

FOUNDATION & OLYMPIAD

CLASS-VIII

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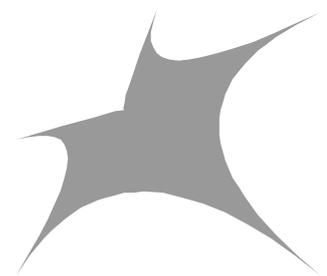
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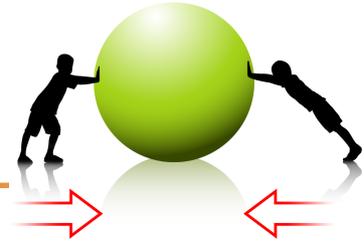
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Specimen Copy





Terminologies

Force, Balanced and Unbalanced force, Resultant force, Contact and Non contact force, Normal force, Friction force, Muscular force, Gravitational force, Electrostatic force, Magnetic force

INTRODUCTION :

Forces are in play around us, Things hanging, sitting, balancing, moving & spinning are all using some kind of force. Force come in different forms & they all result in something. Force can change the direction of an object. Turn things , change the shape of something.

1.1 FORCE :

(a) Defination

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 of motion or shape.

(b) 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 Acceleration = $\frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time}}$ $\left[a = \frac{v - u}{t} \right]$

(c) Units of Force :

(i) In SI system :

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

If $m = 1 \text{ kg}$ 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.

(ii) In CGS system :

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

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

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

(iii) Relation between the newton and dyne :

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

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

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

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

(d) Effects of 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.

(i) 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.

**Fig. 1****(ii) 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.

**Fig. 2**

(iii) 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 can change the direction of your moving bicycle by applying force on its handle in the desired direction.

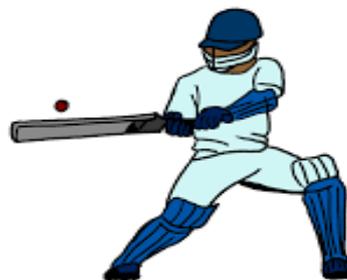


Fig. 3

(iv) 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.

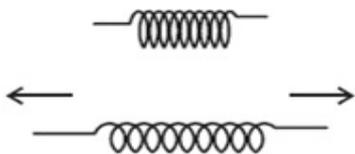


Fig. 4 (a)

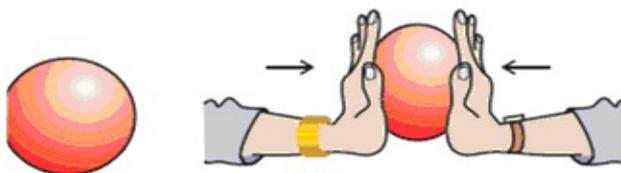


Fig. 4 (b)

(e) Balanced and unbalanced forces:

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

(i) 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 called as balanced forces.

For example :

- (A) A person holding a briefcase in hand.
- (B) A book resting on table.
- (C) Squeezing a lemon etc.



Fig. 5

(ii) 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 :

- (A) A briefcase released from a person's hand. (B) A stone dropped etc.

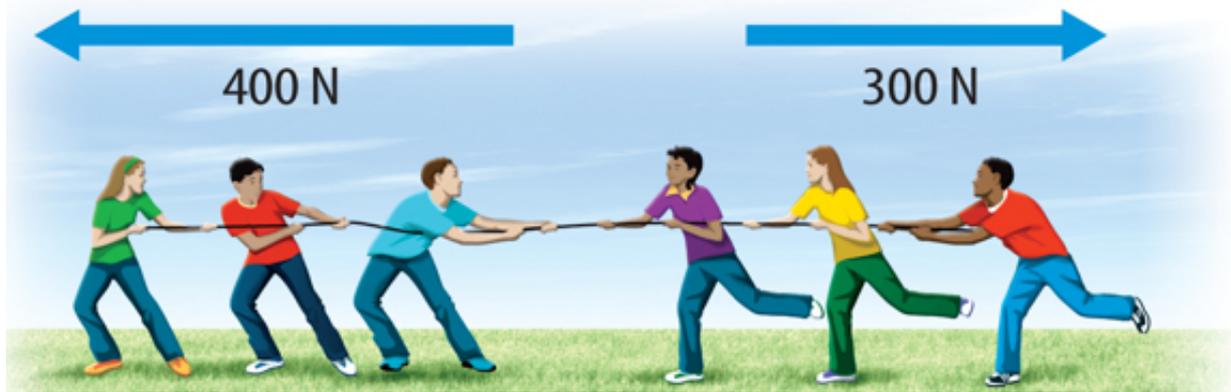


Fig. 6

(f) 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 as 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.

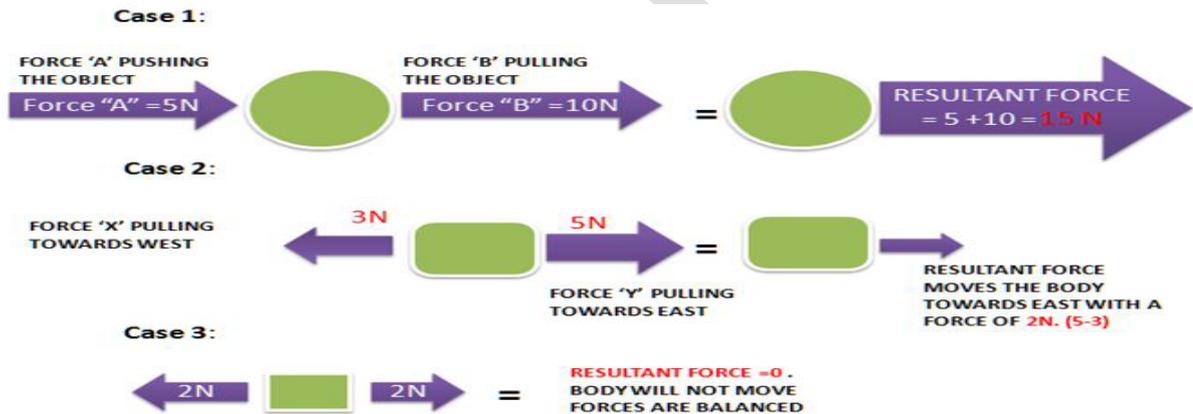
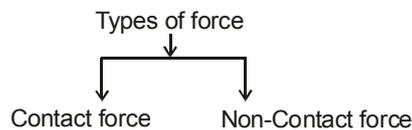


Fig. 7

(g) Types of force:



(i) 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 :

- (A) Normal force (B) Force of friction (C) Muscular force

(A) Normal force :

If contact forces between the bodies is perpendicular to the surface in contact, then the forces are known as normal forces.

Eg. : 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 forces on book in the upward direction and book applies a normal force on table in downward direction.

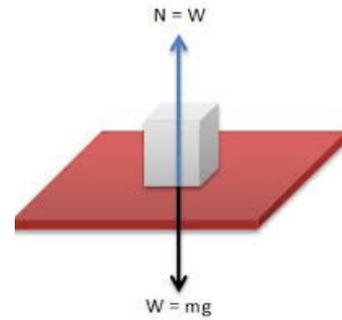


Fig. 8

(B) 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 an object.

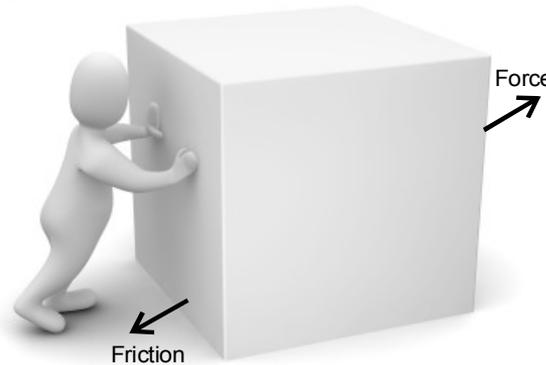


Fig. 9

(C) 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 muscular forces. These are contact forces.

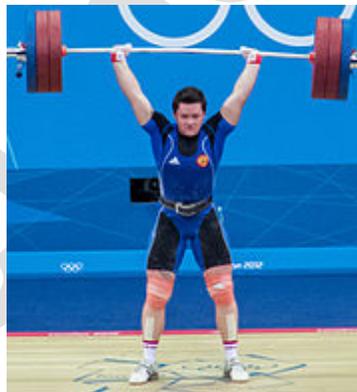


Fig. 10

(ii) Non contact force:

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

Types of non-contact force :

(A) Gravitational force

(B) Electrostatic force

(C) Magnetic force

(A) 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.

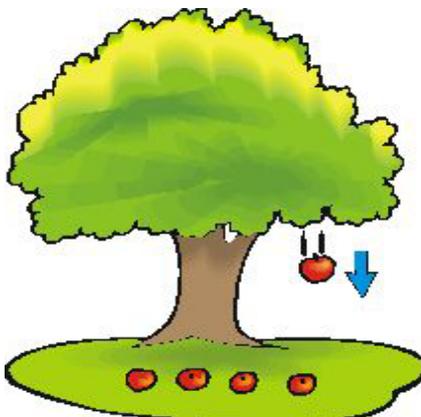


Fig. 11

(I) 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.

(II) 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

$$= 1 \text{ kg mass} \times \text{acceleration due to gravity } g (\text{m/s}^2) = g \text{ newton.}$$

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 CGS 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

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

Since the average value of g is 980 cms^{-2} ,

$$1 \text{ gf} = 980 \text{ dyne}$$

Further, 1 kgf = 1000 gf

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

$$1 \text{ N} = 0.1 \text{ kgf or } 1 \text{ N} = 100 \text{ gf.}$$

(III) 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.

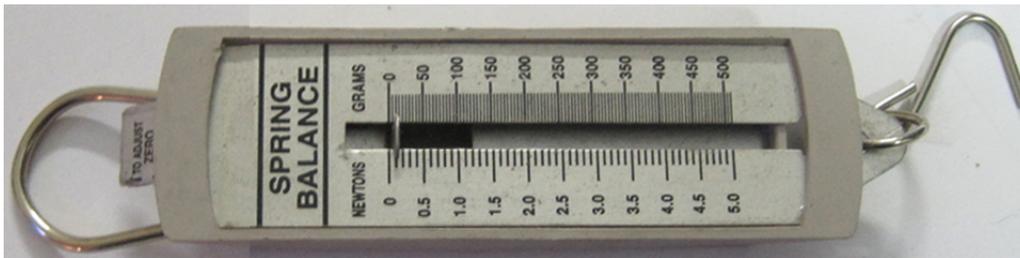


Fig. 12

(IV) Difference between mass and weight :

S. No.	Mass	Weight
1	It is the quantity of matter possessed by a body. It is represented by m.	It is the force with which a body is attracted towards the centre of the earth. It is represented by $W = mg$.
2	A mass is a constant quantity and is same (for a body) everywhere	It varies from place to place due to variation in value of g.
3	Mass is never zero.	A body has zero weight at the centre ($g = 0$) of the earth
4	Its unit is kg.	Its unit is Newton.
5	It is a scalar quantity.	It is a vector quantity.

(B) 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.



Fig. 13

(C) 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.



Fig. 14

Illustrations 1.1 A force produces an acceleration of 5.0 cm/s^2 in a body of mass 20 g . 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, $m = 20 \text{ g} = 0.02 \text{ kg}$
 $\therefore F = ma \Rightarrow F = 0.05 \times 0.02 = 10^{-3} \text{ N}$

Illustrations 1.2 A force of 15 N acts on a body of mass 5 kg for 2 s . What is the change in velocity of body ?

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

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

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

Illustrations 1.3 Find out the weight of an object of mass 25 kg in newton, dyne, kgf and gf. ($g = 10 \text{ m/s}^2$).

Sol. Mass = 25 kg
 Weight = mg
 $W = 25 \times 10 = 250 \text{ N}$
 $= 250 \times 10^5 \text{ dyne}$ (1N = 10^5 dyne)
 $= 250/10 = 25 \text{ kgf}$ (1kgf = 10 N)
 $= 25 \times 1000 = 25000 \text{ gf}$ (1kgf = 1000 gf)

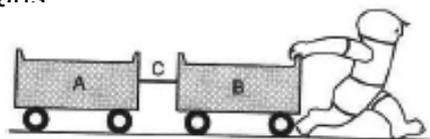
Ask yourself



1. Express 10 N force in terms of dyne.
2. Express 50 N force in terms of g cm s^{-2} .
3. A force of 10 N towards the east and an unknown force F balance each other. Find the unknown force
4. What is the difference between rest & equilibrium ?
5. Equal forces F act on the isolated bodies A & B as shown . The mass of B is three times that of A. Find the ratio of magnitude of the acceleration.



6. How can two forces of 3 N & 4 N combine to give forces of (a) 7 N (b) 1 N
7. A force acting on a particle of mass 200 g . The velocity of the particle changes from 15 m/s to 25 m/s in 2.5 s . Assuming the force to be constant, find its magnitude.
8. Two cart A & B of mass 10 kg each are placed on a horizontal track. They are joined tightly by a light but strong rope C. A man hold a cart B & pulls it towards the right with a force of 70 N . The total force of friction by the track and the air on each cart is 15 N acting towards the left. Find the acceleration of the carts



9. A particle attracts the earth with a force equal to the weight of the particle. (Yes / No)
10. What is the mass of an object whose weight is 49 N ? (Take $g = 9.8 \text{ m/s}^2$)
11. A force acting on a particle of mass 200 g . The velocity of the particle changes from 15 m/s to 25 m/s in 2.5 s . Assuming the force to be constant, find its magnitude.

12. How can two forces of 3 N & 4 N combine to give forces of (a) 7 N (b) 1 N
-



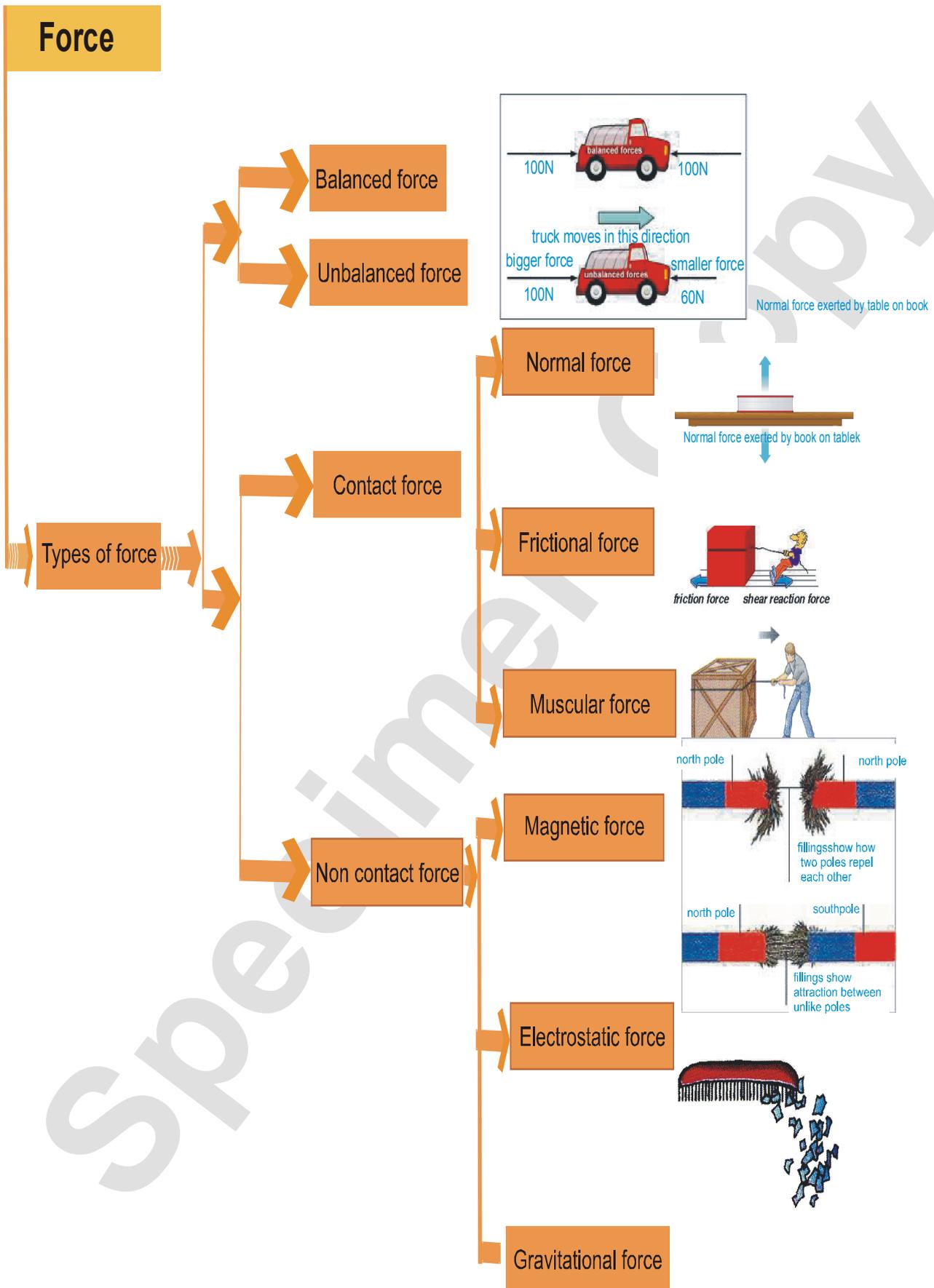
Add to Your Knowledge

1. The concept of force is based on pushing, pulling or hitting an object
2. When balanced forces act on a moving body, it continues to move in the same direction with same speed. In other words, no net external force is required to move an object with constant velocity.
3. The SI unit of force is kg m s^{-2} this is also known as newton and represented by the symbol N. A force of one newton produces an acceleration of 1 m s^{-2} on an object of mass 1 kg.
4. When unbalanced force acts on a body at rest, it begins to move in the direction of the unbalanced force.
When unbalanced force acts on a moving body, its velocity changes. It means, unbalanced force acting on a body accelerates or retards the motion of the body.
5. 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.
6. 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.

Summary

1. 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 of motion or shape. [$F = ma$]
 2. 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 called as balanced forces.
 3. 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.
 4. If contact forces between the bodies is perpendicular to the surface in contact, then the forces are known as normal forces
 5. 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 muscular forces. These are contact forces.
 6. Force which acts on a body when the body is not in contact with another body (exerting force), force is known as non-contact force.
 7. 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.
 8. 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.
 9. The force due to gravity on a body of mass m at a place where acceleration due to gravity is g .
 10. The force exerted by a charged body on another charged or uncharged body is known as electrostatic force.
-

CONCEPT MAP



EXERCISE >> 01

SECTION - A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS :

1. Force is a :
(A) Vector quantity. (B) Scalar quantity. (C) Both (A) & (B). (D) None of these.
2. When a body is stationary
(A) There is no force acting on it
(B) The force acting on it is not in contact with it
(C) The combination of forces acting on it balances each other
(D) The body is in vacuum
3. 5.25N is equal to how many dyne
(A) 5.25×10^{-5} (B) 5.25×10^5 (C) 5.25×10^6 (D) None of these.
4. Suppose a ball slides down an inclined plane than choose the correct option
(A) net force acting on ball is zero (B) acceleration is zero.
(C) net force acting on ball is non zero. (D) while moving down its speed is constant.
5. You and your two friends push a box from opposite sides. the magnitude of the force applied by you is 80N, And that by your two friend is 55N and 25N. Calculate the net force acting upon the box
(A) 160N. (B) 135N. (C) 0N. (D) 105 N.
6. A body is moving with certain velocity towards right. A force of 5 N is applied on it towards right and a force of 6 N 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.
7. A force can :
(A) Change the direction of a moving body.
(B) Change the state of rest or uniform motion of a body.
(C) Change the shape of a body.
(D) All of the above.
8. 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.
9. External forces are :
(A) Always balanced. (B) Never balanced.
(C) May or may not be balanced. (D) None of these.
10. How many dynes are equal to 1 N ?
(A) 10^6 (B) 10^4 (C) 10^5 (D) 10^3
11. SI unit of force is :
(A) dyne. (B) newton. (C) gf. (D) can't say.
12. 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 (D) None of these.
13. How much force is required to lift a mass of 100 g :
(A) 10 N. (B) 1 N. (C) 100 N. (D) 1000 N.

- 14_ A force of 5 N acts on a body of weight 9.8 N. What is the acceleration produced in m/s^2]
 (A) 49.00 (B) 5.00 (C) 1.46 (D) 0.51
15. 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.

FILL IN THE BLANKS :

- (i) CGS unit of force is _____.
- (ii) To draw water from a well we have to _____ the rope.
- (iii) Muscular force is a _____ force.
- (iv) Friction force is a _____ force.
- (v) The north pole of a magnet _____ the north pole of another magnet.

TRUE / FALSE :

- (i) Gravitational force is a type of contact force.
- (ii) Mass of a body is never zero.
- (iii) Weight of a body remains same always
- (iv) Newton and $kg \times m/s^2$ both are the units of force.
- (v) Normal force is a contact force.

MATCH THE COLUMN :

- | Column-I | Column-II |
|-------------------------|---------------------------------|
| (i) Gravitational force | (a) Never changes |
| (ii) Mass | (b) Changes from place to place |
| (iii) Weight | (c) Contact force |
| (iv) Normal force | (d) $Kg \times m/s^2$ |
| (v) Newton | (e) Non contact force |

SECTION - B (FREE RESPONSE TYPE)

VERY SHORT ANSWER TYPE :

- Write the SI and CGS unit of force.
- What are the different types of non contact forces ?
- What do you mean by Resultant Force ?
- What are the gravitational units of force ?
- What measures the earth's gravitational pull on an object, its weight or mass ?

SHORT ANSWER TYPE :

6. Force can change the direction of a moving body. Explain with the help of some examples.
7. What are Balanced and Unbalanced Forces ?
8. A force can change the shape of object. Explain.
9. Differentiate between contact and non-contact force.
10. When a force of 40 N is applied on a body, it moves with an acceleration of 5 ms^{-2} . Calculate the mass of the body.

LONG ANSWER TYPE :

11. It is required to increase the velocity of a scooter of mass 80 kg from 5 ms^{-1} to 25 ms^{-1} in 2 second. Calculate the force required.
12. A car of mass 1000 kg is moving with a velocity of 10 m/s and is acted upon by a forward force of 1000 N due to engine and retarding force of 500 N. Calculate the velocity after 10 seconds.
13. A rocket has been fired upwards to launch a satellite in its orbit. Name the two forces acting on the rocket immediately after leaving the launching pad.
14. State the effect of the force :

(i) Squeezing a lemon. (iii) A lump of dough on a plate. (v) Brakes is applied to a moving car.	(ii) Taking out paste from a toothpaste tube. (iv) Hit a ball by a cricket player with bat.
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15. A car of mass 500 kg starts from rest and is acted upon by a forward force of 200 N due to engine and retarding force of 50 N. Calculate the velocity after 5 seconds.

EXERCISE >> 02**SECTION - A (COMPETITIVE EXAMINATION QUESTION)****MULTIPLE CHOICE QUESTIONS :**

1. A force can be completely described by

(A) Its magnitude.	(B) Its direction.
(C) Its magnitude and direction.	(D) Neither magnitude nor direction.
2. When a body is stationary :

(A) There is no force acting on it.	(B) The forces acting on it are not in contact with it.
(C) The combination of forces acting on it balance each other.	(D) The body is in vacuum.
3. FPS unit of force is

(A) kgf.	(B) gf	(C) pound.	(D) poundal
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4. While racing, suppose that a cyclist of mass 45 kg is travelling with an acceleration of 30 m/s^2 . Calculate the force acting on cyclist

(A) 1250N.	(B) 1350N	(C) 1500N.	(D) 1870N
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5. Which is not a non-contact force :
(A) Gravitational. (B) Electrostatic. (C) Magnetic. (D) Frictional.
6. 1 dyne is equal to :
(A) 10^4 N. (B) 10^5 N. (C) 10^{-5} N. (D) 10^{-4} N.
7. When 2 bodies are moving with equal acceleration then, the relation of force F and mass M is
(A) $F \propto \frac{1}{M}$ (B) $F \propto M$ (C) $F \propto \frac{1}{M^2}$ (D) None of these
8. 1 Newton is a force which produces :
(A) An acceleration of 1 ms^{-2} in a body of mass 1 g.
(B) An acceleration of 1 ms^{-2} in a body of mass 1 kg.
(C) An acceleration of 1 cms^{-2} in a body of mass 1 kg.
(D) An acceleration of 1 ms^{-2} in a body of mass 10 g.
9. The mass of your car is 1500kg. It is initially moving with a velocity of 30m/s, and then within a time duration of 50 sec, it moves with a velocity of 80m/s. Calculate the force produced by your car
(A) 1500N (B) 2000N (C) 4000N. (D) 5000N
10. For moving a body from rest or stopping a moving body, we need :
(A) Force (B) Mass (C) Direction (D) Time

SECTION - B (TECHIE STUFF)

11. A wooden block of mass m_1 accelerates at 10 ms^{-2} when a force of 5 N acts on it. Another block of mass m_2 accelerates at 20 ms^{-2} when same force acts on it. Find the acceleration if both the blocks are tied together and same force acts on their combination.
12. A car of mass 1000 kg is moving with a certain speed when a constant braking force 1000 N acts on it for 5 s and the speed of the car reduces to half its original speed. Find the further time required to stop the car, if the same constant force acts.
13. Two balls of identical shape and size, but of different materials are acted upon by same force, such that the acceleration of first ball is only one fourth that of the second ball. Calculate the ratio of the mass of the first ball with respect to that of the second ball.
14. What is normal force ?
15. A force F gives an object with mass m an acceleration a. If this force is applied to an object of mass $\frac{1}{4}m$, what is the new acceleration ?
16. A car having a mass of 1000 kg is moving at a speed of 30 m/s. Brakes are applied to bring the car to rest. If the frictional force between the tyre and the road surface is 5000 N, calculate the time in which the car will come to rest.
17. A ball of mass 10 g is moving with a velocity of 50 m/s on applying a constant force on ball for 2 sec. It acquires a velocity of 70 m/s calculate
(i) The acceleration of ball (ii) The magnitude of force applied.
18. A force produces an acceleration of 5.0 cm/s^2 in a body of mass 20 g. Find the force acting on the body in Newton.

EXERCISE 03

(PREVIOUS YEAR EXAMINATION QUESTIONS)

1. Match Column-I with Column-II and select the correct option from the codes given below. (NSO-2012)

Column-I

- (a) A child running to catch the school bus
- (b) A man blowing a balloon
- (c) A woman pushing a table
- (d) A cricketer catching a ball
- (A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
- (C) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Column-II

- (i) Force can make a stationary object to move
- (ii) Force can stop a moving object
- (iii) Force can change the shape of an object
- (iv) Force can make an object move faster
- (B) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
- (D) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

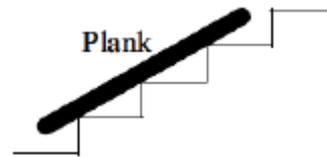
2. A body is acted upon by a constant force directed towards a fixed point. The magnitude of the force varies inversely as the square of the distance from the fixed point. What is the nature of the path? (NSO-2013)

- (A) Straight line (B) Circle (C) Random motion (D) Can't say

3. A ball is dropped from a spacecraft revolving the earth at a height of 100 km. What will happen to the ball? (NSO-2013)

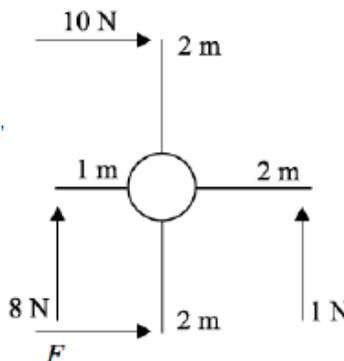
- (A) It will continue to move with the same speed along the original orbit of spacecraft.
- (B) It will move with the same speed, tangentially to the spacecraft.
- (C) It will go very far in the space.
- (D) It will fall down to earth gradually.

4. A plank is supported on the steps of a staircase as shown in the figure. How many forces are acting on the plank? (NSO-2014)



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

5. A windmill is pushed by four external forces as shown in the given figure. The force F required to make the windmill stand still is (NSO-2014)



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

6. Which of the following objects experience balanced forces? **(NSO-2014)**
(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
7. An iron block of dimensions 5 cm × 10 cm × 15 cm has to be pushed along the floor. The force required will be minimum when the surface in contact with ground is : **(NSO-2015)**
- (A) (10 cm x 15 cm) surface
(B) (5 cm x 15 cm) surface
(C) (10 cm x 5 cm) surface
(D) Force is same for all surfaces.

ANSWER KEY >>

EXERCISE # 1

SECTION - A (FIXED RESPONSE TYPE) MULTIPLE CHOICE QUESTIONS

Q.	1	2	3	4	5	6	7	8	9	10
A.	A	C	B	C	C	D	D	D	C	C
Q.	11	12	13	14	15					
A.	B	C	B	B	B					

FILL IN THE BLANKS :

- (i) Dyne (ii) Pull (iii) Contact (iv) Contact (v) Repel

TRUE / FALSE :

- (i) False (ii) True (iii) False (iv) True (v) True

MATCH THE COLUMN :

- (i) → (e) (ii) → (a) (iii) → (b) (iv) → (c) (v) → (d)

SECTION - B (FREE RESPONSE TYPE) SUBJECTIVE ANSWERS

10. 8 kg 11. 800 newton 12. 15 m/s
13. Air resistance and reaction force of gravitation force. 15. 1.5 m/s

EXERCISE # 2

SECTION - A (COMPETITIVE EXAMINATION QUESTION) MULTIPLE CHOICE QUESTIONS

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

SECTION - B (TECHIE STUFF)

11. 6.67 ms^{-2} 12. 5 sec 13. 4 : 1 15. 4 Times
16. 6 Sec 17. (i) 10 ms^{-2} (ii) 0.1 N 19. 10^{-3} N

EXERCISE # 3

(PREVIOUS YEAR EXAMINATION QUESTIONS)

Q.	1	2	3	4	5	6	7
A.	A	B	A	D	B	C	D

01 SYNTHETIC CLOTHING MATERIAL & POLYMER

Terminologies

Polymer, Polymerisation, Rayon, Nylon, Polyester, Acrylic, Spandex, Koroseal, Blended fibres, Plastic, Melamine, Bakelite, Teflon, PET, HDPE, PVC, LDPE, PP, PS, Biodegradable wastes, Non-biodegradable wastes.

INTRODUCTION

In order to fulfil his needs, man has been able to develop new materials from the materials already existing. This has become possible through the scientific knowledge and development of technology that has been achieved over the years. Scarcity and drawbacks of traditional natural materials has spurred development of new man made materials.

Natural

We obtain natural fibres from raw materials.

- Vegetable origin: cotton.
- Animal origin: wool, silk.
- Mineral origin: asbestos.

Advantatges

- Fabrics are durable
- It can be worn by anyone.

Disadvantatges

- If there are a hot weather is not very pleasant.

Synthetic

Synthetic fibres are plastics. For example: polyester and Lycra.

Characteristics:

- Fibers are extremely strong.
- Very durable.

Advantatges

- It has good elasticity.
- Synthetic fibres can handle heavy loads without breaking

Disadvantatges

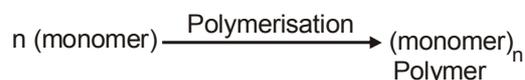
- People have allergies and they can't use this textiles.
- Fabrics accumulate static electricity.
- Some substances can cause irritation.

1.1 POLYMER & POLYMERISATION

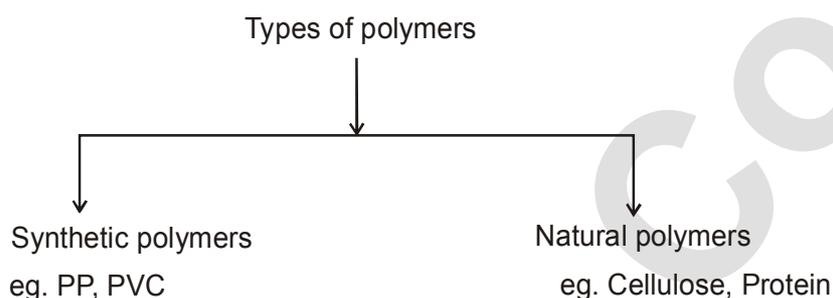
Polymer : A polymer is a compound of high molecular mass formed by combination of a large number of small molecules.

Monomer : The small molecules which constitute the repeating units in a polymer are called monomer units.

Polymerisation : The process by which monomers are transformed into a polymer is called polymerization.



where n is an integer.



In this section, we will study common synthetic polymers -

- (a) Fibres (b) 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.

NOTE :

“poly” means many and “mer” means unit in Latin.

Ask yourself



- 1._ What are the polymer ?
- 2._ What is the functional unit of polymers ?
- 3._ What is the monomer unit of PVC ?
- 4._ What are the monomer units of nylon ?
- 5._ What do you mean by polymerisation ? Give the examples of natural and artificial polymers.

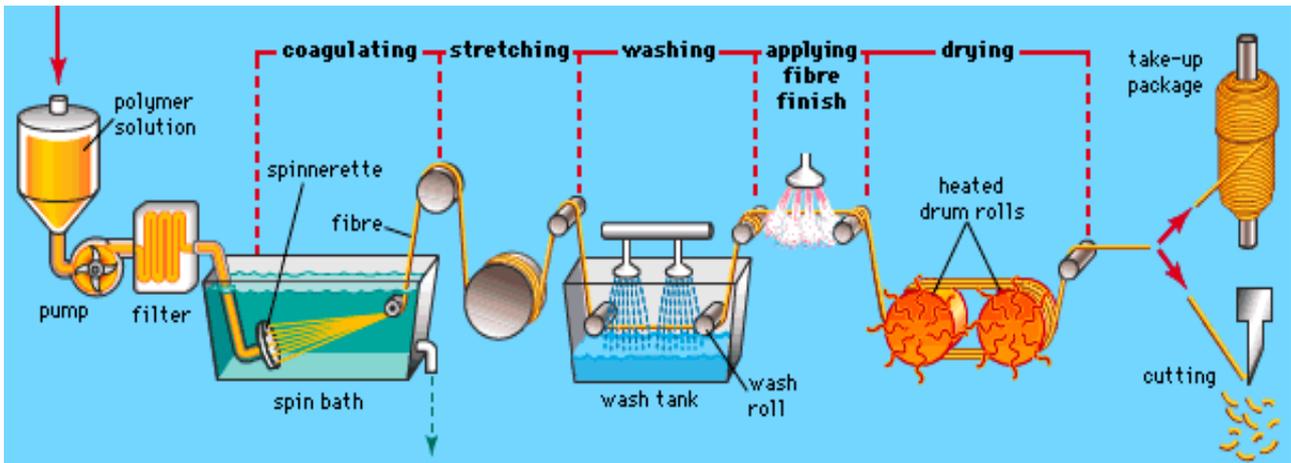
1.2 FIBRES, THEIR TYPES AND PROPERTIES

(a) 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.

To begin with, here is a quick glance at some of the terms and steps associated with fabrics.



Process of formation of Fabric



Some Examples of Synthetic fibres

(b) Types of Fibres :

Fibres may be of three types -

- (i) Natural Fibres
- (ii) Synthetic fibres
- (iii) Semi synthetic fibres

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

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

(ii) Synthetic fibres : Fibres synthesized by human being are known as synthetic fibres. Synthetic fibres are continuous filament fibres.

Example : Nylon, Polyester, Acrylic, Spandex etc.

NOTE :

All synthetic fibres are prepared from raw materials of petroleum origin called 'petrochemicals'.

(iii) Semi synthetic fibres :

Modified natural fibres are known as semi - synthetic fibres.

Example : Rayon or Viscose.

(c) Synthetic clothing material**Some Examples of Synthetic fibres**

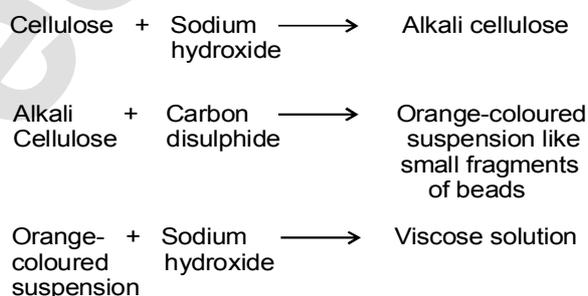
Most synthetic fabrics can be used as clothing material. Nylon, rayon, polyester, acrylic and spandex are some commonly used synthetic clothing fabrics.

(i) Rayon :

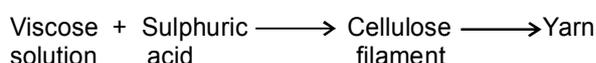
Rayon is the first man-made (semi-synthetic) fibre. It is composed of regenerated cellulose, a component of green plants. It can imitate the feel and the texture of silk, wool, cotton and linen. Rayon was first made in the USA and later on its method of preparation was modified in Europe. The process of making it in Europe is known as **viscose process**. The rayon thus obtained is known as **viscose** in Europe.

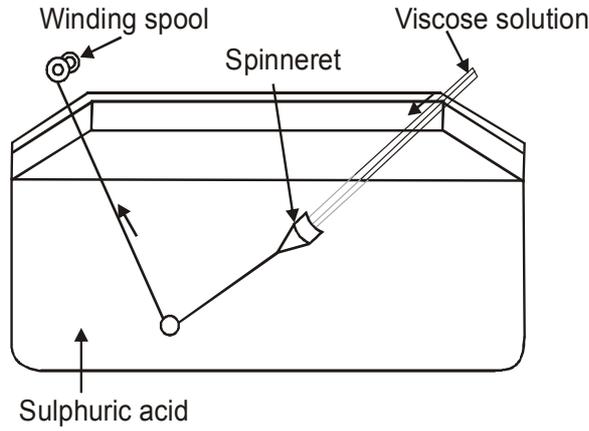
Preparation of Rayon :

The raw material for the preparation of rayon is wood. Wood is changed into wood pulp. The wood pulp is changed into a viscous solution, known as **viscose**, with the help of chemicals.



The viscose solution is then passed through the fine holes of a shower head of a **spinneret** into an acid bath. Finally, these cellulose filaments are spun into rayon yarn.





Production of viscose or rayon yarn

(A) Properties :

- It has tendency to absorb moisture. Because of its tendency to absorb moisture, rayon can absorb sweat. Therefore, it is generally preferred over other synthetic fabrics in summer.
- It is shiny and lustrous and resembles to silk in appearance. So, it is also called artificial silk.

(B) Uses :



Rayon fibres of different colour

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

(ii) Nylon :

It is the first fully synthetic fibre. It was prepared in 1931 using coal, water and air.

(A) Properties : Nylon is a high strength fibre. It is elastic and so does not lose strength even after repeated use. It is one of the light synthetic fibre. It is lustrous and easy to wash.

(B) Uses :

- It is used in making sarees, socks, stockings etc.
- It is blended with wool to increase the strength.

- It is used for making tents, umbrellas, parachutes and tarpaulins.
- Its fibres are used for making tooth brush bristles.
- Due to their high strength and elasticity, nylon threads are used to make fishing nets, climbing ropes, seat belts, sleeping bags and strings in badminton and tennis racquets.



Nylon Fibres used in shaving brushes

NOTE :

Nylon is an acronym obtained from the name of the cities Newyork (NY) and London (LON). Most common nylon is nylon-66. It's monomer units are adipic acid and hexamethylene diamine.

(iii) 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 minimum care.

(A) Properties :

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

(B) Uses :

- Polyester fibres are widely used in textile industry for making a variety of textiles such as sarees, dress materials, curtains etc.
- **Terrywool**, a blend of Terylene (a type of polyester) and wool, is used for making suits.
- **Terrycot**, a blend of Terylene and cotton is commonly used for making skirts, shirts and other dress materials.

- It is light weight and strong. This property makes it suitable for making light weight sails of the boats.
- Terylene is used for making conveyor belts as it is very elastic.
- Polyester films (commonly known as mylar) are also used for making magnetic recording tapes in audio cassettes, video cassettes and floppy discs.

NOTE :

Terylene is also called Dacron or Mylar.

(iv) Acrylic : Acrylic fabric closely resembles to wool in its properties.

(A) Properties : It is warm, soft, light and flexible fibre. Acrylic yarn can be easily knitted. It is cheaper than natural wool and is available in a variety of colours. Resistance to damage by moths and chemical and highly resistance to sunlight.

NOTE :

Acrylic fibre are also known as ORLON or ACRILAN .

(B) Uses :

- Acrylic fibre is used for making sweaters, socks and shawls.
- It is used for making carpets and blankets.
- Car tops, boat covers, filtration material.

(v) Spandex :

(A) Properties : These fibres have excellent elasticity. The high elasticity of these fibres make them suitable for use in clothes that require snug fitting, for example swimming costumes.

- Spandex is mixed with other fibre, such as cotton, to get stretch fabrics, which are used for making T-shirts and caps
- It is the copolymer of polyester and polyurethane.

(B) Uses : It is used in the making of swimming costumes, caps, T-shirts, women wearing laggings, wrestler wearing etc.

NOTE :

Spandex is also known as LYCRA or ELASTANE

(vi) Koroseal :

(A) Properties : Koroseal is water proof as well as air proof. It has a trade name of **high polymer of vinyl chloride**.

(B) Uses : It is used for coating fabrics of silk, rayon or cotton to make them water proof. Water proof fabrics so obtained can be used on rainy days or as bathroom curtains and wall covering.

(vii) Blended fibres :

Mixing of two different fibres results in the formation of blended fibres. More often, a synthetic fibre is mixed with a natural fibre. Two similar fibres, for example, both natural fibres, may also be mixed to form blended fabrics. A few examples of blended fibres are given in table below :

Table : Examples of blended fibres :

Fibres	Blended fibres
Polyester and cotton	Polycot
Polyester and wool	Terry wool
Cotton and wool	Cotswool

On the other hand, polythene and polypropylene are considered to be both macromolecules as well as polymers because they contain a large number of repeating structural units.

Natural and synthetic fibres have their own advantages and disadvantages. For example, natural fibres are comfortable to wear as they retain moisture and breathe. However, they are not very strong. Also, they shrink when washed and are readily attacked by moth.

Synthetic fibres are very strong, do not shrink and are resistant to moth attack, though they are not very comfortable to wear. Hence, the best fibres are obtained by blending two types of fibres which combine the advantages of both and are free from their disadvantages.

(d) Advantages and disadvantages of synthetic fabrics

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

(i) Advantages :

(A) Most synthetic fibres can handle heavy loads without breaking : The ability to withstand loads is due to a property called tensile strength.

(B) Most synthetic fibres are elastic : Elasticity refers to the ability of a material to regain its original shape, after it has been stretched or compressed.

(C) Most synthetic fibres 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 fibres produced is generally soft.

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

(ii) Disadvantages :

(A) Most synthetic fibres can absorb very little moisture. They become sticky when the body sweat. On the other hand, most natural fibres absorb moisture readily. As a result when we sweat, the sweat is not trapped between the fibre and the skin. It keeps on evaporating from the fibre and we feel that our skin can breathe.

(B) Most synthetic fibres melt very easily thus they should not be worn while working in the kitchen and in laboratory. They require very careful ironing.

NOTE :

Ropes made of nylon and polyester are commonly used in cranes and elevators because of their high elasticity and tensile strength.

(e) The structure of various fibres

Materials required :

Fibres of various clothing materials, such as cotton, silk, wool, rayon, nylon, polyester etc.

Procedure : Place fibres on a glass slide and observe them with the help of a magnifying glass (or a microscope)

Record your observations. Can you now explain, why certain clothes are smooth, whereas others are rough to touch ?

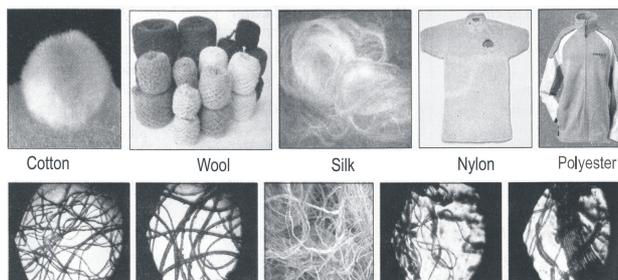
Table : Observations :

Fibre	Structure	Smooth/ Rough to touch
Cotton	Short, uneven, folded, porous	Rough
Wool	Short, uneven, folded, porous	Rough
Silk	Long, even, straight, fine	Smooth
Nylon	Long, even, straight, fine	Smooth
Polyester	Long, even, straight, fine	Smooth

Conclusion : The results show that

- Nylon, silk, polyester are smooth because of long, even, straight and fine structure.
- Cotton and wool are rough because of uneven, folded and porous structure.

Activity Corner



Structure of various fibres

(f) Activity determine effect of flame on different kinds of fibres**Materials required :**

- 10 cm long fibre of (i) Cotton, (ii) Rayon, (iii) Wool, (iv) Silk, (v) Nylon (vi) Polyester (vii) Acrylic
- A spirit lamp or a candle
- Fire-tongs
- A plate made of china clay or glass

Method :

Light the spirit lamp or the candle and place it on the table. Next to it place a plate of china clay or glass. Hold the cotton fibre in the fire-tongs and then hold it over the flame, till it catches fire. Shift the burning fibre over china clay plate and make observations till a small amount of it is left.

Drop this small burning fibre in the china plate.

Repeat the activity with the fibres of other materials. Your observations will be as listed under :

Activity Corner**EFFECTS OF FLAME ON DIFFERENT KINDS OF FIBRES**

	Fibre	Observations
1	Cotton	(i) Burns vigorously producing a large flame. (ii) The smell of burning fibre is like that of burning paper. (iii) Very little ash or beady residue is formed.
2	Rayon	(i) Burns vigorously producing a large flame. (ii) The smell of burning fibre is like that of burning paper. (iii) A hard black globular mass is left behind as residue.
3	Wool	(i) Burns poorly without any flame. (ii) The smell of burning fibre is like that of burning hair. (iii) The residue forms a kind of grey ball along the burning
4	Silk	(i) Burns poorly without any flame. (ii) The smell of burning fibre is like that of burning hair. (iii) The residue swells up to form black ash.
5	Nylon	(i) It melts and burns with difficulty. (ii) The fibre shrinks from flame, forming beady residue. (iii) The smell of burning fibre is like that of burning hair.
6	Polyester	(i) It melts and burns with difficulty and produces black smoke. (ii) The fibre shrinks from flame, forming beady residue. (iii) The smell of burning fibre is like that of burning hair.
7	Acrylic	(i) It produces a sooty flame. (ii) The fibre shrinks from flame forming black beads.

(g) Study of relative tensile strength of different fibres of same thickness and same length**Activity Corner**

Take an iron stand with a clamp. Take a cotton thread of about 60 cm length. Tie it to the clamp so that it hangs freely from it as shown in fig.. At the free end suspend a pan so that weight can be placed in it. Add weight one by one till the thread breaks. Note down the total weight required to break the thread.



An Iron stand with a thread hanging from the clamp

This weight indicates the strength of the fibre. Repeat the same activity with threads of wool, cotton, silk and nylon. Tabulate the data as shown in Table. Arrange the threads in order of their increasing strength.

Table : Observation

S.No.	Type of Thread/Fibre	Weight required to break the Thread
1.	Wool	Minimum
2.	Cotton	More than Wool (75g)
3.	Silk	More than Cotton (150g)
4.	Nylon	Maximum (375g)

You may use a hook or a nail on the wall for hanging the fibres and a polythene bag at the other end. In place of weights you may use marbles (or pebbles) of similar size.

(Precaution : Note that all threads should be of the same length and almost of the same thickness.

Ask yourself



- 1._ What is the monomer unit of polyester ?
- 2._ What are the acrylic fibre ?
- 3._ Give an example of synthetic polymer.
- 4._ What is the other name of terylene ?
- 5._ Which fibre is made up of polyester polyurethane copolymer ?

1.3 PLASTIC

A plastic is a polymeric material which can be easily moulded or set into any desired shape and size.

Types of Plastics :

All plastics do not have same type arrangement of monomer units.

(a) On the basis of structure they are classified as :

(i) **Linear plastics** : The monomer units are joined together to form long straight chains of polymer molecules. These chains are stacked over one another to give a well packed structure.

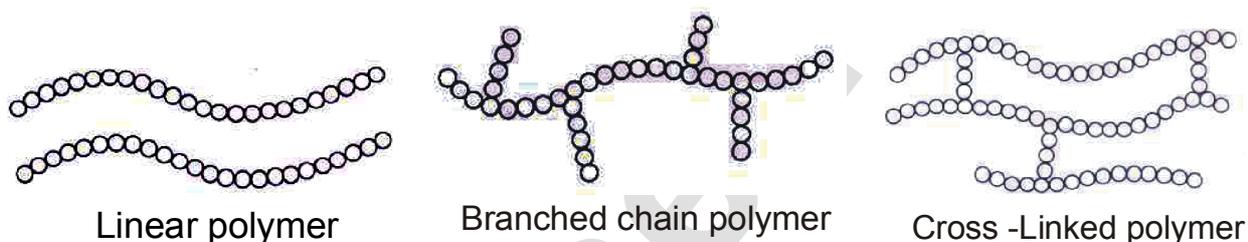
Ex : HDPE, PVC, polythene ,etc.

(ii) **Branched chain plastics** : The monomer units not only combine to produce the linear chain but also form branches of different length along the main chain.

Ex : LDPE, etc.

(iii) **Cross-linked or three dimensional network plastics** : The initially formed linear polymer chains are joined together to form a three - dimensional network structure. These polymers are hard and rigid.

Ex : Bakelite, melamine-formaldehyde etc.



(b) On the basis of their reaction to heat.

(i) **Thermoplastics** : Thermoplastics can be melted by heating and there after moulded into desired shapes and sizes. These plastics soften on heating and become fluids, but on cooling they become hard. These are capable of undergoing such reversible changes on heating and cooling repeatedly. Examples of thermoplastics are polyethene (polyethylene), polyvinylchloride (PVC), polystyrene etc.

(ii) **Thermosetting Plastics** : Thermosetting plastics are harder and stronger than thermoplastics and can retain their shape and size even at high temperature. 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.



We use plastics and synthetic fibres everyday yet these have only been widely used in the past 50 years.



Plastics and synthetic fibres are man-made materials, this is why they are called SYNTHETIC



Plastics are generally cheap to produce and have very useful properties such as lightness strength and durability



In addition, plastics are easily moulded into a variety of shapes and are excellent insulators of both heat and electricity.

Melamine : Melamine is a thermosetting polymer. It is hard and a high polish polymer. Melamine is used for making unbreakable dinner-ware, and decorative objects.

Bakelite : Bakelite is also a thermosetting polymer. Once set into a shape, bakelite does not melt/soften and retains its shape. Bakelite is obtained by reacting phenol with formaldehyde in the presence of a catalyst.

Properties :

- Bakelite is hard and stiff.
- Bakelite is an insulator.

Bakelite is used :

- for making electrical switches and plugs.
- for making gear wheels and table top laminates.
- for making combs, fountain pen bodies, phonograph records.

NOTE :

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

(c) General Properties of Plastics :

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

(i) Thermal Conductivity : 'Thermal' means 'heat'. Plastics (like bakelite etc.) are poor conductors of heat. This is why they are used -

- for making handles of cooking containers.
- in refrigerators (as plastic foam core) to prevent heat from outside to enter inside.
- in the thermal innerwear that people wear in extreme winters.
- for making containers and films used in microwaves ovens.

(ii) 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.

(iii) 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 for drinking water.

(iv) Effect of Flame : Plastic polybags melting on accidentally coming in contact with a hot pan. This happens because plastics are inflammable.

(v) 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.

(vi) Plastics are light, strong, durable and can be moulded in any desired shape and size.

(d) General Characteristics of Plastics

The plastics can be easily moulded. Following are the characteristics of plastics :

i. Chemical resistance : Plastics are hardly affected by strong chemicals such as acids and alkalis. Contrary to it, all natural fibres such as cotton, wool, jute, silk, wood cellulose, etc. are affected by acids and alkalis.

ii. Weather resistance : Plastics are non biodegradable, i.e., they do not affected by weather unlike natural fibres, such as cotton, wool, etc.

iii. Light weight : Plastic materials weigh far less as compared to natural fibres materials, such as wool, jute, etc.

iv. Toughness or Tensile strength : Plastics can withstand lot of force without getting broken. For example, a thread of plastic can withstand a lot of weight as compared to a thread of cotton of same thickness.

v. Insulation : Plastic materials are far better with respect to heat and electrical insulation. It is for the same reason that electric wires are covered with plastic insulation rather than cotton or silk insulation.

vi. Appearance : Plastic material can be made as transparent as glass. Furthermore, they can be used for making large variety of household products.

(e) 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 :

Monomer	Plastic (Polymers)	Uses
Ethylene glycol and terephthalic acid	PET (Poly Ethylene terephthalate)	Containers for microwave cooking, carbonated beverage bottles and other food containers.
Ethylene or Ethene (C ₂ H ₄)	HDPE (High Density PolyEthylene)	For packaging strong and corrosive household and industrial chemicals like bleaches, acids and liquid detergents.
Vinyl Chloride (CH ₂ =CH-Cl)	PVC (PolyVinyl Chloride)	PVC pipes for sanitary fittings (such as water pipes).
Ethylene or Ethene (C ₂ H ₄)	LDPE (Low Density PolyEthylene)	Polybags, grocery bags and packages of frozen foods and bread.
Propylene or Propene (CH ₂ =CH-CH ₃)	PP (PolyPropylene)	Ketchup bottles, yoghurt containers, medicine bottles, automobile battery casings.
Styrene or Vinyl benzene (CH ₂ =CH-C ₆ H ₅)	PS (Polystyrene)	Thermocol, a form of PS, is used for making disposable cups and packaging material for fragile items like computers and televisions.

Teflon :

Teflon is the brand name of polytetrafluoroethylene (PTFE). Its monomer unit is tetrafluoro ethylene (CF₂ = CF₂) Teflon coatings are widely used in nonstick cooking pans and other cookwares. Teflon does not stick to materials easily and has a high melting point which makes it effective for the use in pans for easy cooking and cleaning. Teflon is a type of plastic discovered by US based company DuPont in 1938.

NOTE :

Although plastic catch fire easily, yet there are some fire-proof synthetic plastic, like melamine, which are used to coat the uniforms of firemen to make them fire resistant.

Ask yourself

- 1._ What is the monomer unit of polythene ?
- 2._ Why melamine is called thermosetting plastics ?
- 3._ Which material is used in making kitchen utensil ?
- 4._ Why bakelite is used in preparation of handle of cooking utensil ?
- 5._ Write uses of LDPE ?

1.4 TYPES OF WASTES

Waste materials are of two types :

(a) Biodegradable

(b) Non - biodegradable

(a) Biodegradable wastes :

Waste materials which can be decomposed into simpler and less harmful substances through natural processes, like action of micro - organisms are called biodegradable wastes. Different biodegradable wastes take different time to degenerate. Some examples of biodegradable wastes with the approximate time taken by them to degenerate are given below :

- Cotton cloth - 2 to 5 months
- Woollen clothes - about an year
- Kitchen wastes - 1 to 2 weeks
- Paper - 10 to 30 days
- Wood - 10 to 15 years

(b) Non - biodegradable wastes :

Waste materials which are not easily decomposed by natural resources are called non - biodegradable wastes.

e.g. Metal cans like those of tin, aluminium etc. take about 100 to 500 years to degenerate, plastic bags take several years to degenerate.

Problems Associated with Plastic Disposal :

Despite of the many different uses of plastics, there are environmental and health hazards associated with their disposal. This is because plastics are non-biodegradable, i.e. they cannot be decomposed by micro-organism. Accumulation of plastics is considered a serious problem because most of the methods used to dispose them result in some type of pollution to the environment.

For e.g.

(i) If plastics are buried in soil, they cannot be decomposed by micro-organisms. This prevents rain water from seeping into earth. The water thus remains on the earth's surface, forming muddy puddles. This also affects the plants growing in the area as they do not get enough water from the soil.

(ii) Plastic wastes may end up in littering roadsides, floating in lakes and streams and collecting in ugly dumps. These provide homes for many disease - causing germs.

(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 :

We can use two methods to reduce the hazards associated with the disposal of plastic waste.

(i) Reducing the usage of plastics.

Avoid the use of plastics as far as possible. Make use of bags made of cotton or jute when you go for shopping. The biodegradable and non-biodegradable wastes should be collected separately and disposed off separately.

(ii) Recycling of plastics.

Recycling of plastic involves collecting, sorting and processing plastic waste with an aim to reuse the material in manufacturing other products.

e.g. Polyester soft drink bottles could be melted down and the resulting molten material could be spun into fibres.

Two types of bins are made available by the municipality - a green bin and a blue bin to aid recycling of plastic garbage. Biodegradable wastes such as food items should be thrown into the green bin. Recyclable wastes such as plastic and glass, which cannot be degraded by microorganisms should be thrown into the blue bin.

NOTE :

4 R principle : As a responsible citizen remember the 4 R principle. Reduce, Reuse, Recycle and Recover. Develop habits which are environment friendly.

(i) Scientists all over the world are trying to produce biodegradable (decomposed by micro-organisms) and photodegradable (decomposes in the presence of sunlight) plastics. Some example of biodegradable plastic are starch based biopolymer, Polyhydroxyalkanoates (PHA's) like Poly-3-hydroxy butyrate (PHB)

(ii) 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.

**To show that thermosetting plastic is poor conductor of heat****Activity Corner**

- **Material required :** Sauce pan with a bakelite handle, water, gas stove, sauce pan made of steel with a steel handle
- **Procedure**
 - Fill the stainless steel sauce pan, having steel handle half with water and keep it on a gas stove for five minutes. Put the gas off and try to touch the steel handle carefully.
 - Fill the steel sauce pan, with bakelite handle, half with water and keep it on a gas stove for five minutes. Put the gas off and try to touch the bakelite handle carefully.
- **Observations :** It is difficult to remove the first sauce pan since the handle gets heated up. The second sauce pan can be touched and removed easily since does not get heated up.
- **Conclusion :** Bakelite is a thermosetting plastic which is poor conductor of heat.

Ask yourself _____

- 1._ Which pollutant is responsible for ozone hole ?
- 2._ Why recycling is the best solution to get rid of non biodegradable waste ?
- 3._ What is the monomer unit of polystyrene ?
- 4._ What is the brand name of PTFE ?
- 5._ Give the examples of biodegradable and non-biodegradable wastes.



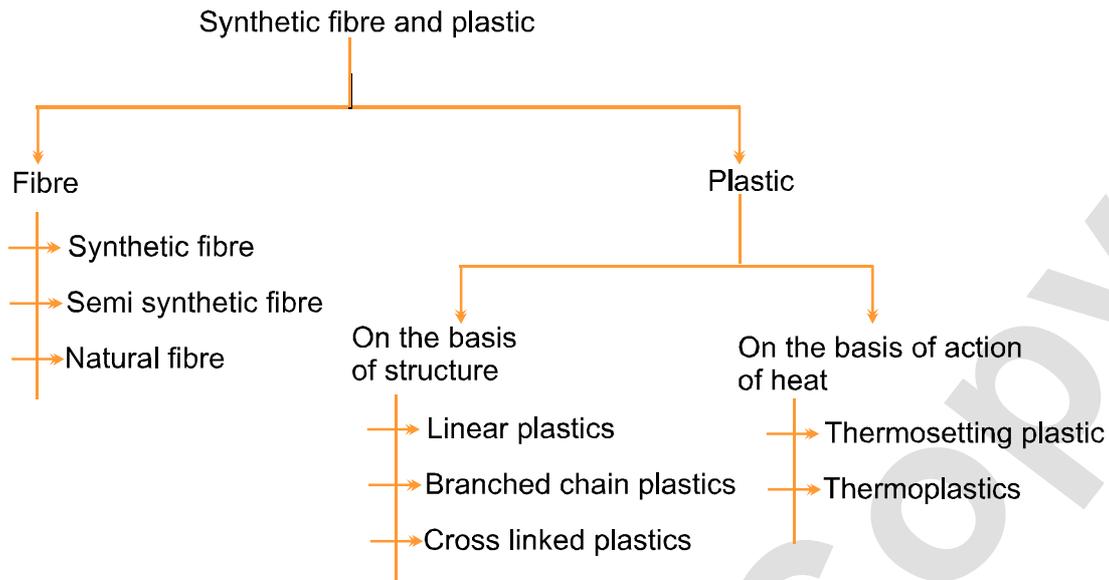
Add to Your Knowledge _____

- Fibre manufacture is classified according to the type of spinning that the polymer liquid undergoes : melt spinning, dry spinning, or wet spinning.
- High density polythylene (HDPE) is a polythylene thermoplastic made from petroleum. It is sometimes called 'alkaline' or 'polythene' when used for pipes with a high strength-to-density ratio, HDPE is used in the production of plastic bottles, corrosion resistant piping etc.
- Bakelite is an early plastic. It is a thermosetting phenol formaldehyde resin, formed from a condensation reaction of phenol and formaldehyde.
- Spandex or lycra or elastane is a synthetic fiber known for its exceptional elasticity. It is stronger and more durable than natural rubber. It is polyether-polyurea copolymer (polyurethane) that was invented in 1958 by chemist Joseph shivers.
- Plastics have many used in the medical field as well to include polymer in plants, however the field of plastic surgery is not named for use of plastic materials but rather the more generic meaning of the word plasticity with regard to the reshaping of flesh.
- Melamine is an organic base and a trimer of cynamide with 1, 3, 5-triazine skeleton.

Summary _____

- $\frac{24}{12}$ A synthetic fibre consists of multiple units joined together to form a single unit called a polymer.
- $\frac{24}{12}$ Rayon, nylon, polyester, acrylic, and spandex are some examples of synthetic fibres.
- $\frac{24}{12}$ Like synthetic fibres, plastics are also polymers. In plastics, arrangement of individual units may be linear or cross linked.
- $\frac{24}{12}$ Since most plastics can be moulded into any shape after heating, they can be used for making a variety of objects of different shapes and sizes.
- $\frac{24}{12}$ Some important types of plastics are PET, HDPE, LDPE, PVC, PP, and PS.
- $\frac{24}{12}$ Plastics are poor conductors of heat and electricity, are insoluble in water, inflammable, and do not corrode or rust.
- $\frac{24}{12}$ Disposal of plastic is considered an environmental hazard because plastics are non-biodegradable substances.
- $\frac{24}{12}$ Reducing the usage of plastics and recycling plastic objects are two ways of countering the harmful effects associated with plastic disposal.
- $\frac{24}{12}$ **Fastskin** : It is a stretch fabric made up of polyester & lycra. Body suit made of fastskin helps swimmers to go through water faster.
- $\frac{24}{12}$ **Insulating plastic** : Mylar is a plastic used to insulate space shuttles. It reflects the intense heat generated when a space shuttle re-enters Earth's atmosphere protecting the craft and its crew.
- $\frac{24}{12}$ **Nylon-6** is also known 'Polyamide' its monomer is caprolactum.

CONCEPT MAP



EXERCISE >> 01

SECTION -A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS :

- 1._ Plastics and synthetic fibres are made of large units called as -
 (A) nylon. (B) rayon. (C) monomers. (D) polymers.
- 2._ The monomer units of the rayon are
 (A) cellulose (B) fructose (C) glucose (D) maltose
- 3._ Which of the following is classified as polyester polymer
 (A) Nylon -66 (B) Terylene (C) Bakelite (D) Melamine
- 4._ Which polymer occur naturally :
 (A) Starch and nylon (B) Starch and cellulose
 (C) Protein and nylon (D) Protein and PVC
- 5._ The natural polymer which contain glucose units :
 (A) cellulose (B) protein
 (C) fats (D) none of these
6. Which of the following is a natural fibre?
 (A) Polyethylene (B) PVC (C) Nylon (D) Wool

7. is an example of synthetic fibre.
 (A) Wool (B) Cotton (C) Polyester (D) Silk
8. Which of the following fibres is also known as artificial silk ?
 (A) Nylon (B) Rayon (C) Polyester (D) Spandex
9. Which of the following is not a polyester fibre ?
 (A) Terylene (B) Styrene (C) Terrycot (D) Terrywool
10. Which of the following fabrics closely resembles to wool in its properties ?
 (A) Orlon (B) Acrilan (C) Acrylic (D) All of these
11. The fibre which is used as a substitute of wool is-
 (A) rayon (B) nylon (C) acrylic (D) polyester
12. Polycot is made by blending polyester with
 (A) wool (B) terylene (C) rayon (D) cotton
13. The fibre obtained from plant is -
 (A) silk (B) wool (C) cotton (D) nylon
14. The synthetic fibre that burns with a smell of burning paper is -
 (A) acrylic (B) polyester (C) nylon (D) rayon
15. Which of the following plastics is used in the making of thermocol ?
 (A) Polyethylene (B) High density polyethylene
 (C) Polypropylene (D) Polystyrene
16. To identify the type of plastic a specific number is allotted to plastic products. This number represent -
 (A) durability of plastic product (B) electrical conductivity of plastic product
 (C) thermal resistance of plastic product (D) recycling of plastic product
17. Which of the following is used in automobile battery casings?
 (A) HDPE (B) PP (C) PVC (D) Polyester
18. Which out of the following is used for making disposable cups?
 (A) LDPE (B) PS (C) PP (D) PVC
19. Which of the following plastic is a thermosetting plastic ?
 (A) PVC (B) Polystyrene (C) Polyethylene (D) Bakelite
20. Non-stick cookwares have the coating of-
 (A) PET (B) teflon (C) acrylic (D) melamine
21. PVC (Poly vinyl chloride) and Polythene are -
 (A) thermosetting plastics (B) thermoplastics
 (C) natural fibres (D) synthetic fibres
22. Uniform of fireman is coated with -
 (A) teflon (B) rayon (C) PVC (D) melamine

23. The property due to which plastic is found in all shapes that it is -
 (A) reusable (B) recyclable (C) mouldable (D) stretchable
24. The material suitable to make buckets is -
 (A) iron (B) brass (C) wood (D) plastic
25. One of the best solution to get rid of non -biodegradable wastes is _____
 (A) burning (B) dumping (C) burying (D) recycling
26. Which of the following is / are non biodegradable waste :
 (A) Metal (B) Diamond (C) Plastic toys (D) All
27. Which of the following is / are biodegradable waste :
 (A) Steel (B) Nylon (C) Jute (D) Stone
28. Detergents are the :
 (A) Biodegradable (B) Non-biodegradable
 (C) Recyclable (D) None of these
29. Non biodegradable materials are the things which can
 (A) broken down easily by natural process
 (B) not broken down easily by natural process
 (C) both (A) and (B)
 (D) None of these

FILL IN THE BLANKS

- Synthetic fibres are also called as _____ fibres.
- _____ is the first synthetic thermosetting pastics.
- _____ does'nt stick to the material and can be easily used in non-stick pans and other cookware.
- _____ is a natural fibre, with continuous filaments which can stretch upto 1 km.
- _____ is the first artificial fibre synthesized by human beings.
- _____ and _____ are obtained from cotton plant and sheep.
- _____ is a thread or filament from which cloth is made
- _____ is spun thread used for sewing, weaving or knitting.
- Plastics are _____ in water.
- These substances are capable of moulding and casting into various shapes and sizes _____ .

TRUE / FALSE

1. Natural fibres are obtained from plants and animals where as synthetic fibres are obtained by chemical processing of petrochemicals.
2. Plastics are eco-friendly.
3. Teflon is special plastic on which oil and water do not stick.
4. Plastics are generally good conductors of electricity.
5. PVC is mainly used for electrical and sanitary fittings.
6. Cooking pans have plastic handles.
7. Ropes made by Rayon are used in cranes and elevators.
8. Fabric is the material produced by weaving of knitting yarn fibres.
9. Polystyrene and PVC are thermoplastics.
10. Nylon has high elasticity and tensile strength.

MATCH THE COLUMN

Column-I

1. Polyester
2. Spandex
3. Nylon
4. Rayon
5. Acrylic

Column-II

- p. Sarees, dresses, suits, jacket, shirts etc.
- q. Sweaters, socks, shawls.
- r. Shirts, tyres, lining
- s. Sarees, socks, stocking etc.
- t. Swimming costumes, caps, T-shirts

SECTION -B (FREE RESPONSE TYPE)

SUBJECTIVE QUESTIONS

VERY SHORT ANSWER TYPE

1. Give two examples each of natural and synthetic fibre.
2. What are the sources of raw materials for synthetic fibre ?
3. Name the man made fibre made of wood pulp.
4. What are natural fibres ?
5. Give other name of spandex ?
6. Who discovered bakelite ?
7. Write the brand name of poly tetra fluoro ethylene.?
8. Why teflon is used in making non-stick cooking pans ?
9. Why is it dangerous to leave plastic bags near a burning gas stove ?
10. What is the full form of LDPE ?

EXERCISE >> 02**SECTION -A (COMPETITIVE EXAMINATION QUESTION)****MULTIPLE CHOICE QUESTIONS**

- 1._ Why is rayon used as a fabric for dress materials ?
a. soft b. silky c. moisture absorbent
(A) a and b only (B) b and c only (C) c and a only (D) a, b and c
- 2._ Which of the following is made by mixing two types of fibres ?
(A) Cotton (B) Polywool (C) Rayon (D) Nylon
- 3._ Handles of saucepan are made of
(A) thermoplastics. (B) acrylic.
(C) thermosetting plastic. (D) polyester.
- 4._ Arrange the following threads in order of their increasing strength assuming all threads are of some length and almost same thickness :
(A) cotton < wool < silk < nylon (B) cotton < silk < wool < nylon
(C) silk < cotton < wool < nylon (D) silk < wool < cotton < nylon
- 5._ Which of the following properties of synthetic plastic makes it the most convenient to use ?
(A) Good electrical conductor (B) Malleable
(C) Light, strong and remouldable (D) Reactive
6. On the basis of following features identify the correct fabric :
I. It is prepared by condensation polymerisation of two monomers.
II. It is very durable and can be recycled.
III. It is used in making curtain, draperies and magnetic recording tapes.
IV. The fabric have two common names.
(A) Nylon (B) Rayon (C) Polyester (D) Acrylic
- 7._ Which of the following is correct about blended fabrics :
(A) They are less expensive
(B) They have combined properties of each fibre
(C) They are made by blended synthetic of each fabric
(D) All of the above

SECTION -B TECHIE STUFF

1. Give examples to show that plastic are non corrosive in nature.
2. Name the monomers units to obtain bakelite which is a thermosetting plastic.
3. What is melamine. How it is obtained ?
4. What is spandex and how it is obtained ?
5. Polymer is prepared in the laboratory by which methods ?

EXERCISE >> 03**SECTION -A (PREVIOUS YEAR EXAMINATION QUESTIONS)**

1. Rayon or artificial silk is obtained from : **[NSO 2015]**
 (A) cocoon (B) petroleum (C) silk fibre (D) wood pulp
2. Artificial (man made) wool is known by the name : **[NSO 2015]**
 (A) rayon (B) acrylic (C) polycot (D) none of these
3. Which type of cloth dries faster in rainy season ? **[NSO 2015]**
 (A) Rayon (B) Wool (C) Polyester (D) Silk
4. What cloth should you wear while cooking in the kitchen ? **[NSO 2015]**
 (A) Rayon (B) Cotton (C) Polyester (D) Polycot
5. Which of the following is NOT true ? **[NSO 2015]**
 (A) Thermosetting plastic are bad conductors of heat and electricity
 (B) Thermoplastics are good conductor of heat and electricity
 (C) Plastic do not get corroded easily
 (D) Plastic is also a polymer
6. Which of the following is a property of plastic : **[NSO 2015]**
 (A) flame resistant (B) noncorrosive (C) mouldable (D) all of the above
7. To which of following 4R principle apply most ? **[NSO 2015]**
 (A) Synthetic fibre (B) Natural fibre (C) Metals (D) Plastic
8. Which of the following material take the longest to degenerate : **[NSO 2015]**
 (A) paper (B) cotton cloth (C) tin can (D) plastic bags
9. We should not wear polyester clothes while working in kitchen because : **[NSO 2011]**
 (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
10. Match Column-I with Column-II and select the correct option from the codes given below. **[NSO 2012]**
- | Column-I | Column-II |
|---|--------------|
| (i) A synthetic fibre obtained from cellulose | (p) Acrylic |
| (ii) A synthetic fibre used for making woollen clothes | (q) Nylon |
| (iii) A thermosetting plastic | (r) Rayon |
| (iv) This polymer is used for making ropes and fishing nets | (s) 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)
11. Sakshi wants to test the quality of her dupatta. She pulled a small strand of yarn from the dupatta and burned it. It smelled like a burning plastic. She inferred that the dupatta is made of **[NSO 2012]**
 (A) Pure wool (B) Nylon (C) Pure silk (D) Cotton

- 12.** Solve the following riddles by identifying X, Y and Z. **[NSO 2013]**
 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. | Melamine. | PET |
- 13.** Match the articles given in Column-I with the fibres/plastics from which they are made in Column-II. **[NSO 2014]**
- | 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) |
- 14.** The characteristics of different fibres are listed as **[NSO 2016]**
 W : I am strong, elastic, light and burn slowly. 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.

ANSWER KEY >>**EXERCISE # 1****SECTION -A (FIXED RESPONSE TYPE)****MULTIPLE CHOICE QUESTIONS :**

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

FILL IN THE BLANKS

1. Filament 2. Bakelite 3. Teflon 4. Silk 5. Nylon
6. Cotton, wool 7. Rayon 8. Yarn 9. Insoluble 10. Thermoplastic

TRUE / FALSE

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

MATCH THE COLUMN

1 → p, 2 → t, 3 → s, 4 → r, 5 → q

SECTION -B (FREE RESPONSE TYPE)**SUBJECTIVE ANSWERS****VERY SHORT ANSWER TYPE**

2. Petrochemicals 3. Rayon 5. Lycra
6. Leo baekeland 7. Teflon 10. Low density poly ethylene

EXERCISE # 2**SECTION -A (COMPETITIVE EXAMINATION QUESTION)****MULTIPLE CHOICE QUESTIONS**

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

EXERCISE # 3**(PREVIOUS YEAR EXAMINATION QUESTIONS)**

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.	D	B	C	B	B	D	D	C	C	B	B	D	C	D

Terminologies

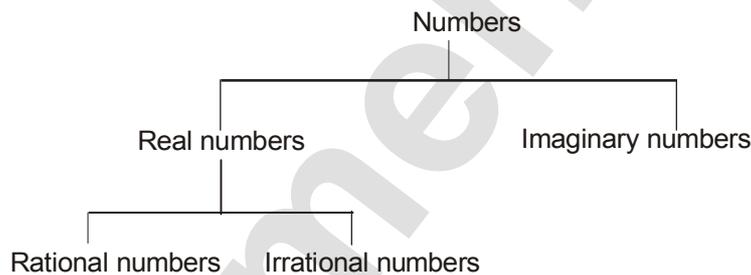
Real numbers, composite numbers, natural numbers, whole numbers, integers, prime numbers, rational numbers, terminating, non-terminating and repeating, recurring decimal, decimal representation, lowest form, number line, absolute value, HCF, LCM, ascending, descending, closure, commutative, associative, additive identity, additive inverse, multiplicative identity, multiplicative inverse, distributive law, division algorithm, dividend, divisor, quotient, remainder.

INTRODUCTION

We will discuss rational numbers, their representation on the number line, various operations on rational numbers and insertion of rational numbers between given rational numbers .

1.1 RATIONAL NUMBERS

Numbers are basically of 2 types : Real numbers & Imaginary numbers.



(a) Real Numbers

These are the numbers which can represent actual physical quantities in a meaningful way. These can be represented on the number line. Number line is geometrical straight line with arbitrarily defined zero (origin).

(b) Natural numbers

Counting numbers are known as **natural numbers**. $\mathbf{N} = \{ 1, 2, 3, 4, \dots \}$.

(c) Whole numbers

All natural numbers together with 0 form the collection of all **whole numbers**.

$$\mathbf{W} = \{ 0, 1, 2, 3, 4, \dots \}.$$

(d) Prime Numbers

All natural numbers that have one & itself as their only two distinct factors are **prime numbers** i.e. prime numbers are exactly divisible by 1 and themselves. **For example** : 2, 3, 5, 7, 11, 13, 17, 19, 23, etc...

(e) Composite number

All natural numbers except 1, which are not prime are composite numbers.

For example : 4, 6, 9, 10 etc

❖ **REMARK** : 1 is neither prime nor composite number.

(f) Integers

All natural numbers, 0 and negative of natural numbers form the collection of all **integers**.

I or **Z** = { ..., -3, -2, -1, 0, 1, 2, 3, ... }.

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.

Illustration 1.1

Is 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.

(g) Rational Numbers

Numbers that can be expressed in the form $\frac{p}{q}$, where q is a non-zero integer and p is any integer are called **rational numbers**.

Each of the numbers $\frac{2}{3}$, $\frac{-5}{7}$, $\frac{-11}{-5}$, $\frac{7}{-9}$ is a rational number.

(i) Definition :

Numbers that can be expressed in the form $\frac{p}{q}$, where q is a non-zero integer and p is any integer are called **rational numbers**.

Each of the numbers $\frac{2}{3}$, $\frac{-5}{7}$, $\frac{-11}{-5}$, $\frac{7}{-9}$ is a rational number.

(ii) 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 $\frac{2}{3}$, $\frac{5}{9}$, $\frac{-7}{-12}$, $\frac{-3}{-11}$ is a positive rational number.

(iii) Negative Rational Number

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

$$\frac{-3}{7}, \frac{5}{-9}, \frac{-15}{26}$$

(iv) Decimal representation of rational numbers

• **Terminating decimals** :- Let x be a rational number whose decimal expansion terminates.

Then x can be expressed in the form of $\frac{p}{q}$ and prime factorization of q is of the form $2^m \times 5^n$, where m, n are non negative integers.

For example : $\frac{1}{2} = 0.5$, $\frac{3}{20} = 0.15$ etc.

• **Non terminating and Repeating (recurring decimal) :-** Let $x = \frac{p}{q}$ be a rational number, such that the prime factorization of q is not of the form $2^m \times 5^n$, where m, n are non negative integers. For example $\frac{2}{3} = 0.6666\dots = 0.\overline{6}$, $\frac{5}{11} = 0.4545\dots = 0.\overline{45}$

(v) Lowest Form of a Rational number

Definition : A rational number $\frac{p}{q}$ is said to be in the lowest form or simplest form if p and q have no common factor other than 1.

Every rational number can be put in the lowest form using the following steps :

Step I : Obtain the rational number $\frac{p}{q}$.

Step II : Find the HCF of p and q say m .

Step III : If $m = 1$, then $\frac{p}{q}$ is in lowest form.

Step IV : If $m \neq 1$, then $\frac{p \div m}{q \div m}$ is the lowest form of $\frac{p}{q}$.

Illustration 1.2

Express each of the following rational numbers to the lowest form.

(i) $\frac{12}{16}$ (ii) $\frac{-60}{72}$

Sol. (i) We have,

$$12 = 2 \times 2 \times 3 \text{ and } 16 = 2 \times 2 \times 2 \times 2$$

$$\therefore \text{HCF of } 12 \text{ and } 16 \text{ is } 2 \times 2 = 4.$$

So, $\frac{12}{16}$ is not in lowest form.

Dividing numerator and denominator by 4, we have

$$\frac{12}{16} = \frac{12 \div 4}{16 \div 4} = \frac{3}{4}$$

$$\therefore \frac{3}{4} \text{ is the lowest form of } \frac{12}{16}.$$

(ii) We have

$$60 = 2 \times 2 \times 3 \times 5 \text{ and } 72 = 2 \times 2 \times 2 \times 3 \times 3$$

$$\therefore \text{HCF of } 60 \text{ and } 72 \text{ is } 2 \times 2 \times 3 = 12.$$

Dividing numerator and denominator by 12.

$$\therefore \frac{-60}{72} = \frac{-5}{6}.$$

NOTE:

(i) Two rational numbers are equal, if they have the same standard form.

(ii) If $\frac{x}{y}$ is a rational number and m is any non-zero integer, then $\frac{x}{y} = \frac{x \times m}{y \times m}$.

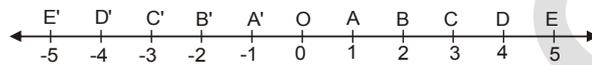
For example : $\frac{3}{8} = \frac{3 \times 4}{8 \times 4} = \frac{12}{32}$.

(iii) If $\frac{x}{y}$ is a rational number and m is a common divisor of x and y , then $\frac{x}{y} = \frac{x \div m}{y \div m}$

For example : $\frac{-27}{45} = \frac{(-27) \div 3}{45 \div 3} = \frac{-9}{15} = \frac{(-9) \div 3}{15 \div 3} = \frac{-3}{5}$.

(vi) Representation of a rational number on a real number line

Draw any line. Take a point 0 on it. Call it 0 (zero). Set off equal distances on the right as well as on the left of 0. Such a distance is known as a unit length. Clearly, the points A, B, C, D, E represent the integers 1, 2, 3, 4, 5 respectively and the points A', B', C', D', E', represent the integers -1, -2, -3, -4, -5 respectively.



Thus, we may represent any integer by a point on the number line. Clearly, every positive integer lies to the right of 0 and every negative integer lies to the left of 0. Similarly, we can represent rational numbers.

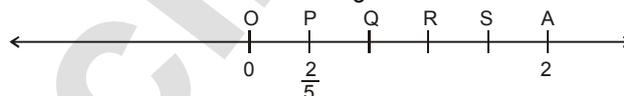
Illustration 1.3

Represent

(a) $\frac{2}{5}$ (b) $\frac{-7}{3}$ on the number line.

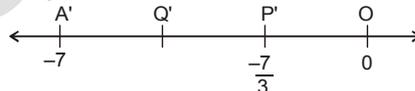
Sol. (a) Draw a number line. Mark a point O to represent 0 and another point A to represent the distance 2 units. Divide, OA into 5 equal parts (equal to the denominator of $\frac{2}{5}$), at P, Q, R and S.

The point P represents the rational number $\frac{2}{5}$.



(b) Draw a number line Mark a point O to represent 0 and a point A' at a distance of 7 units on the left of O to represent -7. Divide OA' into 3 equal parts at P' and Q'.

The point P' represents $\frac{-7}{3}$



(vii) Absolute value

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

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

Illustration 1.4

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

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

But $\frac{5}{15} < \frac{13}{15}$. Hence $|x + y| \leq |x| + |y|$ is true in this case.

Illustration 1.5

Verify that $|x \times y| = |x| \times |y|$ by taking $x = \frac{-5}{3}$, $y = \frac{7}{9}$

Sol. $|x \times y| = \left| \left(\frac{-5}{3} \times \frac{7}{9} \right) \right| = \left| \frac{-35}{27} \right| = \frac{35}{27} \Rightarrow |x| \times |y| = \left| \left(\frac{-5}{3} \right) \right| \times \left| \frac{7}{9} \right| = \frac{5}{3} \times \frac{7}{9} = \frac{35}{27}$

$$\therefore |x \times y| = |x| \times |y|$$

(viii) Comparing two rational numbers

Comparing two rational numbers : In order to compare any two rational numbers, we can use the following steps :

Step I : Obtain the given rational numbers.

Step II : Write the given rational numbers so that their denominators are positive.

Step III : Find the LCM of the positive denominators of the rational numbers obtained in step II

Step IV : Express each rational number (obtained in step II) with the LCM (obtained in step III) as common denominator.

Step V : Compare the numerators of rational numbers obtained in step IV. The number having greater numerator is the greater rational number.

Illustration 1.6

Which of the two rational numbers $\frac{3}{5}$ and $\frac{-2}{3}$ is greater ?

Sol. Clearly, $\frac{3}{5}$ is a positive rational number and $\frac{-2}{3}$ is a negative rational number. We know that every positive rational number is greater than every negative rational number.

$$\therefore \frac{3}{5} > \frac{-2}{3}$$

Illustration 1.7

Which of the two rational numbers $\frac{5}{7}$ and $\frac{3}{5}$ is greater ?

Sol. Clearly, denominators of the given rational numbers are positive. The denominators are 7 and 5. The LCM of 7 and 5 is 35. So, we first express each rational number with 35 as common denominator.

$$\therefore \frac{5}{7} = \frac{5 \times 5}{7 \times 5} = \frac{25}{35} \text{ and } \frac{3}{5} = \frac{3 \times 7}{5 \times 7} = \frac{21}{35}$$

Now, we compare the numerators of these rational numbers.

$$\therefore 25 > 21 \Rightarrow \frac{25}{35} > \frac{21}{35} \Rightarrow \frac{5}{7} > \frac{3}{5}$$

Illustration 1.8

Arrange the rational numbers $\frac{-7}{10}, \frac{5}{-8}, \frac{2}{-3}$ in ascending order.

Sol. First write the given rational numbers so that their denominators are positive.

We have,

$$\frac{5}{-8} = \frac{5 \times (-1)}{-8 \times (-1)} = \frac{-5}{8} \text{ and } \frac{2}{-3} = \frac{2 \times (-1)}{-3 \times (-1)} = \frac{-2}{3}$$

Thus, the given rational numbers with positive denominators are $\frac{-7}{10}, \frac{-5}{8}, \frac{-2}{3}$.

Now, LCM of the denominators 10, 8 and 3 is : $2 \times 2 \times 5 \times 2 \times 3 = 120$

Write the numbers so that they have a common denominator 120 as follows :

$$\frac{-7}{10} = \frac{-7 \times 12}{10 \times 12} = \frac{-84}{120}, \frac{-5}{8} = \frac{-5 \times 15}{8 \times 15} = \frac{-75}{120} \text{ and } \frac{-2}{3} = \frac{-2 \times 40}{3 \times 40} = \frac{-80}{120}$$

Comparing the numerators of these numbers, we get

$$-84 < -80 < -75$$

$$\therefore \frac{-84}{120} < \frac{-80}{120} < \frac{-75}{120} \Rightarrow \frac{-7}{10} < \frac{-2}{3} < \frac{-5}{8} \Rightarrow \frac{-7}{10} < \frac{2}{-3} < \frac{5}{-8}$$

Ask yourself

1. A number which can be expressed as $\frac{p}{q}$ where p and q are integers and $q \neq 0$ is
(A) natural number (B) whole number (C) integer (D) rational number
2. A number of the form $\frac{p}{q}$ is said to be a rational number if
(A) p and q are integers (B) p and q are integers and $q \neq 0$.
(C) p and q are integers and $p \neq 0$. (D) p and q are integers and $p \neq 0$ also $q \neq 0$.
3. The reciprocal of any rational number $\frac{p}{q}$, where p and q are integers and $q \neq 0$, is
(A) $\frac{p}{q}$ (B) 1 (C) 0 (D) $\frac{q}{p}$
4. Check 972 a prime number ?
5. Express 0.88 into $\frac{p}{q}$ form ?
6. Show that $\frac{-8}{12} = \frac{24}{-36}$?
7. $|-138| - |-243| = ?$
8. Find the greater number in the following pairs of rational numbers :-
(a) $\frac{9}{11}$ and $\frac{10}{12}$ (b) $\frac{-5}{8}$ and $\frac{12}{16}$
9. Write the following rational numbers in descending order $\frac{2}{9}, \frac{5}{12}, \frac{7}{15}, \frac{10}{14}$

1.2 OPERATIONS ON RATIONAL NUMBERS

(a) Addition

If two rational numbers are to be added we should convert each of them into a rational number with positive denominator.

Case I : When given number have same denominator.

In this case we define $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$.

Illustration 1.9

Add $\frac{7}{5}$ and $\frac{9}{5}$

Sol. $\frac{7}{5} + \frac{9}{5} = \frac{7+9}{5} = \frac{16}{5}$.

Case II : When denominator of given number are unequal.

In this case we take the LCM of their denominators and express each of the given numbers with this LCM as the common denominator. Now we add these numbers as shown above.

Illustration 1.10

Add $\frac{3}{8}$ and $\frac{5}{6}$.

Sol. The denominators of the given rational numbers are 8 and 6 respectively.

LCM of 8 and 6 is 24

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

$\therefore \frac{3}{8} + \frac{5}{6} = \frac{9}{24} + \frac{20}{24} = \frac{9+20}{24} = \frac{29}{24}$.

❖ Short cut method

Illustration 1.11

Find the sum : $\frac{-7}{5} + \frac{2}{3}$.

Sol. LCM of 5 and 3 = $(5 \times 3) = 15$.

$\therefore \frac{-7}{5} + \frac{2}{3} = \frac{3 \times (-7) + 5 \times 2}{15} = \frac{-21+10}{15} = \frac{-11}{15}$.

(b) Properties of addition

Property 1. Closure Property :

The sum of two rational numbers is always a rational number.

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\left(\frac{a}{b} + \frac{c}{d}\right)$ is also a rational number.

For example : Consider the rational numbers $\frac{1}{3}$ and $\frac{3}{4}$. Then, $\left(\frac{1}{3} + \frac{3}{4}\right) = \frac{(4+9)}{12} = \frac{13}{12}$, which is a rational number.

Property 2. Commutative Law :

Two rational numbers can be added in any order.

Thus for any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, we have $\left(\frac{a}{b} + \frac{c}{d}\right) = \left(\frac{c}{d} + \frac{a}{b}\right)$.

For example :

$$(i) \quad \left(\frac{1}{2} + \frac{3}{4}\right) = \frac{(2+3)}{4} = \frac{5}{4} \text{ and } \left(\frac{3}{4} + \frac{1}{2}\right) = \frac{(3+2)}{4} = \frac{5}{4}.$$

$$\text{So, } \left(\frac{1}{2} + \frac{3}{4}\right) = \left(\frac{3}{4} + \frac{1}{2}\right).$$

Property 3. Associative Law :

While adding three rational numbers, they can be grouped in any order.

Thus, for any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$, we have $\left(\frac{a}{b} + \frac{c}{d}\right) + \frac{e}{f} = \frac{a}{b} + \left(\frac{c}{d} + \frac{e}{f}\right)$.

For example, consider three rationals $\frac{-2}{3}$, $\frac{5}{7}$ and $\frac{1}{6}$. Then,

$$\left\{\left(\frac{-2}{3} + \frac{5}{7}\right) + \frac{1}{6}\right\} = \left\{\frac{(-14+15)}{21} + \frac{1}{6}\right\} = \left(\frac{1}{21} + \frac{1}{6}\right) = \frac{(2+7)}{42} = \frac{9}{42} = \frac{3}{14}$$

$$\text{and } \left\{\frac{-2}{3} + \left(\frac{5}{7} + \frac{1}{6}\right)\right\} = \left\{\frac{-2}{3} + \frac{(30+7)}{42}\right\} = \left(\frac{-2}{3} + \frac{37}{42}\right) = \frac{(-28+37)}{42} = \frac{9}{42} = \frac{3}{14}.$$

$$\therefore \left\{\left(\frac{-2}{3} + \frac{5}{6}\right) + \frac{1}{6}\right\} = \left\{\frac{-2}{3} + \left(\frac{5}{7} + \frac{1}{6}\right)\right\}.$$

Property 4. Existence of Additive identity :

0 is a rational number such that the sum of any rational number and 0 is the rational number itself.

Thus, $\left(\frac{a}{b} + 0\right) = \left(0 + \frac{a}{b}\right) = \frac{a}{b}$, for every rational number $\frac{a}{b}$.

0 is called the additive identity for rationals.

For example, (i) $\left(\frac{3}{5} + 0\right) = \left(\frac{3}{5} + \frac{0}{5}\right) \Rightarrow \frac{(3+0)}{5} = \frac{3}{5}$ and similarly, $\left(0 + \frac{3}{5}\right) = \frac{3}{5}$.

$$\therefore \left(\frac{3}{5} + 0\right) = \left(0 + \frac{3}{5}\right) = \frac{3}{5}.$$

Property 5. Existence of Additive Inverse :

For every rational number $\frac{a}{b}$, there exists a rational number $\frac{-a}{b}$ such that

$$\left(\frac{a}{b} + \frac{-a}{b}\right) = \frac{\{a + (-a)\}}{b} = \frac{0}{b} = 0 \text{ and similarly, } \left(\frac{-a}{b} + \frac{a}{b}\right) = 0.$$

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

$\frac{-a}{b}$ is called the additive inverse of $\frac{a}{b}$.

For example : $\left(\frac{4}{7} + \frac{-4}{7}\right) = \frac{\{4 + (-4)\}}{7} = \frac{0}{7} = 0$ and Similarly, $\left(\frac{-4}{7} + \frac{4}{7}\right) = 0$.

$$\therefore \left(\frac{4}{7} + \frac{-4}{7}\right) = \left(\frac{-4}{7} + \frac{4}{7}\right) = 0.$$

Thus, $\frac{4}{7}$ and $\frac{-4}{7}$ are additive inverse of each other.

Properties of Multiplication**Property 1. Closure Property :**

The product of two rational numbers is always a rational number.

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers then $\left(\frac{a}{b} \times \frac{c}{d}\right)$ is also a rational number .

For example : Consider the rational numbers $\frac{1}{2}$ and $\frac{5}{7}$.

Then, $\left(\frac{1}{2} \times \frac{5}{7}\right) = \frac{(1 \times 5)}{(2 \times 7)} = \frac{5}{14}$, which is a rational number.

Property 2. Commutative Law :

Two rational numbers can be multiplied in any order.

Thus, for any rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, we have :

$$\left(\frac{a}{b} \times \frac{c}{d}\right) = \left(\frac{c}{d} \times \frac{a}{b}\right).$$

For example : let us consider the rational numbers $\frac{3}{4}$ and $\frac{5}{7}$. Then,

$$\left(\frac{3}{4} \times \frac{5}{7}\right) = \frac{(3 \times 5)}{(4 \times 7)} = \frac{15}{28} \text{ and } \left(\frac{5}{7} \times \frac{3}{4}\right) = \frac{(5 \times 3)}{(7 \times 4)} = \frac{15}{28}.$$

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

Property 3. Associative Law :

While multiplying three or more rational numbers, they can be grouped in any order.

Thus, for any rationals $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$, we have

$$\left(\frac{a}{b} \times \frac{c}{d}\right) \times \frac{e}{f} = \frac{a}{b} \times \left(\frac{c}{d} \times \frac{e}{f}\right).$$

For example : Consider the rationals $\frac{-5}{2}$, $\frac{-7}{4}$ and $\frac{1}{3}$. We have

$$\left(\frac{-5}{2} \times \frac{-7}{4}\right) \times \frac{1}{3} = \left\{\frac{(-5) \times (-7)}{2 \times 4} \times \frac{1}{3}\right\} = \left(\frac{35}{8} \times \frac{1}{3}\right) = \frac{(35 \times 1)}{(8 \times 3)} = \frac{35}{24}$$

$$\text{and } \frac{-5}{2} \times \left(\frac{-7}{4} \times \frac{1}{3}\right) = \frac{-5}{2} \times \frac{(-7) \times 1}{4 \times 3} = \left(\frac{-5}{2} \times \frac{-7}{12}\right) = \frac{(-5) \times (-7)}{(2 \times 12)} = \frac{35}{24}.$$

$$\therefore \left(\frac{-5}{2} \times \frac{-7}{4}\right) \times \frac{1}{3} = \frac{-5}{2} \times \left(\frac{-7}{4} \times \frac{1}{3}\right).$$

Property 4. Existence of Multiplicative Identity :

For any rational number $\frac{a}{b}$, we have

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

1 is called the multiplicative identity for rationals.

For example : Consider the rational number $\frac{3}{4}$. Then, we have

$$\left(\frac{3}{4} \times 1\right) = \left(\frac{3}{4} \times \frac{1}{1}\right) = \frac{(3 \times 1)}{(4 \times 1)} = \frac{3}{4} \text{ and } \left(1 \times \frac{3}{4}\right) = \left(\frac{1}{1} \times \frac{3}{4}\right) = \frac{(1 \times 3)}{(1 \times 4)} = \frac{3}{4}.$$

Property 5. Existence of Multiplicative Inverse :

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).

For example : Reciprocal of $\frac{5}{7}$ is $\frac{7}{5}$, since $\left(\frac{5}{7} \times \frac{7}{5}\right) = \left(\frac{7}{5} \times \frac{5}{7}\right) = 1$.

Property 6. Distributive Law of Multiplication Over Addition :

For any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$ and $\frac{e}{f}$, we have : $\frac{a}{b} \times \left(\frac{c}{d} + \frac{e}{f}\right) = \left(\frac{a}{b} \times \frac{c}{d}\right) + \left(\frac{a}{b} \times \frac{e}{f}\right)$.

For example : Consider the rational numbers $\frac{-3}{4}$, $\frac{2}{3}$ and $\frac{-5}{6}$. We have

$$\left(\frac{-3}{4}\right) \times \left\{\frac{2}{3} + \frac{-5}{6}\right\} = \left(\frac{-3}{4}\right) \times \left\{\frac{4+(-5)}{6}\right\} = \left(\frac{-3}{4}\right) \times \left(\frac{-1}{6}\right) = \frac{(-3) \times (-1)}{4 \times 6} = \frac{3}{24} = \frac{1}{8}.$$

$$\text{Again, } \left(\frac{-3}{4}\right) \times \frac{2}{3} = \frac{(-3) \times 2}{4 \times 3} = \frac{-6}{12} = \frac{-1}{2} \text{ and } \left(\frac{-3}{4}\right) \times \left(\frac{-5}{6}\right) = \frac{(-3) \times (-5)}{4 \times 6} = \frac{15}{24} = \frac{5}{8}.$$

$$\left\{\left(\frac{-3}{4}\right) \times \frac{2}{3}\right\} + \left\{\left(\frac{-3}{4}\right) \times \left(\frac{-5}{6}\right)\right\} = \left(\frac{-1}{2} + \frac{5}{8}\right) = \frac{(-4+5)}{8} = \frac{1}{8}.$$

Hence,

$$\left(\frac{-3}{4}\right) \times \left\{\frac{2}{3} + \frac{-5}{6}\right\} = \left\{\left(\frac{-3}{4}\right) \times \frac{2}{3}\right\} + \left\{\left(\frac{-3}{4}\right) \times \left(\frac{-5}{6}\right)\right\}.$$

Property 7. Multiplicative Property of 0 :

Every rational number multiplied with 0 gives 0.

Thus, for any rational number $\frac{a}{b}$, we have : $\left(\frac{a}{b} \times 0\right) = \left(0 \times \frac{a}{b}\right) = 0$.

For example, $\left(\frac{5}{18} \times 0\right) = \left(\frac{5}{18} \times \frac{0}{1}\right) = \frac{(5 \times 0)}{(18 \times 1)} = \frac{0}{18} = 0$. Similarly, $\left(0 \times \frac{5}{18}\right) = 0$.

Illustration 1.16

Find the reciprocal of each of the following :

(i) -8 (ii) $\frac{5}{16}$

Sol. (i) Reciprocal of -8 is $\frac{1}{-8}$, i.e., $-\frac{1}{8}$. (ii) Reciprocal of $\frac{5}{16}$ is $\frac{16}{5}$.

(d) Division

When $\frac{a}{b}$ is divided by $\frac{c}{d}$, then $\frac{a}{b}$ is called dividend; $\frac{c}{d}$ is called the divisor and the result is known as quotient.

Properties of division**Property 1. Closure Property :**

If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers such that $\frac{c}{d} \neq 0$, then $\left(\frac{a}{b} \div \frac{c}{d}\right)$ is also a rational number.

Property 2.

For every rational number $\frac{a}{b}$, we have: $\left(\frac{a}{b} \div 1\right) = \frac{a}{b}$

Property 3.

For every non-zero rational number $\frac{a}{b}$, we have $\left(\frac{a}{b} \div \frac{a}{b}\right) = 1$

Illustration 1.17

Divide $\frac{4}{7}$ by $\frac{-3}{8}$.

Sol. $\frac{4}{7} \div \frac{-3}{8} = \frac{4}{7} \times \frac{-8}{3} = \frac{-32}{21}$.

(e) Insertion of Rational number between two given Rational Numbers:

If a and b be two rational number such that $a < b$, then $\frac{1}{2}(a + b)$ is a rational number between a and b.

Illustration 1.18

Find 3 Rational numbers between $\frac{1}{3}$ & $\frac{1}{2}$.

Sol. A rational number between $\frac{1}{3}$ & $\frac{1}{2}$.

$$= \frac{\frac{1}{3} + \frac{1}{2}}{2} = \frac{\frac{2+3}{6}}{2} = \frac{5}{12} \quad \left(\because \frac{1}{3}, \frac{5}{12}, \frac{1}{2}\right)$$

A rational number between $\frac{1}{3}$ and $\frac{5}{12}$

$$= \frac{\frac{1}{3} + \frac{5}{12}}{2} = \frac{\frac{4+5}{12}}{2} = \frac{9}{24}$$

A rational number between $\frac{5}{12}$ and $\frac{1}{2}$

$$= \frac{\frac{5}{12} + \frac{1}{2}}{2} = \frac{\frac{5+6}{12}}{2} = \frac{11}{24} \quad ; \quad \left(\because \frac{1}{3}, \frac{9}{24}, \frac{5}{12}, \frac{11}{24}, \frac{1}{2}\right)$$

\therefore Three rational number between $\frac{1}{3}$ & $\frac{1}{2}$ are $\frac{5}{12}, \frac{9}{24}, \frac{11}{24}$.

Illustration 1.19

Find 5 rational number between $\frac{-3}{5}$ and $\frac{1}{4}$.

Sol. Convert to equivalent rational numbers having same denominators

$$\frac{-3}{5} = \frac{-3 \times 4}{5 \times 4} = \frac{-12}{20} \quad \text{and} \quad \frac{1}{4} = \frac{1 \times 5}{4 \times 5} = \frac{5}{20}$$

The integers between -12 and 5 are $-11, -10, -9, \dots, 3, 4$.

The corresponding rational number are $\frac{-11}{20}, \frac{-10}{20}, \frac{-9}{20}, \dots, \frac{2}{20}, \frac{3}{20}, \frac{4}{20}$.

Selecting any five of them, we get

$$\frac{-11}{20}, \frac{-10}{20}, \frac{-9}{20}, \frac{-8}{20}, \frac{-7}{20} \text{ are five rational numbers between } \frac{-3}{5} \text{ and } \frac{1}{4}$$



Ask yourself

1. The sum of two rational numbers is $\frac{-8}{9}$. If one of the numbers is $\frac{-5}{7}$, find the other.
2. What should be subtracted from $\frac{-4}{9}$ so as to get $\frac{5}{12}$?
3. The product of two rational numbers is $\frac{-25}{49}$. If one of the numbers is $\frac{5}{8}$, find the other?
4. Divide the sum of $\frac{-7}{6}$ and $\frac{4}{5}$ by their product.
5. Write any 5 rational numbers between $\frac{-5}{6}$ and $\frac{7}{8}$.
6. $\frac{x+y}{2}$ is a rational number.
 - (a) Between x and y
 - (b) Less than x and y both.
 - (c) Greater than x and y both.
 - (d) Less than x but greater than y.
7. Find two rational numbers whose absolute value is $\frac{1}{5}$.



Add to Your Knowledge

1. DIVISION ALGORITHM

Division Algorithm : General representation of result is,

$$\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}}$$

$$\text{Dividend} = (\text{Divisor} \times \text{Quotient}) + \text{Remainder}$$

Example. On dividing 4150 by certain number, the quotient is 55 and the remainder is 25. Find the divisor.

Sol. $4150 = 55 \times x + 25 \Rightarrow 55x = 4125 \Rightarrow x = \frac{4125}{55} = 75.$

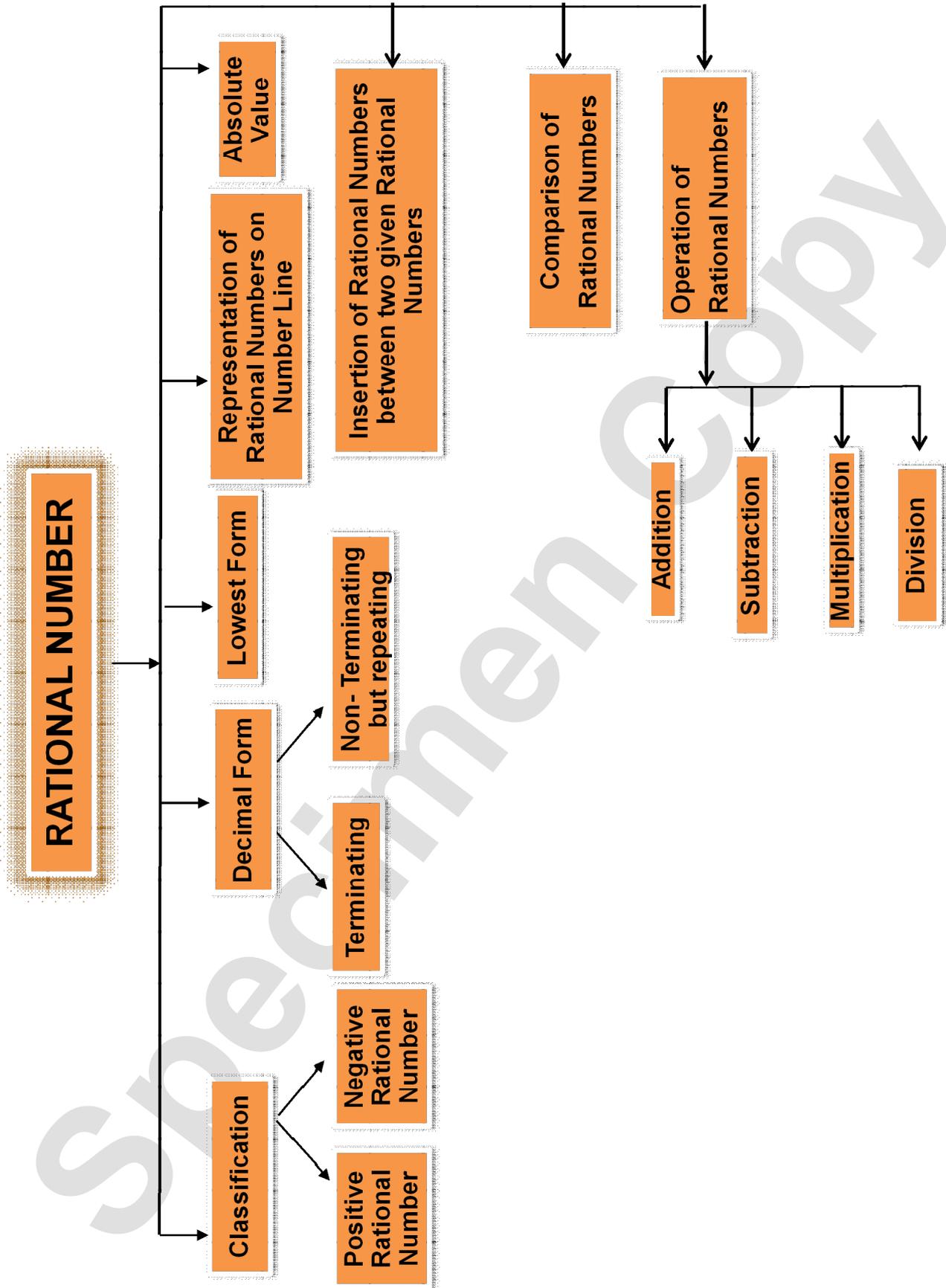
2. In order to convert a non terminating and repeating decimal number into fraction, follow the following steps :-

Step 1 - To obtain the numerator subtract the number formed by non-repeating digits from the complete number without decimal.

Step 2 - To obtain the denominator take the number of nines = Number of repeating digits and after that put the number zeros = number of non repeating digits.

For example :- $0.\overline{737} = \frac{737-7}{990} = \frac{730}{990} = \frac{73}{99}$

Concept Map



Summary :

1. Zero is neither positive nor negative rational number.
2. There can be infinite rational numbers between two given rational number .
3. $1.066666\dots$ can also be written as $1.0\bar{6}$, to represent a recurring decimal.
4. By repeated use of commutative and associative properties , the sum (multiplication) of three or more rational numbers can be found and this sum (product) remains the same, whatever be the order of numbers before addition (multiplication) . This is also called the re-arrangement property of addition(multiplication) of rational numbers.
5. The reciprocal or multiplicative inverse of 0 does not exist. Hence , **zero has no multiplicative inverse.**
6. Division by zero is meaningless (not defined) .
7. Each rational number can be represented by a point on the number line but vice versa is not always true.
8. **Dividend = Divisor x quotient + remainder.**

Specimen

EXERCISE >> 01

SECTION -A (FIXED RESPONSE TYPE)

OBJECTIVE QUESTIONS

- Which of the following is prime
(A) 141 (B) 241 (C) 341 (D) 441
- Which of the following natural numbers is neither prime nor composite.
(A) 0 (B) 1 (C) 2 (D) None
- The reciprocal of a negative rational number :
(A) is a positive rational number
(B) is a negative rational number
(C) can be either a positive or a negative rational number
(D) does not exist
- Lowest form of $\frac{-219}{365}$.
(A) $-\frac{73}{125}$ (B) $-\frac{3}{5}$ (C) $\frac{3}{5}$ (D) None of these
- $|-138| - |-243| = ?$
(A) 105 (B) 381 (C) -381 (D) -105
- 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
- Arrange the following fractions in ascending order $\frac{3}{7}, \frac{4}{5}, \frac{7}{9}, \frac{1}{2}$.
(A) $\frac{4}{5}, \frac{7}{9}, \frac{3}{7}, \frac{1}{2}$ (B) $\frac{3}{7}, \frac{1}{2}, \frac{7}{9}, \frac{4}{5}$ (C) $\frac{4}{5}, \frac{7}{9}, \frac{1}{2}, \frac{3}{7}$ (D) $\frac{1}{2}, \frac{3}{7}, \frac{7}{9}, \frac{4}{5}$
- Multiplicative inverse of $\frac{3}{5}$ is :
(A) 1 (B) 0 (C) $-\frac{3}{5}$ (D) $\frac{5}{3}$
- What number should be subtracted from -5 to get $\frac{8}{9}$.
(A) $\frac{-53}{9}$ (B) $\frac{37}{9}$ (C) $\frac{9}{37}$ (D) $\frac{-9}{37}$
- If $x/y = 6/5$ then $\frac{x^2 + y^2}{x^2 - y^2}$ is :
(A) $\frac{36}{25}$ (B) $\frac{25}{36}$ (C) $\frac{11}{61}$ (D) $\frac{61}{11}$
- The product of a non - zero rational number with an irrational number is :
(A) Irrational number (B) Rational number (C) Whole number (D) Natural number

12. If $\frac{3}{11}$ of a number is 22, what is $\frac{6}{11}$ of that number ?
 (A) 6 (B) 11 (C) 12 (D) 44
13. How many rational numbers exist between any two distinct rational numbers ?
 (A) 2 (B) 3 (C) 11 (D) Infinite
14. Rational number between 1 and 2
 (A) $\frac{5}{6}$ (B) $\frac{6}{5}$ (C) $\frac{3}{7}$ (D) $\frac{7}{3}$

FILL IN THE BLANKS

1. All natural numbers that have one and itself as their only 2 distinct factors are _____.
2. $\frac{5}{11}$ is _____ decimal
3. Lowest form of $\frac{8}{12}$ is _____.
4. $\frac{3}{7} \times \frac{5}{8} = \frac{\quad}{\quad} \times \frac{3}{7}$.
5. $\frac{3}{7} \times \left(\frac{5}{8} + \frac{4}{7} \right) = \frac{3}{7} \times \frac{5}{8} + \frac{3}{7} \times \frac{\quad}{\quad}$
6. $\frac{37}{58} \times \frac{\quad}{\quad} = 1$.
7. $\frac{4}{9} \times \frac{\quad}{\quad} = \frac{4}{9}$.
8. $\frac{-5}{9} + \frac{\quad}{\quad} = 0$.
9. Additive inverse of 5 is _____.
10. Product of $\frac{2}{3}$ and $-\frac{3}{2}$ is _____.

TRUE / FALSE

1. 91 is a prime number .
2. Prime number can also be negative integers .
3. 2 is the only even prime number.
4. 0 is a rational number.
5. Rational number can not be represented on real number line.
6. $\frac{3}{5} > \frac{2}{3}$.
7. The sum of 2 rational number is always a rational number.
8. Reciprocal of a positive rational number can either be negative or positive.
9. There are only 4 integers between -3 and 2.
10. There exist infinite rational number between any 2 integers.

MATCH THE COLUMN

1. Match the value of column-I with the value in column-II

Column-I

(A) $2/3 \div 1/2$

(B) $6/7 - 1/2$

(C) $2/3 + 4/5$

(D) $4 \div 2$

(E) $7/2 \times 1/7$

(F) $4/5 \times 3/2$

Column-II

(p) $1/2$

(q) $4/3$

(r) $6/5$

(s) $22/15$

(t) $5/14$

(u) 2

- 2.
- Column-I**

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

(B) $\frac{-1}{9} \times 1 = 1 \times \frac{-1}{9} = \frac{-1}{9}$

(C) $\frac{4}{7} \times \frac{7}{4} = 1$

(D) $6 + \frac{5}{9} = \frac{5}{9} + 6$

(E) $-\frac{3}{8} + 0 = 0 + \left(\frac{-3}{8}\right) = \frac{-3}{8}$

Column-II

(p) commutativity under addition

(q) associativity under multiplication

(r) existence of multiplicative identity

(s) existence of additive identity

(t) existence of multiplicative inverse

SECTION -B (FREE RESPONSE TYPE)**VERY SHORT ANSWER TYPE**

- Smallest natural number is
- Smallest composite number is
- Smallest prime number is
- Only even prime number is
- Represent $\frac{13}{5}$ and $\frac{-13}{5}$ on the number line.
- Represent -17.5 on the number line.
- Find the additive inverse of the following :
 (a) $\frac{1}{3}$ (b) 0 (c) 5 (d) $\frac{5}{-7}$

8. Find the multiplicative inverse of the following :

(a) $\frac{7}{5}$ (b) 0 (c) -8 (d) $\frac{-2}{5}$

SHORT ANSWER TYPE

9. Arrange the following rational number in ascending order : $\frac{1}{3}, \frac{5}{8}, \frac{23}{24}, \frac{5}{6}$.
10. Standard form of $\frac{205}{82}$.
11. The product of two rational numbers is $\frac{-5}{7}$, if one of the number is $\frac{2}{9}$, find the other.
12. Find the number which when divided by $\frac{8}{21}$ gives 1.
13. Give three rational numbers between -2 and -1 .
14. Give three rational numbers between 3 and 4 .
15. Find three different rational numbers between $\frac{5}{7}$ and $\frac{9}{11}$.

LONG ANSWER TYPE

16. (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 $x = \frac{-2}{3}, y = \frac{-9}{8}$.
17. (i) Which rational number is its own additive inverse ?
- (ii) Is the difference of two rational numbers a rational number ?
- (iii) Is addition commutative on rational numbers ?
- (iv) Is addition associative on rational numbers ?
- (v) Is subtraction commutative on rational numbers ?
- (vi) Is subtraction associative on rational numbers ?
- (vii) What is the negative of negative rational number ?
18. The cost of $3\frac{7}{9}$ m cloth is Rs. $212\frac{4}{5}$. Find the cost of $7\frac{2}{3}$ m cloth.
19. Simplify :
- (i) $2\frac{3}{4} \times 1\frac{2}{3} + 9\frac{11}{12} - 1\frac{5}{6}$. (ii) $5 - \left[\frac{3}{4} + \left\{ 2\frac{1}{2} - \left(0.5 + \frac{1}{6} - \frac{1}{7} \right) \right\} \right]$.

EXERCISE >> 02**SECTION -A (COMPETITIVE EXAMINATION QUESTION)****OBJECTIVE QUESTIONS**

1. There are four prime numbers written in ascending order. The product of the first three is 385 and that of the last three is 1001. The last number is :
 (A) 11 (B) 13 (C) 17 (D) 19

- 2._ Let x , y and z be distinct integers where x and y are odd and positive, and z is even and positive. Which one of the following statements cannot be true ?
 (A) $(x - z)^2y$ is even (B) $(x - z)y^2$ is odd (C) $(x - z)y$ is odd (D) $(x - y)^2z$ is even
- 3._ Choose the rational number which does not lie between rational numbers $\frac{3}{5}$ and $\frac{2}{3}$
 (A) $\frac{46}{75}$ (B) $\frac{47}{75}$ (C) $\frac{49}{75}$ (D) $\frac{50}{75}$
4. Evaluate : $\frac{8 - [5 - (-3 + 2)] \div 2}{|5 - 3| - |5 - 8| \div 3}$.
 (A) 2 (B) 3 (C) 4 (D) 5
5. A student was asked to multiply a number by $\frac{3}{2}$. Instead he divided the number by $\frac{3}{2}$ and obtained a number smaller by $\frac{2}{3}$, the number is :
 (A) $\frac{4}{5}$ (B) $\frac{3}{5}$ (C) $\frac{2}{3}$ (D) $\frac{1}{2}$
- 6._ Which one of the following is Rational number in simplest form ?
 (A) $\frac{-8}{28}$ (B) $\frac{-13}{38}$ (C) $\frac{14}{-49}$ (D) $\frac{16}{56}$
- 7._ If a and b are positive integers, then which of the following is correct?
 (A) $a + b$ is rational (B) $a - b$ is a positive integer
 (C) $\frac{a}{b}$ is irrational (D) none of these
- 8._ $\left[\frac{9}{4} \times \frac{3}{5} \div \frac{12}{5} + \frac{7}{8} \div \frac{5}{4} + \frac{3}{5} \right]$ is equal to
 (A) $1 \frac{69}{80}$ (B) $1 \frac{41}{80}$ (C) $2 \frac{2}{9}$ (D) $20 \frac{7}{9}$
- 9._ The product $\left(2 - \frac{1}{3}\right) \left(2 - \frac{3}{5}\right) \left(2 - \frac{5}{7}\right) \dots \left(2 - \frac{97}{99}\right)$ is equal to :
 (A) $\frac{5}{99}$ (B) $\frac{101}{99}$ (C) $\frac{101}{3}$ (D) $\frac{97}{99}$
- 10_(d). The product of the following fractions
 $\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{3} - \frac{1}{4}} \times \frac{\frac{1}{4} - \frac{1}{5}}{\frac{1}{5} - \frac{1}{6}} \times \frac{\frac{1}{6} - \frac{1}{7}}{\frac{1}{7} - \frac{1}{8}} \times \dots \times \frac{\frac{1}{99} - \frac{1}{99}}{\frac{1}{99} - \frac{1}{100}}$, is :
 (A) 2 (B) 50 (C) 100 (D) $\frac{1}{100}$

SECTION -B (TECHIE STUFF)

11. $0.\overline{018}$ can be expressed in the rational form as :
 (A) $\frac{18}{1000}$ (B) $\frac{18}{990}$ (C) $\frac{18}{9900}$ (D) $\frac{18}{999}$
12. On dividing a number by 999, the quotient is 366 and the remainder is 103. The number is :
 (A) 364724 (B) 365387 (C) 365737 (D) 366757
13. The number 2.525252..... can be written as a fraction, when reduced to the lowest term, the sum of the numerator and denominator is:-
 (A) 7 (B) 29 (C) 141 (D) 349

EXERCISE >> 03**SECTION -A (PREVIOUS YEAR EXAMINATION QUESTIONS)**

1. $0.\overline{2} + 0.\overline{3} + 0.\overline{4} + 0.\overline{5}$ is equivalent to **[Aryabhata 2005]**
 (A) $\frac{14}{9}$ (B) $\frac{15}{9}$ (C) $\frac{1}{3}$ (D) 1
2. If a number is divided by 45, then the remainder is 32. If the same number is divided by 15, then the remainder is **[Aryabhata 2008]**
 (A) 2 (B) 3 (C) 16 (D) 4
3. A rational number can be expressed as a terminating decimal if the denominator has factors **[NSTSE 2010]**
 (A) 2 or 5 (B) 3 or 5 (C) 2, 3 or 5 (D) None of these
4. The product of x^2y and $\left(\frac{x}{y}\right)$ is equal to the quotient obtained when x^2 is divided by **[NSTSE 2010]**
 (A) 0 (B) 1 (C) X (D) $\frac{1}{x}$
5. If $1 + \frac{1}{x} = \frac{x+1}{x}$, which does 'x' equal to ? **[NSTSE - 2011]**
 (A) 1 or 2 only (B) 1 and 0 only
 (C) + 1 or - 2 only (D) any number except '0'
6. Identify a rational number between $\frac{1}{3}$ and $\frac{4}{5}$ **[NSTSE 2012]**
 (A) $\frac{1}{4}$ (B) $\frac{9}{10}$ (C) $\frac{17}{30}$ (D) $1\frac{7}{10}$

7. Which of the statements is true about consecutive natural numbers ? **[NSTSE 2012]**
 (A) There are $2n + 1$ numbers between the difference of squares of consecutive numbers.
 (B) There are $2n$ non-perfect square numbers between the squares
 (C) The sum of the squares of two consecutive numbers is not a perfect square
 (D) $n^2 - 1$ is the standard form of the difference between two consecutive numbers
8. Identify the ones that is/are greater than 'm' if $m = \frac{9}{11}$ **[NSTSE 2014]**
 (i) $\frac{1}{m}$ (ii) $\frac{m+1}{m}$ (iii) $\frac{m+1}{m-1}$
 (A) (i) only (B) (ii) and (iii) only (C) (i) and (iii) only (D) (i) and (ii) only
9. Which number is in the middle if $\frac{-1}{6}$, $\frac{4}{9}$, $\frac{6}{-7}$, $\frac{2}{5}$ and $\frac{-3}{4}$ are arranged in descending order **[NSTSE 2014]**
 (A) $\frac{2}{5}$ (B) $\frac{4}{9}$ (C) $\frac{-1}{6}$ (D) $\frac{-6}{7}$
10. If the division $N \div 5$ leaves a remainder of 3, what might be the ones digit of N ? **[NSTSE 2014]**
 (A) 2 (B) 3 (C) 4 (D) 6
11. Which of the following numbers does NOT have a multiplicative inverse? **[NSTSE 2014]**
 (A) $-\frac{1}{3}$ (B) 0 (C) 1 (D) 3
12. Nalini and three of her friends worked together to make a quilt. The given table lists the fractional part of the quilt that each of the girls made. Which list shows the girls in order from the one who sewed the most to the one who sewed the least? **[NSTSE 2014]**
- | Girl | Parts Sewn |
|---------|----------------|
| Nalini | $\frac{3}{8}$ |
| Kamini | $\frac{1}{5}$ |
| Shalini | $\frac{2}{5}$ |
| Reena | $\frac{1}{40}$ |
- (A) Reena, Nalini, Shalini, Kamini (B) Shalini, Nalini, Kamini, Reena
 (C) Reena, Kamini, Nalini, Shalini (D) Kamini, Shalini, Nalini, Reena
13. The difference between the place value and the face value of 6 in the numeral 856973 is _____. **[NSTSE 2014]**
 (A) 973 (B) 6973 (C) 5994 (D) None of these

14. Which of the following expressions is true? **[NSTSE 2014]**
(A) $0.09 > \frac{7}{8}$ (B) $6\% < 0.09$ (C) $\frac{7}{8} < 8.0 \times 10^{-3}$ (D) $8.0 \times 10^{-3} > 6\%$
15. If $x:y = 5:2$, then $(8x + 9y) : (8x + 2y)$ is **[NSTSE 2014]**
(A) $22 : 29$ (B) $26 : 61$ (C) $29 : 22$ (D) $61 : 26$
16. Closure property for rational numbers is satisfied in case of _____ **[NSTSE 2014]**
(A) Addition (B) Subtraction (C) Multiplication (D) All of these
17. Which of the following statements is INCORRECT for rational numbers? **[NSTSE 2014]**
(A) The rational number 0 is the additive identity for rational numbers.
(B) The rational number 1 is the multiplicative identity for rational numbers.
(C) Subtraction is associative for rational numbers.
(D) There are infinite rational numbers between any two given rational numbers.

ANSWER KEY >>**EXERCISE** >> **01****SECTION -A (FIXED RESPONSE TYPE)****OBJECTIVE QUESTIONS**

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.	B	B	B	B	D	B	B	D	A	D	A	D	D	B

FILL IN THE BLANKS

1. Prime 2. non terminating repeating 3. $(\frac{2}{3})$
 4. $\frac{5}{8}$ 5. $(\frac{4}{7})$ 6. $(\frac{58}{37})$ 7. 1
 8. $(\frac{5}{9})$ 9. (-5) 10. (-1)

TRUE / FALSE

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

MATCH THE COLUMN

1. (A) q, (B) t, (C) s, (D) u, (E) p, (F) r
 2. (A) q, (B) r, (C) t, (D) p, (E) s

SECTION -B (FREE RESPONSE TYPE)**VERY SHORT ANSWER TYPE**

1. 1 2. 4 3. 2 4. 2
 7. (a) $-\frac{1}{3}$ (b) 0 (c) -5 (d) $\frac{5}{7}$
 8. (a) $\frac{5}{7}$ (b) Does not exist (c) $-\frac{1}{8}$ (d) $-\frac{5}{2}$

SHORT ANSWER TYPE

9. $(\frac{1}{3} < \frac{5}{8} < \frac{5}{6} < \frac{23}{24})$ 10. $\frac{5}{2}$ 11. $(\frac{-45}{14})$ 12. $\frac{8}{21}$
 13. $(-\frac{7}{4}, -\frac{3}{2}, -\frac{5}{4})$ 14. $(\frac{31}{10}, \frac{33}{10}, \frac{37}{10})$ 15. $(\frac{56}{77}, \frac{57}{77}, \frac{58}{77})$

LONG ANSWER TYPE

16. (i) (ii)
17. (i) 0 (ii) yes (iii) yes (iv) yes
(v) no (vi) no (vii) positive rational number
18. Rs. $431\frac{73}{85}$
19. (i) $12\frac{2}{3}$ (ii) $2\frac{23}{84}$

EXERCISE >> 02**SECTION -A (COMPETITIVE EXAMINATION QUESTION)****OBJECTIVE QUESTIONS**

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

EXERCISE >> 03**SECTION -A (PREVIOUS YEAR EXAMINATION QUESTIONS)**

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

Terminologies

Sustainable Agriculture, Horticulture, Aquaculture, Olericulture, Fumigation, Macro-nutrient, Micro-nutrient, Organic Farming, Vermicomposting, Biofertilizer, Fertigation, Animal husbandary.

INTRODUCTION

- ◆ For their existence of all living organisms essentially they require food.
- ◆ Food is required for growth, development and body repair. It also protects the body from diseases and provides energy for doing all life functions.
- ◆ Among all the living organisms, only green plants are autotrophs, i.e., they make their own food. In fact, green plants perform a basic metabolic activity, called photosynthesis.
- ◆ In photosynthesis by using the energy of sunlight, green plants combine carbon dioxide (CO₂) and water (H₂O) to produce carbohydrates (Food).
- ◆ In contrast to green plants, animals and human beings are heterotrophs, i.e., they depend on plants and other animals for food. Plants as food are gift of nature to humans and most animals.
- ◆ In fact, different parts of plants, such as root, stem, leaf, flower and fruit, are consumed by humans in the form of cereals, vegetables, spices and fruits.

1.1 AGRICULTURE

Agriculture is derived from Latin words 'Ager' and 'Cultura'. Ager means land or field and cultura means cultivation. Therefore the term agriculture means cultivation of land i.e. the science and art of producing crops and livestock for economic purposes.

(a) Different branches of agriculture

Agriculture is the science and practice of farming, which mainly involves rearing of livestock, cultivating land, raising crops, harvesting and marketing the produce. It is further subdivided into many categories

(I) Agronomy : The branch of agricultural science dealing with production of field crops and management of the soil. Agronomist sometimes known as crop scientist , specialize in producing and improving food crops through conducting experiments and developing methods of production

(II) Horticulture : Branch of agriculture that deal in growth and management of fruit and flowering plants in orchards and gardens.

(III) Olericulture : Refers to growing and managing of vegetables.

(IV) Aquaculture : The farming and harvesting of plants and animals in a water bodies for economical Purpose.

(b) Source of food :

Crops are plants which are cultivated by humans for food, fodder, fiber, flowers, timber, etc. There are about 2000 species which are cultivated for eating purposes. Following parts of the plants are eaten as food.

(I) Seeds :

Not all seeds of plants are edible. For example, large seeds such as those from a lemon pose a choking hazard, whereas seeds from apple and cherries contain poison cyanide. Edible seeds include cereals, pulses, oil seeds and nuts (dry fruits).

- (i) **Cereals** : They include crops such as wheat, rice, maize, barley, sorghum, etc. They are a rich source of carbohydrates.



Fig.1.1 Seeds

- (ii) **Pulses**. They include legumes such as chicken pea gram, (chana), pea (matar), black gram (urad), green gram (moong), pigeon pea (arhar), cow pea (lobia) and lentil (masoor). They are excellent source of proteins.
- (iii) **Oil seed crops**. They include cotton seed, niger (Ramtil), sunflower, soybean, flax (linseed oil), rapeseed, groundnut, sesame, mustard, sunflower, olive, etc. They are source of oil, fats and fatty acids.

- (iv) **Nuts or Dry fruits**. Nuts are rich in proteins and fatty acids, so are considered energetic food items. Examples include almond, walnut, cashew nut etc.

(II) Fruits : They include apple, orange, mango, banana, pineapple, pomegranate, pear, peach, apricot, grapes, dates, custard apple, etc. Essentially fruits are ripened ovaries of plants and are a good source of vitamins, minerals, roughage, proteins, carbohydrates and fats.

(III)Vegetables : They are the edible parts of the herbaceous plants. They are eaten in raw or cooked form. Vegetables are of following types:

- (i) **Roots** : Roots of some plants such as carrot, radish, turnip, sweet potato and beet root are eaten as vegetables.



Fig.1.1 Modified stem and Roots (Potato, Sweet Potato)

- (ii) **Stems** : Stems of some plants such as mustard, bamboo, banana, asparagus, etc., are used as vegetables. Certain plants have modified underground stems that are eaten, e.g., potato, onion, garlic, ginger, etc. Stems of sugarcane are used for making of cane juice and jaggery.

- (iii) **Leafy vegetables** : They include leaves of spinach, lettuce, cabbage, turnip, radish, mustard, methi, bathua (pigweed) and curry-leaf tree.

- (iv) **Inflorescence vegetables** : They include broccoli, cauliflower, etc. Flowers of banana, fennel, gourd and saffron are also good examples of vegetables.

- (v) **Fruit vegetables** : They include tomato, pumpkin, brinjal (egg plant), jack fruit, bitter gourd, bottle gourd, ridged gourd, cluster bean, cucumber, lady's finger, pumpkin (sitaphal), etc.

(IV) Spices : Certain parts of some plants (e.g., leaves, stems, flowers, fruits and seeds) are used to enhance the palatability of food. They include chilly, turmeric, black pepper, cumin, fenugreek, etc.

(V) Fodder crops : They provide green fodder to the cattle, e.g., berseem, oat, sudan grass, sorghum, etc.

(VI) Other crops : Crop plants also yield fibres (e.g., cotton), tobacco, tea, coffee, chocolate, peppermint, etc.

(c) Improvement in food resources

- ◆ Protects and renews soil fertility and the natural resource base.
- ◆ Optimizes the management and use of farm resources.
- ◆ Reduces the use of non-renewable resources and purchased production inputs.
- ◆ Provides an adequate and dependable form of income.
- ◆ Promotes opportunity in family farming and farm communities.

Ask yourself

Q.1 Why does India need improved agriculture practices ?

Q.2 Define Agronomy ?

Q.3 Why do we need agriculture ?



1.2 BASIC CROP PRACTICING

When plants of the same kind are grown and cultivated at one place on a large scale, it is called a crop. India is a vast country. The climatic conditions like temperature, humidity and rainfall vary from one region to another.

(a) Crop seasons :

Different crop requires different climatic conditions, temperature and photoperiod for their growth and maturity. Sunlight is required for photosynthesis - the process of manufacturing food by green plants. Photoperiods are duration of sunlight that influences plants in their growth, flowering, formation of storage organs, leaf fall, etc. In India, there are three main seasons of crop growth: Kharif , Rabi and zayad crop.

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.

(b) Crop Production Management :

India is an agriculture based country. In this country, agriculture sector engages about 70% of its population and accounts for 40% of the Gross National Product (GNP). Farming practices being followed depend upon size of land holding, education and financial conditions of the farmers. Crop production management refers to controlling the various aspects of crop production, to obtain the maximum and best yield. It has the following three components: 1. nutrient management; 2.Agricultural practices and 3. cropping pattern.

- ◆ **Basic practices of crop production** : Cultivation of crops involves several activities undertaken by a farmers over period of time.

²³/₁₁ These activities are listed below :

- | | | |
|--------------------------------|-----------------------|--|
| (I) Preparation of soil | (II) Sowing | (III) Adding manure and fertilizers |
| (IV) Irrigation | (V) Harvesting | (VI) Storage |

(I) Preparation of soil : The preparation of soil is the first step before growing a crop.

- ◆ One of the most important tasks in agriculture is to turn the soil and loosen it.
- ◆ This allows the roots to penetrate deep into the soil.
- ◆ The loose soil allows the roots to breathe easily even when they go deep into the soil.
- ◆ Various processes are included under preparation of soil these are as follows —



Fig.1.2 Soil Preparation

(i) Ploughing or Tilling : The process of loosening and turning of the soil is called tilling or ploughing.

- ◆ This is done by using a plough. Ploughs are made of wood or iron.
- ◆ The ploughed field may have big pieces of soil called crumbs.

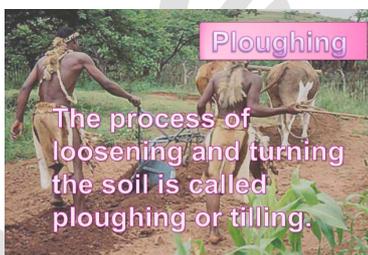


Fig.1.2 Ploughing

²³/₁₁ **Significance of ploughing** :

- ◆ This practice loosens the soil.
- ◆ The soil is overturned and properly aerated.
- ◆ This allows the roots to penetrate deeper easily.

(ii) Levelling : 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.



Fig.1.2 Levelling

Significance of levelling :

- ◆ This practice smoothen the soil surface.

(iii) **Agricultural Implements :** The tools which are used in cultivation of plants are known as agricultural implements. Some of these tools are used manually whereas others are used with the help of some animals like bullocks and camels. Nowadays tractors and combine harvesters are helping the farmers in their work. A list of commonly used agricultural implements along with their uses are given below.

TABLE : DIFFERENT AGRICULTURAL IMPLEMENTS AND THEIR USES			
NAME OF IMPLEMENT	Uses	Name of implement	Uses
Khurpa	For weeding	Seed drill	For sowing
Spade	For digging and bunds formation	Harrow	For weeding
		Sickle	For harvesting
Wooden plough	For tillage	Combines	For harvesting and threshing
Soil plank	For breaking crumbs	Sprayers	For spraying insecticides

Maintenance and Care of Agricultural Implements

- ◆ The tip of the plough should be sharpened at regular intervals for easy penetration into the soil.
- ◆ Tools should not be kept in the open during rains, otherwise they will rust.
- ◆ Tools of iron can be rubbed with a piece of brick to clean them from rust.
- ◆ Occasional servicing of tractors and combines is advisable.
- ◆ Sprayers should be washed with water thoroughly before and after each spraying.

(II) **Sowing** Sowing is the most important part of crop production. Before sowing, good quality seeds are selected.

- ◆ Good quality seeds should be clean, ealthy and good variety.
- ◆ **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.
- ◆ **Sowing the seeds :** It is done by broadcaster and seed drill.



Fig.1.2 Selection of Seeds



Fig.1.2 Using seed drill

- ◆ Broadcasting is the random sowing of seeds manually.

- ◆ In seed drill method seeds are sown uniformly at proper distances and depths.

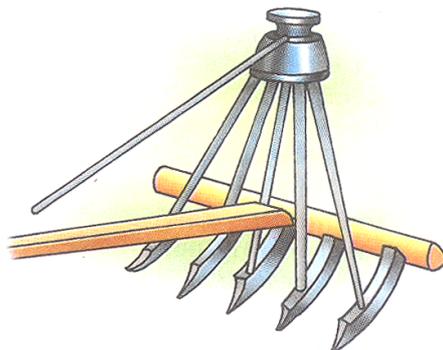


Fig.1.2 Seed drill

- ◆ It ensures that seeds get covered by the soil after sowing.
- ◆ This prevents damage caused by birds.
- ◆ Sowing by using a seed drill saves time and labour.

²³₁₁ **Transplantation** : The process in which seeds are sown in nurseries and seedlings are transferred to the main field e.g. Paddy.

- ◆ The uncultivated fields are known as fallow land.
- ◆ Precautions during sowing :
 - Spacing should be proper.
 - Seeds should be treated with fungicides.
 - Depth should be proper.

(III) Nutrient Management : Nutrients are supplied to the plants by air, water and soil. There are about 40 elements found in the plant ash, but only 16 of those elements are essential for plant growth and development. Hence, these 16 **elements** are called essential **elements or essential plant nutrients**. Out of 16 essential elements, two elements, carbon and oxygen are obtained from air and hydrogen from water. Remaining 13 elements are supplied by the soil. These 13 elements are minerals. A mineral is a substance which is obtained by mining.

ESSENTIAL NUTRIENTS OF PLANTS THEIR SOURCES, TYPES AND EXAMPLES.			
S.NO.	SOURCE	NUTRIENTS	TYPE
1.	Air	Carbon (C) , Oxygen (O)	Macronutrients (=2)
2.	Water	Hydrogen (H)	Macronutrient (= 1)
3.	Soil	• Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) Magnesium (Mg) , Sulphur (S). • Iron (Fe), Manganese (Mn), Boron (B), Zinc (Zn), Copper (Cu), Molybdenum (Mo), Chlorine (Cl)	Macronutrients (= 6) Micronutrients (=7)

²³₁₁ **Types of Essential Nutrients** Maze (1915) divided essential plant nutrients into two categories, macronutrients and micronutrients.

- Macronutrients (Macroelements).** They are those essential elements which are present in plants in easily detectable quantities, more than 1ppm of plant body (1 mg per gm of dry weight). Out of 13 essential mineral elements, six are macronutrients, i.e., nitrogen, phosphorus, potassium, calcium, magnesium and sulphur (Table 1.2).
- Micronutrients (Microelements).** They are those essential elements which are present in plants in small quantities, less than 1ppm or 1 mg/gram of dry matter. Out of 13 essential mineral elements, seven are micronutrients, i.e., iron, manganese, boron, zinc, copper, molybdenum and chlorine.

²³/₁₁ **Mineral Replenishment** Soil is the most important reservoir of plant nutrients. Crop plants regularly withdraw minerals (in the form of nutrients) from the soil. Unless and until minerals are replenished at regular intervals, the crop plants will develop disorders in structure, growth, reproduction, functioning and susceptibility to diseases. Mineral replenishment is done through the addition of manures and fertilizers to the crop fields.

(iii) Manures and Fertilizers : The deficiency of plant nutrients and organic matter in the soil is made up by adding manures and fertilizers to the soil of crop-fields. Both manures and fertilizers are major sources of nutrients of plants, so they are used in crop production.

²³⁸/₉₃ **Manures** : Manures are natural fertilizers. They are bulky sources of organic matter which supply nutrients in small quantities, and organic matter in large quantities. Manures are prepared by the decomposed animal excreta and plant waste. Manures include farmyard manure (FYM), compost, green manures, vermicompost, etc.

²³/₁₁ **Advantages of manures** : The organic manure is considered better than fertilizers. This is because,

- (i) It costs less.
- (ii) it increases organic matter in soil.
- (iii) it reduces soil erosion.
- (iv) it enhances the water holding capacity of the soil.
- (v) it increases the number of friendly microbes.
- (vi) it makes the soil porous due to which exchange of gases becomes easy.
- (vii) it improves the texture of the soil.

²³/₁₁ **Disadvantages of manures** :

- (i) Manures are bulky and not easy to be absorbed.
- (ii) They have low amount of nutrients.

²³⁸/₉₃ **Fertilizers** :



Fig.1.2 Applying Fertilizers

Fertilizers provide plant nutrients, commercially manufactured using chemicals. Fertilizers supply Nitrogen, Phosphorus and Potassium (NPK). They are used for good vegetative growth (i.e., growth of leaves, branches and flowers), giving rise to healthy plants. On the basis of the availability of nutrients from them.

◆ **Advantages of fertilizers** :

- (i) They are nutrient specific.
- (ii) They are required in small quantities.
- (iii) They are water soluble so can be applied to absorb by the plants easily.

♦ **Disadvantages of fertilizers :**

- (i) They cause water pollution.
- (ii) Fertilizers can change the chemical composition of soil.
- (iii) They can cause eutrophication in near by water bodies.

²³/₁₁ Fertilizers are divided into following four groups :

1. **Nitrogenous fertilizers** : Contain high amount of nitrogen.
2. **Phosphatic fertilizers** : Contain high amount of phosphate.
3. **Potassium fertilizers** : Contain high amount of potassium.
4. **Complex fertilizers** : (When a fertilizer contains at least two or more nutrients)

TABLE.COMPARISON OF MANURE AND FERTILIZER		
S.NO.	MANURE	FERTILIZER
1.	A Manure is a natural substance. It is obtained by the decomposition of animal wastes such as dung (gobar) of cattle and buffaloes and plant residues.	A fertilizer is a human-made substance. It is an inorganic salt or an organic compound.
2.	A manure contains small amounts of essential plant nutrients such as nitrogen, phosphorus and potassium.	Fertilizers are very rich in plant nutrients such as nitrogen, phosphorus and potassium.
3.	A manure adds a great amount of organic matter in the form of humus in the soil.	A fertilizer does not add any humus to the soil.
4.	Nutrients present in the manure are absorbed slowly by the crop plants, since manure is not soluble in water. Nutrients exist locked inside the organic compounds of humus.	Being soluble in water, a fertilizer is readily absorbed by the crop plants.
5.	A manure is not nutrient specific and it tends to remove the general deficiency from the soil.	A fertilizer is nutrient specific. It can specifically provide nutrients such as nitrogen, phosphorus and potassium to the soil according to the need.
6.	A manure is voluminous and bulky so it is inconvenient to store, transport, handle and apply to the crop.	A fertilizer is compact and concentrated so it is easy to store, transport and apply to the crop.
7.	A manure is cheap and is prepared in rural homes or fields.	A fertilizer is costly and is prepared in factories.

²³⁸/₉₃ **Biofertilizers** : Organisms which enrich the soil with nutrients are called biofertilizers. Biofertilizers are renewable and non-pollutant sources of plant nutrients such as nitrogen. Nitrogen fixing microorganisms, i.e., non-symbiotic and symbiotic cyanobacteria and phosphate-solubilising microorganism, are the main type of biofertilizers that are being used in India. Recently, two biofertilizers, namely Rhizobium cultures and blue green algae (such as Anabaena and Nostoc).

(IV) Irrigation : Process of supplying water to crop plants growing in the fields by means of canals, reservoir, wells, tube-wells etc. is known as irrigation.

²³/₁₁ **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 called **tillers** in the crop plants so as to get good crop yield.

²³/₁₁ Wells and tube wells are successful in those areas where underground water is saline, canal water is used to for irrigation.

²³/₁₁ Excessive irrigation causes water logging and increases surface salinity. In water logged soil plant, roots do not get proper aeration.

(i) 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 :

²³/₁₁ By proper selection of appropriate crop and cropping system.

²³/₁₁ By applying only **optimum quantity** of water at appropriate time.

²³/₁₁ By keeping weeds under control in the fields.

²³/₁₁ By time scheduling during irrigation operations.

(ii) Water requirements or irrigation of crop plants depends on two factors

²³/₁₁ **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.

²³/₁₁ **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.

(iii) Irrigation Systems :

- ◆ **Traditional methods of irrigation :** The water available in wells, lakes and canals is lifted up by different methods, for taking it to the fields.
- ◆ Cattle or human labour is used in these methods. So these methods are cheaper, but less efficient.
- ◆ The traditional methods are following :

(A) Moat (pulley system)

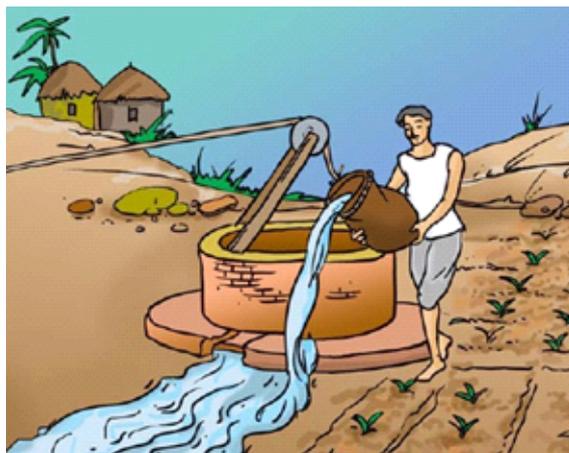


Fig.1.2 Moat

(B) Chain pump : Pumps are commonly used for lifting water. Diesel, biogas, electricity and solar energy is used to run these pumps.

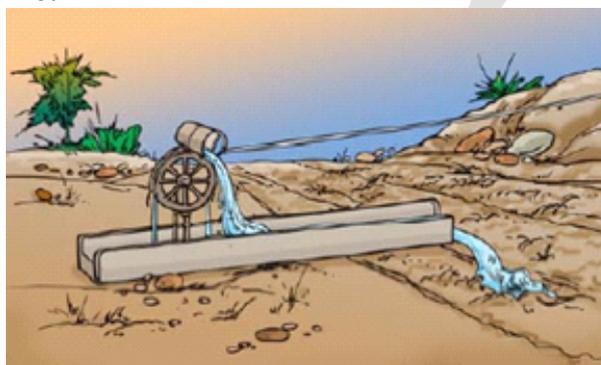


Fig.1.2 Chain Pump

(C) Dhekli & Rahat (lever system)

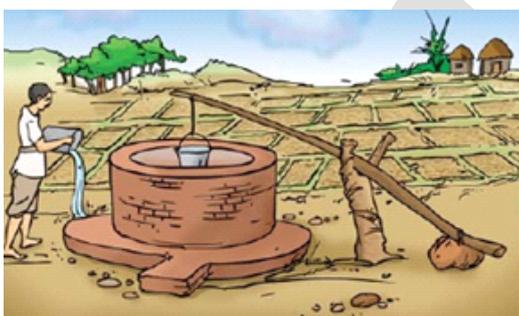


Fig.1.2 Dhekli, Rahat

²³/₁₁ **Modern methods of irrigation :** Modern method of irrigation help us to use water economically.

◆ The modern methods are as follows :

[A] Sprinkler irrigation system : It is water efficient system and is being introduced in the canal irrigated areas of Maharashtra, Karnataka, Andhra Pradesh, Orissa and Tamil Nadu for fruit crops

◆ A device having perforated ring or small stand with a revolving nozzle to which a base is attached, is used for watering crop plants.

◆ This system spreads water uniformly over crop plants and fields, required quantity of water is supplied.

- ◆ Sprinkler irrigation system is being introduced in canal irrigated areas of Haryana, Rajasthan and Madhya Pradesh. 2. Drip irrigation system is being encouraged in Maharashtra, Karnataka, Andhra Pradesh, Orissa and Tamil Nadu for fruit crops. Fertigation is an innovation of applying fertilizer through drip irrigation to maximise farm productivity with available water.

[B] Drip- irrigation system : Modern system being encouraged in Haryana, Rajasthan and Madhya Pradesh.

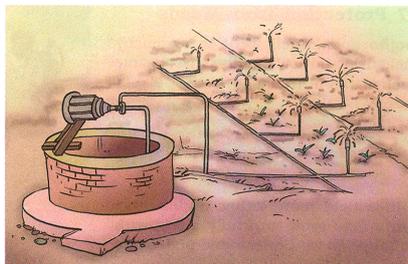


Fig.1.2 Sprinkler System

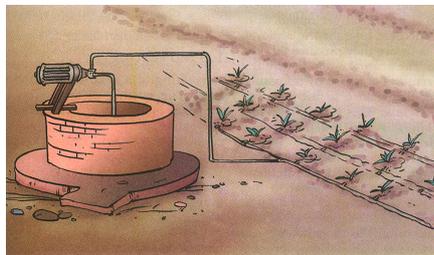


Fig.1.2 Drip System

(V) Harvesting : The cutting of crop after its maturation is called harvesting.

- ◆ It is either done manually by sickle or by a machine called harvester.
- ◆ In the harvested crop, the grain seeds need to be separated from the chaff. This process is called threshing. This is carried out with the help of a machine called 'combine' which is a combined harvester and thresher.
- ◆ Farmers with small holdings of land do the separation of grain and chaff by winnowing.
- ◆ The period of harvest is celebrated with great joy and happiness in all parts of India.
- ◆ People celebrate it with great enthusiasm.
- ◆ Special festivals associated with the harvest season are Pongal, Baisakhi, Holi, Diwali, Nabanya and Bihu



Fig.1.2 Threshing a machine manually combine harvester can be used for both harvesting and threshing winnowing, which involved the separation of the grain from chaff (seed covering and tiny pieces of leaves or stem), can be done manually, or using a winnowing machine.

(c) Crop protection management

(I) Weed Control : Weeds are unwanted plants in the cultivated fields. In other words, plants other than crops are the weeds. Weeds tend to compete with the crops for food (water and nutrients), space and light. The process of removing the weeds from crop field is called weeding.



Fig.1.2 Certain common weeds.

(i) Mechanical methods. Mechanical Weeding can be done by the following methods :

²³⁸₉₃ Weeds may be pulled out with hand. Ploughing helps in removing large number of the weeds because it uproots majority of them.

²³⁸₉₃ The weeds which appear during the growth of crop plants are removed manually by using a trowel (khurpa).

(ii) Cultural methods. They include the following methods : proper bed preparation, timely sowing of crops, intercropping and crop rotation.

(iii) Chemical methods. Chemical weed killers, called herbicides or weedicides, are sprayed on weeds to destroy (kill) them. This is called chemical control of weeds. Some common examples of weedicides are the following : (i) 2, 4-D (2, 4-Dichlorophenoxy acetic acid); (ii) Atrazine; (iii) Fluchioralin; (iv) Isoproturon.

(iv) Biological control : Biological control of weeds involves the deliberate use of insects or some other organisms which consume and specifically destroy the weed plants. The best Indian example of biological control is eradication of prickly-pear cactus (Opuntia) by using the cochineal insects in Maharashtra and Tamil Nadu. Generally, a combination of one or more of these weed control methods are employed to get good results. Aquatic weeds are controlled by the fish grass carp.

ACTIVITY 1.2

Visit a weed infested field in the month of July or August and make a list of weeds, insect pests and diseases noticed in crops of the field.

(II) Diseases of Crop Plants : Our environment contains a variety of pathogens. When they get favourable conditions for their growth and propagation, they spread and infest the crop plants causing diseases. Depending upon their mode of occurrence, crop diseases are of following four main types :

(i) Seed-borne diseases : These diseases spread through seeds, e.g., "ergot of bajra" or of pearl millet; "leaf spot of rice"; "loose smut of wheat"; red rot of sugarcane; - all are caused by fungi.

(ii) Soil-borne diseases : These diseases spread through the soil and mostly affect roots and stems of crop plants, e.g., "smut of bajra," "tikka disease of groundnut".

(iii) Air-borne diseases : These crop diseases are transmitted by the air, e.g., "rust of wheat", "blast of rice", etc. Air-borne diseases attack all aerial parts of the plants, e.g., leaf, flower, and fruits.

(iv) Water-borne diseases : Pathogens of these crop diseases are transmitted by the water, e.g., "bacterial blight of rice". Control of crop diseases. All the seed-borne and soil-borne diseases can be controlled by treating the seed or soil. Air-borne diseases are controlled by spraying fungicide solution on infested parts. Diseases of the major crops and their control measures have been given in

(III) Storage of Grain : Most crops are harvested only once a year. Thus, they are available in plenty amount during a selective time. For getting seasonal foods regularly throughout the year, they are stored in safe storage. Cereals or food grains are stored at following three levels :

1. At producer (farmer) level (called rural storage) ;
2. At trader's level (this is done by keeping food grains in gunny bags).
3. At FCI (Food Corporation of India) level (This is done by storing grains in silos. During storage, grains and seeds are subjected to spoilage and wastage by various means. This loss has been estimated to be 9.3 per cent annually. During storage damage of grains can take place by following two main types of factors :

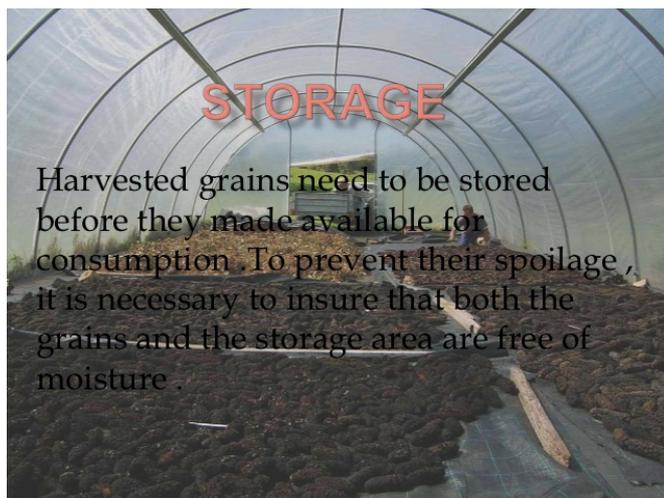


Fig.1.2 Storage of Grain

²³/₁₁ **Factors Responsible for Loss of Grains during storage :**

- (A) Biotic (living) factors :** insects, rodents, birds, mites etc.
- (B) Abiotic (nonliving) factors :** Temperature, Moisture, Humidity, Material of container in which grains are stored

²³/₁₁ **Preventive Measures :**

- ◆ Drying before storage
- ◆ Maintenance of hygiene
- ◆ Plant - product treatment
- ◆ Prophylactic treatment (example- treatment of seeds with antimicrobial agents before sowing)
- ◆ Improved storage structures

²³/₁₁ **Fumigation :** Those pesticides which can destroy insects by forming toxic fumes are called fumigants and process of their use is called fumigation. Fumigants may be solid, liquid or gaseous. Ultimately they volatalise or react with moisture of the air, forming poisonous fumes.

(IV) Cropping Pattern : These are models of raising crops which help in obtaining maximum benefit from the same piece of land, reduce risk of crop failure, disease and infestation. Three common types of cropping patterns are mixed cropping and crop rotation.

(i) Mixed Cropping In mixed cropping

1. Seeds of two crops are mixed before sowing and there is no definite pattern for sowing the Seeds.
2. Same fertilizers and pesticides are used for all crops.
3. Products of different crops are harvested, threshed, marketed and consumed in mixed form.

²³/₁₁ **Crop-combination used in mixed cropping :** In India, the following combinations of the crops are used by farmers in mixed cropping :

- | | |
|-----------------------------|---------------------------|
| (i) Maize + Urad bean | (ii) Cotton + Moong bean |
| (iii) Groundnut + Sunflower | (iv) Sorghum + Pigeon pea |
| (v) Wheat + Chick pea | (vi) Barley + Chick pea |
| (vii) Wheat + Mustard. | |

²³/₁₁ **Advantages of Mixed Cropping**

1. The risk of total crop failure due to uncertain monsoon is reduced.
2. Fertility of the soil is improved by growing two crops simultaneously.
3. Chances of pest infestation are greatly reduced.

(ii) Intercropping Intercropping is a practice of growing two or more crops simultaneously in a same field in definite row patterns with the objective of increasing productivity per unit area.

²³/₁₁ **Advantages of Intercropping**

1. It makes better use of the natural resources of sunlight, land and water.
2. Soil erosion is effectively arrested.
3. Since the seed maturity period of these crops vary, the different crops can be harvested and threshed separately

(iii) Crop Rotation : If we grow a crop continuously in the same field for many years, it results into various problems such as (i) depletion (deficiency) of same types of nutrients and (ii) build up of diseases and insect-pests. This demands for the requirement of the practice of crop rotation. Crop rotation can be defined as the practice of growing of different crops in a piece of land in a preplanned succession. Depending upon the duration crop rotation may be of following three types.

TYPES OF CROP ROTATION	COMPONENT CROPS INVOLVED IN ROTATION
One year rotation	Maize - Mustard
	Rice - Wheat
Two years rotation	Maize - Mustard - Sugarcane-Fenugreek (Methi)
	Maize - Potato - Sugarcane Peas
Three years rotation	Maize - Potato - Sugarcane Peas
	Cotton - Oat-Sugarcane - Peas - Maize Wheat

²³/₁₁ **Advantages of Crop Rotation :**

1. **It controls pests and weeds.** Most pathogens survive on crop residue, but only for a limited time, and most pathogens do not infect multiple crops.
2. **Crop rotation reduces the need of fertilizers.** For example, nitrogen supply is maintained in the crop field when leguminous crops are alternated with others.

ACTIVITY

Sow seeds of wheat, paddy, vegetables in different pots with and without manuring and fertilizer application. Record observations given below and note on each crop with special emphasis on the following aspects :

1. Percentage of seed germination.
2. Flowering and maturity time.

Green Revolution in India

The bumper increase in the yield of food grains (especially the wheat crop) as during the 1970s, is often termed as green revolution. The 1970 Nobel laureate, American scientist Dr.N.E. Borlaug was the person behind triple dwarf Mexican wheat varieties. Their colour was changed to Indian liking through gamma irradiation (by M. S.Swaminathan, Father of Green Revolution in India).Green revolution has made our country self-sufficient in food, increased the buffer stock of food grains and improved the economic conditions of Indian farmers as well as provided employment avenues to large number of people.



M.S.Swaminathan

(V) Crop Variety improvement :

²³/₁₁ **Hybridisation** : The crossing between genetically dissimilar plants to produce a new kind (hybrid) is called hybridisation. Crossing may be between two different varieties (intervarietal cross-breeding), between two different species of the same genus (interspecific cross-breeding) and between different genera (intergeneric cross-breeding). This method incorporates the desired (good) characteristics of both parents in one variety. The most common type of breeding is inter varietal.

Ask yourself

- Q.1 How biofertilizers are ecofriendly.
- Q.2 What is the importance of crop in our daily life ?
- Q.3 How ploughing help in cropping ?
- Q.4 If there is low rainfall in a village throughout the year, what measures will you suggest to the farmers for better cropping.
- Q.5 At what time is irrigation required by all crops ?

**1.3 DIFFERENTIAL AGRICULTURE PRACTICE****(a) Organic Farming**

It is the practice of raising crops which have not been polluted. Healthy cropping systems that provide optimum nutrients to plants and keep the pests as well as weeds under control are used. In organic farming there is little or no use of chemical fertilizers, pesticides and herbicides. Organic wastes are recycled in the form of manure. Biofertilizers include the nitrogen fixing organisms (bacteria and blue green algae) and mineral solubilizing bacteria. Biopesticides are organisms or their extracts which repel or kill weeds, insects and other pests, Neem leaves are often used in grain storage as biopesticides. Healthy cropping includes mixed cropping, intercropping and crop rotation. These cropping systems help in controlling insects, pests and weeds.

²³/₁₁ **Advantages of Organic Farming**

- ◆ It prevents pollution of any component of our environment.

- ◆ Farm wastes are recycled.
- ◆ The foods obtained from organic farming are free from pesticides and toxic chemicals.
- ◆ Organic farming maintains the soil health.
- ◆ The cropping system of organic farming keeps insect pests and weeds under check.



Fig.1.3 Organic Farming.

(b) Sustainable Agriculture

In the past, to meet the demands of growing Indian population, our scientists (such as Swaminathan, Kurein) adapted methods to increase food production. This resulted in a variety of 'revolutions', which helped India become self-reliant. These revolutions include: Our scientists are continuously making efforts to increase the pulse production, i.e. to spread the golden revolution. Sustainable agriculture can be defined as the adoption of various farming and production management techniques to maximize agricultural yield. Implementing such practices would help in (i) conserving natural resources, (ii) maintaining environmental balance and (iii) coping with changing human needs Hence, to assure sustained livelihood of Indian farmers and related persons, it is necessary to adopt sustainable agricultural practices such as mixed farming, crop rotation, intercropping and integrated farming (also known as integrated agriculture).

- ◆ **Farming** : It is the process the harnessing solar energy from plants and animals in the form of economic produce.
- ◆ **Conservation** : It means careful utilization, preservation or Restoration of the Natural environment and resources.
- ◆ **Integrated agriculture** : Implies a combination of agriculture with other forms of culture such as pisciculture (fish culture), aquaculture, apiculture (bee- keeping), sericulture (silk worm culture), poultry farming, piggery, livestock production (animal husbandry), etc.
- ◆ **Advantages of Sustainable agriculture.** Sustainable agriculture is an agricultural production and distribution system that achieves the integration of natural biological cycles and controls.

(c) Animal Husbandry

The branch of agriculture that deals with the feeding, caring and breeding of domestic animals is called animal husbandry. Husbanding means to use a resource carefully and without waste. Thus, animal farming or animal husbandry requires planning for domestic animal's shelter, breeding, health, disease control and proper economic utilisation. Our domestic animals or livestock includes those animals which are raised for farm purposes, e.g., cattle (cow, bull or ox), buffalo, yak, horse, ass, goat, sheep, camel, etc.

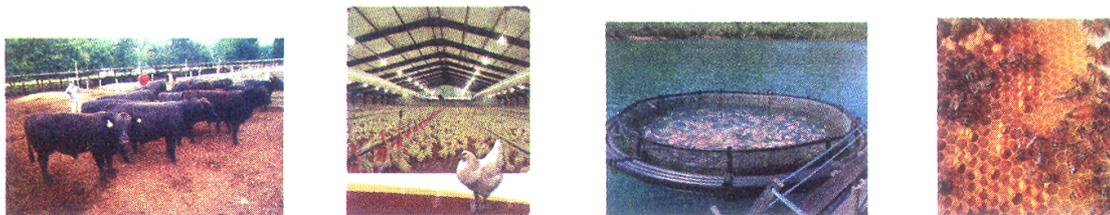


Fig.1.3 Cattle production, Poultry, Fish farming & Bee keeping.

Ask yourself

- Q.1 How organic farming is useful forest ?
- Q.2 Why sustainable agriculture use ?
- Q.3 What is animal Husbandry ?
- Q.4 What is the advantages of sustainable agriculture ?
- Q.5 What is integrated agriculture ?



Add to Your Knowledge

²³⁸/₉₂ India is a large country with an enormous area under cultivation. India is blessed with continuous growing seasons which means that crops can be grown throughout the year. This is due to the subtropical climate, plenty of sunshine and lack of frost in most part of the country.

²³⁸/₉₂ Green revolution (high production of food grains), blue revolution (enhanced fish production), white revolution (increased milk production) and yellow revolution (increased oil production).

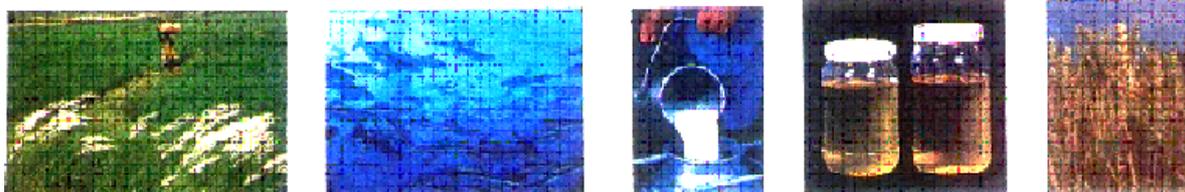


Fig.1.3 Green Revolution , Blue revolution , White revolution, Yellow revolution & Colour revolution.

²³⁸/₉₂ In modern system of sanitation, water is used for removal of human excreta and other wastes. Sewage consists of two components: (i) The solid part, called the sludge and (ii) the liquid part, called effluent or sewage water. The dried sludge may be used as soil conditioner in lawns and flower gardens. Sewage water is quite rich in many nutrients of plants so can be used for fertilizing and irrigating the soil.

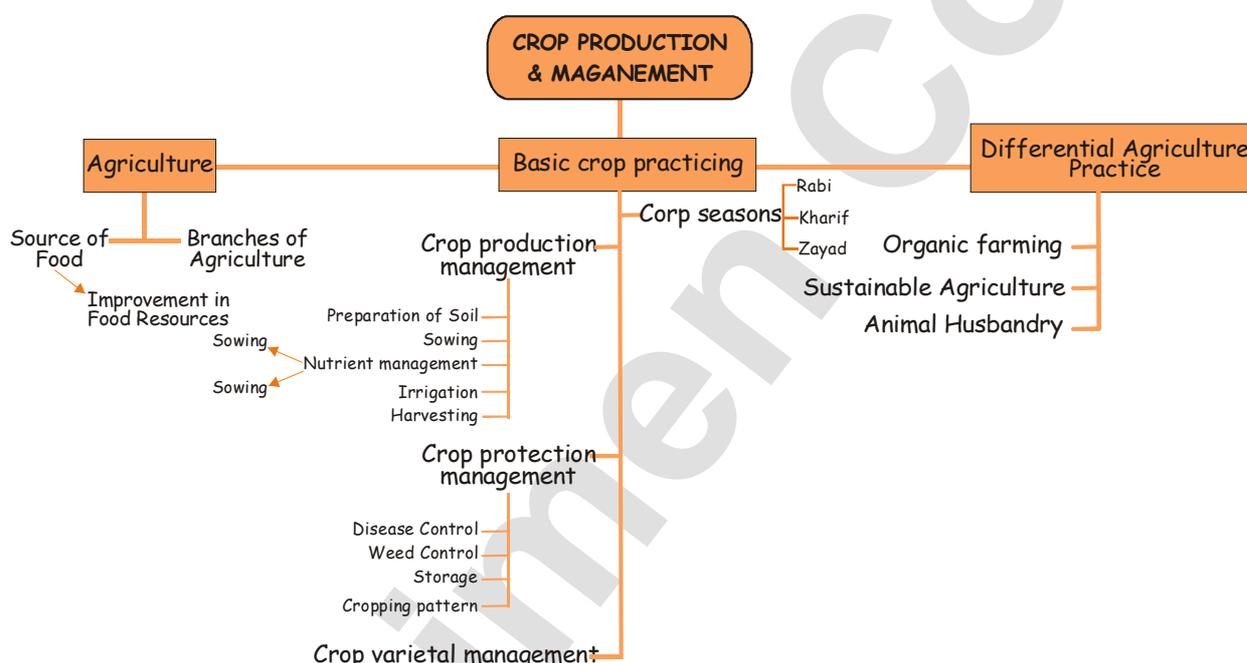
²³⁸/₉₂ The degradation of organic waste through the consumption by the earthworms is called vermicomposting. An earthworm is physically an aerator, crusher and mixer, chemically a degrader and biologically a stimulator of decomposition. In India, following species of earthworms are used in vermicomposting: Dichogaster bofani, Drawida willsi, Perionyx excavatus (Indian species) and Eisenia foetida, Eudrilus eugeniae (Exotic species).

²³⁸/₉₂ Selection by human beings is also called artificial selection. Artificial selection operating over long time spans can give rise to varieties strikingly different from starting generation. For example broccoli, cabbage, cauliflower and other varieties have been obtained through artificial selection from wild cabbage.

Important point :

- ◆ Bananas are the number one fruit crop in the world. They are the 4th largest overall crop, after wheat, rice, and corn. They grow in more than 100 countries on farms. India grows more bananas than any other country.
- ◆ More than 6,000 different kinds of apples are grown around the world. The biggest producer is China.
- ◆ According to many historians, goats were the first animal to be domesticated. Goats are typically the cleanest of animals. Pigs, a common farm animal, are thought to be the 4th most intelligent animal, after chimps, dolphins, and elephants.
- ◆ Subsistence farmers are farmers who produce the food they need to survive on a daily basis. They are farmers who raise enough food for themselves and their families. The food is not intended to be sold in a market.

CONCEPT MAP



EXERCISE >> 01

SECTION -A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS :

BASIC CROP PRACTICING

1. Transfer of seedlings from the nurseries to the main field is termed as -
 (A) weeding (B) sowing (C*) transplantation (D) ploughing
2. The unwanted wild plants growing along with the crop plants are called -
 (A*) weeds (B) seedlings (C) minor crops (D) grasses
3. Which one of the following does not cause plant diseases ?
 (A) Viruses (B) Bacteria (C*) Protozoa (D) Fungi
4. Which one of the following is traditional method of Irrigation ?
 (A) Moat (B) Chain pump (C) Rahat (D*) All of these

5. Chemicals which are used for removal of weeds are
 (A) Insecticides (B) Pesticides (C*) Weedicides. (D) None of these
6. In which of the following storage structure food grains are stored ?
 (A) Silos (B) Jute bags (C) Granaries (D*) All of the these
7. 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.
8. Which one of the following is kharif crop ?
 (A) Wheat (B) Maize (C*) Rice (D) Mustard
9. Which one of the following is the advantage of soil preparation ?
 (A) It increase soil fertility (B) It makes soil compact
 (C) Soil become loose for roots to penetrate (D*) All of these are correct
10. Fertigation is a new method to apply :
 (A) Manures (B) Fertilizers (C) Water (D*) Both (B) & (C)
11. In _____ soil, frequent irrigation is required :
 (A*) Sandy (B) Clayey (C) Loamy (D) All of these
12. An irrigation practice common in southern region of India is :
 (A*) Sprinkler system (B) River valley system (C) Fertigation (D) Canal system
15. 'SILOS' are structures used for
 (A) Storage of Milk (B) Storage of Water
 (C*) Storage of Grains (D) Release of Smoke
16. 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
17. Ecological Importance of Earthworms is that :
 (a) It damages roots of plants.
 (b) It takes organic matter from the soil surface, deeper into the soil for absorption by plants.
 (c) It's castings are rich in organic matter.
 (d) It serves as food for protozoa.

Which of the above statements are correct.

- (A) a and c (B*) b and c (C) a and b (D) a,b and c

DIFFERENTIAL AGRICULTURE

13. Which is the by-product of honeycomb ?
 (A) Grease (B*) Wax (C) Vitamin (D) Sugar
14. Milch animals are given to increase the quantity of milk.
 (A) grass (B*) straw (C) ambon (D) horse gram

FILL IN THE BLANKS

- (i) _____ contain _____ matter in large quantities.
- (ii) The undesirable plants are called _____
- (iii) Father of green _____ is _____
- (iv) Big pieces of soils are called as _____
- (v) Zayad crops are grown during mainly in _____
- (vi) Rice, Jawar, Bajra are _____ crop.
- (viii) In _____ Dr. M.S.Swaminathan has developed a high yield dwarf variety of wheat.

TRUE / FALSE

- (i) Fertilisers are nutrient specific
- (ii) The plants grown in a field for food and fibres are called crop plants
- (iii) In India, special festivals are held commemorating the harvest
- (iv) Mustard, sunflower and groundnuts are all pulses
- (v) The soil should be loosened before seeds are sown

MATCH THE COLUMN**Uses**

- (i) Weeding
- (ii) Digging and bunds formation
- (iii) Tillage
- (iv) Sowing
- (v) Harvesting

Instruments

- (a) sickles
- (B) seed drill
- (C) wooden plough
- (D) spade
- (e) Khurpa

SECTION -B (FREE RESPONSE TYPE)**VERY SHORT ANSWER TYPE**

1. Name the chemicals used to destroy weeds.
2. Why is drip irrigation the best method of watering plants ?

SHORT ANSWER TYPE

1. Differentiate between fertilisers and manures.
2. What are traditional methods of irrigation ?

LONG ANSWER TYPE

1. How do farmers protect their crops from pests for weed.
2. Define harvesting. Name the implements used.

EXERCISE >> 02**SECTION -A (COMPETITIVE EXAMINATION QUESTION)****MULTIPLE CHOICE QUESTIONS**

1. Which one of the following condition is not essential to grow maize?
(A) High temperature (B) Humidity (C) Low temperature (D) Rainfall
2. Propagation of ginger is generally done using
(A) seed (B) stem (rhizome) (C) root (D) leaf
3. Which of the following statement is not true for organic manure?
(A) It enhances water holding capacity of soil.
(B) It has a balance of all plant nutrients.

- (C) It provides humus to soil.
(D) It improves texture of soil.
4. The term used for the process of separation of grains from chaff is
(A) sieving (B) threshing (C) winnowing (D) hand picking
5. Which of the following tools would a farmer use to remove weeds from the field?
(A) Hoe (B) Plough (C) Axe (D) Cultivator
6. Which of the following is not true for fertilisers?
(A) They increase the yield.
(B) Their excessive use disturbs the balance of nutrients in soil.
(C) They are generally used in small quantity.
(D) They are environment friendly.
7. Given below are statements about the harmful effects of weeds on crop plants.
(i) They interfere in harvesting.
(ii) They help crop plants to grow healthily.
(iii) They compete with crop plants for water, nutrients, space and light.
(iv) They affect plant growth.
Choose the correct combination of statements.
(A) i, iii, iv (B) iii only (C) iii, iv (D) i, ii, iii, iv
8. The process of loosening and turning of soil is called
(A) irrigation and manuring (B) digging and winnowing
(C) tilling and ploughing (D) harvesting and storage
9. The monsoon season in our country is during the months
(A) April to December (B) June to September
(C) November to March (D) January to May
10. The system of irrigation where in water is supplied drop by drop near the roots of plants, is called
(A) Pully system (B) drip system (C) sprinkler system (D) lever system

SECTION -B (TECHIE STUFF)

11. Read the statements given below.
(i) Seeds require moisture for germination.
(ii) Plants can absorb nutrients mostly in dissolved form.
(iii) Irrigation protects crops from both frost and hot air currents.
(iv) Irrigation improves soil texture.
Choose the combination of statements which indicate the need to irrigate crops.
(A) i and ii (B) i, ii, iii (C) i, ii, iii, iv (D) i and iii
12. The bacteria that fix nitrogen in the root nodules is called
(A) Azobacter. (B) Rhizobium. (C) Nitrosomonas. (D) Putrefying bacteria

EXERCISE >> 03

(PREVIOUS YEAR EXAMINATION QUESTIONS)

1. Refer the given figure showing root nodules of a leguminous plant and select the incorrect statement regarding this.
(A) The root nodules contain N_2 -fixing bacteria such as Rhizobium which perform biological N_2 -fixation.
(B) Association between the leguminous plants and N_2 -fixing bacteria is referred to as symbiosis.
(C) The N_2 -fixing bacteria convert atmospheric free nitrogen into nitrogenous compounds such as nitrates.

- (D) Examples of leguminous plants are maize, rice, cotton, peas, beans etc.
2. Read the given statements and select the correct option.
 Statement 1 : Fertilizers are chemical substances.
 Statement 2 : Manures are natural organic substances.
 (A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
 (B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
 (C) Statement 1 is true but statement 2 is false.
 (D) Both statements 1 and 2 are false.
3. Match different terms in column I with their related description in column II and select the correct option from the codes given below.
- | Column - I | Column - II |
|--|--|
| (a) Weeding | (i) Loosening and turning of soil |
| (B) Winnowing | (ii) Removing unwanted plants from a field |
| (C) Tilling | (iii) Cutting and gathering of mature crop |
| (D) Harvesting | (iv) Separation of grain from the chaff |
| (A) (a) - (i), (B) - (iii), (C) - (ii), (D) - (iv) | (B) (a) - (ii), (B) - (i), (C) - (iv), (D) - (iii) |
| (C) (a) - (ii), (B) - (iv), (C) - (i), (D) - (iii) | (D) (a) - (iv), (B) - (iii), (C) - (i), (D)-(ii) |
4. Read the given statements and select the correct option.
 Statement 1 : Biofertilizers are the living organisms that enhance the nutrient quality of the soil.
 Statement 2 : N_2 fixing bacteria, N_2 -fixing cyanobacteria and mycorrhizae act as important biofertilizers.
 (A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
 (B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
 (C) Statement 1 is true and statement 2 is false.
 (D) Both statements 1 and 2 are false.
5. Preparation of soil helps the soil to turn and loosen. This turning and loosening of soil is necessary as
 (A) The loose soil helps roots to breathe easily
 (B) The loose soil helps in the growth of earthworms and friendly microbes present in the soil
 (C) Nutrients present in soil crumbs become easily available
 (D) All of these.
6. Factor responsible for increased crop production in India is
 (A) Use of improved seeds developed by plant breeding and scientific methods
 (B) Protection of plants against pests and better storage
 (C) Control of plant diseases
 (D) All of these.
7. Which one of the following is a correct match?
 (A) Rabi - sowing (June-July), harvesting (September-October)
 (B) Kharif - sowing (June-July), harvesting (September-October)
 (C) Rabi - sowing (October-December), harvesting (June-July)
 (D) Both (B) and (C)
8. Crop rotation is performed to
 (A) Improve the fertility of soil
 (B) Save nitrogenous fertilizers

- (C) Help in weed control and pest control (D) All of these.
9. Pesticides are chemical substances that control pests. They include
 (A) Herbicides and insecticides
 (B) Insecticides only
 (C) Insecticides and rodenticides
 (D) Fungicides, herbicides, insecticides, rodenticides and nematicides.
10. Which of the following is/are incorrect statement(s) regarding manure?
 (i) Manure enhances the water holding capacity of the soil.
 (ii) Manure is nutrient specific i.e. supply a particular desired nutrient.
 (iii) Manure decreases the number of friendly microbes.
 (iv) Manure improves the texture of the soil.
 (v) Manure is prepared by the decomposition of dead plant and animal matter.
 (A) (i), (iii) and (v) (B) (i) & (v) (C) (ii), (iii), (iv) & (v) (D) (ii) & (iii)

ANSWER KEY >>

1.CROP PRODUCTION & MANAGEMENT EXERCISE-1

SECTION -A (FIXED RESPONSE TYPE)

MULTIPLE CHOICE QUESTIONS

Q.	1	2	3	4	5	6	7	8	9	10
A.	C	A	C	D	C	D	B	C	D	D
Q.	11	12	13	14	15	16	17			
A.	A	A	B	B	C	A	B			

FILL IN THE BLANKS

- (i) Manures ,Organic (ii) Weed
 (iii) revolution , Dr. M.S. Swaminathan (iv) crumbs
 (v) Summer season (vi) Kharif crop
 (vii)1967

WRITE TRUE OF FALSE

- (i) True (ii) True (iii) True (iv) False (v) True

MATCH THE FOLLOWINGS

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

EXERCISE-2

SECTION -A (COMPETITIVE EXAMINATION QUESTION)

MULTIPLE CHOICE QUESTIONS

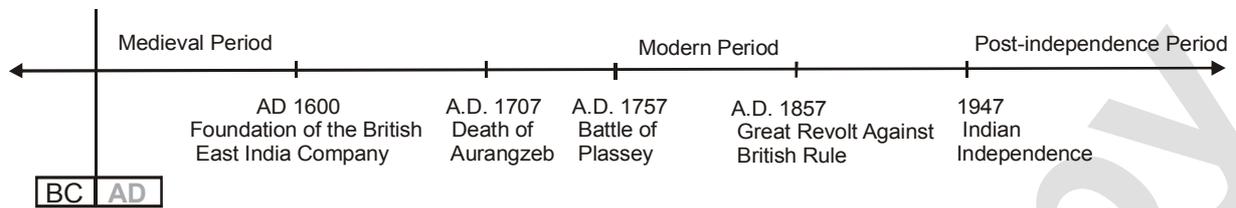
SECTION -B (TECHIE STUFF)

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

EXERCISE-3

(PREVIOUS YEAR EXAMINATION QUESTIONS)

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



INTRODUCTION

History is the branch of knowledge that records and analyses past events and happenings. It is difficult to study a very long past which ranges from the start of life till date. Therefore, historians have divided it into three periods - namely Ancient, Medieval and Modern, on the basis of commonness of characteristics found during each period. This is called periodisation of History.

1.1 MODERN PERIOD : AN OVERVIEW

The European Renaissance laid emphasis on the spirit of enquiry. Revival of interest in the life of human beings led to humanism which found expression in music, painting, sculpture, theatre and literature.

Humanism : European intellectual movement, which held that, though God created the universe, development and industrialization were the achievements of man.

- In AD 1453, the Turks took control of the overland trade routes connecting Europe to the East. This forced the Europeans to look for alternative sea routes.
- The zest for an adventure initiated by the movement called Renaissance also encouraged long sea voyages.
- Spanish and Portuguese explorers such as Magellan, Christopher Columbus and Vasco da Gama made their mark in finding new sea routes across the globe.
- Discovery of new sea routes helped in new trade contacts, which led to the emergence of imperialism



Vasco da Gama discovered the sea route to India by travelling around the continent of Africa. He reached the port of

1.2 IMPORTANCE OF DATES

Historical events usually refer to a particular time in the past. It is easy to mention the dates when we take incidence of war and the events of the kind as per the following example:-

- The Battle of Plassey took place on 23rd June 1757 at Plassey, West Bengal, India.
- Warren Hastings became the first Governor-General of British India from 1773 to 1785.

- In 1877, Queen Victoria took the title of Empress of India.
- The Indian National Congress was formed in the year 1885.
- In 1905, Curzon, the Viceroy and Governor-General (1899-1905), ordered the partition of the province of Bengal.
- The Jallianwala Bagh massacre took place on 13th April 1919.
- In March 1931, the Gandhi-Irwin Pact was signed.
- The Quit India Movement or the civil disobedience movement in India was launched in August 1942.
- On 3rd June 1947, Lord Mountbatten, the last British Governor-General of India, announced the partition of the British Indian Empire into a secular India and a Muslim Pakistan.
- On 14 August, Pakistan was declared a separate nation. At midnight, on 15th August 1947, India became an independent nation.

Do you Know

- Bengal Gazette was India's first newspaper published in 1780 from Calcutta. Rast Goftar was the first newspaper in Gujarat published in 1851 from Bombay.



Fig. - Brahmans offering the Shastras to Britannia, frontispiece to the first map produced by James Rennel, 1782

Rennel was asked by Robert Clive to produce maps of Hindustan. An enthusiastic supporter of British conquest of India, Rennel saw preparation of maps as essential to the process of domination. The picture here tries to suggest that Indians willingly gave over their ancient texts to Britannia – the symbol of British power – as if asking her to become the protector of Indian culture.

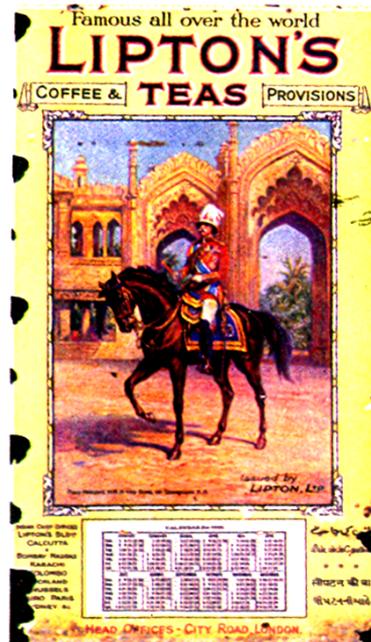


Fig. - Advertisements help create taste

Old advertisements help us understand how markets for new products were created and new tastes were popularised. This 1922 advertisement for Lipton tea suggests that royalty all over the world is associated with this tea. In the background you see the outer wall of an Indian palace, while in the foreground, seated on horseback is the third son of Queen Victoria of Britain, Prince Arthur, who was given the title Duke of Connaught.

1.3 HOW DO WE PERIODISE ?

So, we have come to the conclusion that dates and time frames are essential to record history. Let us see how historian divided history into periods or time - frames.

Historians divided history according to their ideas of the past.

To understand this statement let us look at one particular history book- '**The History of British India**'. **This** book was written by James Mill was born in 1773. He was a Scottish historian, economist, political theorist, and philosopher. In this book, James Mill has divided Indian history into three periods.

(1) Hindu period

(2) Muslim Period

(3) British Period

Let us see the reasons for this division by James Mill

- According to Mill, before the British came to India, Hindu and Muslim kings/dictators ruled the country.
- There was religious intolerance, caste discrimination and superstitious practices in the Indian society.
- Mill felt that only the British could bring enlightenment and happiness to the Indians by refining them.

1.4 HOW CAN WE STUDY THE MODERN PERIOD ?

We are already familiar with the various types of sources used by a historian in writing the history of a particular period. The advantages of sources for the modern period are that they are found in abundance and are also well preserved. Scientific methods are available in today's world, which make it easier for us to preserve the records.

The sources for studying the modern period of Indian history are varied. These sources are of the following two types:

(A) Primary Sources

These include archaeological sources, original documents, photographs and videotapes.

- Archaeological sources** include the buildings spread across the country such as the Gateway of India, Parliament House and the Rashtrapati Bhavan.
- Original documents** such as government orders and official correspondence are **costlier** significant sources of historical information. These are well preserved in the archives and give us a first-hand knowledge of events.
- Newspapers, magazines, letters and pamphlets** belonging to the period are also kept in libraries and archives. They were printed in different languages in different periods of time. Some of these newspapers are printed even today. Letters are also important as they help us understand the prevailing situations from a personal point of view.
- Printed books** give us a detailed idea about the achievements in various fields such as art, literature, science and technology, medicine, etc. Books also tell us about social, economic and political conditions of a period. Biographies and autobiographies give an account of the life and thoughts of famous personalities.
- Films, photography and videotapes** display the lives of famous people and events. The impression left after watching such films or video clippings are of more permanent nature than the events which we see with our own eyes.

(vi) Mapping

In order to effectively administer India, the British Government felt need to map the subcontinent for which they got various surveys conducted. They set up at Dehradun, the Survey of India. Elaborate maps were drawn up showing the location of towns and cities with various geographical features, flora, fauna, etc.

(B) Secondary Sources

These include reports, reviews, articles and printed books based on primary sources.

The **Indologists** such as James Mill, Max Mueller, Vincent Smith took keen interest in Indian culture and examined the ancient Indian texts. Through these texts the British tried to understand the Indian traditions, customs and norms that would help them to rule India efficiently. These colonial writers projected the view that India was a backward country and British rule was a blessing in disguise for India. However, the nationalist writers such as Bankim Chandra Chatterjee wanted to rediscover Indian's glorious past. Dadabhai Naoroji's 'Poverty and British Rule in India', Jawahar Lal Nehru's Discovery of India exposed the negative impact of British rule while highlighting India's glorious past. The Indian people's grievances against the British rule were reflected in the many of the writings such as 'Neel Darpan'.

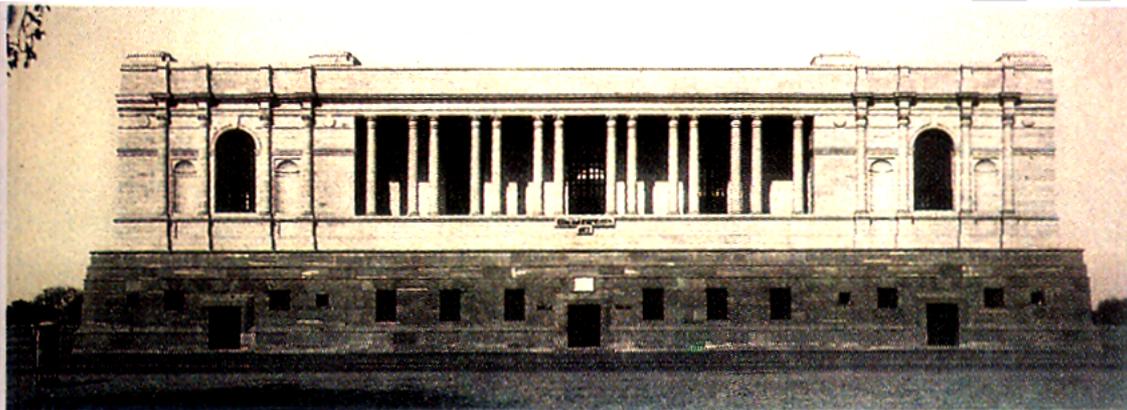


Fig. – The National Archives of India came up in the 1920s

When New Delhi was built, the National Museum and the National Archives were both located close to the Viceregal Palace. This location reflects the importance these institutions had in British imagination.

Surveys become 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. 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 as seen necessary to know 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, collected information on castes, religions and occupation. There were many other surveys e.g. – **Botanical Surveys, Zoological Surveys, Archaeological Surveys, Anthropological Surveys, Forest Surveys.**



Fig. – A custard-apple plant, 1770s

Botanical gardens and natural history museums established by the British collected plant specimens and information about their uses. Local artists were asked to draw pictures of these specimens. Historians are now looking at the way such information was gathered and what this information reveals about the nature of colonialism.

1.5 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.

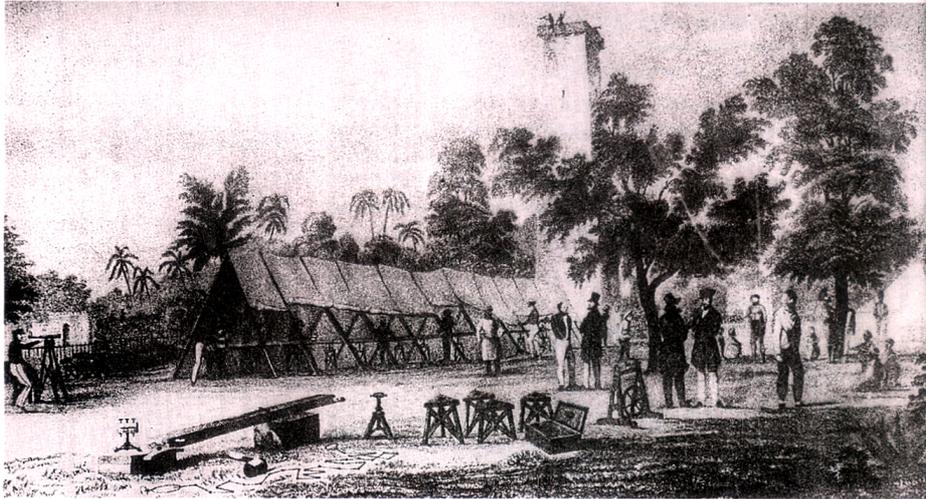


Fig. – Mapping and survey operations in progress in Bengal, a drawing by James Prinsep, 1832



Fig. – The rebels of 1857

Images need to be carefully studied for they project the viewpoint of those who create them. This image can be found in several illustrated books produced by the British after the 1857 rebellion. The caption at the bottom says: "Mutinous sepoy's share the loot". In British representations the rebels appear as greedy, vicious and brutal.

Key Words :

Imperialism - the practice of controlling the territory, political system and economic life of a less powerful country by a more powerful one.

TYRANT	:	An oppressive ruler
BEACON	:	Signal, a lighthouse to guide the sailor
POSTERITY	:	Future generations
ARTEFACT	:	An object that is made by a person, especially of historical, artistic or cultural interest
BIOGRAPHY	:	The story or account of a person's life (written by anybody)
AUTOBIOGRAPHY	:	The story or account of one's own life.
ARCHIVE	:	The place where government records and documents are preserved
COLONIAL	:	Possessing or inhabiting a colony or colonies
COLONISATION	:	The policy of acquiring other countries as colonies
PERIODISATION	:	The act or process of dividing history into periods.
COSTLIER	:	Having high price
INDOLOGISTS	:	Students (can be from any part of world) of Indian literature, history, philosophy etc.)
POSTERITY	:	Next generation

Let's Recall

- ✘ History tells us the story of our past. It tells us how things were in the past and how they have changed.
- ✘ In the 19th century AD, Scottish economist and political philosopher James Mill divided India's past into three periods - Hindu, Muslims and British
- ✘ Nowadays, many historians classify India's past into ancient, medieval and modern periods.
- ✘ The modern period is said to have begun in India in the 18th century AD. As this period saw the colonisation of India, it is also called colonial period.
- ✘ A number of sources tell us about the modern period official records kept by and surveys conducted by the British, monuments constructed by them, diaries maintained by people, accounts written by travellers and pilgrims, and autobiographies of important leaders. These are primary historical sources.
- ✘ Books, newspapers, magazines, and pamphlets published at the time also throw valuable light on the period. These are secondary historical records.

EXERCISE >> 01**FIXED RESPONSE TYPE****OBJECTIVE QUESTIONS**

1. James Mill was a –
 (A) An Indian economist (B) An Italian economist
 (C) A Scottish economist (D) A Dutch economist
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
3. Who wrote “History of British India” ?
 (A) Rippon (B) Liton (C) James Mill (D) Irwin
4. Who was asked by Robert Clive to produce the maps of Hindustan ?
 (A) Hastings (B) Brahmans (C) Rennel (D) None of the above
5. 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
6. The census operations are held every –
 (A) 1 year (B) 5 years (C) 10 years (D) 20 years
7. On _____, Lord Mountbatten, the last British Governor - General of India announced the partition of British Indian Empire.
 (A) 3rd June 1947 (B) 4rd June 1948 (C) 5rd June 1949 (D) 6rd June 1947
8. What was important in the history 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.
9. Gandhi Irwin pact was signed in
 (A) 1931 (B) 1905 (C) 1877 (D) 1600
10. The last British Governor General of India
 (A) Lord curzon (B) Lord Mountbatten (C) Lord Dalhousie (D) Lord Macualy

FILL IN THE BLANKS

1. The Indologists such as James Mill, _____, Vincent Smith too keen interest in Indian Culture.
2. National Archives of India came up in the year _____
3. The practice of controlling the territory, political system and economic life of a less powerful country by a more powerful one is called _____.
4. The _____ set up record rooms attached to all administrative institution.
5. _____ became the first governor General of India in 1773.

TRUE / FALSE

1. On 14 August, Pakistan was declared a separate nation
2. In AD 1453, The Turks took control of the overland trade routes connecting Europe to the East.
3. Videotapes are archaeological sources.
4. Many regional kingdoms emerged in the beginning of the 19th century.
5. The Battle of Plassey was the turning point in the history of India.

MATCH THE COLUMN**Column-I**

- (a) James Mill
 (b) Bangal Gazette
 (c) Lord Mount Betten
 (d) Jaliwalabagh
 (e) Lord Curzon
 (A) a-v, b-iv, c-i, d-ii, e-iii
 (C) a-iv, b-v, c-ii, d-i, e-iii

Column-II

- (i) 1905
 (ii) 1947
 (iii) 1780
 (iv) 1919
 (v) 1773
 (B) a-iv, b-v, c-i, d-iii, e-ii
 (D) a-v, b-iii, c-ii, d-iv, e-i

EXERCISE >> 02**FREE RESPONSE TYPE****SUBJECTIVE QUESTIONS****SHORT ANSWER TYPE**

1. What is history ?
2. How does history help us ?
3. What is Census ?
4. Why do we divide history into different periods ?
5. Why do we connect history with dates?

LONG ANSWER TYPE

6. How the periodisation done by James Mill differ from other Historians ?
7. Explain, how can we study modern period?
8. How the various surveys conducted by British became an important source of history ?
9. How the periodisation done by James Mill differ from other Historians ?
10. What official records do not tell us?

ANSWER KEY >>

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	C	D	C	C	C	C	A	C	A	B

Fill in the blanks :

1. Max Mueller
2. 1920
3. Imperialism.
4. British
5. Warren Hasting

True and False :

1. True
2. True
3. False
4. True
5. True

Match the following :

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





Terminologies

Noun, Common noun, Proper noun, Abstract noun, Collective noun, Material noun, Countable noun, Uncountable noun, Masculine gender, Feminine gender, Common gender, Neuter gender

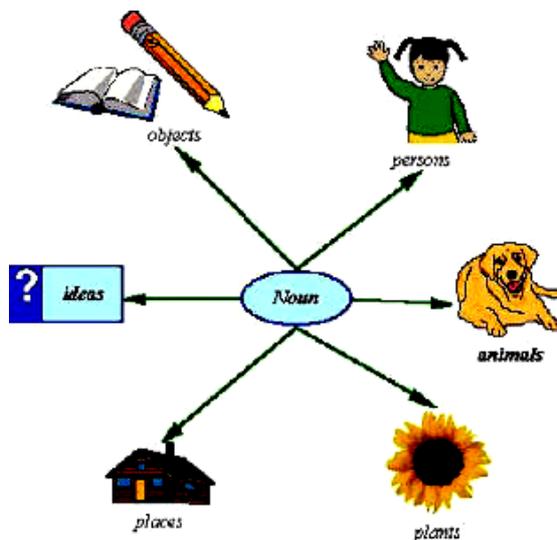
INTRODUCTION

As for nouns in sentences, they establish the topic of the communication and, in their object role, provide information about outcomes, relationships and so on.

1.1 DEFINITION & KINDS OF NOUNS

A noun is a word that refers to a thing (book), a person (Betty Crocker), an animal (cat), a place (Omaha), a quality (softness), an idea (justice), or an action (yodeling).

Take a look at the sentences below:



Example:

- Paul and Carla will meet at the coffee shop on Tuesday.
- For me, birthdays are just ordinary days.

All of the underlined words in the sample sentences above are nouns.

There are specific types of the nouns :

(a) Proper Noun:

It is the name of particular person, place or thing.

- First alphabet of a proper noun is always capital.
- Proper Noun takes singular helping verb whether it looks singular or plural.

Example:

- **History** is an interesting subject.
- **Mathematics** is a difficult subject.

(b) Common Noun:

It is a name given in common to every person or thing of the same class or kind. (like girls, city, boys)

Example :

- Be sure to pick a top **university**.
- **People** are strange.

(c) Collective Noun:

(i) It is the name of number of persons or things taken together and spoken of as one whole. Generally, it is used in singular form.

(ii) They can be used as plural if there is a division among the members of the collective noun or the members are being talked about.

Example:

- Our **class** graduates two years from now.
- Our **team** is enjoying an unbroken winning streak.

List of collective nouns		
aerie of eagles	agenda of tasks	ambush of tigers
army of eagles	army of frogs	budget of papers
bunch of bananas	bunch of grapes	bunch of pigeons
cache of jewels	cache of weapons	canteen of cutlery
chain of events	chain of islands	cluster of spiders
cluster of stars	deck of sailors	den of thieves
eleven of cricketers	fleet of ships	herd of wolves
murder of crows	pace of donkeys	parade of penguins
school of fish	troop of lions	

(d) Material Noun:

It refers to a material or substance from which things are made such as silver, gold, iron, cotton, diamond and plastic.

(i) Material Noun remains singular in form and takes singular helping verb.

(ii) No article is used before material noun.

Example:

- **Gold** is a metal.
- **Protein** is critical for energy.

(e) Abstract Noun:

A word which is used to express emotion , condition , quality or can't be expressed in terms of numbers.

(i) Abstract noun remains singular in form and takes singular helping verbs.

(ii) No article is used before the abstract noun.

Example :

- **Success** seems to come easily to certain people.
- His **hatred** of people smoking indoors is legendary.

(f) Countable Noun

Anything that can be counted, whether singular - a dog, a house, a friend, etc. or plural - a few books, lots of oranges, etc. is a countable noun.

Example :

- There are at least twenty Italian **restaurants** in Little Italy.
- Megan took a lot of **photographs** when she went to the Grand Canyon.

(g) Uncountable Noun

Anything that cannot be counted is an uncountable noun. Even though uncountable nouns are not individual objects, they are always singular and one must always use singular verbs in conjunction with uncountable nouns.

Example :

- There is no more **water** in the pond.
- I need to find **information** about Pulitzer Prize winners.

Ask yourself _____**Match the following:-**

	Noun	Type of Nouns
1	Education	Proper noun
2	President	Abstract noun
3	Eiffel Tower	Common noun
4	Choir	Abstract noun
5.	Determination	Collective noun

1.2 FORMS & GENDERS**(a) Forms**

Nouns normally come in their singular form, however, if these nouns name more than one person, place, thing, animal, event, or idea, it is necessary for you to transform them into their plural form.

These are most common ways of pluralizing nouns:

(i) Add "s"

- | | |
|-----------------------------------|-----------------|
| (A) bike- bikes | (D) trap- traps |
| (B) coin- coins | (E) game- games |
| (C) swimming pool- swimming pools | |

(ii) Add "es"

- | | |
|--------------------|----------------------|
| (A) beach- beaches | (D) potato- potatoes |
| (B) hero- heroes | (E) box- boxes |
| (C) torch- torches | |

(iii) Change "y" to "i," and then add "es"

- | | |
|----------------------------|------------------------|
| (A) butterfly- butterflies | (D) party- parties |
| (B) reply- replies | (E) factory- factories |
| (C) baby- babies | |

NOTE: Sometimes, you just have to add "s" without changing "y" to "i" (e.g., chimney- chimneys; trolley- trolleys)

(iv) Change "f" to "v," and then add "s" or "es"

- | | |
|----------------------------|------------------------------|
| (A) wife- wives ("s" only) | (D) thief- thieves ("es") |
| (B) loaf- loaves ("es") | (E) knife- knives ("s" only) |
| (C) wolf- wolves ("es") | |

NOTE: Sometimes, you only need to add "s" without changing "f" to "v" (e.g., cliff- cliffs; chef- chefs).

(v) For some nouns ending in "um," change "um" to "a"

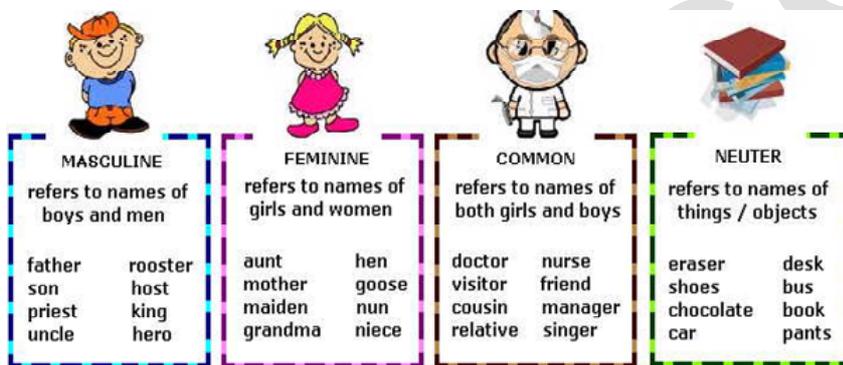
- | | |
|-------------------------|---------------------------|
| (A) medium- media | (D) curriculum- curricula |
| (B) bacterium- bacteria | (E) ovum- ova |
| (C) datum- data | |

- (vi) For some nouns ending in "is," change "is" to "es"
 (A) crisis- crises (D) analysis- analyses
 (B) thesis- theses (E) axis- axes
 (C) oasis- oases
- (vii) For some nouns ending in "us" change "us" to "i"
 (A) radius- radii (D) nucleus- nuclei
 (B) fungus- fungi (E) stimulus- stimuli
 (C) bacillus- bacilli
- (viii) Some nouns have the same singular and plural form
 (A) sheep (B) deer (D) moose

(b) Genders

Basically, there are four genders of nouns, and these are:

- Masculine
- Feminine
- Common
- Neuter



Ask yourself



Fill in the blanks

- Parliamentarian and leader are nouns. (common gender / Feminine gender)
- We sat down in the shade of aof trees. (clump / bunch)
- "Eraser" can be considered as a.....? (common gender / neuter gender)
- "Nun" can be considered as a.....? (common gender / Feminine gender)
- Our picnic was completely ruined by aof bees. (colony / swarm)

1.3 RULES OF NOUNS

(a) Rule :1

The following words are uncountable and are normally used in the singular form only. The indefinite article "A or An" should not be used with them. They have no plural forms.

Machinery, Work, Wood, Dust, Traffic, Electricity, Scenery, Poetry, Furniture, Advice, Luggage, Information, Luggage, Hair, Money, Language, Business, Mischief, Knowledge, Bread, Stationery, Crockery, Baggage, Postage, Wastage, Jewellery, Breakage etc.

Example:

- The Sceneries of Kashmir is very beautiful. (Wrong)
 The Scenery of Kashmir is very beautiful. (Correct)
- I know that he has many informations. (Wrong)
 I know that he has much information / a lot of information. (Correct)

(b) Rule :2

The words such as "News / Mathematics / Ethics / Politics / Phonetics / Economics / Statistics / Measles / Mumps / Rickets / Billiards / Innings/ summons" look like plural nouns but give singular meaning. So, they take singular form of verbs.

Example:

- Mathematics is a difficult subject. (Correct)
But say "His Mathematics are very weak". (Correct)
- Billiards are an interesting game. (Wrong)
Billiards is an interesting game. (Correct)
- The news are not reliable. (Wrong)
The news is not reliable. (Correct)

(c) Rule :3

Some Nouns have the same form whether singular or plural.

Ex : Sheep, Fish, Crew, Family, Team, Carp, Pike, Trout, Deer, Aircraft, Counsel, Swine, Vermin, Species etc.

Example:

- He saw two sheeps in the zoo. (Wrong)
He saw two sheep in the zoo (correct)
- A series of lectures are to be delivered tomorrow. (Wrong)
A series of lectures is to be delivered tomorrow. (correct)

(d) Rule :4

The following nouns are always used in the plural form only.

Cattle, Assets, Alms, Police, Amends, Annals, Archives, Ashes, Arrears, Athletics, Wages, Auspices, Species, Scissors, Gentry, Trousers, Pants, Clippers, Shambles, Bellows, Gallows, Eyeglasses, Tidings, Goggles, Belongings etc.

Example:

- The police is coming towards us now. (Wrong)
The police are coming towards us now. (Correct)
- The scissor is very sharp. (Wrong)
The scissors are very sharp. (correct)

(e) Rule :5

Here are some rules for the use of Apostrophe 's' or possessive nouns.

(i) Possessive case is used with the nouns of living things.

Example :

- This is Sachin's bat.
- The car's wheel is punctured. (Wrong)
The wheel of the car is punctured (Correct)

(ii) Non-living things are used in possessive case when they are personified.

Example :

- Ramu is at death's door.
- This is earth's surface.

(iii) Possessive case is used with nouns denoting space, time or weight.

Example :

- I want a day's leave.
- Shila will be back in a month's time.

(iv) If two or more noun jointly possess something then possessive sign is put on the latter only.

Example :

- Sachin and Saurav's partnership was awesome.
- This is Rahul and Sonam's shop.

(v) If else is used after somebody, anybody, nobody etc then apostrophe is used with else.

Example :

- I obey your orders and nobody else's.
- This watch is not mine, it is somebody else's.

- (vi) Apostrophe is not used with possessive pronouns like; his, hers, yours, mine, ours, its, theirs, etc
 Apostrophe is not used with two consecutive nouns.

Example :

- Sonal's car's colour is very nice. (Wrong)
- The colour of Sonal's car is very nice. (Correct)

(f) Rule :6

After the phrases One of / Some of/ Each of / Either of /Neither of / Any of / None of, a plural form of a noun is used.

Example :

- One of my best friends lives in jaipur. (not One of my best friend)
- Each of the boys is punished. (not Each of the boys are)

(g) Rule :7

After collective nouns either a singular or plural form of verb is used.

Example :

- The team is strong (here, we are treating the TEAM as an UNIT) (Correct)
- The team are fighting among themselves (Here, we are saying about the players of the team) (Correct)

(h) Rule :8

Don't say "family members / cousin brother or cousin sister" but say "The members of the family / he or she is my cousin".

Example:

- Aditi and Aditya are my family members. (wrong)
- Aditi and Aditya are the members of my family (Correct)

Ask yourself

Tick "True and False" for following questions:-

- | | |
|--|--------------|
| 1. Rahul's hairs have turned grey. | (True/False) |
| 2. All his sister-in-laws are very beautiful to look at. | (True/False) |
| 3. I obey your orders and nobody's else. | (True/False) |
| 4. One of my uncle are living in Jaipur. | (True/False) |
| 5. I saw many deer in the zoo. | (True/False) |



Add to Your Knowledge

Spend/Waste Time + Gerund

When the phrases "spend time" or "waste time" are used, the noun "time" is NOT followed by an infinitive. A gerund always follows these phrases. Also note that the noun "time" can be replaced by an amount of time (using the nouns months, days, hours, minutes, etc.) and a gerund is still required.

Example:

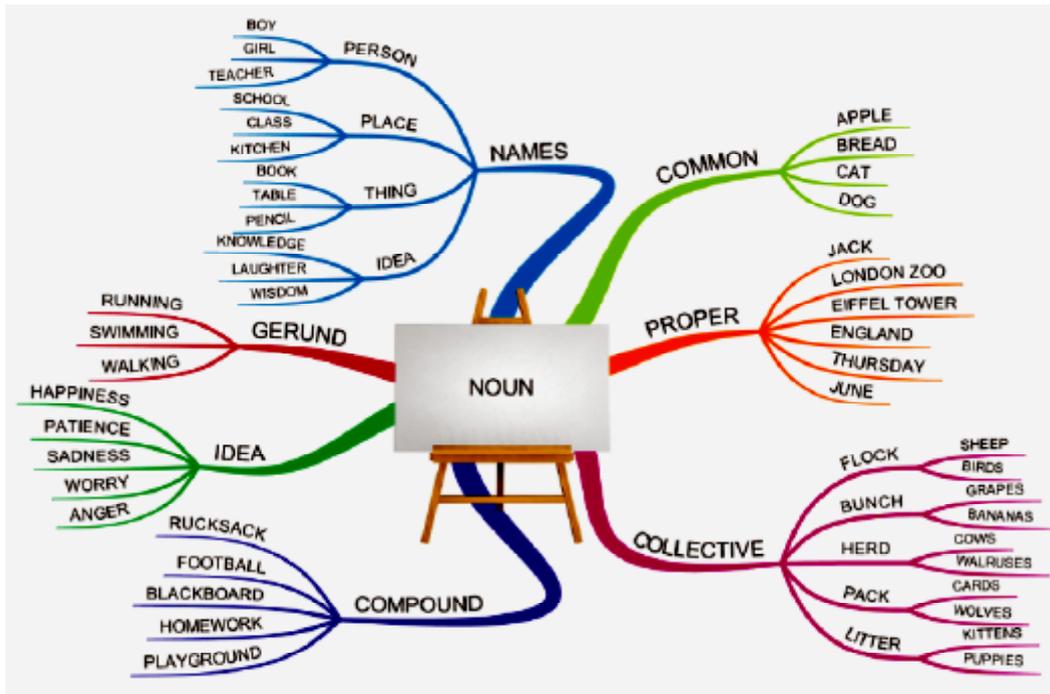
- I spent time working on my project last night.
- He wastes a lot of time watching TV.

But be careful! If the noun "time" is not part of the spend time/waste time phrase, the normal noun + infinitive rule applies.

Example:

- She uses free time to enhance her knowledge.
- Rohan kills time to chide his parents.
- I have time to help you today.
- They need more time to finish the test

CONCEPT MAP



Specimen

EXERCISE >> 01**(FIXED RESPONSE TYPE)****MULTIPLE CHOICE QUESTIONS**

1. Does wood sink in water ?
(Which word is a material noun ?)
(A) Sink (B) Does (C) In (D) Wood
2. The crowd was on the main street.
(Which word is a collective noun ?)
(A) main (B) Crowd (C) Street (D) On
3. Beauty is skin deep.
(Which word is abstract noun)
(A) Beauty (B) Skin (C) Is (D) Deep
4. Choose the noun which is always singular.
(A) Furniture (B) Knife (C) baby (D) Chair
5. Which of the the following nouns is masculine counterpart of 'bride'.
(A) Groom (B) Bridemaid (C) Lad (D) Drake
6. What is the gender of duke
(A) Feminine (B) Common (C) Neuter (D) Masculine
7. (A) Dart are / (B) played by / (C) men as well as women/ (D) No error.
8. (A) Recently I visited / (B) Bhutan and found / (C) the sceneries to be breath taking / (D) No error.
9. (A) The present datas / (B) show that the / (C) death rate has fallen down / (D) No error

FILL IN THE BLANKS :

10. Solomon was famous for his wisdom. Here Solomon is a _____ noun (Collective/Proper)
11. Wisdom is better than riches. Here Wisdom is a / an _____ noun (Abstract/Proper)
12. There were many _____ in the pond. (duck/ducks)
13. My friend ate three _____ of cake (piece/pieces)
14. My father always brings home two _____ apples. (dozens /dozen)
15. Though he is still in his twenties he has grey _____ (hair/hairs)

TRUE OR FALSE :

16. Honesty is an abstract noun. (True / False)
17. Committee is a common noun. (True / False)
18. They are sending some man to fix the roof. (True / False)
19. I clean my tooth three times a day. (True / False)
20. He badly needs two pairs of boots. (True / False)
21. He narrated the story superbly in great detail . (True / False) .

EXERCISE >> 02**(FIXED / FREE RESPONSE TYPE)****MULTIPLE CHOICE QUESTIONS :**

1. Which of the following noun is a Proper Noun?
(A) singer (B) Peter (C) milk (D) sister
2. Which of the following noun is a Common Noun?
(A) birds (B) London (C) iron (D) India
3. Which of the following noun is a Collective Noun?
(A) team (B) book (C) marbles (D) ships
4. The feminine form of the noun 'monk' is
(A) friar. (B) lady. (C) woman. (D) nun.
5. The feminine form of the noun 'lord' is
(A) lady. (B) lordess. (C) lordy. (D) sister.
6. The feminine gender of horse is
(A) colt. (B) mare. (C) filly. (D) stag.
7. Pranav wants _____.
(A) One bread (B) a slice of bread (C) a bread (D) None of these
8. It is not my duty to arrange files, it is someone _____.
(A) else's (B) else (C) elses (D) None of these

SUBJECTIVE QUESTIONS :**Directions (9 to 16): Correct the following sentences.**

9. She likes to feed the poors.
10. He is working for the blinds.
11. I told these news to my father.
12. The teacher gave us many advices.
13. I have a five dollars note.
14. She has bought two dozens apples.
15. Please put your sign here.
16. Riya gave me a good advice.

ANSWER KEY >>**EXERCISE** >> **01****(FIXED RESPONSE TYPE)****MULTIPLE CHOICE QUESTIONS**

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

FILL IN THE BLANKS :

10. Proper 11. Abstract 12. Ducks 13. Pieces
14. Dozen 15. Hair

TRUE OR FALSE :

16. True 17. False
18. False 19. False 20. True 21. True

EXERCISE >> **02****(FIXED / FREE RESPONSE TYPE)****MULTIPLE CHOICE QUESTIONS :**

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

SUBJECTIVE

9. Correct: She likes to feed the poor.
10. Correct: He is working for the blind.
11. Correct: I told this news to my father.
12. Correct: The teacher gave us some advice.
13. Correct: I have a five dollar note.
14. Correct: She has bought two dozen apples.
15. Correct: Please put your signature here.
16. Correct: Riya gave me a piece of advice.

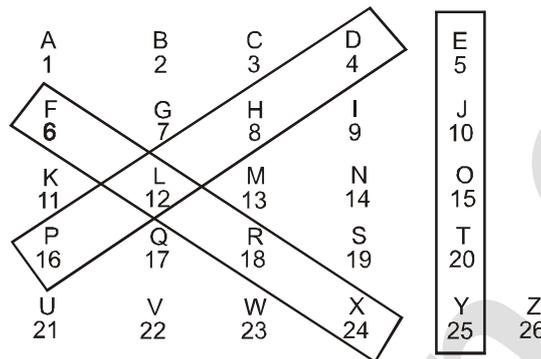


INTRODUCTION

How many pairs of letter in the word "Cabble" have as many letters between them as in the alphabet series. Can you make a meaning full word using R C O T A

1 2 3 4 5

1.1 POSITION OF ALPHABETS



1.2 ALPHABETICAL ORDER

You have to arrange the given words in order in which they are arranged in a dictionary. In a dictionary the words are placed in alphabetical order w.r.t. the second alphabet of the words and so on (that is, third alphabet, fourth alphabet....).

Illustration : 1.1

Arrange the given words in the correct alphabetical order.

Length, Lenient, Legacy, Legal, Legible, Launch, Laugh, Leave

Sol. The given words can be arranged in the alphabetical order as :

Laugh, Launch, Leave, Legacy, Legal, Legible, Length, Lenient

Illustration : 1.2

Arrange the given words in alphabetical order and tick the one that comes last.

Plane, Shock, Plenty, Sound, Player, Place, Sharp, Disturb

Sol. The given words can be arranged in the alphabetical order as :

Disturb, Place, Plane, Player, Plenty, Sharp, Shock, Sound

Illustration : 1.3

Arrange the given words in the order they occur in dictionary.

1. Grind 2. Growth 3. Great 4. Greed
 (A) 3, 1, 2, 4 (B) 3, 4, 1, 2 (C) 3, 1, 4, 2 (D) 3, 4, 2, 1

Sol. (B) The correct alphabetical order of the given words is : Great, Greed, Grind, Growth. Thus, the correct sequence is **3, 4, 1, 2**

1.3 ALPHABETICAL QUIBBLE

In this type of questions, generally a letter-series is given, it can be a word or the English alphabets from A to Z or Z to A. The candidate is then required to trace the letters satisfying certain given conditions as regards their position in the given sequence or the sequence obtained by performing certain given operations on the given sequence.

Illustration : 1.4

If the alphabet series is written in a reverse order, which of the following will be the seventh letter to the left of eighth letter from your right ?

- (A) L (B) M (C) O (D) P

Sol. (C) The new alphabet series is
 ZYXWVUTSRQPONMLKJIHGFEDCBA
 The eight letter from the right is H.
 The seventh letter to the left of H is O.

Illustration : 1.5

If in the word 'DISTURBANCE', the first letter is interchanged with the last letter, the second letter is interchanged with the tenth letter and so on, which letter would come after the letter 'T' in the newly formed word ?

- (A) I (B) N (C) S (D) T

Sol. (C) E C N A B R U T S I D Change the word According to direction. New word is E C N A B R U T S I D
 So, S is after letter T.

1.4 LETTER WORD PROBLEM

Illustration : 1.6

How many pairs of letter in the word **DABBLE** have as many letters between them as in the Alphabet series ?

- (A) Nil (B) One (C) Two (D) More than three

Sol. (D) Letters in the given Word : Letters in the Alphabet

A B	A B
D <u>A</u> B	D <u>C</u> B
B <u>B</u> <u>L</u> E	B <u>C</u> <u>D</u> E
A <u>B</u> <u>B</u> <u>L</u> E	A <u>B</u> <u>C</u> <u>D</u> E

1.5 WORD FORMATION BY UNSCRAMBLING LETTERS

In this type of questions, a set of English letters is given in a jumbled order. The candidate is required to arrange these letters to form a meaningful word.

Illustration : 1.7

Arrange the following group of letters such that when arranged in a specific order, meaningful word is formed.

- | | | | | | |
|----------|----------|----------|----------|----------|----------|
| G | T | A | E | N | M |
| 1 | 2 | 3 | 4 | 5 | 6 |
- (A) 6, 2, 3, 4, 5, 1 (B) 6, 3, 2, 5, 1, 4 (C) 6, 3, 1, 5, 4, 2 (D) 1, 5, 2, 3, 4, 6

Sol. (C) The given letter, when arranged in the order 6, 3, 1, 5, 4, 2. form the word **MAGNET**.

1.6 WORD FORMATION USING LETTERS OF A GIVEN WORD

Illustration : 1.8

A meaningful word starting with first, the fourth, the seventh and the eleventh letters of the word **SUPERFLUOUS**, which of the following is the first letter of the word ?

- (A) E (B) L (C) S (D) R

Sol. (B) The first, the fourth, the seventh and the eleventh letters of the word SUPERFLUOUS are S, E, L and S respectively. The meaningful word will be LESS and L will be the required letter.

Illustration : 1.9

find which one word can not be made from the letters of the given word.

TEMPERAMENT

- (A) METER (B) PETER (C) TENTER (D) TESTER

Sol. The word TEMPERAMENT contains all the letters of the word TESTER except S. So, the word **TESTER** cannot be formed.

EXERCISE >> 01

Directions : (1 to 2) Arrange the given words in alphabetical order and tick the one that comes first.

- (A) Grammar (B) Granary (C) Gradient (D) Grand
- (A) Mahender (B) Mahendra (C) Maninder (D) Mahindra
- If the following words are arranged in an alphabetical order, which word will appear in the second place?
(A) Principal (B) Principle (C) Principia (D) Principled
- If the following words are arranged as they are found in the dictionary, then what will be the fourth letter from the left in the last word ?
INTIMATION, INFORMATION, INTEREST, INTERROGATION, INSTIGATION
(A) R (B) O (C) T (D) I
- Which letter will be the midway between the fourteenth letter from the left end and nineteenth letter from the right end of the following alphabet?
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
(A) I (B) K (C) M (D) G
- Which letter will be the sixth to the left of the eleventh letter from the right end of the alphabet ?
(A) K (B) V (C) J (D) U
- If the alphabets were written in the reverse order, which letter will be the fifth letter to the left of the fourteenth letter from the left.
(A) R (B) I (C) S (D) H
- If the positions of the first and sixth letters of the word **BENEFICIAL** are interchanged; similarly the positions of the second and seventh letters are interchanged and so on, which letter will be third from the right end after rearrangement ?
(A) C (B) E (C) F (D) N

Directions : (9 to 15) In each of the following questions, a group of letters is given which are numbered 1, 2, 3, 4, 5 and more. They are four alternatives given containing the combinations of these numbers. Select that combination of numbers in which letters arranged accordingly to form a meaningful word.

9. R A C E T
1 2 3 4 5
(A) 1, 2, 3, 4, 5 (B) 3, 1, 2, 4, 5 (C) 5, 2, 3, 4, 1 (D) 5, 1, 2, 3, 4
10. R U S G A
1 2 3 4 5
(A) 1, 5, 4, 2, 3 (B) 5, 3, 4, 1, 2 (C) 3, 2, 4, 5, 1 (D) 4, 5, 3, 2, 1
11. R T A O U H
1 2 3 4 5 6
(A) 1, 3, 4, 5, 6, 2 (B) 2, 3, 6, 4, 5, 1 (C) 6, 3, 2, 4, 5, 1 (D) 3, 5, 2, 6, 4, 1
12. T L E M N A
1 2 3 4 5 6
(A) 2, 6, 4, 5, 3, 1 (B) 3, 2, 4, 6, 5, 1 (C) 4, 3, 5, 1, 6, 2 (D) 5, 3, 2, 4, 6, 1
13. R M N B U E
1 2 3 4 5 6
(A) 1, 5, 4, 2, 6, 3 (B) 2, 6, 3, 4, 1, 5 (C) 3, 5, 2, 4, 6, 1 (D) 4, 6, 3, 2, 1, 5
14. D I F E R N
1 2 3 4 5 6
(A) 1, 4, 3, 6, 2, 5 (B) 6, 4, 3, 5, 2, 1 (C) 3, 5, 2, 4, 6, 1 (D) 5, 4, 3, 2, 6, 1
15. R T A N U E
1 2 3 4 5 6
(A) 1, 3, 2, 6, 4, 5 (B) 3, 2, 4, 6, 1, 5 (C) 4, 3, 2, 5, 1, 6 (D) 4, 6, 5, 2, 3, 1
16. If a meaningful word can be formed by rearranging the letters **USCALA**, the first letter of the word so formed is the answer. If no such word can be formed the answer is X.
(A) C (B) S (C) A (D) X
17. If it is possible to make a meaningful word with the third, the fourth and the eleventh letters of the word **CONTROVERSIAL**, which of the following will be the last letter of that word? If more than one such words can be made, give **M** as the answer and if no such word is there, give **X** as the answer.
(A) S (B) I (C) X (D) M
18. If it is possible to make a meaningful word with the second, the sixth, the ninth and the twelfth letters of the word **CONTRIBUTION**, which of the following will be the last letter of that word? If more than one such words can be made, give **M** as the answer and if no such word is there, give **X** as the answer.
(A) N (B) O (C) X (D) M
19. A word given in Capital Letters is followed by four answer words. Out of these only one can be formed by using the letters of the given words. Find out that word.
SOMNAMBULISM
(A) NAMES (B) BASAL (C) SOUL (D) BIOME

Directions : (20 to 21) In each of the following questions, find that one word which can not be made from the letters of the given word.

20. KALEIDOSCOPE
 (A) SCALE (B) PADLOCK (C) PACKET (D) DIESEL
21. SUPERIMPOSABLE
 (A) SPIRE (B) REPTILE (C) POSSIBLE (D) REPOSE
22. If Letters of alphabets are written in reverse way then which letter will be seventh letter right to Q ?
 (A) K (B) U (C) J (D) W
23. Select the word from given alternatives which can not be written from the letters of the word **EDUCATED**
 (A) DUCK (B) CUTE (C) TADE (D) ACTE
24. If the following scrambled letters are rearranged to form the name of a city, the city so formed is the sun city, which letter will appear in the middle?
DHJOPRU
 (A) J (B) O (C) H (D) P
25. If the following scrambled letters are rearranged to form the name of a city, the city so formed is famous for its.
ABKOOR
 (A) Locks (B) Steel Plant (C) Temples (D) Pottery



Add to Your Knowledge

→ Number of letters skipped in between adjacent letters in the series increases by one. Which of the following series observes this rule ?

- (A) DBPUY (B) DBUYP (C) DBYPU (D) DBYUP

In the above question we have to find the series in which the number of letters between two adjacent letters increased by one . The number of letters between D and B is 1 which is C similarly between H and O is 6. So the series DBYUP follow the same rule.

D C B A Z Y X W V U T S R Q P

EXERCISE >> 02

1. If in the word 'ELECTROCARDIOGRAPH' the first half of the letters are reversed, second letter from left end is then prefixed and finally 'S' is suffixed, then the letter exactly in the middle is _____.
[NSO_SET-B_2012]
 (A) L (B) R (C) D (D) E
2. If the alphabets are written in the reverse order after interchanging alphabets from `D to L' with those from `R to Z' respectively, which letter would be midway between W and E in the new order?
[NSO_SET-A_2014]
 (A) Z (B) N (C) D (D) None of these
3. Which letter will be the fifth from the right if the first and second, the third and fourth and so on are interchanged among each other in the word "COMPANIONATE"?
[IMO_2010]
 (A) A (B) I (C) N (D) O

4. Choose one word which can be formed from the letters of the given word. **[IMO_2011]**
 RECOMMENDATION
 (A) MEDICINE (B) MEDIATE (C) REMINDER (D) COMMUNICATE
5. Study the following letter-number arrangement and answer the question given below.
 B 8 4 C R M 9 P D K W F A 2 E J J X U Q H L T Y 6 G S
 If every alternate letter / number is dropped in the above arrangement beginning with dropping '4' as first number to be dropped, which of the following will be third to the right of the fifth letter / number from left end? **[IMO_SET-A_2012]**
 (A) W (B) 2 (C) 7 (D) A
6. If the following words are arranged in the alphabetical order, which word will appear at the end? **[IMO_SET-B_2012]**
 (A) Olympic (B) Olympia (C) Oval (D) Ovulet
7. If it is possible to make a meaningful word with the second, third, fifth and eighth letters of the word PARAGRAPH which of the following will be second letter of that word? If more than one such word can be made, give X as the answer. If no such word can be made, give M as the answer. **[IMO_SET-B_2012]**
 (A) X (B) M (C) G (D) P
8. If the first half of the English alphabet series are written in reverse order, then which letter should be 8th letter to the left of 14 letter from the right end? **[IMO_SET-A_2014]**
 (A) E (B) G (C) F (D) I
9. Which letter is tenth to the right of the letter which is exactly the middle letter between F and D? **[IMO_Level-II_2011-12]**
 F J M P O W R N B E Y C K A V L D G X U H Q I S Z T
 (A) D (B) G (C) H (D) None of these
10. Letters of the word given below have been jumbled up. Choose the option which gives the correct order of the letters as indicated by the numbers to form a meaningful word. **[IMO_Level-II_2011-12]**
 A C P E T S
 1 2 3 4 5 6
 (A) 1, 6, 3, 4, 2, 5 (B) 2, 3, 4, 1, 5, 6 (C) 5, 6, 3, 4, 1, 2 (D) 6, 5, 3, 4, 2, 1

ANSWER KEY >>

EXERCISE # 1

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

EXERCISE # 2

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