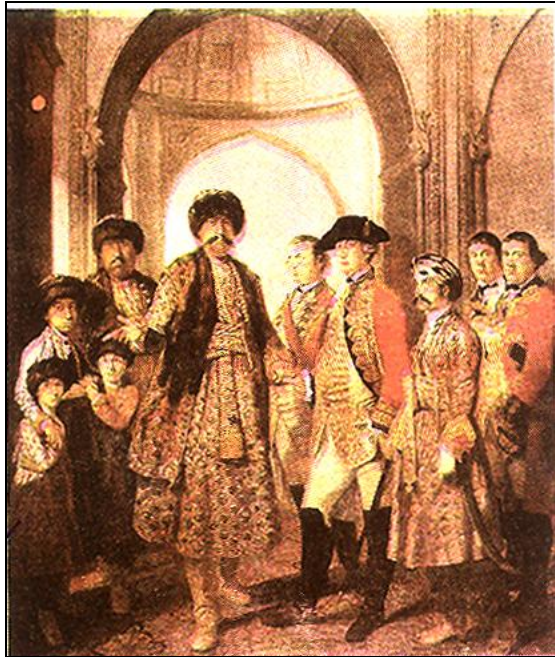


Fig.: Nawab Shujaudaulah of Awadh, with his sons and the British Resident., painted by Tilly Kettle (oil, 1772)
The treaties that followed the Battle of Buxar forced Nawab Shujaudaulah to give up much of his authority.

- (1) The company rarely launched a direct military attack on an unknown territory. Instead it used a variety of political, economic and diplomatic methods to extend its influence before annexing an Indian kingdom.
- (2) After the Battle of Buxar (1764), the Company appointed Residents in Indian states. They were political or commercial agents and their job was to serve and fulfil the interests of the company. Through the Residents, company began interfering in the internal affairs of Indian states.
- (3) **Subsidiary Alliance :** Sometimes the company forced the states into a “subsidiary alliance”. This policy was introduced by Richard Wellesly. According to the terms of this alliance, Indian rulers were not allowed to have their independent armed forces. They were to be protected by the Company, but had to pay for the “subsidiary forces” that the Company was supposed to maintain for the purpose of this protection. If the Indian rulers failed to make the payment, then part of their territory was taken away as penalty. The Nawab of Awadh was forced to give over half of his territory to the Company in 1801, as he failed to pay for the “subsidiary forces”. Hyderabad was also forced to cede territories on similar grounds.

(a) Tipu Sultan – The “Tiger of Mysore”



Fig. – Tipu Sultan

In 1760 Hyder Ali, the General of Mysore Army became the king of Mysore and ruled up to 1782. After his death his son Tipu Sultan ruled from 1782 to 1799. He controlled the profitable trade of the Malabar coast where the Company purchased pepper and cardamom. In 1785 Tipu Sultan stopped the export of sandalwood, pepper and cardamom through the ports of his kingdom, and disallowed local merchants from trading with the Company. He also established a close relationship with the French in India, and modernised his army with their help.

There were mainly three reasons for Anglo-Mysore conflict :

- (1) The friendly relations of Tipu and French and modernisation of his army with their help.
- (2) Restriction on sandalwood, cardamom, spice and pepper trade for British on Malabar Coast by Tipu Sultan.
- (3) The British saw Haidar and Tipu as ambitious, arrogant and dangerous - rulers who had to be controlled and crushed.



Fig. Cornwallis receiving the sons of Tipu Sultan as hostages, painted by Daniel Orme, 1793



Fig.: Tipu's toy tiger

This is the picture of a big mechanical toy that Tipu possessed. You can see a tiger mauling a European soldier. When its handle was turned the toy tiger roared and the soldier shrieked. This toy-tiger is now kept in the Victoria and Albert Museum in London.

Four battles were fought between British and Mysore.

- (a) The First Anglo -Mysore war (1767-1769)
- (b) The Second Anglo Mysore war (1780-1784)
- (c) The Third Anglo Mysore war (1790-1792)
- (d) The Fourth Anglo Mysore war (1799)

The Company forces were defeated by Haidar Ali and Tipu Sultan in several battles. Only in the last - the Battle of Seringapatam - did the company ultimately win a victory. Tipu Sultan was killed, Mysore was placed under the former ruling dynasty of the Wodeyars and a Subsidiary alliance was imposed on the state.

(b) War with the Marathas :

The First Anglo-Maratha War started in 1775 and continued till 1782. Root cause of this war was the issue of succession to the throne of Peshwa. The clash involved Madhav Rao II, supported by the Maratha chiefs under the leadership of Nana Fadnavis on the one hand and Raghunath Rao supported by the British, on the other.

The Maratha chiefs united and defeated the British forces. However, British Governor-General Warren Hasting sent an army contingent from Bengal to help the British forces. Finally, peace was concluded by the Treaty of Salbai in 1782. The British recognized Madhav Rao II as the Peshwa.

The Second Anglo-Maratha War-The Maratha rulers of Scindia and Bhonsle clans refused to accept the subsidiary Alliance and declared war on the British in 1803. However, they were defeated and had to agree to the Subsidiary Alliance and Part with the territories of Ahmednagar and Broach.

When the Holkar ruler of Indore refused to accept the Subsidiary Alliance, the British attacked him. The war did not lead to a decisive result as Wellesley was recalled to England and peace was concluded with the Holkars.

The Third Anglo-Maratha War (1817–1819)

In 1817, Peshwa Baji Rao attacked British Presidency. In return, the British defeated the Marathas and completely broke their power. The office of the Peshwa was abolished and his territories were annexed to the British Empire.

Conclusion

The Marathas were subdued in a series of wars. In the first war that ended in 1782 with the Treaty of Salbai, there was no clear victor. The Second Anglo-Maratha War (1803-05) was fought on different fronts, resulting in the British gaining Orissa and the territories north of the Yamuna river including Agra and Delhi. Finally, the Third Anglo-Maratha War of 1817-19 crushed Maratha power. The Company now had complete control over the territories south of the Vindhya.

(c) The Claim to Paramountcy :

- (1) From the early nineteenth century the Company pursued an aggressive policy of territorial expansion. Under Lord Hastings (Governor-General from 1813 to 1823) a new policy of "Paramountcy" was initiated. Now the Company claimed that its authority was paramount or supreme, hence its power was greater than that of Indian states. This view continued to guide later British policies as well.
- (2) The policy of Paramountcy was continuously challenged. For example, when the British tried to annex the small state of Kitor (in Karnataka today), Rani Channamma took to arms and led an anti-British resistance movement. She was arrested in 1824 and died in prison in 1829. But Rayanna, a poor chowkidar of Sangoli in Kitor, carried on the resistance. With popular support he destroyed many British camps and records. He was caught and hanged by the British in 1830.
- (3) In the late 1830s the Company became worried about Russia. So they wanted to secure their control over the north-west. They fought a prolonged war with Afghanistan between 1838 and 1842 and established indirect rule there. Sind was taken over in 1843. Next in line was Punjab. After the death of Maharaja Ranjit Singh in 1839, two

prolonged wars were fought with the Sikh kingdom. Ultimately, in 1849, Punjab was annexed.

(d) The Doctrine of Lapse :

- (1) Lord Dalhousie, the Governor-General from 1848 to 1856 introduced Doctrine of Lapse. This policy refused the customary adoption of son and stated that a dependent state would pass into British hands in the absence of natural born heir. Satara (1848), Sambalpur (1850), Udaipur (1852), Nagpur (1853) and Jhansi (1854) were all annexed under this policy only.
- (2) In 1856, the Company also took over Awadh. They said they were "obliged by duty" to take over Awadh in order to free the people from the "misgovernment" of the Nawab.

▶ SETTING UP A NEW ADMINISTRATION

British territories were broadly divided into administrative units called Presidencies. There were three Presidencies : Bengal, Madras and Bombay. Each was ruled by a Governor. The supreme head of the administration in India was the Governor-General. Warren Hastings, the first Governor-General, introduced several administrative reforms notably in the sphere of justice.

(a) Judiciary :

- (1) From 1772 a new system of justice was established. Each district was to have two courts – a criminal court (faujdari adalat) and a civil court (diwani adalat). Maulvis and Hindu pandits interpreted Indian laws for the European district collectors who presided over civil courts. The criminal courts were still under a qazi and a mufti but under the supervision of the collectors.
- (2) In 1775 eleven pandits were asked to compile a digest of Hindu laws. N.B. Halhed translated this digest into English. By 1778 a code of Muslim laws was also compiled for the benefit of European judges. Under the Regulating Act of 1773, a new Supreme Court was established, while a court of appeal – the Sadar Nizamat Adalat – was also set up at Calcutta.

(3) The principal figure in an Indian district was the Collector. His main job was to collect revenue and taxes and maintain law and order in his district with the help of judges, police officers and darogas. His office – the Collectorate – became the new centre of power.

(b) The Company army :

(1) The power of Colonial rule in India rested on its military strength.

(2) In the eighteenth century the Company began recruitment for its own army. It started recruiting peasants into armies and training them as professional soldiers. This came to be known as the sepoy army.

(3) As warfare technology changed from the 1820s, the cavalry requirements of the Company's army declined. The soldiers of the Company's army had to keep pace with changing military requirements and its infantry regiments now became more important.

(4) In the early nineteenth century the British began to develop a uniform military culture. Soldiers were increasingly subjected to European-style training, drill and discipline that regulated their life far more than before. Often this created problems since caste and community feelings were ignored in building a force of professional soldiers.

CONCLUSION :

The East India Company was transformed from a trading company to a territorial colonial power. By 1857 the Company came to exercise direct rule over about 63 percent of the Indian territory and 78 percent of the population of the Indian subcontinent. Combined with its indirect influence on the remaining territory and population of the country, the East India Company had virtually the whole of India under its control.

GLOSSARY

1. **Mercantile** : A business enterprise that makes profit primarily through trade, buying goods cheap and selling them at higher prices.

2. **Farman** : A royal edict, a royal order.

3. **Puppet** : Literally, a toy that you can move with strings. The term is used disapprovingly to refer to a person who is controlled by someone else.

4. **Injunction** : Instruction

5. **Confederacy** : Alliance

6. **Qazi** : A judge

7. **Mufti** : A jurist of the Muslim community responsible for expounding the law that the Qazi would administer.

8. **Impeachment** : A trial by the House of Lords in England for charges of misconduct brought against a person in the House of Commons.

9. **Dharmashastras** : Sanskrit texts prescribing social rules and codes of behaviour, composed from c. 500 BCE onwards.

10. **Sawar** : Men on horses.

11. **Musket** : A heavy gun used by infantry soldiers.

12. **Matchlock** : An early type of gun in which the powder was ignited by a match.

EXERCISE-1

A Objective Type Questions

- Q.1** In the 1600s East India Company was a mere
(A) Trading Company (B) Machine Unit
(C) Political Group (D) None of these
- Q.2** Punjab was annexed in
(A) 1839 (B) 1848
(C) 1849 (D) None
- Q.3** Hyder Ali was the Commander-in-Chief in the army of
(A) Maratha (B) Mysore
(C) British (D) None of these
- Q.4** Tipu Sultan was killed in the Fourth Mysore War in the year
(A) 1784 (B) 1799
(C) 1790 (D) 1847
- Q.5** Who was the last of the powerful mughal emperors ?
(A) Akbar (B) Aurangzeb
(C) Babur (D) Humayun
- Q.6** Who succeeded Siraj-ud-daulah as the Nawab of Bengal ?
(A) Mir Qasim (B) Jagat Seth
(C) Mir Jafar (D) Khadim khan
- Q.7** Vasco da Gama discovered the sea route to India in -
(A) 1478 (B) 1488
(C) 1498 (D) None of these
- Q.8** At which place the first English factory was established ?
(A) Hyderabad (B) Tanjore
(C) Mysore (D) Hugli
- Q.9** When was the Battle of Plassey fought ?
(A) 1752 (B) 1754
(C) 1757 (D) None
- Q.10** Which policy was introduced by Lord Dalhousie ?
(A) Zamindari (B) Diwani
(C) Doctrine of Lapse (D) None of these
- Q.11** Who asked the company to stop meddling in the political affairs of Bengal ?
(A) Sirajuddaulah
(B) Aurangzeb
(C) Murchid Quli Khan
(D) Mir Jaffer
- Q.12** Aurangzeb died in
(A) 1680 (B) 1707
(C) 1709 (D) 1711
- Q.13** When was Charter granted by Queen of England to English East India Company ?
(A) 1600 (B) 1607
(C) 1650 (D) 1617
- Q.14** Under who's command the British fought the Battle of Plassey ?
(A) Hastings (B) Watson
(C) Robert Clive (D) Lord Dalhousie
- Q.15** Who replaced Mir Jafar as the Nawab of Bengal ?
(A) Mir Qasim (B) Sirajuddaulah
(C) Robert Clive (D) None of the above
- Q.16** Which European was first to reach India through sea route ?
(A) Amerigo (B) Magellan
(C) Vasco de Gama (D) Columbus
- Q.17** After which battle the company started appointing residents in Indian states ?
(A) Battle of Plassey
(B) Battle of Panipat
(C) Battle of Wandiwass
(D) Battle of Buxar

- Q.18** Before the battle of Plassey Sirajuddulah attacked on
 (A) Company's factory at Kassimbazar
 (B) The fort of company
 (C) Clive's Residence
 (D) (A) and (B) both
- Q.19** The battle of Buxar was fought in
 (A) 1750 (B) 1757
 (C) 1764 (D) 1766
- Q.20** Who was the Tiger of Mysore ?
 (A) Haider Ali (B) Tipu Sultan
 (C) Wadeyars (D) None
- Q.21** In British period the Supreme Court was established in
 (A) 1759 (B) 1772
 (C) 1775 (D) 1773
- Q.22** Satara was annexed in
 (A) 1848 (B) 1852
 (C) 1853 (D) 1854
- Q.23** Which Queen protested against British in Kitoor ?
 (A) Rani Laxmi Bai
 (B) Begam Hajrat Mahal
 (C) Rani Channamma
 (D) Rani Jinghan

B Fill in the blanks

- Q.1** started the Subsidiary Alliance
- Q.2** Lord Dalhousie is known for the
- Q.3** was defeated in Battle of Plassey
- Q.4** Hyder Ali ruled
- Q.5** Tipu died at

C True or False

- Q.1** The first factory of British was set up at Surat.
- Q.2** Indians were happy with the policy of Subsidiary Alliance.
- Q.3** Subsidiary Alliance was introduced by Robert Clive.
- Q.4** Tipu Sultan was killed in the Fourth Battle of Mysore.
- Q.5** Awadh was annexed due to mismanagement.

EXERCISE-2

A Very Short Answer Type Questions

- Q.1** After the death of which Mughal emperor, powerful regional kingdoms emerged in various parts of India?
- Q.2** What led to intense conflicts between local rulers and various trading companies?
- Q.3** Why did the English turn hostile towards Mir Qasim ?
- Q.4** When was Tipu Sultan killed?
- Q.5** Who issued the charter granting monopoly rights to trade with India?
- Q.6** What was the main cause of the defeat of Siraj-du-daulah?
- Q.7** Who were "nabobs"? Why they were called so?
- Q.8** In which battle, the British defeated Tipu Sultan?

B Short Answer Type Questions

- Q.1** What were the mercantile companies ?
- Q.2** Briefly describe the composition of the British army in India.
- Q.3** What was the policy of Paramountcy?
- Q.4** Describe the various changes in Judiciary brought by Warren Hastings
- Q.5** What were the causes of trade rivalries?
- Q.6** On what pretext was Awadh annexed?
- Q.7** What were the results of the fourth Mysore war?
- Q.8** Describe the conditions prior to battle of Plassey.
- Q.9** How did the assumption of Diwani benefit the East India Company?
- Q.10** What were Carnatic Wars?

C Long Answer Type Questions

- Q.1** Describe the new administration set up by British.
- Q.2** What were the terms of Subsidiary alliance?
- Q.3** What do you understand by the ' Doctrine of Lapse? Who introduced it?
- Q.4** Briefly write about the Battle of Plassey.
- Q.5** What were the causes and consequences of the Maratha Wars?

WEAVERS, IRON SMELTERS & FACTORY OWNERS

CONTENTS

- **Introduction**
- **Indian Textiles and the World Market**
- **Words Tell us Histories**
- **Indian Textiles in European Market**
- **Weaving Centres : 1500-1750**
- **Who were the Weavers?**
- **The Decline of Indian Textiles**
- **Cotton Mills Come up**
- **The Sword of Tipu Sultan and Wootz Steel**
- **Abandoned Furnaces in Villages**
- **Iron and Steel Factories Come up in India**

➤ INTRODUCTION

1. The crafts and industries of India during British rule focused on two industries, namely, textiles and iron and steel. Both these industries were crucial for the industrial revolution in the modern world.
2. Mechanised production of cotton textiles made Britain the foremost industrial nation in the nineteenth century. And when its iron and steel industry started growing from the 1850s, Britain came to be known as the “workshop of the world”.
3. The industrialisation of Britain had a close connection with the conquest and colonisation of

India. The English East India Company’s interest in trade led to occupation of territory, and the pattern of trade changed over the decades.

4. In the late eighteenth century the Company was buying goods in India and exporting them to England and Europe, making profit through this sale.
5. With the growth of industrial production, British industrialists began to see India as a vast market for their industrial products and over time manufactured goods from Britain began flooding India. This affected Indian crafts and industries.

➤ INDIAN TEXTILES AND THE WORLD MARKET

1. Around 1750, before the British conquered Bengal, India was by far the world’s largest producer of cotton textiles.
2. Indian textiles had long been renowned both for their fine quality and exquisite craftsmanship.
3. They were extensively traded in Southeast Asia (Java, Sumatra and Penang) and West and Central Asia.
4. From the sixteenth century European trading companies began buying Indian textiles for sale in Europe.

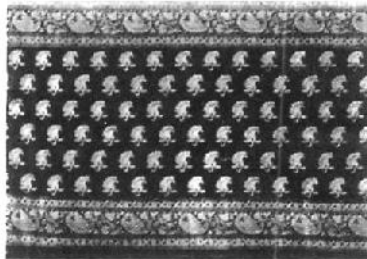
➤ WORDS TELL US HISTORIES

1. **Muslin** : European traders first encountered fine cotton cloth from India carried by Arab merchants in Mosul in present-day Iraq. So they began referring to all finely woven textiles as “muslin” – a word that acquired wide currency.
2. **Calico** : When the Portuguese first came to India in search of spices they landed in Calicut on the Kerala coast in south-west India. The cotton textiles which they took back to Europe, along with the spices, came to be called “calico” (derived from Calicut) and subsequently calico became the general name for all cotton textiles.

- Chintz** : Term chintz it is derived from the Hindi word chhint, a cloth with small and colourful flowery designs. From the 1680s there started a craze for printed Indian cotton textiles in England and Europe mainly for their exquisite floral designs, fine texture and relative cheapness. Rich people of England including the Queen herself wore clothes of Indian fabric.
- Bandana** : The word bandanna now refers to any brightly coloured and printed scarf for the neck or head. Originally, the term derived from the word “bandhna” (Hindi for tying), and referred to a variety of brightly coloured cloth produced through a method of tying and dying.



Patola weave, mid-nineteenth century

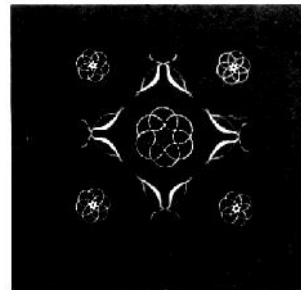


Jamdani weave, early twentieth century

- Jamdani** : Jamdani is a fine muslin on which decorative motifs are woven on the loom, typically in grey and white. Often a mixture of cotton and gold thread was used, as in the cloth in this picture. The most important centres of jamdani weaving were Dacca in Bengal and Lucknow in the United Provinces.
- Patola** : Patola was woven in Surat, Ahmedabad and Patan. Highly valued in Indonesia, it became part of the local weaving tradition there.



Chhint cotton textile



Bandanna design,
early twentieth century

➤ INDIAN TEXTILES IN EUROPEAN MARKETS

- By the early eighteenth century, worried by the popularity of Indian textiles, wool and silk makers in England began protesting against the import of Indian cotton textiles.
- In 1720, the British government enacted a legislation banning the use of printed cotton textiles – chintz – in England. Interestingly, this Act was known as the Calico Act.
- At this time textile industries had just begun to develop in England. Unable to compete with Indian textiles, English producers wanted a secure market within the country by preventing the entry of Indian textiles.
- The first to grow under government protection was the calico printing industry. Indian designs were now imitated and printed in England on white muslin or plain unbleached Indian cloth.
- Competition with Indian textiles also led to a search for technological innovation in England. In 1764, the **spinning jenny** was invented by John Kaye which increased the productivity of the traditional spindles.
- The invention of the steam engine by Richard Arkwright in 1786 revolutionised cotton textile weaving. Cloth could now be woven in immense quantities and cheaply too. However, Indian textiles continued to dominate world trade till the end of the eighteenth century.

7. European trading companies – the Dutch, the French and the English – made enormous profits out of this flourishing trade. These companies purchased cotton and silk textiles in India by importing silver.
8. When the English East India Company gained political power in Bengal, it no longer had to import precious metal to buy Indian goods. Instead, they collected revenues from peasants and zamindars in India, and used this revenue to buy Indian textiles.

WEAVING CENTRES : 1500-1750

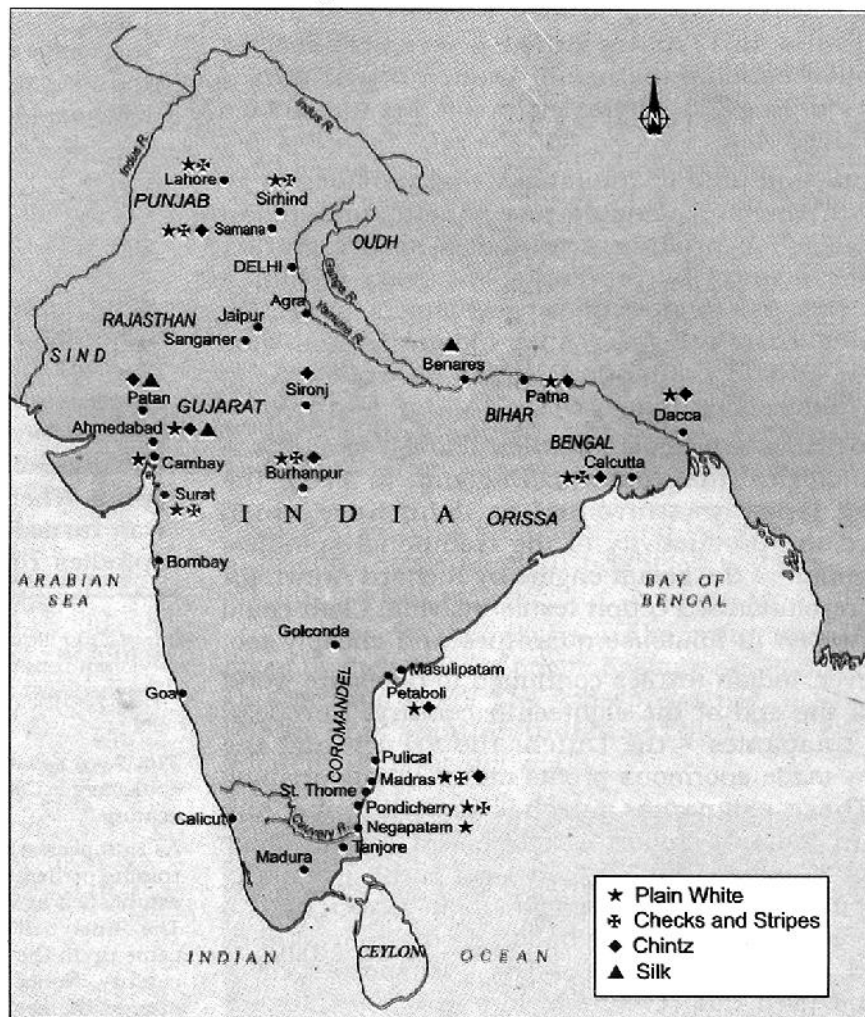
Textile production was concentrated in four regions in the early nineteenth century. Bengal

was one of the most important centres. Located along the numerous rivers in the delta, the production centres in Bengal could easily transport goods to distant places. In the early nineteenth century railways had not developed and roads were only just beginning to be laid on an extensive scale.

Dacca in Eastern Bengal (now Bangladesh) was the foremost textile centre in the eighteenth century. It was famous for its mulmul and jamdani weaving.

At the southern part of India there was a second cluster of cotton weaving centres along the Coromandel coast stretching from Madras to northern Andhra Pradesh. On the western coast there were important weaving centres in Gujarat.

Weaving centres: 1500-1750



WHO WERE THE WEAVERS ?

1. Weavers often belonged to communities that specialized in weaving. Their skills were passed on from one generation to the next. The *tanti* weavers of Bengal, the *julahas* or *momin* weavers of north India, *sale* and *kaikollar* and *devangs* of south India are some of the communities famous for weaving.
2. The first stage of production was spinning – a work done mostly by women.
3. The *charkha* and the *takli* were household spinning instruments. The thread was spun on the *charkha* and rolled on the *takli*.
4. When the spinning was over the thread was woven into cloth by the weaver.
5. In most communities weaving was a task done by men.
6. For coloured textiles, the thread was dyed by the dyer, known as *rangrez*.
7. For printed cloth the weavers needed the help of specialist block printers known as *chhipigars*.
8. Handloom weaving & the occupations associated with it provided livelihood for millions of Indians.

THE DECLINE OF INDIAN TEXTILES

1. The development of cotton industries in Britain affected textile producers in India in several ways.
 - (a) Indian textiles now had to compete with British textiles in the European and American markets.
 - (b) Exporting textiles to England also became increasingly difficult since very high duties were imposed on Indian textiles imported into Britain.
2. By the beginning of the nineteenth century, Englishmade cotton textiles successfully ousted Indian goods from their traditional markets in Africa, America and Europe. Thousands of weavers in India were now thrown out of employment.

3. Bengal weavers were the worst hit. English and European companies stopped buying Indian goods and their agents no longer gave out advances to weavers to secure supplies. Distressed weavers wrote petitions to the government to help them.
4. But worse was still to come. By the 1830s British cotton cloth flooded Indian markets. In fact, by the 1880s two-thirds of all the cotton clothes worn by Indians were made of cloth produced in Britain. This affected not only specialist weavers but also spinners. Thousands of rural women who made a living by spinning cotton thread were rendered jobless.
5. Handloom weaving did not completely die in India. This was because some types of cloths could not be supplied by machines. How could machines produce saris with intricate borders or cloths with traditional woven patterns? These had a wide demand not only amongst the rich but also amongst the middle classes. Nor did the textile manufacturers in Britain produce the very coarse cloths used by the poor people in India.
6. Sholapur in western India and Madura in South India emerged as important new centres of weaving in the late nineteenth century.
7. Later, during the national movement, Mahatma Gandhi urged people to boycott imported textiles and use hand-spun and handwoven cloth. *Khadi* gradually became a symbol of nationalism. The *charkha* came to represent India, and it was put at the centre of the tricolour flag of the Indian National Congress adopted in 1931.
8. Many weavers became agricultural labourers. Some migrated to cities in search of work, and yet others went out of the country to work in plantations in Africa and South America.
9. Some of these handloom weavers also found work in the new cotton mills that were established in Bombay (now Mumbai), Ahmedabad, Sholapur, Nagpur and Kanpur.



Evolution of the Indian National Flag



COTTON MILLS COME UP

1. The first cotton mill in India was set up as a spinning mill in Bombay in 1854.
2. From the early nineteenth century, Bombay had grown as an important port for the export of raw cotton from India to England and China.
3. It was close to the vast black soil tract of western India where cotton was grown. When the cotton textile mills came up they could get supplies of raw material with ease.
4. By 1900, over 84 mills started operating in Bombay. Many of these were established by Parsi and Gujarati businessmen who had made their money through trade with China.
5. Mills came up in other cities too. The first mill in Ahmedabad was started in 1861.
6. In 1862, a mill was established in Kanpur, in the United Provinces.
7. Growth of cotton mills led to a demand for labour. Thousands of poor peasants, artisans and agricultural labourers moved to the cities to work in the mills.
8. In the first few decades of its existence, the textile factory industry in India faced many problems.
 - (i) It found it difficult to compete with the cheap textiles imported from Britain, heavy taxes by British Government etc.
 - (ii) In most countries, governments supported industrialisation by imposing heavy duties on imports.
 - (iii) This eliminated competition and protected infant industries.
 - (iv) The colonial government in India usually refused such protection to local industries.
9. The first major spurt in the development of cotton factory production in India, therefore, was during the First World War when textile imports from Britain declined and Indian factories were called upon to produce cloth for military supplies.



THE SWORD OF TIPU SULTAN AND WOOTZ STEEL



Fig. – Tipu's sword made in the late eighteenth century

1. The story of Indian steel and iron metallurgy is related with the famous story of Tipu Sultan who ruled Mysore till 1799.
2. Tipu's legendary swords are now part of valuable collections in museums in England.
3. The sword had an incredibly hard and sharp edge that could easily rip through the opponent's armour.
4. This quality of the sword came from a special type of high carbon steel called Wootz which was produced all over south India.
5. Wootz steel when made into swords produced a very sharp edge with a flowing water pattern.
6. This pattern came from very small carbon crystals embedded in the iron.
7. Francis Buchanan who toured through Mysore in 1800, a year after Tipu Sultan's death, has left us an account of the technique by which Wootz steel was produced in many hundreds of **smelting** furnaces in Mysore.
8. In these furnaces, iron was mixed with charcoal and put inside small clay pots.

9. Through an intricate control of temperatures the smelters produced steel ingots that were used for sword making not just in India but in West and Central Asia too. Wootz is an anglicized version of the Kannada word *ukku*, Telugu *hukku* and Tamil and Malayalam *urukku* – meaning steel.
10. Indian Wootz steel fascinated European scientists. Michael Faraday, the legendary scientist and discoverer of electricity and electromagnetism, spent four years studying the properties of Indian Wootz (1818-22).
11. However, the Wootz steel making process, which was so widely known in south India, was completely lost by the mid-nineteenth century because the swords and armour making industry died with the conquest of India by the British and imports of iron and steel from England displaced the iron and steel produced by craftspeople in India.

➤ ABANDONED FURNACES IN VILLAGES

1. Production of Wootz steel required a highly specialized technique of refining iron.
2. But iron smelting in India was extremely common till the end of the nineteenth century.
3. In Bihar and Central India, in particular, every district had smelters that used local deposits of ore to produce iron which was widely used for the manufacture of implements and tools of daily use.
4. The furnaces were most often built of clay and sun-dried bricks.
5. The smelting was done by men while women worked the **bellows**, pumping air that kept the charcoal burning.
6. By the late nineteenth century, however, the craft of iron smelting was in decline. In most villages, furnaces fell into disuse and the amount of iron produced came down. Why was this so?
 - (a) One reason was the new forest laws that you have read about. When the colonial government prevented people from entering the reserved forests, how could the iron smelters find wood for charcoal? Where could they get iron ore? Defying forest laws, they often entered the forests secretly and

collected wood, but they could not sustain their occupation on this basis for long. Many gave up their craft and looked for other means of livelihood.

- (b) In some areas the government did grant access to the forest. But the iron smelters had to pay a very high tax to the forest department for every furnace they used. This reduced their income.
- (c) Moreover, by the late nineteenth century iron and steel was being imported from Britain. Ironsmiths in India began using the imported iron to manufacture utensils and implements. This inevitably lowered the demand for iron produced by local smelters.
- (d) By the early twentieth century, the artisans producing iron and steel faced a new competition.

➤ IRON AND STEEL FACTORIES COME UP IN INDIA

1. The year was 1904. In the hot month of April, Charles Weld, an American geologist and Dorabji Tata, the eldest son of Jamsetji Tata, were travelling in Chhattisgarh in search of iron ore deposits.
2. They had spent many months on a costly venture looking for sources of good iron ore to set up a modern iron and steel plant in India.
3. Jamsetji Tata had decided to spend a large part of his fortune to build a big iron and steel industry in India. But this could not be done without identifying the source of fine quality iron ore.
4. One day, after travelling for many hours in the forests, Weld and Dorabji came upon a small village and found a group of men and women carrying basketloads of iron ore.
5. These people were the Agarias.
6. When asked where they had found the iron ore, the Agarias pointed to a hill in the distance.
7. Weld and Dorabji reached the hill after an exhausting trek through dense forests.
8. On exploring the hill the geologist declared that they had at last found what they had been looking for. Rajhara Hills had one of the finest ores in the world.

9. But there was a problem. The region was dry and water – necessary for running the factory – was not to be found nearby.
10. The Tatas had to continue their search for a more suitable place to set up their factory.
11. However, the Agarias helped in the discovery of a source of iron ore that would later supply the Bhilai Steel Plant.
12. A few years later a large area of forest was cleared on the banks of the river Subarnarekha to set up the factory and an industrial township – Jamshedpur. Here there was water near iron ore deposits.
13. The Tata Iron and Steel Company (TISCO) that came up began producing steel in 1912.
14. TISCO was set up at an opportune time. All through the late nineteenth century, India was importing steel that was manufactured in Britain.
 - (a) Expansion of the railways in India had provided a huge market for rails that Britain produced. For a long while, British experts in the Indian Railways were unwilling to believe that good quality steel could be produced in India.
 - (b) By the time TISCO was set up the situation was changing. In 1914 the First World War broke out. Steel produced in Britain now had to meet the demands of war in Europe. So imports of British steel into India declined dramatically and the Indian Railways turned to TISCO for supply of rails.
 - (c) As the war dragged on for several years, TISCO had to produce shells and carriage wheels for the war. By 1919 the colonial government was buying 90 per cent of the steel manufactured by TISCO. Over time TISCO became the biggest steel industry within the British empire.
15. In the case of iron and steel, as in the case of cotton textiles, industrial expansion occurred only when British imports into India declined and the market for Indian industrial goods increased. This happened during the First World War and after.
16. As the nationalist movement developed and the industrial class became stronger, the demand for government protection became louder. Struggling to retain its control over India, the British government had to concede many of these demands in the last decades of colonial rule.

GLOSSARY

1. **Muslin** : It was a finely woven cotton textile cloth that was made in India. Particularly in Bengal.
2. **Smelting** : An association of people with similar interests especially an association of merchants or craftsmen.
3. **Spinning Jenny** : A machine by which a single worker could operate many spindles, at the same time.
4. **Handicrafts** : Any art work which is produced by manual labour rather than by machine.
5. **Pathshala** : Traditional schools attended by Hindus.
6. **Madrassa** : Traditional schools attended by Muslims.

EXERCISE-1

A Objective Type Questions

- Q.1** Before the establishment of British rule, India-
- (A) was an economically underdeveloped and industrially backward land
 - (B) had a flourishing economy with many large textile and steel factories
 - (C) was a flourishing centre of craft and industry
 - (D) had to import all its requirements from other lands and had nothing of value to export
- Q.2** What was the impact of the industrial Revolution in Britain on the Indian industries?
- (A) The British introduced new methods of production in India and thus helped the Indian industries to improve the quality of their goods.
 - (B) The British encouraged Indian industries by giving them loans and providing them with a market in Britain
 - (C) Indian industries slowly died as they were unable to compete against the cheaper machine made products from Britain
 - (D) All of the above
- Q.3** Which of these was not a cause for the decline of traditional industries in India during British rule?
- (A) Loss of royal patronage
 - (B) Loss of external markets
 - (C) The British moved all their factories to India
 - (D) Indifference of the British rulers to the plight of the artisans displaced by the import of cheap cloth from Britain
- Q.4** Which did the British start building roads and railways across India?
- (A) They wanted to help India to develop into an economically strong nation
 - (B) They wanted to unite the people of India by opening ways of communication between the different regions of India
 - (C) They needed to link the sources of raw materials with the manufacturing centres and the places of consumption.
 - (D) They enjoyed traveling and wanted to see the different parts of India
- Q.5** The Tata Iron and Steel Company was founded in -
- (A) Sholapur
 - (B) Nagpur
 - (C) Bokaro
 - (D) Jamshedpur
- Q.6** First cotton mill in India was established at -
- (A) Delhi
 - (B) Bombay
 - (C) Madras
 - (D) Calcutta
- Q.7** The tricolour flag of the Indian National congress was adopted in -
- (A) 1922
 - (B) 1927
 - (C) 1929
 - (D) 1931
- Q.8** Wootz steel was the main feature of -
- (A) Gujarat
 - (B) Andhra Pradesh
 - (C) Mysore
 - (D) Bombay
- Q.9** The Tata Iron and Steel Company was established in -
- (A) 1904
 - (B) 1907
 - (C) 1912
 - (D) 1914
- Q.10** Bhilai steel plant was supported by the Iron ore from -
- (A) Bhilai
 - (B) Jamshedpur
 - (C) Rajhara hills
 - (D) None

B Fill in the blanks

- Q.1** The word chintz comes from the word _____.
- Q.2** Tipu's sword was made of _____ steel.
- Q.3** Before the British conquered Bengal, _____ was by far the world's largest producer of cotton textiles.
- Q.4** For coloured textiles, the thread was dyed by the dyer, known as _____.
- Q.5** The _____ was put at the centre of the tricolour flag of the Indian National Congress adopted in 1931.

C True or False

- Q.1** Kerala was famous for patola.
- Q.2** First Cotton Mill was established at Madras.
- Q.3** Rennel invented the spinning Jenny.
- Q.4** TISCO was established in 1902.
- Q.5** The late 19th century saw a decline in iron smelting.

EXERCISE-2

A Very Short Answer Type Questions

- Q.1** What is Muslin?
- Q.2** Who are the Agaria?
- Q.3** What is Bandanna?
- Q.4** What is Jamadani?
- Q.5** Who toured for the search of Iron ore?
- Q.6** Which famous king used the Wootz Steel in making of the swords?
- Q.7** Which river supported the TISCO plant?

B Short Answer Type Questions

- Q.1** How do the names of different textiles tell us about their histories?
- Q.2** Why did the wool and silk producers in England protest against the import of Indian textiles in the early eighteenth century?
- Q.3** Why did the Indian iron smelting industry decline in the nineteenth century?
- Q.4** What was the process of making Wootz Steel?
- Q.5** Who were the weavers?
- Q.6** What kinds of cloth had a large market in Europe?

C Long Answer Type Questions

- Q.1** How did the development of cotton industries in Britain affect textile producers in India?
- Q.2** What problems did the Indian textile industry face in the early years of its development?
- Q.3** What helped TISCO expand steel production during the First World War?
- Q.4** Why did the Indian iron smelting industry decline in the nineteenth century?

CIVILISING THE NATIVE, EDUCATING THE NATION

CONTENTS

- **How the British Saw Education**
- **What Happened to the Local Schools?**
- **The Agenda for a National Education**

▶ HOW THE BRITISH SAW EDUCATION

The British in India wanted not only territorial conquest and control over revenues. They also felt that they had a cultural mission : they had to “civilise the natives”, change their customs and values.



Fig.– William Jones learning Persian

What changes were to be introduced ? How were Indians to be educated, “civilised”, and made into what the British believed were “good subjects” ? In the process of this enquiry we will see how Indians reacted to British ideas, and how they developed their own views about how Indians were to be educated.

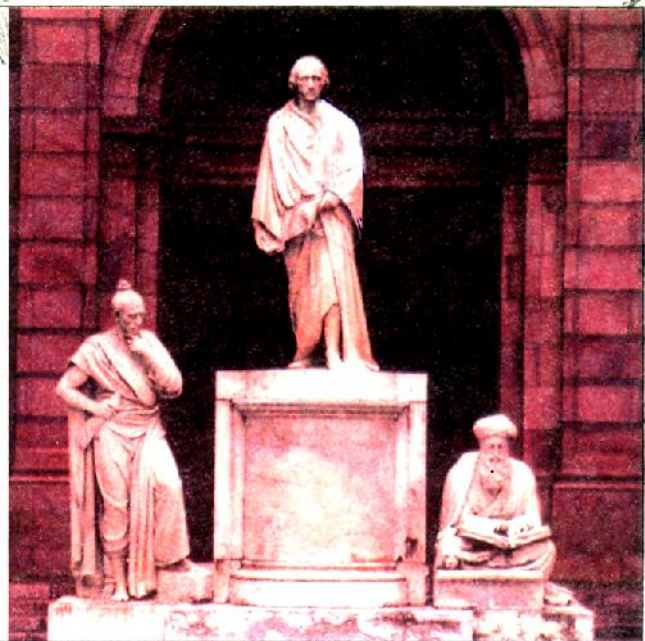
◆ The Tradition of Orientation

1. In 1783, a person named William Jones arrived in Calcutta. He had an appointment as a junior judge at the Supreme Court that the Company had set up.
2. In addition to being an expert in law, Jones was a **linguist**. He had studied Greek and Latin at Oxford, knew French and English, had picked up Arabic from a friend, and had also learnt Persian.
3. At Calcutta, he began spending many hours a day with pandits who taught him the subtleties of Sanskrit language, grammar and poetry.
4. Soon he was studying ancient Indian texts on law, philosophy, religion, politics, morality, arithmetic, medicine and the other sciences.
5. Jones discovered that his interests were shared by many British officials living in Calcutta at the time. Englishmen like Henry Thomas Colebrooke and Nathaniel Halhed were also busy discovering the ancient Indian heritage, mastering Indian languages and translating Sanskrit and Persian works into English. Together with them, Jones set up the Asiatic Society of Bengal and started a journal called *Asiatick Researches*.
6. Jones and Colebrooke came to represent a particular attitude towards India. They shared a deep respect for ancient cultures, both of India and the West. Indian civilisation, they felt, had attained its glory in the ancient past, but had subsequently declined. In order to understand India it was necessary to discover the sacred and legal texts that were produced in the ancient period. For only those texts could reveal the real ideas and laws of the Hindus and Muslims, and only a new study of these texts could form the basis of future development in India.

7. So Jones and Colebrooke went about discovering ancient texts, understanding their meaning, translating them and making their findings known to others.
8. This project, they believed, would not only help the British learn from Indian culture, but it would also help Indians rediscover their own heritage, and understand the lost glories of their past. In this process the British would become the guardians of Indian culture as well as its masters.
9. Influenced by such ideas, many Company officials argued that the British ought to promote Indian rather than Western learning. They felt that institutions should be set up to encourage the study of ancient Indian texts and teach Sanskrit and Persian literature and poetry.
10. The officials also thought that Hindus and Muslims ought to be taught what they were already familiar with, and what they valued and treasured, not subjects that were alien to them. Only then, they believed, could the British hope to win a place in the hearts of the “natives”; only then could the alien rulers expect to be respected by their subjects.
11. With this object in view a **madrassa** was set up in Calcutta in 1781 to promote the study of Arabic, Persian and Islamic law; and the Hindu College was established in Benaras in 1791 to encourage the study of ancient Sanskrit texts that would be useful for the administration of the country.

Fig. – Monument to Warren Hastings, by Richard Westmacott, 1830, now in Victoria Memorial in Calcutta

This image represents how **Orientalists** thought of British power in India. You will notice that the majestic figure of Hastings, an enthusiastic supporter of the Orientalists, is placed between the standing figure of a **pandit** on one side and a seated **munshi** on the other side. Hastings and other Orientalists needed Indian scholars to teach them the “**vernacular**” languages, tell them about local customs and laws, and help them translate and interpret ancient texts. Hastings took the initiative to set up the Calcutta Madrasa, and believed that the ancient customs of the country and Oriental learning ought to be the basis of British rule in India.



◆ "Grave Errors of the East"

1. From the early nineteenth century many British officials began to criticise the Orientalist vision of learning.
2. They said that knowledge of the East was full of errors and unscientific thought; Eastern literature was non-serious and light-hearted. So they argued that it was wrong on the part of the British to spend so much effort in encouraging the study of Arabic and Sanskrit language and literature.
3. James Mill was one of those who attacked the Orientalists. The British effort, he declared, should not be to teach what the natives wanted, or what they respected, in order to please them and “win a place in their heart”. The aim of education ought to be to teach what was useful and practical. So Indians should be made familiar with the scientific and technical advances that the West had made, rather than with the poetry and sacred literature of the Orient.

4. By the 1830s the attack on the Orientalists became sharper.
5. One of the most outspoken and influential of such critics of the time was Thomas Babington Macaulay. He saw India as an uncivilised country that needed to be civilised. No branch of Eastern knowledge, according to him could be compared to what England had produced. Who could deny, declared Macaulay, that “a single shelf of a good European library was worth the whole native literature of India and Arabia”. He urged that the British government in India stop wasting public money in promoting Oriental learning, for it was of no practical use.



Fig. – Thomas Babington Macaulay in his study

6. With great energy and passion, Macaulay emphasized the need to teach the English language. He felt that knowledge of English would allow Indians to read some of the finest literature the world had produced; it would make them aware of the developments in Western science and philosophy. Teaching of English could thus be a way of civilising people, changing their tastes, values and culture.
7. Following Macaulay’s minute, the English Education Act of 1835 was introduced. The decision was to make English the medium of instruction for higher education and to stop the promotion of Oriental institutions like the Calcutta Madrasa and Benaras Sanskrit College. These institutions were seen as “temples of darkness that were falling of themselves into decay”. English textbooks now began to be produced for schools.

◆ Education for Commerce

1. In 1854, the Court of Directors of the East India Company in London sent an educational despatch to the Governor-General in India.
2. Issued by Charles Wood, the President of the Board of Control of the Company, it has come to be known as Wood’s Despatch.
3. Outlining the educational policy that was to be followed in India, it emphasised once again the practical benefits of a system of European learning, as opposed to Oriental knowledge.
4. One of the practical uses the Despatch pointed to was economic. European learning, it said, would enable Indians to recognise the advantages that flow from the expansion of trade and commerce, and make them see the importance of developing the resources of the country.
5. Introducing them to European ways of life, would change their tastes and desires, and create a demand for British goods, for Indians would begin to appreciate and buy things that were produced in Europe.
6. Wood’s Despatch also argued that European learning would improve the moral character of Indians. It would make them truthful and honest, and thus supply the Company with civil servants who could be trusted and depended upon.
7. The literature of the East was not only full of grave errors, it could also not instill in people a sense of duty and a commitment to work, nor could it develop the skills required for administration.
8. Following the 1854 Despatch, several measures were introduced by the British.
 - (i) Education departments of the government were set up to extend control over all matters regarding education.
 - (ii) Steps were taken to establish a system of university education.
9. In 1857, while the sepoys rose in revolt in Meerut and Delhi, universities were being established in Calcutta, Madras and Bombay. Attempts were also made to bring about changes within the system of school education.

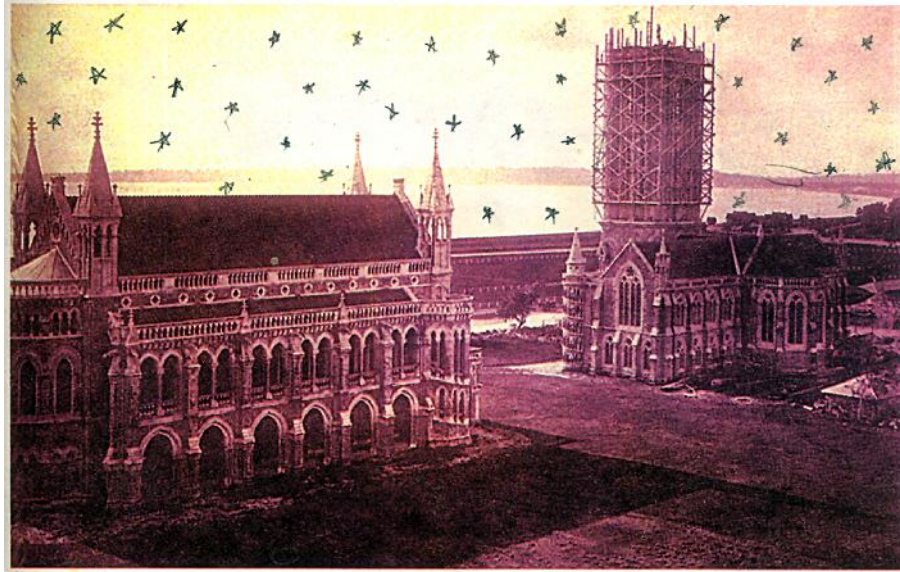


Fig. – Bombay University in the nineteenth century

The demand for moral education



Fig. – William Carey was a Scottish missionary who helped establish the Serampore Mission

The argument for practical education was strongly criticised by the Christian missionaries in India in the nineteenth century. The missionaries felt that education should attempt to improve the moral character of the people, and morality could be improved only through Christian education.

Until 1813, the East India Company was opposed to missionary activities in India. It feared that missionary activities would provoke reaction amongst the local population and make them suspicious of British presence in India. Unable to establish an institution within British-controlled territories, the missionaries set up a mission at Serampore in an area under the control of the Danish East India Company. A printing press was set up in 1800 and a college established in 1818.

Over the nineteenth century, missionary schools were set up all over India. After 1857, however, the British government in India was reluctant to directly support missionary education. There was a feeling that any strong attack on local customs, practices, beliefs and religious ideas might enrage "native" opinion.

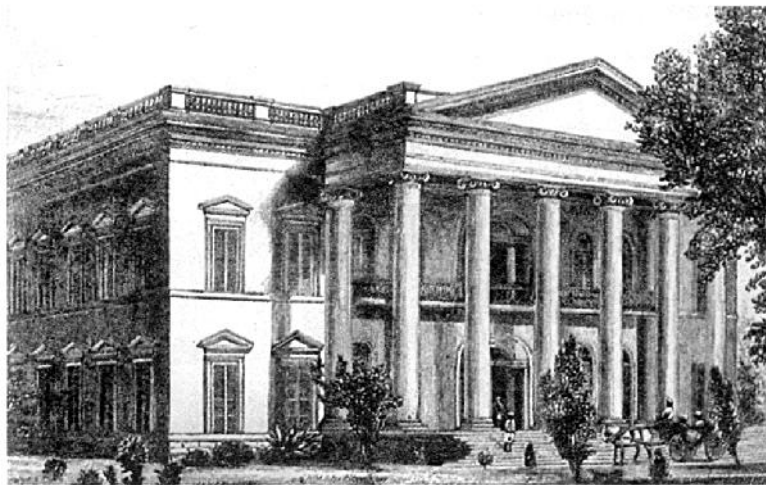


Fig. – Serampore College on the banks of the river Hooghly near Calcutta

◆ **The report of William Adam**

1. Adam found that there were over 1 lakh *pathshalas* in Bengal and Bihar.
2. These were small institutions with no more than 20 students each. But the total number of children being taught in these *pathshalas* was considerable – over 20 lakh.
3. These institutions were set up by wealthy people, or the local community. At times they were started by a teacher (*guru*).
4. The system of education was flexible. There were no fixed fee, no printed books, no separate school building, no benches or chairs, no blackboards, no system of separate classes, no rollcall registers, no annual examinations, and no regular time-table.
5. In some places classes were held under a banyan tree, in other places in the corner of a village shop or temple, or at the *guru's* home.
6. Fee depended on the income of parents: the rich had to pay more than the poor.
7. Teaching was oral, and the *guru* decided what to teach, in accordance with the needs of the students.
8. Students were not separated out into different classes: all of them sat together in one place.
9. The *guru* interacted separately with groups of children with different levels of learning.
10. Adam discovered that this flexible system was suited to local needs. For instance, classes were not held during harvest time when rural children often worked in the fields. The *pathshala* started once again when the crops had been cut and stored. This meant that even children of peasant families could study.

◆ **New Routines, New Rules**

1. Up to the mid-nineteenth century, the Company was concerned primarily with higher education. So it allowed the local *pathshalas* to function without much interference.

2. After 1854 the Company decided to improve the system of vernacular education. It felt that this could be done by introducing order within the system, imposing routines, establishing rules, ensuring regular inspections.
3. It appointed a number of government pandits, each in charge of looking after four to five schools.
4. The task of the pandit was to visit the *pathshalas* and try and improve the standard of teaching.
5. Each *guru* was asked to submit periodic reports and take classes according to a regular timetable.
6. Teaching was now to be based on textbooks and learning was to be tested through a system of annual examination.
7. Students were asked to pay a regular fee, attend regular classes, sit on fixed seats, and obey the new rules of discipline.
8. *Pathshalas* which accepted the new rules were supported through government grants. Those who were unwilling to work within the new system received no government support.
9. Over time *gurus* who wanted to retain their independence found it difficult to compete with the government aided and regulated *pathshalas*.
10. The new rules and routines had another consequence. In the earlier system children from poor peasant families had been able to go to *pathshalas*, since the timetable was flexible.
11. The discipline of the new system demanded regular attendance, even during harvest time when children of poor families had to work in the fields. Inability to attend school came to be seen as indiscipline, as evidence of the lack of desire to learn.

THE AGENDA FOR A NATIONAL EDUCATION

1. British officials were not the only people thinking about education in India. From the early nineteenth century many thinkers from different parts of India began to talk of the need for a wider spread of education.
2. Impressed with the developments in Europe, some Indians felt that Western education would help modernize India.
3. They urged the British to open more schools, colleges and universities, and spend more money on education.
4. There were other Indians, however, who reacted against Western education. Mahatma Gandhi and Rabindranath Tagore were two such individuals.

◆ MAHATMA GANDHI'S VIEWS :

“English education has enslaved us”

1. Mahatma Gandhi argued that colonial education created a sense of inferiority in the minds of Indians.
2. It made them see Western civilisation as superior, and destroyed the pride they had in their own culture.
3. There was poison in this education, said Mahatma Gandhi, it was sinful, it enslaved Indians, it cast an evil spell on them.
4. Charmed by the West, appreciating everything that came from the West, Indians educated in these institutions began admiring British rule. Mahatma Gandhi wanted an education that could help Indians recover their sense of dignity and self-respect.
5. During the national movement he urged students to leave educational institutions in order to show to the British that Indians were no longer willing to be enslaved.
6. Mahatma Gandhi strongly felt that Indian languages ought to be the medium of teaching. Education in English crippled Indians, distanced them from their own social surroundings, and made them “strangers in

their own lands”. Speaking a foreign tongue, despising local culture, the English educated did not know how to relate to the masses.

7. Western education, Mahatma Gandhi said, focused on reading and writing rather than oral knowledge; it valued textbooks rather than lived experience and practical knowledge.
8. He argued that education ought to develop a person’s mind and soul.
9. Literacy – or simply learning to read and write – by itself did not count as education. People had to work with their hands, learn a craft and know how different things operated. This would develop their mind and their capacity to understand.
10. As nationalist sentiments spread, other thinkers also began thinking of a system of national education which would be radically different from that set up by the British.

◆ TAGORE’S :

“Abode of Peace”

1. Rabindranath Tagore started Shantiniketan in 1901.
2. As a child, Tagore hated going to school. He found it suffocating and oppressive. The school appeared like a prison, for he could never do what he felt like doing. So while other children listened to the teacher, Tagore’s mind would wander away.



Fig. – A class in progress in Shantiniketan in the 1930s

3. The experience of his schooldays in Calcutta shaped Tagore’s ideas of education. On growing up, he wanted to set up a school where the child was happy, where she could be free and creative, where she was able to explore her own thoughts and desires.

4. Tagore felt that childhood ought to be a time of self-learning, outside the rigid and restricting discipline of the schooling system set up by the British.
5. Teachers had to be imaginative, understand the child, and help the child develop her curiosity. According to Tagore, the existing schools killed the natural desire of the child to be creative, her sense of wonder.
6. Tagore was of the view that creative learning could be encouraged only within a natural environment. So he chose to set up his school 100 kilometres away from Calcutta, in a rural setting. He saw it as an abode of peace (*santiniketan*), where living in harmony with nature, children could cultivate their natural creativity.



Fig. – Children playing in a missionary school in Coimbatore, early twentieth century. By the mid-nineteenth century, schools for girls were being set up by Christian missionaries and Indian reform organisations.

7. In many senses Tagore and Mahatma Gandhi thought about education in similar ways. There were, however, differences too.
 - (i) Gandhiji was highly critical of Western civilisation and its worship of machines and technology.
 - (ii) Tagore wanted to combine elements of modern Western civilisation with what he saw as the best within Indian tradition.
 - (iii) He emphasized the need to teach science and technology at Santiniketan, along with art, music and dance.
8. Many individuals and thinkers were thus thinking about the way a national educational system could be fashioned. Some wanted changes within the system set up by the British, and felt that the system could be extended so as to include wider sections of people.
9. Others urged that alternative systems be created so that people were educated into a culture that was truly national.

GLOSSARY

1. **Pathshala** : Traditional schools attended by Hindus.
2. **Madrassa** : Traditional schools attended by Muslims.
3. **New Education system** : Modern education including the study of English language and literature.
4. **Indigenous** : Native to the country.
5. **Orientalists**: Those with a scholarly knowledge of the language and culture of Asia.
6. **Vernacular** : Local language or dialect.

EXERCISE-1

A Objective Type Questions

- Q.1** The universities of Calcutta, Bombay and Madras were established as a result of the recommendations of the -
(A) Wood's Despatch
(B) Macaulay's Minutes
(C) Hunter Commission
(D) None of these
- Q.2** Pathshalas were -
(A) Elementary school for Hindus
(B) Elementary schools for Muslims
(C) Higher education centres for Muslims
(D) Higher education centres for Hindus
- Q.3** Who among the following was a supporter of national Education?
(A) Bhagat Singh
(B) Rabindranath Tagore
(C) Subhash Chandra Bose
(D) Bal Gangadhar Tilak
- Q.4** Who came to be referred to as the father of orientalism in India?
(A) H.T. Colebrooke (B) Sir William Jones
(C) Charles Wilkins (D) James Mill
- Q.5** Who said, "A single shelf of a good European library was worth the whole native literature of India and Arabia"?
(A) James Mill (B) H.T. Colebrooke
(C) William Jones (D) I.B. Macaulay
- Q.6** Who was fond of learning Indian languages ?
(A) Jones mills (B) William Jones
(C) Woods (D) None
- Q.7** What is vernacular ?
(A) Local language (B) Arabic
(C) Persian (D) None
- Q.8** Who founded Asiatic Society of Bengal ?
(A) Rabindra Nath Tagore
(B) Jones
(C) William Adam
(D) None

- Q.9** Which Act was framed on the basis of Macaulay's Minutes?
(A) Act of 1853
(B) Act of 1835
(C) Act of 1858
(D) None
- Q.10** James Mill was against -
(A) Orientalist
(B) Anglicist
(C) Westernisation
(D) Modernisation

B Fill in the blanks

- Q.1** _____ started Shantiniketan in 1901.
- Q.2** James Mill was one of those who attacked the _____.
- Q.3** A madrasa was set up in _____ in 1781 to promote the study of Arabic, Persian and Islamic law.
- Q.4** _____ was established in Benaras in 1791.
- Q.5** During the national movement _____ urged students to leave educational institutions.

C True or False

- Q.1** Before the arrival of the British there was no school boards in India.
- Q.2** Knowledge of English aided the spread of nationalism.
- Q.3** Lord Macaulay sent a dispatch in 1854.
- Q.4** Before the arrival of the British, there were no schools in India.
- Q.5** Mahatma Gandhi was in favour of Western education.

EXERCISE-2

A Very Short Answer Type Questions

- Q.1** Name some of the Europe reformers who promoted education in India.
- Q.2** Name the social reformers who contributed for the growth of education.
- Q.3** Name some of the famous universities set-up during British period.
- Q.4** Name the Indian leaders who also played an important role in the spread of education.
- Q.5** How started the Royal Asiatic Society of Bengal.
- Q.6** Which were the traditional centres of learning for Hindus and Muslims ?
- Q.7** Name the famous Anglicist whose minute or note became the basis for British educational policy.

B Short Answer Type Questions

- Q.1** What did the British do to promote education?
- Q.2** Why did British want Indians to be educated?
- Q.3** Mention three benefits of English education in India.

- Q.4** What was Mahatma Gandhi's concept of education?
- Q.5** What was unique about the Santiniketan?
- Q.6** How William Adam described about Indian schools?
- Q.7** What was the Agenda for a National education?

C Long Answer Type Questions

- Q.1** Write a short note on Wood's Dispatch.
- Q.2** Why did William Jones feel the need to study Indian history, philosophy and law?
- Q.3** Why did Mahatma Gandhi think that English education had enslaved Indians?
- Q.4** Why did Mahatma Gandhi want to teach children handicrafts?