

## **Table of Contents**

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### **Class-10**

#### **Physics**

- Human Eye and The Colourful World

#### **Chemistry**

- Acids Bases and Salts

#### **Mathematics**

- Real Numbers

#### **Biology**

- Control and Coordination

#### **Social Science**

- The Rise of Nationalism in Europe



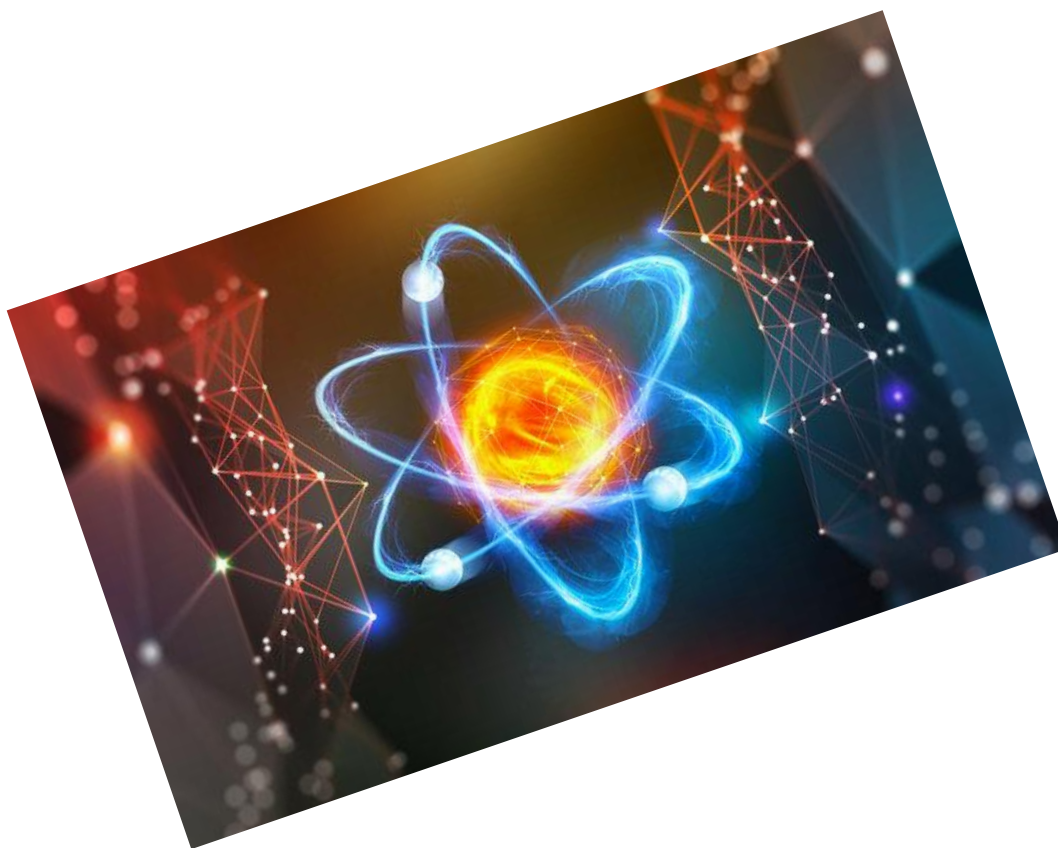
# FOUNDATION

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CLASS-X

SAMPLE

PHYSICS





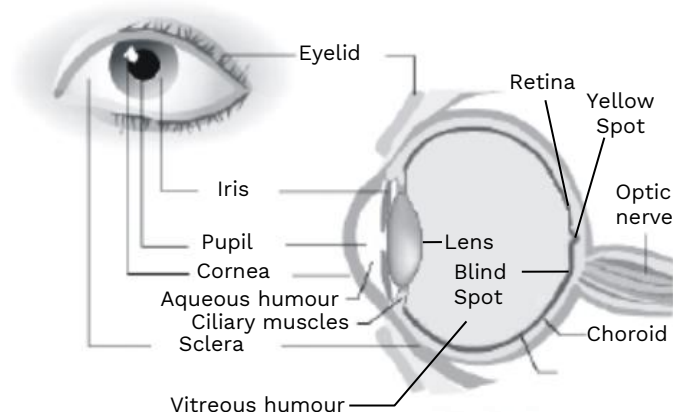
# 1

## THE HUMAN EYE AND THE COLOURFUL WORLD

### Human Eye

The human eye is one of the most sensitive sense organs of sight which enables us to see the wonderful world of light and colour around us. It is like a camera having a lens system and forming an inverted, real image on a light sensitive screen inside the eye. The structure and working of the eye is as follows:

### Components and Structure



### The Human Eye

- (I) **Sclera:** 'Sclera' or sclerotic is the outermost covering of eye and it is made of white fibrous tissue. 'Choroid' is a grey membrane attached to sclera.
- (II) **Cornea:** The eye has a nearly spherical shape, the eye ball has a diameter of about one inch (nearly 2.3cm). The front portion is more sharply curved and it is covered by a thin transparent protective membrane called 'cornea', which is visible from the outside.
- (III) **Iris:** It is a coloured diaphragm between the cornea and lens.

**Role of iris:** Iris controls the size of the pupil and therefore, helps in regulating the amount of light entering the eye through a variable aperture (the pupil). In low intensity of light, iris expands the pupil to allow more light to enter into the eye. When the light is very bright, iris contracts the pupil and the pupil becomes very small, thus, only a small amount of light enters into the eye.

- (IV) **Pupil:** It is a small hole in the iris.
- (V) **Eye lens:** It is a transparent lens made of jelly like material. ( $\mu = 1.396$ )
- (VI) **Ciliary muscles:** These muscles hold the lens in position.
- (VII) **Retina:** It is a back surface of the eye.  
The light entering the eye forms an image on the retina which is a delicate membrane having enormous number of light sensitive cells. It contains about 125 million receptors called 'rod' and 'cones' which receive the light rays and about one million optic nerve fibre which transmit the information to the brain.
- (VIII) **Blind spot:** It is a point at which the optic nerve leaves the eye. An image formed at this point is not sent to the brain.
- (IX) **Yellow Spot:** The macula lutea also called 'yellow spot' is a central part of the retina responsible for sensing fine detail and for looking straight ahead. It has high concentration of nerve endings and it is slightly raised. Its function is to form a very clear image, by sensing a large number of electrical signals to the brain.
- (X) **Aqueous humor:** It is a clear liquid region between the cornea and the lens. ( $\mu = 1.336$ )
- (XI) **Vitreous humor:** The space between eye lens and retina is filled with another liquid called vitreous humor. ( $\mu = 1.336$ )

### Working of Eye

- (a) When the light enters the eye from air, most of the bending of light occurs at cornea. Some additional bending is done by the lens so as to form an inverted, real image of the object on retina.
- (b) When the eye is focused on a distant object, the ciliary muscles relaxes allowing ligaments to increase tension on the lens and cause it to flatten i.e., the lens becomes





thin or less curved. Finally, the image is formed on the retina and we see the object clearly.

- (c) When the eye is focused on a closer object, the ciliary muscles contract, allowing the lens, by virtue of its elasticity, to become more curved i.e., the lens becomes thick. Again, the image is formed on the retina and we see the object clearly.
- (d) The light-sensitive cells get activated upon illumination and generate electrical signals. These signals are sent to the brain via the optic nerves. The brain interprets these signals, and finally, processes the information so that we perceive objects as they are i.e., the brain makes the inverted image formed on the retina again erect (or upright).

### Power of Accommodation

By contracting or relaxing the ciliary muscles connected to the lens, its shape can be changed such that we can see the nearby as well as the distant objects clearly.

- The ability or property of the eye to change the shape of lens so as to see the object clearly is called 'accommodation'.
- The muscles cannot be strained beyond a limit and thus, an object placed too close to the eye cannot be seen clearly.

### Near Point and Far Point

The nearest point at which a small object can be seen distinctly by the eye is called the near point. For a normal eye, it is about 25 cm and is denoted by the symbol  $D$ . With advancing age, the power of accommodation of the eye decreases as the eye lens gradually loses its flexibility. For most of the old persons aged nearly 60 years, the near point is about 200 cm and corrective glasses are needed to see the nearby objects clearly.

The farthest point up to which our eye can see objects clearly, without any strain on the eye is called the far point. For a person with normal vision, the far point is at infinity.

### Least Distance of Distinct Vision

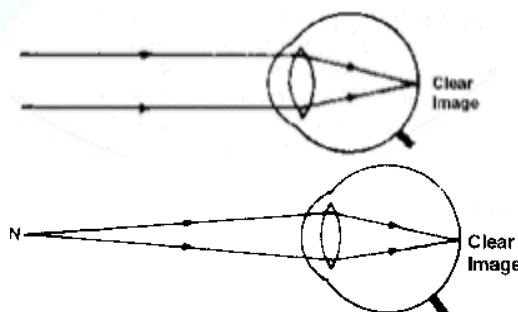
The minimum distance of an object from the eye at which it can be seen most clearly and distinctly without any strain on the eye, is called the least distance of distinct vision. For a person with normal vision, it is about 25 cm and is represented by the symbol  $D$ , i.e.

Least distance of distinct vision =  $D = 25 \text{ cm}$

### Persistence of Vision

The image formed on the retina of the eye does not fade away instantaneously, when the object is removed from the sight. The impression (or sensation) of the object remains on the retina for about  $(1/16)^{\text{th}}$  of a second, even after the object is removed from the sight. This continuance of the sensation of eye is called the persistence of vision.

Let a sequence of still pictures is taken by a movie camera. If the sequence of these still pictures is projected on a screen at a rate of 24 images or more per second then the successive impressions of the images on the screen appear to blend or merge smoothly into one another. This is because an image (or a scene) on the screen appears just before the impression of previous image on the retina is lost. Hence, the sequence of images blend into one another giving the impression of a moving picture. This principle is used in motion picture projection or in cinematography.



People with normal vision can also focus clearly on near objects up to a distance of 25 cm. We say their near point is at a distance of 25 cm from the eye.

### Colour Perception

Our retina has a large number of light sensitive cells having shapes of rods and cones.



- The rod shaped cells respond to the intensity of light with different degree of brightness and darkness. In dim light, the rods are sensitive but the cones are not. But, the rods cannot distinguish between various colours.
- It is the cone-shaped cells which respond to colours. They are active only in bright light and make colour perception possible. The cones are sensitive to red, green and blue light to different extents. When a particular colour like red falls on the retina, it mainly stimulates the red colour sensitive cones than the other kinds of cones. Colour perception of different animals is different due to different structure of rods and cones :
- Bees have some retina cones which are sensitive to ultra-violet rays, which have wavelengths shorter than that of the violet light. Thus, bees can see objects in ultra-violet rays and can recognise colours.
- Human beings cannot see objects in ultra-violet rays as their retina cones are not sensitive to such short wavelengths that are possessed by ultra-violet rays.
- The retina of a chick has mostly cones and only a few rods. As the cones are sensitive to bright light only, the chicks wake up with sunrise (dawn) and sleep by the sunset (dusk).

### Colour-Blindness

The retina of our eye has large number of light sensitive cells having shapes of rods and cones. The rod-shaped cells respond to the intensity of light with different degrees of brightness and darkness whereas the cone shaped cells respond to colours. In dim light rods are sensitive, but cones are sensitive only in bright light. The cones are sensitive to red, green and blue colours of light to different extents. Due to genetic disorder, some persons do not possess some cone-shaped cells that respond to certain specific colours only. Such persons cannot distinguish between certain colours but can see well otherwise. Such persons are said to have colour-blindness. Driving licenses are generally not issued to persons having colour-blindness.

### Defect of Vision:

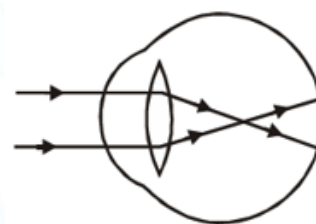
#### Shortsightedness (or Myopia):

A person with myopia can see nearby objects clearly but cannot see distant objects clearly. A myopic person has a far point nearer than infinity. In a myopic eye, the image of distant object forms in front of the retina.

This defect arises due to:

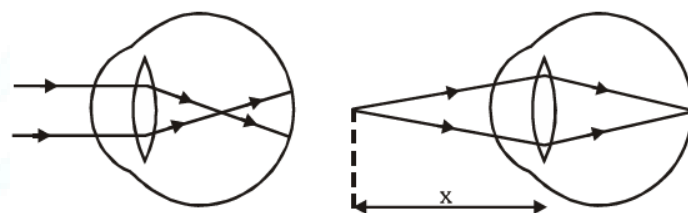
- Excessive curvature of eye lens
- Elongation of eyeball

This defect can be corrected by using a concave lens of suitable power. A concave lens of suitable power bring image back on retina, this way defect can be corrected.



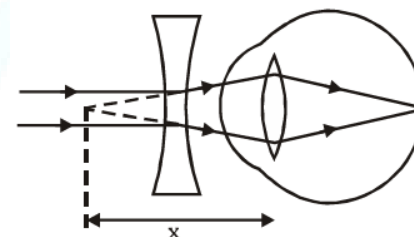
A myopic eye

Ray diagram in case of short sightedness



A myopic eye

Far point of a myopic eye



Correction for a myopic eye

#### Correction of short sightedness by concave lens

#### Farsightedness (or Hyperopia or Hypermetropia)

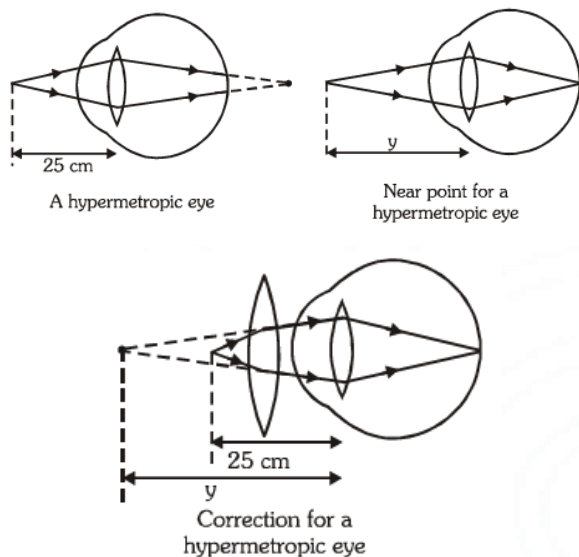
A person with hypermetropia can see distant objects clearly but cannot see nearby objects clearly & distinctly. A hypermetropic person has the near point farther away from minimum distance of distinct vision (i.e. 25 cm). In a hypermetropic eye, the image of a nearby object is formed behind the retina. This defect arises because:





- (i) Increase in focal length of eye lens  
 (ii) The eyeball has become too small. This defect can be corrected by using a convex lens of suitable power.

The converging lens of correct focal length will cause the virtual image to be formed at the actual near point of the farsighted person's eye as shown in figure.



**Presbyopia:** This defect arises with aging. A person suffering from this defect can see neither nearby objects nor distant objects clearly/distinctly. This is because the power of accommodation of the eye decreases due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens. This defect can be corrected by using bi-focal lenses. Its lower part consists of a convex lens and is used for reading purposes whereas the upper part consists of a concave lens and is used for seeing distant objects.

#### Example 1:

Least distance of distinct vision of a long-sighted man is 40 cm. He wishes to reduce it to 25 cm by using a lens, calculate the focal length of the lens used.

**Solution:** The least distance of long-sighted man,  $d = 40$  cm. He wants to reduce it to,  $D = 25$  cm. If object is placed at  $u = -25$  cm and with the help of a lens image is formed at,  $v = -40$  cm. Then the defected eye can see the object clearly.

$$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{-40} - \frac{1}{-25} \Rightarrow f = \frac{200}{3} \text{ cm}$$

#### Example 2:

A student needs a lens of power  $-2.0$  diopter to correct his distant vision. Find the focal length of the given lens.

**Solution:** Power of lens,  $P = -2$

$$\therefore P = \frac{1}{f} \Rightarrow -2 = \frac{1}{f}$$

$$\text{or } f = -0.5 \text{ m} = -50 \text{ cm}$$

#### Example 3:

A long sighted person has a minimum distance of distinct vision of 50 cm. He wants to reduce it to 25 cm. Find the focal length of lens used for correction.

**Solution:**

Near point of the defected eye is 50 cm and normal eye it is 25 cm so,  $u = -25$  cm and  $v = -50$  cm

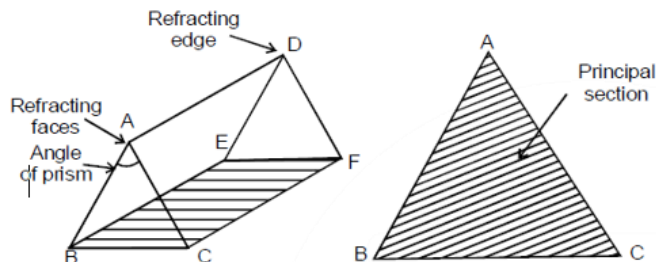
$$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-50} + \frac{1}{25} \text{ or } f = 50 \text{ cm}$$

#### Refraction through Prism

A prism is a wedge-shaped portion of a transparent refracting medium bounded by two plane faces inclined to each other at a certain angle. In the following figure:

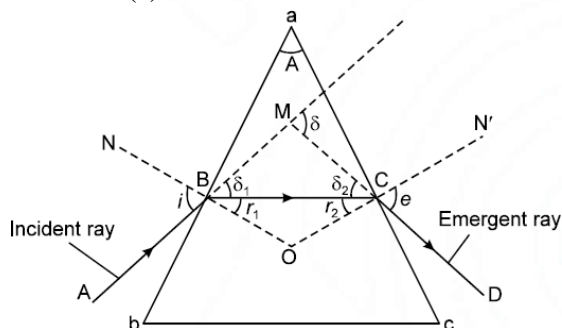
The two plane faces (ABED and ACFD) inclined to each other are called refracting faces of the prism.

The line (AD) along which the two refracting faces meet is called the refracting edge of the prism. The third face (BCFE) of the prism opposite to the refracting edge is called the base of the prism. The angle A included between the two refracting faces is called angle of the prism.



### Determination of angle of deviation

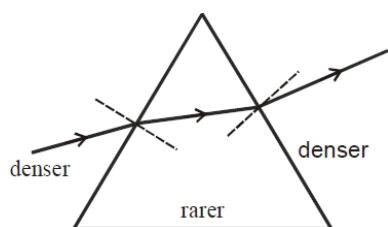
Let  $abc$  be the principal section of a prism of refracting angle  $A$ . Let a light ray  $AB$  be incident on the refracting surface  $ab$  of the prism at an angle  $i$ . After refraction at  $B$ , the ray of light bends towards the normal  $NO$  and travels along  $BC$ . The refracted ray  $BC$  again suffers refraction at  $C$  and bends away from the normal  $N'O$  and travels along  $CD$ . The ray  $CD$  is called emergent ray. The angle made by the emergent ray with the normal is called angle of emergence (i.e.  $e$ ). When the emergent ray is produced backward, it meets the incident ray produced forward at point  $M$ . The angle between the emergent ray and the incident ray is called angle of deviation ( $\delta$ ).



Angle of deviation is the angle through which incident ray is turned by the prism while passing through it. In other words, the angle between the emergent ray and the direction of incident ray is called angle of deviation.

#### Note:

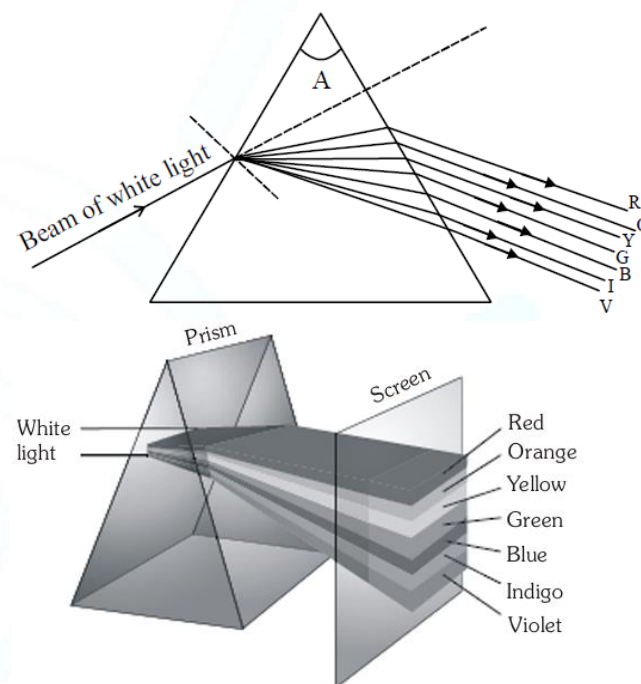
If the refractive index of the material of prism is less than the refractive index of the medium of its surrounding, the emergent ray may bend away from the base of the prism as shown in the figure.



### Factors on which angle of deviation depends

- (i) The angle of incidence
- (ii) The material of the prism
- (iii) The wavelength of light used
- (iv) The angle of the prism

### Dispersion of Light through a Prism



The phenomenon of splitting of white light into its constituent colours is known as dispersion of light. It is discovered by Newton.

### Colour of Objects in White and Coloured Light:

We know that white light is a mixture of seven colours. Light can be of different colours. Let us understand why different objects appear to have different colours. A rose appears red because when white light falls on rose, it reflects only the red component and absorbs the other components. We conclude that the colour of an object depends upon the colour of light it reflects.

#### Note:

- (I) If an object absorbs lights of all colours and reflects none, it appears black.
- (II) If an object reflects light of all colour, it appears white when seen in white light.





- (III) When we talk of colour of an object, we refer to its colour as seen in white light.
- (IV) A rose will appear black in green light because there is no red component in the light and it will not reflect any light. Hence no light will come from rose to the eye. Similarly if a green leaf is seen in red light, it appears black.
- (V) If a white flower is seen in red light, it appears red because a white object reflects light of all colours falling on it. So it reflects the red light falling on it, which then enters the eye. The phenomenon of splitting of white light into its constituent colours is known as dispersion of light. It is discovered by Newton

Color	Frequency in $10^{14}$ Hz	Wavelength (nearly)
Violet	6.73–7.5	4000 Å to 4460 Å
Indigo	6.47–6.73	4460 Å to 4640 Å
Blue	6.01–6.47	4640 Å to 5000 Å
Green	5.19–6.0	5000 Å to 5780 Å
Yellow	5.07–5.19	5780 Å to 5920 Å
Orange	4.84–5.07	5920 Å to 6200 Å
Red	3.75–4.84	6200 Å to 8000 Å

Dispersion takes place because light of different colours have different speed in a medium. Therefore the refractive index of glass is different for different colours of light. When white light is incident on the first surface of a prism and enters it, light of different colours is refracted or deviated through different angles. Thus, the dispersion or splitting of white light into its constituent colours takes place.

#### Note:

From the definition of **refractive index**

$$\mu_{\text{glass}} = \frac{\text{speed of light in vacuum}}{\text{speed of light in glass}}$$

The speed of light for different colours is different in glass (medium). The speed of violet light is minimum and the speed of red light is maximum. Therefore

$$\mu_{\text{violet}} > \mu_{\text{red}}$$

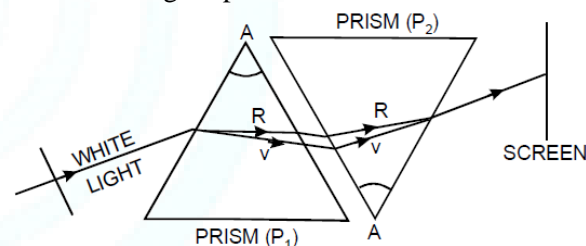
But,  $\mu = \sin i / \sin r$  or  $\sin r = \sin i / \mu$

Therefore, the angle of refraction is minimum for light of violet colour and maximum for light of red colour. Each colour is deviated towards the base of the prism. The violet is deviated the most and the red is deviated the least. As a matter of fact, the colours in the spectrum do not have any sharp boundaries.

#### Recombination of the Spectrum

Recombination of spectrum is suggested by Newton. By this, he concluded that once dispersed seven colors can be combined together to get white light again using another prism.

For this experiment, two prisms  $P_1$  and  $P_2$  of the same material and of the same refracting angle  $A$  are arranged as shown in figure. Sunlight from a narrow-slit  $S$  falls on the first prism  $P_1$  with its base downwards and gets dispersed into constituent colours (VIBGYOR) and the bending takes place downwards. Now this dispersed light falls on the second prism  $P_2$  with its base upwards so that it deviate the light upwards.



It is found that the light coming out of the second prism  $P_2$  is almost white and is in direction parallel to the direction of light incident on the first prism  $P_1$ . In fact, the two prisms  $P_1$  and  $P_2$  combined together effectively acts like a parallel sided glass slab. This shows that the prism  $P_1$  simply disperses the white light into its constituent colours and the prism  $P_2$  recombines these colours to form white light. The prism  $P_1$  is called **dispersing-prism** and the prism  $P_2$  is known as **recombination-prism**.

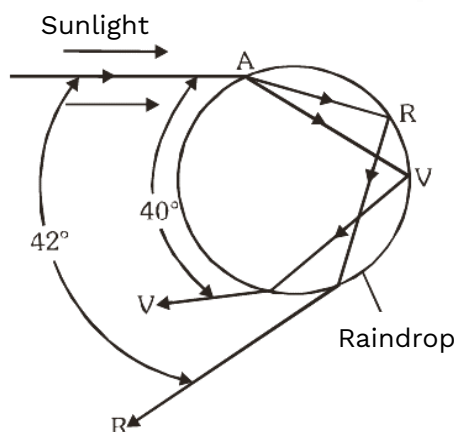
#### Total internal reflection

The phenomenon of reflection when a ray of light travelling from a denser to rarer medium is sent back to the same denser medium, provided when it strikes the interface of the denser and the rarer media at an angle greater than the critical angle, is called total internal reflection.



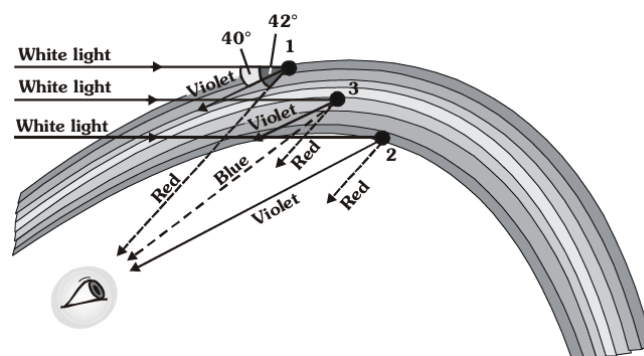
## Rainbow

When the sun shines upon falling raindrops and observer with his back towards the sun sees concentric arcs of spectral colours hanging in the sky.



### Formation of rainbow

- The rainbow is the nature's most spectacular display of the spectrum of white light.
- The required conditions for the appearance of the phenomenon are that Sun be shining in one part of the sky and the rain be falling in opposite part of sky. The observer's back must be towards the Sun.
- Primary rainbow is formed due to two refractions, dispersion and one internal reflection (partial) of light falling on raindrops (see fig.).
- Violet rays emerge at an angle of  $40^\circ$  relative to incoming sunlight and red light emerges at an angle of  $42^\circ$ . For other colours, angles lie in between these two values.
- The observer sees a rainbow with red colour on the top and violet on the bottom. The large number of raindrops in sky especially just after rain makes a prominent rainbow.
- All the seven colours of rainbow in a hollow circular arc which is making an angle of  $40^\circ$  and  $42^\circ$  at our eye.
- Sometimes, a fainter '**secondary rainbow**' with order of colours reversed is also seen along with primary rainbow. At very high altitudes from an aeroplane, the rainbow can be seen as complete circles.



### Atmospheric Refraction

The atmosphere around the earth has thick layers of air that do not have the same temperature. The hotter air is lighter and hence less dense than the cooler air. Due to the difference in densities, the air layers in the atmosphere have a different refractive index. When light rays from the sun pass through the multiple layers of different refractive indexes of the atmosphere, then refraction takes place. The refraction of light caused by the earth's atmosphere is called atmospheric refraction.

### Twinkling of stars

On a clear night, you might have observed the twinkling of a star, which is due to an atmospheric refraction of star light. The density of the atmosphere, as we know, goes on decreasing as the distance above sea level increases. For the sake of simplicity, air can be supposed to be made up of a very large number of layers whose density decreases with the distance above the surface of the earth. Therefore, the light from a heavenly body, such as a star, goes on gradually bending towards normal as it travels through the earth's atmosphere. As the object is always seen in the direction of the light reaching the observer's eye, the star appears higher up in the sky than its actual position. Further, the densities of the various layers go on varying due to the convection currents set up in air by temperature differences. Thus, the refractive index of a layer of air at a particular level goes on changing.

Due to these variations in the refractive indices of the various layers of air, the light from a star passing through the atmospheric air changes its path from time to time and therefore, the amount of light



reaching the eye is not always the same. This increase or decrease in the intensity of light reaching the eye results in the change in apparent position or twinkling of the star.

### **Stars appear slightly higher than its actual position**

Due to the gradually increasing refractive index of air towards the earth's surface, as the star light enters from rarer medium to comparatively denser medium, it bends more and more towards the normal as it is reaching the earth's surface. Thus, apparent position of star is slightly higher than its actual position when it is viewed from the earth's surface. This apparent position is not stationary but it changes with time because of variable physical conditions of the refracting medium (earth's atmosphere).

### **Planets do not twinkle**

The apparent size of stars is very small as compared to apparent size of planets. Thus, the star may be considered as a 'point sized' source of light and the planet as an 'extended source' of light. So, the planet can be considered as a collection of large number of 'point sized' sources of light, such that the dimming effect of some 'point sources' is nullified by the brighter effect of the other 'point sources'. The variable atmospheric conditions are unable to create variations in light flux from planet entering our eyes and thus, planet do not twinkle.

### **Scattering of light**

When light falls on tiny particles then diffused reflection takes place and light spreads in all possible direction. This phenomenon is known as scattering of light.

Small particles scatter mainly blue light. When size of the particle increases then the light of longer wavelength also scatter. The path of a beam of light passing through a true solution is not visible. However, its path becomes visible through a colloidal solution where the size of the particles is relatively larger.

Rayleigh proved that the intensity of scattered light is inversely proportional to the fourth power of the wavelength, provided the scattering is smaller in size than the wavelength of light:

$$\text{scattering} \propto \frac{1}{\lambda^4}$$

### **Tyndall Effect**

The earth's atmosphere is a heterogeneous mixture of minute particles. These particles include smoke, tiny water droplets, suspended particles of dust and molecules of air. When a beam of light strikes such fine particles, the path of the beam becomes visible.

The light reaches us after being reflected diffusely by these particles. The phenomenon of scattering of light by the colloidal particle gives rise to Tyndall effect. This phenomenon is seen when a fine beam of sunlight enters a smoke-filled room through a small hole. Thus, scattering of light makes the particles visible. Tyndall effect can also be observed when sunlight passes through a canopy of a dense forest. Here, tiny water droplets in the mist scatter light.

### **Phenomena based upon Scattering of Light**

A number of optical phenomena can be explained on the basis of scattering of light:

- (I) **Colour of the clear sky is blue:** When we look at the sky, we receive sunlight scattered by fine dust particles, air molecules and water-vapour molecules present in the atmosphere. Since blue light, which is present in larger proportion than violet light in the sunlight, is scattered about ten times more than the orange-red light, the light reaching the eye is mainly blue. Hence the sky appears bluish. If the earth had no atmosphere, there were no scattered sunlight and the sky would have appeared black. In fact, the sky does appear black to the astronauts in the space above the earth's atmosphere.
- (II) **The clouds appear white:** The dependence of scattering on  $1/\lambda^4$  is valid only when the scattering particles or molecules are much smaller than the wavelength of light, as air molecules. Clouds, however, contain water droplets or ice crystals that are much larger than  $\lambda$  and they hence scatter light of all wavelengths nearly equally. Hence clouds appear white.



- (III) **At sunrise or sunset the sun appears reddish:** The scattering of light also explains the reddish appearance of sun at sunrise or sunset. At sunrise or sunset, the sun is near the horizon and the sun rays reach the earth after passing through a maximum distance in the atmosphere. During this passage, the light is scattered by air molecules and fine dust particles. Since scattering  $\propto 1/\lambda^4$ , most of the blue and neighbouring-coloured light is scattered out before reaching the observer. Hence the light received by the observer is predominantly red. (For a similar reason, the sun appears orange-red in fog or mist.)
- At noon, when the sun is overhead, the sunrays travel minimum distance in the atmosphere and there is little scattering. Hence the sun appears almost white (in fact, slightly yellowish because some blue light is scattered).
- (IV) **Sun looks white at noon:** At the noon, the light has to travel a comparatively shorter distance through the atmosphere before reaching the eye of an observer. Thus, only a very little amount of blue or violet light is scattered away. Hence, the sun at noon looks almost white.
- (V) **Danger signals are red:** 'Danger' signals are made of red colour because red colour is scattered least by the air particles, smoke or fog due to its longer wavelength. Hence, red colour can be seen in the same shade even at the large distance.

**Example 4:**

Is the position of a star as seen by us its true position? Justify your answer.

**Solution:**

Light coming from star experience continuous refraction when it enters in the earth's atmosphere. Refraction occurs in a medium of gradually changing refractive index. Since the atmosphere bends light coming from star towards the normal, the apparent position of the star is slightly different from its actual position. The star appears slightly higher (above) than its actual position.

**Example 5:**

Why do we see a rainbow in the sky only after rainfall?

**Solution:**

When sunlight falls on the tiny water droplets present in the atmosphere after rainfall, light gets dispersed by them, causing the rainbow. A rainbow is always formed in a direction opposite to that of the Sun. The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop.

**Example 6:**

What is the difference in colours of the Sun observed during sunrise/sunset and noon? Give an explanation for each.

**Solution:**

At sunrise and sunset, the sun is closer to the horizon. The sunlight passes through a denser layer of air and covers a larger distance before reaching our eyes. Most of the blue light gets scattered. And red colour reaches us which make the sun appears red at sunrise.

At noon, the sun is overhead. The sunlight passes through layers of air and covers a shorter distance before reaching our eye. So, almost all colours of light are scattered equally. Hence the sun appears white.

**FUNDAMENTAL UNLOCKED- (FU#1)**

- Q.1** What kind of lens is used to correct myopia?
- Q.2** To read small letters in a newspaper, an aged person keeps it farther than 25 cm. Explain the reason.
- Q.3** Explain the meaning of the power of accommodation.
- Q.4** A person suffering from defective vision can see objects clearly only beyond 100 cm from the eye.
- Q.5** Find the power of the lens required to correct a myopic eye having far point at 50 cm.

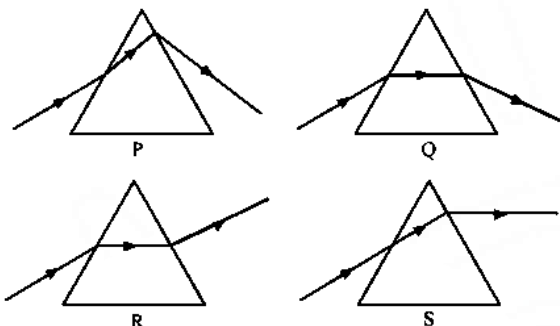




## EXERCISE - I

## Single Correct Type Questions

1. Study the following diagrams in which the path of a ray of light passing through a glass prism as traced by four students P, Q, R and S is shown:



The student who has traced the path correctly is  
(A) P (B) Q (C) R (D) S

2. Which of the following colour has the least wavelength?  
(A) Red (B) Orange (C) Violet (D) Blue
3. A student traces the path of a ray of light through a triangular glass prism for different values of angle of incidence. On analyzing the ray diagram, which one of the following conclusions is he likely to draw?  
(A) The emergent ray is parallel to the incident ray.  
(B) The emergent ray bends at an angle to the direction of the incident ray.  
(C) The emergent ray and the refracted ray are at right angles to each other.  
(D) The emergent ray is perpendicular to the incident ray.
4. The focal length of eye lens is controlled by  
(A) Iris (B) Cornea  
(C) Ciliary muscles (D) Optic nerve
5. A white light falls on a glass prism, the least deviated color is  
(A) Violet (B) Orange  
(C) Red (D) Yellow
6. Blue color of sky is due to  
(A) dispersion of light  
(B) scattering of light  
(C) refraction of light  
(D) reflection of light
7. Rainbow is formed due to  
(A) reflection and dispersion of light through the water droplets  
(B) internal reflection, refraction, and dispersion of light through the water droplets  
(C) only dispersion of light  
(D) only refraction of light
8. The least distance of distinct vision for a young adult with normal vision is about  
(A) 25 m (B) 2.5 cm (C) 25 cm (D) 2.5 m
9. Dispersion of light by a prism is due to the change in  
(A) frequency of light (B) speed of light  
(C) scattering (D) none of these
10. Which of the following color has the least wavelength?  
(A) Red (B) Orange  
(C) Violet (D) Blue
11. Convex lens of suitable focal length can correct  
(A) short sightedness (B) long sightedness  
(C) presbyopia (D) astigmatism
12. The twinkling of stars is due to atmospheric  
(A) Reflection of light  
(B) Dispersion of light  
(C) Interference of light  
(D) Refraction of light
13. The image formed on the retina of a human eye is  
(A) Temporary  
(B) Permanent  
(C) Blurred  
(D) None of these





14. While looking at nearby objects, the muscles so as to the focal length of eye lens.  
(A) Contracts, increase  
(B) Relax, increase  
(C) Contracts, decrease  
(D) Relax, decrease
15. Presbyopia is corrected by  
(A) Cylindrical lens (B) Concave lens  
(C) Bifocal lens (D) Convex lens
16. In eye, the focusing is done by  
(A) To and fro movement of the eye lens  
(B) To and fro movement of retina  
(C) Change in the convexity of the lens through ciliary muscles.  
(D) Change in refractive index of the eye fluid
17. Motion pictures or cinematography make use of  
(A) Least distance of distinct vision  
(B) Persistence of vision  
(C) Power of accommodation  
(D) None of these
18. The human eye forms the image of an object at its  
(A) cornea (B) iris (C) pupil (D) retina
19. For total internal reflection, rays of light must go from  
(A) Rarer to denser medium  
(B) Rarer to rarer medium  
(C) Denser to rarer medium  
(D) Denser to denser medium
20. The middle color in sunlight spectrum is  
(A) yellow (B) green (C) blue (D) orange
5. Define Dispersion of light
6. What kind of lens is present in the human eye?
7. What is meant by persistence of vision?
8. Which type of material can be used to make a lens?
9. Which type of lens would you prefer to use while reading small letters found in a dictionary?
10. State the role of ciliary muscles in the human eye.

### Short Answer Type Questions

### Very Short Answer Type Questions

1. State the functions of iris and yellow spot in the human eye.
2. What is aqueous humor and vitreous humor?
3. Which part of the eye is similar to film in a camera?
4. What is the far point of vision for normal human eye?
1. Find the power of the lens required to correct farsightedness with a near point at 75cm.
2. What is the Tyndall effect?
3. Explain the formation of rainbow?
4. Define Atmospheric refraction.
5. A doctor has prescribed a corrective lens of power +1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?
6. Draw a labeled ray diagram to illustrate the dispersion of a narrow beam of white light when it passes through a glass prism.
7. What is meant by scattering of light? Use this phenomenon to explain why the clear sky appears blue or the sun appears reddish at sunrise.
8. Describe an activity to show that the colors of white light splitted by a glass prism can be recombined to get white light by another identical glass prism. Also draw ray diagram to show the recombination of the spectrum of white light.
9. What is the color of the clear sky during daytime? Give reason for it.
10. State the role of ciliary muscles, Retina, Sclera, eye cornea, optic nerve in the human eye.

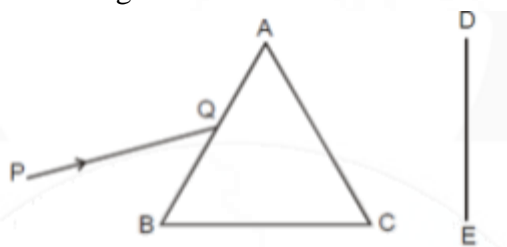






## Long Answer Type Questions

- List the parts of the human eye that control the amount of light entering into it. Explain how they perform this function.
  - Write the function of retina in human eye.
  - Do you know that the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye? How and why should we organize groups to motivate the community members to donate their eyes after death?
- What is atmospheric refraction? Use this phenomenon to explain the following natural events.
  - Twinkling of stars
  - Advanced sun-rise and delayed sun-set. Draw diagrams to illustrate your answers.
- A narrow beam PQ of white light is passing through a glass prism ABC as shown in the diagram



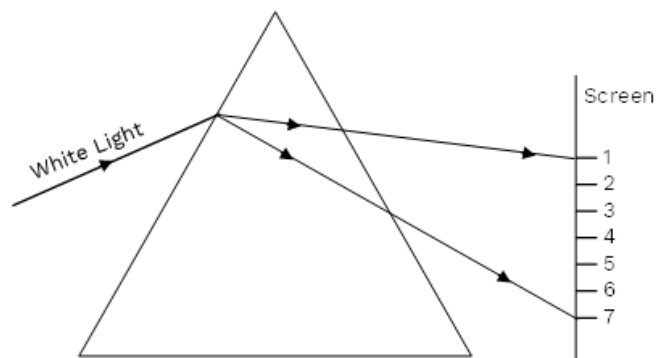
Trace it on your answer sheet and show the path of the emergent beam as observed on the screen DE.

- Write the name and cause of the phenomenon observed.
  - Where else in nature is this phenomenon observed?
  - Based on this observation, state the conclusion which can be drawn about the constituents of white light.
- What is far-sightedness? What are the causes for far-sightedness? Describe with a ray diagram how this defect can be corrected by using spectacles?

- What is short-sightedness? What are the causes for short-sightedness? Describe with a ray diagram how this defect can be corrected by using spectacles?
- What is Presbyopia? What are the causes of Presbyopia? How this defect can be corrected by using spectacles?
- Explain the phenomenon of rainbow formation.
  - Why does the sky appear dark to astronauts when seeing from space?
- Explain the phenomenon of dispersion of white light by glass prism, also explain how to recombine spectrum of light by using two prisms.

## Case Based Question

- The phenomenon of splitting white light into its constituent colors is known as dispersion of light. It was discovered by Newton.



- Which ray is least deviated by a prism?
- Which ray is most deviated by prism?
- Which phenomenon of light is used by prism to form a spectrum of light?
- Name the colours 2, 4 and 6.





2. The refraction of light induced by the earth's atmosphere is known as atmospheric refraction. Atmospheric refraction occurs because the different layers of the earth's atmosphere vary in terms of optical densities.
- There are many optical phenomena occurring in nature due to atmospheric refraction of light.
- (I) What will be the color of the sky as seen from the earth if there is no atmosphere?
- (A) Black  
(B) Blue  
(C) Orange  
(D) Red
- (II) As the thickness of the atmosphere increases, color of scattered light is found in the..... order.
- (A) blue, violet, yellow, red  
(B) violet, blue, yellow, red  
(C) red, yellow, blue, violet  
(D) violet, blue, red, yellow
- (III) The sun is visible to us ----minute before the sunrise & minute after the sunrise
- (A) 1, 2  
(B) 2, 1  
(C) 2, 2  
(D) 1, 1
- (IV) Which of the following phenomena in nature occur due to atmospheric refraction of light
- (A) Oval shape of sun in the morning and evening  
(B) Twinkling of stars  
(C) Blue color of sky  
(D) Both A and B





## EXERCISE - II

## Multiple Correct Type Questions

- Angle of deviation in prism depends on  
(A) The angle of incidence  
(B) The material of the prism  
(C) The wavelength of light used  
(D) The angle of the prism
- Which of the following statements are correct?  
(A) Sun appears reddish at the time of sunrise and sunset.  
(B) More scattering of light takes place during the morning.  
(C) Atmospheric refraction increases duration of the day.  
(D) Sky will appear dark if there is no atmosphere.
- Choose the correct statement related to refraction of light.  
(A) Twinkling of stars  
(B) Oval shape of sun in morning and evening  
(C) Object in water appears bigger in size  
(D) More scattering of light takes place during the morning.
- Air is not visible because it  
(A) is nearly a perfectly transparent substance  
(B) neither absorbs nor reflects light  
(C) transmits whole of light  
(D) absorb all the light
- A light wave of certain frequency moves from air to glass, then its  
(A) wavelength does not change  
(B) frequency does not change  
(C) wavelength changes  
(D) frequency changes

## Match the Column Type Questions

## 1. Match the column -

Phenomenon		Reason
(i)	Rainbow	A. Scattering of light
(ii)	Twinkling of Stars	B. Dispersion of light
(iii)	Blue color of sky	C. Fluctuation of Refractive index in atmosphere layers
(iv)	Advancement of sunrise and delay of sunset	D. Refraction of light

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

## Assertion and Reason

**Assertion:** A normal healthy person can clearly see all the objects beyond a certain minimum distance.

**Reason:** The human eye has ability to adjust focal length of its lens to certain extent.

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

## Comprehension

The human eye is the most significant one as it enables us to see the beautiful, colorful world around us. The eye is spherical in shape and has a diameter of 2.3 cm on average. The internal structure of the eye includes- the cornea, iris, pupil, lens, ciliary muscles, retina, nerve cells, optic nerve, yellow spot, aqueous and vitreous humor, and suspensory ligament.





- (I) When a milky and cloudy layer is formed on the eye lens of an old person, they lose their vision partially or completely. This type of situation is called?
- (A) Myopia  
(B) Cataract  
(C) Hypermetropia  
(D) Presbyopia
- (II) The image of an object is formed by the human eye at its-
- (A) cornea  
(B) iris  
(C) pupil  
(D) retina
- (III) Most of the refraction takes place at when light enter the eye.
- (A) Pupil  
(B) Iris  
(C) Outer surface of cornea  
(D) Crystalline lens
- (IV) The change in focal length of an eye lens is caused by the action of the
- (A) pupil  
(B) retina  
(C) ciliary muscles  
(D) iris
4. The far point of a myopic person is 75 cm in front of the eye. The nature and power of the lens required to correct the problem, will be?
5. The far point of a myopic person is 80 cm, in front of the eye. What is the power and kind of lens required to correct the problem?
6. A short-sighted person uses a spectacle of power  $-0.4\text{ D}$  to see very distant objects. How far can he see without using a spectacle?
7. A short-sighted person uses a spectacle of power  $-0.5\text{ D}$  to see very distant objects. What is the power and kind of lens required to correct the problem?
8. A person cannot see clearly beyond 60cm. What should be the power of lens required to correct his vision?
9. A person uses spectacles of power  $-1.5\text{D}$ . Calculate his far point?
10. The near point of person is 40cm. To correct his defect, what should be the power of lens required?

## HOTS

## Numerical Type Questions

1. A person needs a lens of power  $-5.5\text{ D}$  for correcting his distant vision. What is the focal length of the lens required for correcting distant vision?
2. A person needs a lens of power correcting his near vision he needs a lens of power  $+1.5\text{ D}$ . What is the focal length of the lens required for correcting near vision?
3. A farsighted person cannot focus distinctly objects closer than 120 cm. The lens that will permit him to read from a distance of 40 cm will have a focal length.
1. A person is suffering from both near-sightedness and far-sightedness. His spectacles would be made of?
2. Calculate refractive index of glass for following colors.
- (A) red color  
(B) yellow color  
(C) violet color  
(D) green color
3. When a light wave of frequency  $5 \times 10^{14}\text{ Hz}$  is passed through a medium of refractive index 1.5, then its wavelength will become?
4. A young girl can adjust the power of her lens between 55D to 60D. If her far point is infinite, then find her near point.





- |   |  |
|---|--|
| <p>5. A person with myopic eye cannot see objects beyond 1.4m distinctly. The type of corrective lens used to restore proper vision should be?</p> <p>6. A myopic person having far point 80 cm uses spectacles of power -1.0 D. How far can he see clearly?</p> <p>7. A 52-year-old near-sighted person wears eye-glass with a power of -5.5 D for distance viewing. His doctor prescribes a correction of +1.5 D in the near-vision section of his bi-focal. This is measured relative to the main part of the lens</p> <p>(a) What is the focal length of his distance-viewing part of the lens?</p> <p>(b) What is the focal length of the near-vision section of the lens?</p> | <p>8. A 15-year-old student is not able to see clearly the questions written on the blackboard placed at a distance of 5 m from him.</p> <p>(a) Name the defect of vision he is suffering from.</p> <p>(b) State two causes of this defect.</p> <p>(c) Name the type of lens used to correct this defect.</p> <p>9. A person suffering from far-sightedness wears a spectacle having a convex lens of focal length 50 cm. What is the distance of the near point of his eye?</p> <p>10. A person wants to read a book placed at 20 cm, whereas near point of his eye is 30 cm. Calculate the power of the lens required.</p> |
|---|--|





## EXERCISE - III

## Previous Year Questions

1. How many times does a ray bend on passing through a prism? (NTSE Stage-1/2018)  
(A) once (B) twice (C) thrice (D) none
2. Which is the colour at lower end of visible spectrum? (NTSE Stage-1/2018)  
(A) red (B) green  
(C) yellow (D) violet
3. A short sighted person uses a spectacle of power  $-0.4$  D to see very distant objects. How far can he see without using spectacle? (NTSE Stage-1/2018)  
(A) 40 m (B) 100 m (C) 2.5 m (D) 10 m
4. A rainbow is formed because of (NTSE Stage-1/2018)  
(A) Refraction  
(B) dispersion  
(C) total internal reflection  
(D) All of these
5. The image of an object is formed by the human eye at its- (NTSE Stage-1/2018)  
(A) cornea (B) iris  
(C) pupil (D) retina
6. Which of the following statements is true? (NTSE Stage-1/2018)  
(A) A convex lens with power  $+4$  D has a focal length  $-0.25$  m.  
(B) A convex lens with power  $-4$  D has a focal length  $+0.25$  m.  
(C) A concave lens with power  $+4$  D has a focal length  $-0.25$  m.  
(D) A concave lens with power  $-4$  D has a focal length  $-0.25$  m.
7. Choose the wrong statement related to refraction of light. (NTSE Stage-1/2018)  
(A) Twinkling of stars  
(B) Oval shape of sun in morning and evening  
(C) Object in water appears bigger in size  
(D) Red light undergoes dispersion, while passing through prism
8. What will be the colour of the sky as seen from the earth if there is no atmosphere? (NTSE Stage-I/2015)  
(A) Black (B) Blue  
(C) Orange (D) Red
9. A person is suffering from both near sightedness and far sightedness. His spectacles would be made of (NTSE Stage-II/2015)  
(A) two convex lenses with the upper lens having a larger focal length than the lower lens  
(B) two concave lenses with the upper lens having a smaller focal length than the lower lens  
(C) a concave lens as the upper lens and a convex lens as the lower lens  
(D) a convex lens as the upper lens and a concave lens as the lower lens
10. Which one of the following phenomena is an example of scattering of light? (NTSE Stage-I/2017)  
(A) Bending of rod at interface of air and water  
(B) Twinkling of stars  
(C) Tyndall effect  
(D) Mirage in desert during summer





**ANSWER KEY****EXERCISE - I****Single Choice Questions**

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

**Case Study Questions**

Case-2				
Que.	(I)	(II)	(III)	(IV)
Ans.	A	D	C	D

**EXERCISE - II****Multiple Choice Questions**

Que.	1	2	3	4	5										
Ans.	A,B,C,D	A,B,C,D	A,B,C	B,C	B,C										

**Match the Column Type Questions**

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

**Assertion and Reason**

1. (A)

Comprehension-2				
Que.	(I)	(II)	(III)	(IV)
Ans.	B	D	C	C

**EXERCISE - III****Previous Year Questions**

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





# DPP

## Daily Practice Problems

**SUBJECT: PHYSICS****CLASS-10****DPP NO. 1****TOPIC: HUMAN EYE AND COLOURFUL WORLD****Multiple Choice Questions**

1. The human eye forms the image of an object at is :  
(A) Cornea (B) iris (C) pupil (D) retina
2. The change in focal length of an eye-lens is caused by the action of the :  
(A) pupil (B) retina (C) ciliary muscles (D) iris
3. The least distance of distinct vision for a young adult with normal vision is about :  
(A) 25m (B) 2.5 cm (C) 25 cm (D) 2.5 m
4. Refraction of light in the eye occurs at :  
(A) the lens only (B) the cornea only  
(C) both the cornea and the lens (D) the pupil
5. To focus the image of nearby object on the retina of an eye :  
(A) the distance between eye-lens and retina is increased  
(B) the distance between eye-lens and retina is decreased  
(C) the thickness of eye-lens is decreased  
(D) the thickness of eye-lens is increased
6. The term “accommodation” as applied to the eye, refers to its ability to :  
(A) control the light intensity falling on the retina  
(B) effect the inverted image formed on the retina  
(C) vary the focal length of the lens  
(D) vary the distance between the lens and retina
7. Which of the following controls the amount of light entering the eye?  
(A) ciliary muscles (B) lens (C) iris (D) cornea
8. The human eye possesses the power of accommodation. This is the power to:  
(A) alter the diameter of the pupil as the intensity of light changes  
(B) distinguish between lights of different colours  
(C) focus on objects at different distances  
(D) decide which of the two objects is colours.

9. The human eye can focus objects at different distances by adjusting the focal length of the eye-lens. This is due to :  
 (A) presbyopia (B) accommodation  
 (C) near-sightedness (D) far-sightedness
10. The defect of vision which cannot be corrected by using spectacles is:  
 (A) myopia (B) presbyopia (C) cataract (D) hypermetropia
11. A person cannot see the distant objects clearly (though he can see the nearby objects clearly.) He is suffering from the defect of vision called:  
 (A) cataract (B) hypermetropia (C) myopia (D) presbyopia
12. Though a woman can see the distant objects clearly, she cannot see the nearby objects clearly. She is suffering from the defect of vision called:  
 (A) long-sight (B) short-sight (C) hind-sight (D) mid-sight
13. A young man has to hold a book at arm's length to be able to read it clearly. The defect of vision is :  
 (A) astigmatism (B) myopia (C) presbyopia (D) hypermetropia
14. After testing the eyes of a child, the optician has prescribed the following lenses for his spectacles :  
 Left eye : + 2.00 D Right eye : + 2.25 D  
 The child is suffering from the defect of vision called:  
 (A) short-sightedness (B) long-sightedness  
 (C) cataract (D) presbyopia
15. A person got his eyes tested. The optician's prescription for the spectacles reads:  
 Left eye : - 3.00 D Right eye : - 3.50 D  
 The person is having a defect of vision called:  
 (A) presbyopia (B) myopia (C) astigmatism (D) hypermetropia

### Very short answer type Questions:

- What kind of lens is present in the human eye ?
- Name two parts of the eye which refract light rays (or bend light rays).
- Name the part of the eye :  
 (A) which controls the amount of light entering the eye.  
 (B) on which the image is formed.  
 (C) which changes the focal length of eye-lens.

4. What is the name of :  
 (A) the curved, transparent front surface of the eye ?  
 (B) the light-sensitive layer in the eye ?
5. Where is the image formed in a human eye ?

### Short answer type Questions:

1. Why is a normal eye not able to see clearly the objects placed closer than 25 cm.
2. What changes take place in the shape of eye-lens :  
 (A) when the eye is focused on a near object ?  
 (B) when the eye is focused on a distant object ?
3. The eye of a person are focused (i) on a nearby object, and (ii) on a distant object, turn by turn. In which case :  
 (A) The focal length of eye-lens will be the maximum ?  
 (B) The converging power of eye-lens will be the maximum ?
4. What change is made in the eye to enable it to focus on objects situated at different ? Illustrate your answer with the help of diagrams ?
5. How is the amount of light entering the eye controlled ?

### Long answer type Questions:

1. (A) Draw a simple diagram of the human eye and label clearly the cornea, iris, pupil, ciliary muscles eye-lens, retina, optic nerve and blind spot.  
 (B) Describe the working of the human eye with the help of the above diagram.  
 (C) How does the eye adjust itself to deal with light of varying intensity?
2. (A) Explain the function of the following parts of the eye:  
 (A) Cornea                      (B) iris                      (C) pupil                      (D) ciliary muscles  
 (E) eye-lens                      (D) retina                      (D) optic-nerve  
 (B) If you walk from a dark room into sunlight and back again into dark room, how would your pupils alter in size? What makes this happen?  
 (C) Explain why, we cannot see our seats first when we enter a darkened cinema hall from bright light but gradually they become visible.

3. (A) What is long-sightedness? State the two causes of long-sightedness (or hypermetropia). With the help of ray diagrams, show:  
 (I) the eye-defect long-sightedness  
 (II) correction of long-sightedness by using a lens.  
 (B) An eye has a near point distance of 0.75m. What short of lens in spectacles would be needed to reduce the near point distance to 0.25 m ? Also calculate the power of lens required. Is this eye long-sighted or short-sighted ?  
 (C) An eye has a far point of 2 m. What type of lens in spectacles would be needed to increase the far point to infinity ? Also calculate the power of lens required. Is this eye long-sighted or short-sighted ?

### Case based Study

1. What shape are your eye-lenses :  
 (A) when you look at your hand ?  
 (B) When you look at a distance tree?
2. Suggest how your irises help to protect the retinas of your eyes from damage by bright light.
3. A short-sighted person has a near point of 15 cm and a far point of 40 cm.  
 (A) Can he see clearly an object at a distance of :  
 (I) 5 cm                      (II) 25 cm                      (III) 50 cm  
 (B) To see clearly an object at infinity, what kind of spectacle lenses does he need?

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

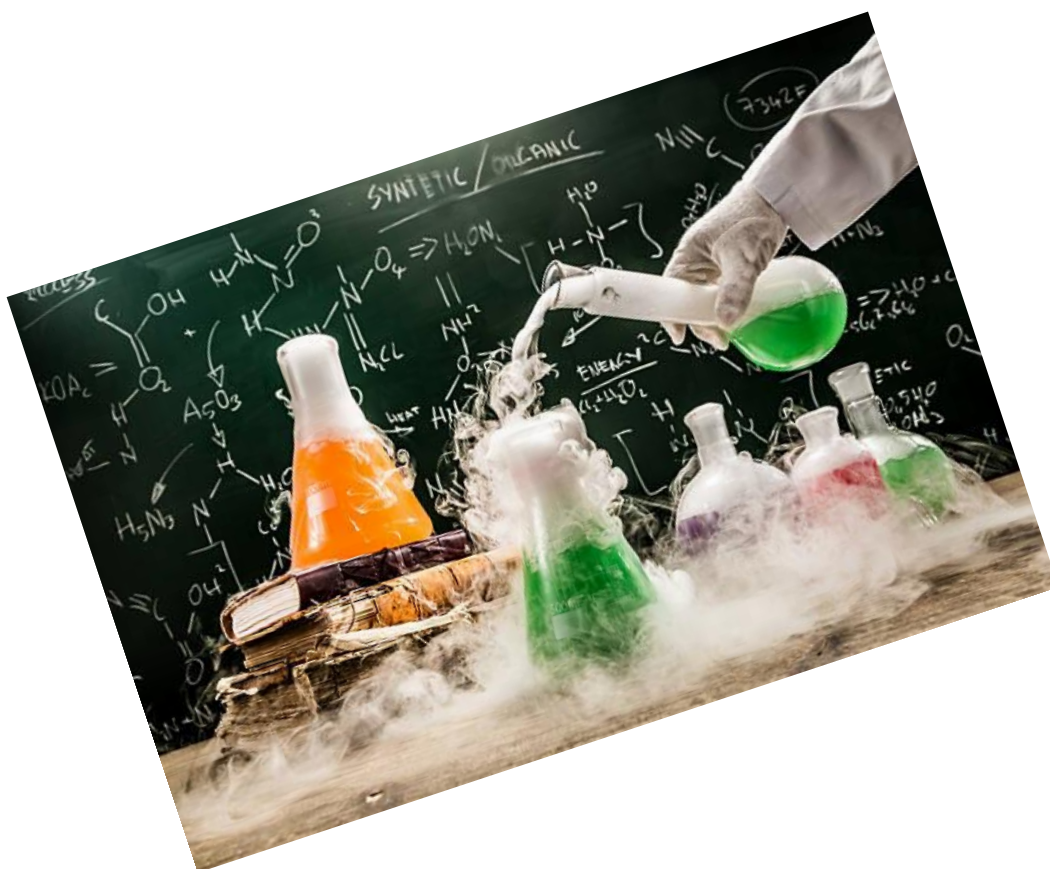
# FOUNDATION

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CLASS-X

SAMPLE

CHEMISTRY





# 1

## ACIDS, BASES AND SALTS

### Introduction

Arrhenius Concept of Acid and Base: This concept was given in 1884. According to this concept, all substances which give  $H^+$  ions when dissolved in water are called acids, e.g.  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$  etc. while those which ionise in water to give  $OH^-$  ions are called bases e.g.  $NaOH$ ,  $KOH$ ,  $NH_4OH$  etc.

Examples:  $HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$

$NaOH(aq) \longrightarrow Na^+(aq) + OH^-(aq)$

Acids generally are those chemical substances which have a sour taste. Acids change the colour of blue litmus solution to red. If we cut a lemon with a knife and taste, it will taste sour.

Substances with sour taste are regarded as acids. Lemon juice, vinegar, grape fruit juice and spoilt milk etc. taste sour since they are acidic. Many substances can be identified as acids based on their taste but some of the acids like sulphuric acid have very strong action on the skin which means that they are corrosive in nature. In such cases it would be according to modern definition.

An acid may be defined as a substance which releases one or more  $H^+$  ions or hydronium ions in aqueous solution.

Acids are mostly obtained from natural sources.

### Classification And Properties of Acids

#### Classification:

#### (1) Depending on strength

- Strong acids
- Weak acids

#### (2) Depending on sources

- Organic acids
- Inorganic acids

#### (3) Depending on concentration

- Concentrated acids
- Dilute acids

#### (1) Based on Degree of dissociation/ strength

##### (A) Strong Acids :

The acids which undergo almost complete ionisation in a dilute aqueous solution, thereby producing a high concentration of hydronium ions ( $H_3O^+$ ) are known as strong acids.

Example:  $HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$

Some examples of strong acids are :

- Hydrochloric acid ( $HCl$ )
- Sulphuric acid ( $H_2SO_4$ )
- Nitric acid ( $HNO_3$ )

All these three mineral acids are considered to be strong acids because they ionise almost completely in their dilute aqueous solutions.

##### (B) Weak Acids:

The acids which undergo partial or incomplete ionisation in a dilute aqueous solution, thereby producing a low concentration of hydronium ions ( $H_3O^+$ ) are known as weak acids.

$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$

Some examples of weak acids are :

- Acetic acid ( $CH_3COOH$ )
- Formic acid ( $HCOOH$ )
- Oxalic acid [ $(COOH)_2$ ]
- Carbonic acid ( $H_2CO_3$ )
- Sulphurous acid ( $H_2SO_3$ )
- Hydrogen sulphide ( $H_2S$ )
- Hydrocyanic acid ( $HCN$ )

The aqueous solution of weak acids contain both ions as well as undissociated molecules.

#### (2) Classification of acids on the basis of their Source:

On the basis of their source, acids can be classified in two categories :

- Organic acids
- Inorganic acids

**(A) Organic acids**

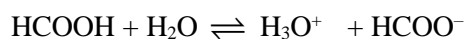
The acids which are usually obtained from natural resources or organisms are known as organic acids. Oxalic acid  $[(\text{COOH})_2]$ , acetic acid  $(\text{CH}_3\text{COOH})$  etc. are very common examples of organic acids. Some other organic acids with their natural sources are given in the following table.

**Some Organic Acids with Their Natural Sources**

S. No	Organic acid	Natural sources
1	Acetic acid	Micro-organism (bacteria)
2	Citric acid	Citrus fruits (like orange and lemon)
3	Butyric acid	Rancid butter
4	Formic acid	Sting of bees and ants
5	Lactic acid	Sour milk
6	Malic acid	Apples

S. No	Organic acid	Natural sources
7	Oleic acid	Olive oil
8	Stearic acid	Fats
9	Amino acid	Proteins
10	Uric acid	Urine
11	Tartaric acid	Tamarind
12	Oxalic acid	Tomatoes

It may be noted that all organic acids contain carbon as one of their constituting elements. These are weak acids and, therefore, do not ionise completely in their aqueous solutions. Since these acids do not ionise completely in their aqueous solutions, therefore, their solutions contains both ions as well as undissociated molecules. For example, formic acid's aqueous solution contains  $\text{H}_3\text{O}^+$ ,  $\text{HCOO}^-$  as well as undissociated  $\text{HCOOH}$  molecules.



Formic acid      Hydronium ion  
Formate ion

**(B) Inorganic Acids.**

The acids which are obtained from artificial methods in laboratory are called Inorganic Acids

**OR**

The acids which are usually obtained from minerals are known as inorganic acids. Since the acids are obtained from minerals, therefore, these acids are also called mineral acids. Some common examples of inorganic acids are : Hydrochloric acid ( $\text{HCl}$ ), Sulphuric acid ( $\text{H}_2\text{SO}_4$ ), Nitric acid ( $\text{HNO}_3$ ) etc.

It may be pointed out that except carbonic acid ( $\text{H}_2\text{CO}_3$ ), these acids do not contain carbon. Acids like  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  are strong acids which ionise completely in their aqueous solutions and, therefore, their aqueous solutions do not contain any undissociated molecules.

**(3) Classification on the basis of concentration of the acid:**

By the term concentration, we mean the amount of water present in the given sample of acid solution in water.

**(A) Concentrated Acid :**

The sample of an acid which contains very small or no amount of water is called a concentrated acid. E.g.- Conc.  $\text{HCl}$

**(B) Dilute Acid :**

The sample of an acid which contains far more amount of water than its own mass is known as a dilute acid. E.g.- dil.  $\text{HCl}$

A concentrated acid may not necessarily be a strong acid while a dilute acid may not necessarily be a weak acid. A strong acid will remain strong even if it is dilute because it produces a large concentration of hydronium ions in aqueous solution. On the other hand, a weak acid will remain weak even when concentrated because it will produce lesser concentration of hydronium ions in aqueous solution.

**(4) Classification of acids on the basis of their basicity:**

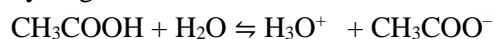
The basicity of an acid is defined as the number of hydronium ions  $[\text{H}_3\text{O}^+ (\text{aq.})]$  that can be produced by the complete ionisation of one molecule of that acid in aqueous solution.

For example, basicity of  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$  is 1, 2 and 3 respectively because one molecule of





these acids, on ionisation, produces 1, 2 and 3 hydronium ions in aqueous solution respectively. It may be pointed out here that the basicity of an acid is determined by number of hydronium ions produced per molecule of an acid on ionisation and not the number of hydrogen atoms present in one molecule of an acid. For example, basicity of acetic acid ( $\text{CH}_3\text{COOH}$ ) is 1 because one molecule of acetic acid, on ionisation in aqueous solution, produces one hydronium ion although one molecule of acetic acid contains four hydrogen atoms.



Acetic acid    Hydronium ion    Acetate ion

On the basis of basicity, the acids can be classified as under :

#### (A) Monobasic Acids:

When one molecule of an acid on complete ionisation produces one hydronium ion ( $\text{H}_3\text{O}^+$ ) in aqueous solution, the acid is said to be a monobasic acid.

##### Examples of monobasic acids.

Some examples of monobasic acids are :

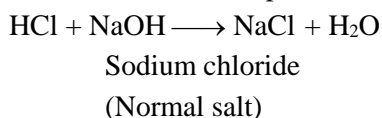
- (i) Hydrochloric acid ( $\text{HCl}$ )
- (ii) Hydrobromic acid ( $\text{HBr}$ )
- (iii) Nitric acid ( $\text{HNO}_3$ )
- (iv) Acetic acid ( $\text{CH}_3\text{COOH}$ )
- (v) Formic acid ( $\text{HCOOH}$ )

Characteristics of Monobasic Acids.

Two important characteristics of monobasic acids are :

- (i) A monobasic acid ionises in one step in aqueous solution. For example,  

$$\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$$
 (Single step ionisation)
- (ii) A monobasic acid forms only single salt or a normal salt. For example,



#### (B) Dibasic Acids:

When one molecule of an acid on complete ionisation produces two hydronium ions ( $\text{H}_3\text{O}^+$ ) in aqueous solution, the acid is said to be a dibasic acid.

#### Examples of dibasic acids :

Some examples of dibasic acids are :

- (i) Sulphuric acid ( $\text{H}_2\text{SO}_4$ )
- (ii) Sulphurous acid ( $\text{H}_2\text{SO}_3$ )
- (iii) Carbonic acid ( $\text{H}_2\text{CO}_3$ )
- (iv) Oxalic acid [ $(\text{COOH})_2$ ]

Characteristics of Dibasic Acids :

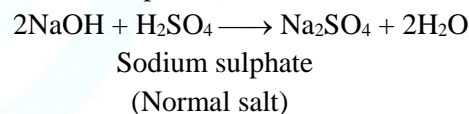
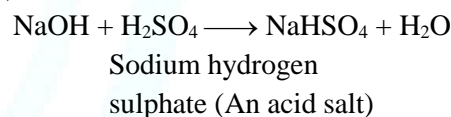
Two important characteristics of dibasic acids are:

- (i) A dibasic acid ionises in two steps in aqueous solution. For example, sulphuric acid which is a dibasic acid ionises to produce bisulphate ion ( $\text{HSO}_4^-$ ) in the first step which further ionises to produce sulphate ion ( $\text{SO}_4^{2-}$ ) in the second step.  

$$\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{HSO}_4^-$$

Sulphuric acid	Bisulphate ion
$\text{HSO}_4^- + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^+ + \text{SO}_4^{2-}$	
	Sulphate ion

- (ii) Because of the presence of two replaceable hydrogen ions, a dibasic acid forms two series of salts i.e., an acid salt and a normal salt. For example,  $\text{H}_2\text{SO}_4$  reacts with  $\text{NaOH}$  to form  $\text{NaHSO}_4$  (an acid salt) and  $\text{Na}_2\text{SO}_4$  (a normal salt).



#### (C) Tribasic Acids:

When one molecule of an acid on complete ionisation produces three hydronium ions ( $\text{H}_3\text{O}^+$ ) in aqueous solution, the acid is said to be a tribasic acid.

An example of tribasic acids is phosphoric acid ( $\text{H}_3\text{PO}_4$ ), citric acid ( $\text{C}_6\text{H}_8\text{O}_7$ )

#### (5) Classification on the basis of molecules:

- (i) Hydra Acids      (ii) Oxy Acids

#### Physical properties of acids

##### (1) Physical properties

- (a) **Taste:** Acids have a sour taste. Mineral acids like  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  are highly corrosive in nature and hence they should not be tasted or touched as they may cause harm.





**(b) Physical state:** Acids are generally solids or liquids at room temperature.

**Note:** Hydrochloric acid is the aqueous solution of hydrogen chloride gas.

**(c) They change the colours of indicators:**

Indicators are complex substances that acquire different colours in acidic and basic media. Indicators are helpful in detecting the acidic or basic nature of a given solution by changing their colour. Although many indicators are known, some main indicators are as follows:

Indicators	Colour change in acidic medium
Litmus solution	Blue to red
Phenolphthalein	Remains colourless
Turmeric	Remains yellow
China rose indicator	Becomes dark pink (Magenta)

**(d) They are good electrolytes:** Electrolytes are the substances that conduct electricity in molten or aqueous state due to the presence of free ions or free electrons. All acids when dissolved in water dissociate to form ions, therefore conduct electricity.

**(e) Acids have corrosive nature:** The mineral acids (strong acids) cause severe burns on the skin and attack and eat up materials like cloth, wood, metal structures etc. e.g., if conc.  $\text{H}_2\text{SO}_4$  falls accidentally on skin, clothes etc., it causes severe burns and it makes holes in the clothes.

#### Chemical Formulae, Types and Uses Of Some Common Acids

Name	Type	Chemical Formula	Where found or used
Carbonic acid	Mineral acid	$\text{H}_2\text{CO}_3$	In soft drinks and lends fizz.
Nitric acid	Mineral acid	$\text{HNO}_3$	Used in the manufacture of explosives (TNT, Nitroglycerine) and fertilizers (Ammonium nitrate, Calcium nitrate, Purification of Au, Ag)
Hydrochloric acid	Mineral acid	$\text{HCl}$	In purification of common salt, in textile industry as bleaching agent, to make aqua regia, in stomach as gastric juice, used in tanning industry
Sulphuric acid	Mineral acid	$\text{H}_2\text{SO}_4$	Commonly used in car batteries, in the manufacture of fertilizers (Ammonium sulphate, super phosphate) detergents etc, in paints, plastics, drugs, in manufacture of artificial silk, in petroleum refining.
Phosphoric acid	Mineral acid	$\text{H}_3\text{PO}_4$	Used in antirust paints and in fertilizers.
Formic acid	Organic acid	$\text{HCOOH}$	Found in the stings of ants and bees, used in tanning leather, in medicines for treating gout.
Acetic acid	Organic acid	$\text{CH}_3\text{COOH}$	Found in vinegar, used as solvent in the manufacture of dyes and perfumes.
Lactic acid	Organic acid	$\text{CH}_3\text{CH}(\text{OH})\text{COOH}$	Responsible for souring of milk in curd.
Benzoic acid	Organic acid	$\text{C}_6\text{H}_5\text{COOH}$	Used as a food preservative.
Citric acid	Organic acid	$\text{C}_6\text{H}_8\text{O}_7$	Present in lemons, oranges and citrus fruits
Tartaric acid	Organic acid	$\text{C}_4\text{H}_6\text{O}_6$	Present in tamarind.

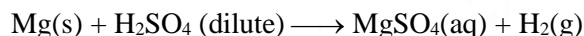
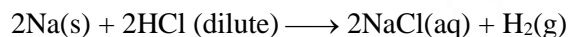


**Chemical Properties of Acids**
**(i) Action with metals:**

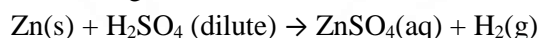
Acid + More reactive Metal than hydrogen in reactivity series  $\rightarrow$  Salt + hydrogen gas

Acid + Less reactive metal than hydrogen  $\rightarrow$  No reaction

Dilute acids like dilute HCl and dilute  $\text{H}_2\text{SO}_4$  react with certain active metals to evolve hydrogen gas.



Metals which can displace hydrogen from dilute acids are known as active metals. e.g. Na, K, Zn, Fe, Ca, Mg etc.

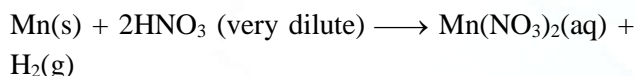
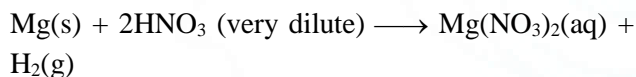


The active metals which lie above hydrogen in the activity series are electropositive and more reactive in nature.

For such reactions dilute acids are taken and generally dilute  $\text{H}_2\text{SO}_4$  and HCl are preferred.

Dilute  $\text{HNO}_3$  is a strong oxidizing agent due to which the released  $\text{H}_2$  gets converted into  $\text{H}_2\text{O}$ .

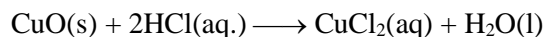
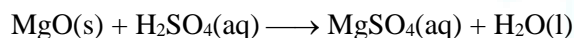
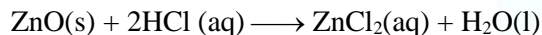
Therefore, very dilute  $\text{HNO}_3$  (1%) is used.


**(ii) Action with metal oxides:**

Metal oxide + Acid  $\longrightarrow$  Salt + water

Acids react with metal oxides to form salt and water. These reactions are mostly carried out upon heating.

e.g.



(Black) (Bluish green)

In the above reaction copper chloride formed is bluish-green in colour.

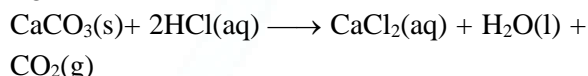
Metal oxides react with acids to give salt and water similar to the reaction of a base with acid (neutralisation).

**(iii) Action with metal carbonates and metal bicarbonates:**

Metal carbonate/hydrogen carbonate + Acid  $\longrightarrow$  Salt + water + carbon dioxide

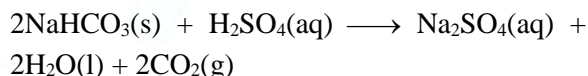
Both metal carbonates and bicarbonates react with acids to evolve  $\text{CO}_2$  gas and form salts.

e.g.



Calcium Calcium

Carbonate Chloride



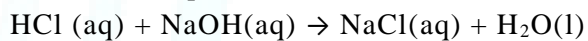
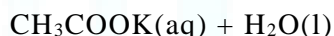
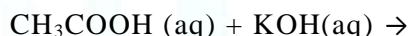
Sodium Sodium

bicarbonate sulphate

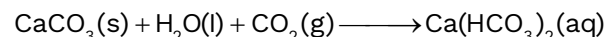
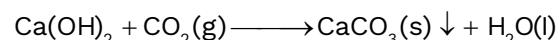
**(iv) Action with bases:**

Acids react with bases to give salt and water.

Neutralisation reaction takes place between acid and bases.

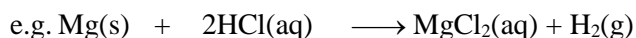

**Note:**

On passing carbon dioxide gas through lime water, a white insoluble precipitate of calcium carbonate is formed but on passing excess of  $\text{CO}_2$ , the white precipitate disappears due to the formation of soluble calcium bicarbonate. (Calcium hydrogencarbonate salt.)



**Example 1:** Which gas is usually liberated when an acid reacts with metal? Illustrate with an example. How will you test the presence of the gas?

**Solution:** When a metal reacts with an acid, hydrogen gas is produced.



Magnesium Hydrochloric

Magnesium Hydrogen

(metal) acid chloride





Hydrogen gas can be tested by bringing a burning splinter near the mouth of the test tube. If it starts burning with a pop-sound, the gas being liberated is hydrogen.

**Example 2:** Give one example each of a strong acid and a weak acid.

**Solution:** Strong acid: HCl, Weak acid: CH<sub>3</sub>COOH

**Example 3:** Match the acids given in Column (A) with their correct source given in Column (B)

Column (A)	Column (B)
(a) Lactic acid	(i) Tomato
(b) Acetic acid	(ii) Lemon
(c) Citric acid	(iii) Vinegar
(d) Oxalic acid	(iv) Curd

**Solution:** (a)-(iv); (b)-(iii); (c)-(ii); (d)-(i)

#### FUNDAMENTAL UNLOCKED- (FU#1)

- Q.1** Equal amounts of calcium are taken in test tubes (A) and (B). Hydrochloric acid (HCl) is added to test tube (A) while acetic acid (CH<sub>3</sub>COOH) is added to test tube (B). In which case, fizzing occurs more vigorously and why?
- Q.2** What happens when nitric acid is added to egg shell?
- Q.3** Name two metals which displace H<sub>2</sub> with very dilute HNO<sub>3</sub> (5%)?

### Classification and Properties of Bases

#### BASE

Substances with bitter taste and soapy touch are regarded as bases. Since many bases like sodium hydroxide and potassium hydroxide have corrosive action on the skin and can even harm the body, so according to the modern definition - A base may be defined as a substance capable of releasing one or more OH<sup>-</sup> ions in aqueous solution.

Metal oxides, Metal hydroxides and aq. Ammonia solution are basic in nature. With acids all these compounds form salt and water, which is a neutralization reaction.

#### (a) Alkalis:

Some bases like sodium hydroxide and potassium hydroxide are water soluble. These are known as alkalis. Therefore water soluble bases are known as alkalis eg. KOH, NaOH.

Bases like Cu(OH)<sub>2</sub>, Fe(OH)<sub>3</sub> and Al(OH)<sub>3</sub> these are not alkalis.

All alkalis are bases but not all bases are alkalis.

A list of a few typical bases along with their chemical formulae and uses is given below-

Name	Commercial Name	Chemical Formula	Uses
Sodium hydroxide	Caustic soda	NaOH	In manufacture of soap, paper, pulp, rayon, refining of petroleum etc.
Potassium hydroxide	Caustic potash	KOH	In alkaline storage batteries, manufacture of soap, absorbing CO <sub>2</sub> gas etc.
Calcium hydroxide	Slaked lime	Ca(OH) <sub>2</sub>	In Manufacture of bleaching powder, softening of hard water etc.
Magnesium hydroxide	Milk of magnesia	Mg(OH) <sub>2</sub>	As an antacid to remove acidity from stomach.
Aluminium hydroxide	—	Al(OH) <sub>3</sub>	As foaming agent in fire extinguishers.
Ammonium hydroxide	—	NH <sub>4</sub> OH	In removing greases stains from clothes and in cleaning window panes.





**Classification of Bases**

Classification of bases or alkalis can be done in different ways as given below :

**(i) Classification on the basis of their strength**

- Strong bases
- Weak bases

**(ii) Classification on the basis of their concentration**

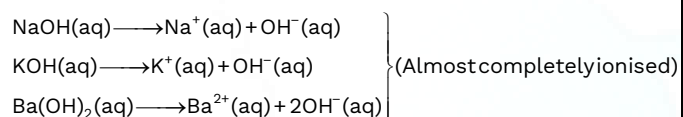
- Concentrated bases
- Dilute bases

**(iii) Classification on the basis of their acidity.**

- Mono acidic base
- Di acidic base
- Tri acidic base

**(1) Classification of the Bases or Alkalis on the Basis of their Strength**
**(A) Strong alkalis or bases:**

The alkalis or bases which undergo almost complete ionisation in aqueous solution to produce high concentration of hydroxyl ( $\text{OH}^-$ ) ions are known as strong alkalis or strong bases. Some example of strong alkalis or bases are : Sodium hydroxide ( $\text{NaOH}$ ), Potassium hydroxide ( $\text{KOH}$ ) and Barium hydroxide [ $\text{Ba}(\text{OH})_2$ ] etc.


**(B) Weak alkalis or bases:**

The alkalis or bases which undergo only partial ionisation in aqueous solution to produce a relatively low concentration of hydroxyl ( $\text{OH}^-$ ) ions are known as weak alkalis or weak bases. Some examples of weak alkalis or bases are : Ammonium hydroxide ( $\text{NH}_4\text{OH}$ ), Calcium hydroxide [ $\text{Ca}(\text{OH})_2$ ], Magnesium hydroxide [ $\text{Mg}(\text{OH})_2$ ] etc.



Since these alkalis are not ionising completely, therefore, there is a dynamic equilibrium between the undissolved alkali and the ions produced by it.

**(2) Classification of Bases or Alkalis on the Basis of their Concentration:**

By the term concentration, we mean the amount of alkali present in the given sample of alkali solution in water. On the basis of concentration, the alkalis can be classified as under:

**(A) Concentrated alkali:**

A solution of alkali having a relatively high percentage of alkali in its aqueous solution is known as concentrated alkali. Eg. conc.  $\text{NaOH}$

**(B) Dilute alkali:**

A solution of alkali having a relatively low percentage of alkali in its aqueous solution is known as a dilute alkali. Eg. dil.  $\text{NaOH}$

If the concentration of alkali in the solution is less than 1 mole per litre, then it is considered to be a dilute alkali.

**(iii) Classification of Bases or Alkalis on the Basis of their Acidity:**

Before we discuss this classification, let us understand the meaning of the word 'acidity' of an alkali.

The number of hydroxyl ( $\text{OH}^-$ ) ions produced by one molecule of an alkali on complete dissociation in water or the number of hydrogen ions (of an acid) with which a molecule of that alkali reacts to produce salt and water only is known as acidity of an alkali.

For water insoluble hydroxides, acidity of the base is equal to the number of  $\text{OH}^-$  ions present in one molecule of that base.

On the basis of acidity, the bases can be classified as under:

**(A) Monoacidic Bases (or alkalis):**

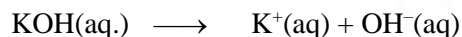
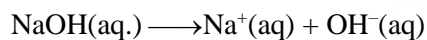
When one molecule of the base on complete ionisation produces one hydroxyl ( $\text{OH}^-$ ) ion in aqueous solution, the base or alkali is said to be monoacidic

**OR**

A monoacidic base (or alkali) may be defined as one whose one molecule reacts with one hydrogen ( $\text{H}^+$ ) ion completely to form salt and water as the only products.

**Examples of Monoacidic Bases (or alkalis):**

Sodium hydroxide (NaOH), Potassium hydroxide (KOH), Ammonium hydroxide (NH<sub>4</sub>OH). All these substances produce only one hydroxyl ion on complete ionisation in aqueous solution.



The dissociation of monoacidic bases or alkalis takes place in a single step.

**(B) Diacidic Bases (or alkalis):**

When one molecule of a base or alkali on complete ionisation produces two hydroxyl (OH<sup>-</sup>) ions in aqueous solution, the base or alkali is said to be diacidic.

**OR**

A diacidic base (or alkali) may be defined as one whose one molecule reacts with two hydrogen (H<sup>+</sup>) ions completely to form salt and water as the only products.

**Examples of Diacidic Bases**

Calcium hydroxide [Ca(OH)<sub>2</sub>] and magnesium hydroxide [Mg(OH)<sub>2</sub>]



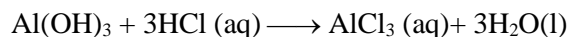
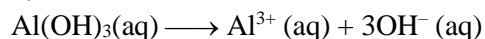
One molecule of both the bases are producing two OH<sup>-</sup> ions in aqueous solution, therefore, these are termed as diacidic bases.

**(C) Triacidic Bases:**

When one molecule of a base or alkali on complete ionisation produces three hydroxyl (OH<sup>-</sup>) ions in aqueous solution, the base or alkali is said to be triacidic base.

**Examples of Triacidic Bases:**

Aluminium hydroxide [Al(OH)<sub>3</sub>], Ferric hydroxide [Fe(OH)<sub>3</sub>]



In the above equations, one molecule of Al(OH)<sub>3</sub> is producing three OH<sup>-</sup> ions and one molecule of Al(OH)<sub>3</sub> is reacting with three hydrogen (H<sup>+</sup>) ions to form salt and water only, therefore, it is termed as a triacidic base.

**Physical properties**

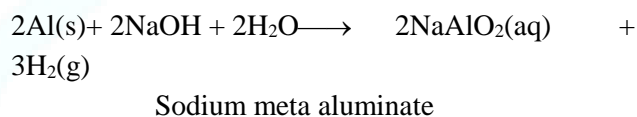
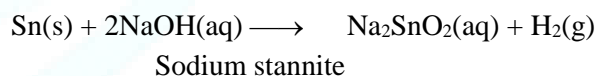
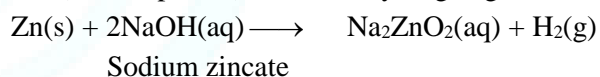
- (a) **Taste:** Bases have a bitter taste.
- (b) **Physical state:** Bases are generally solids or liquids. They are soapy to touch.
- (c) **They change the colour of indicators:**

Indicator	Colour change in basic medium
Litmus solution	Red to blue
Methyl orange	Remains yellow
Turmeric	Reddish brown
China rose indicator	Green

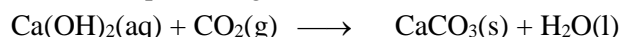
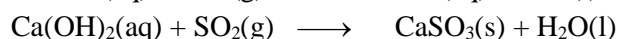
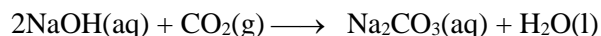
- (d) **They are good electrolytes:** Bases dissociate into ions on dissolving in water and hence conduct electricity to show electrolytic property.
- (e) **They have corrosive action:** Strong bases or alkalis such as NaOH are corrosive. Strong bases show slight burn on the skin as compared to acids.

**Chemical Properties of bases****1. Action with metals:**

Metals like zinc, tin and aluminium react with strong alkalis like NaOH (caustic soda), KOH (caustic potash) to evolve hydrogen gas.

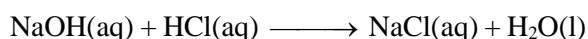
**2. Action with non-metallic oxides:**

Acids react with metal oxides, but bases react with oxides of non-metals to form salt and water.  
e.g.

**3. Action with Acid:**

(a) Reaction with acids:

Base + Acid → Salt + Water



In these reactions, an acid reacts with a base to produce salt and water.

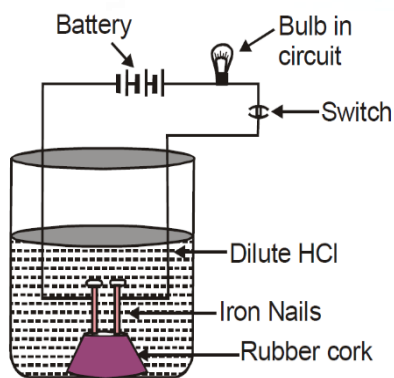
### Conducting Nature of Acids and Bases

Acids are the substances which contain one or more hydrogen atoms in their molecules which they can release in water as  $H^+$  ions. Similarly, bases are the substances which contain one or more hydroxyl groups in their molecules which they can release in water as  $OH^-$  ions. Since the ions are the carrier of charge therefore, the aqueous solutions of both acids and bases are conductors of electricity.

### All the compound containing Hydrogen are not acids

Experiment:

In a glass beaker, take a dilute solution of hydrochloric acid (HCl). Fix two small nails of iron in a rubber cork in the beaker as shown in the figure. Connect the nails to the terminals of a 6 volt battery through a bulb. Switch on the current and bulb will start glowing. This shows that the electric current has passed through the acid solution. As the current is carried by the movement of ions, this shows that in solution HCl has ionised to give  $H^+$  and  $Cl^-$  ions. Current will also be in a position to pass if the beaker contains in it dilute  $H_2SO_4$  ( $H^+$  ions are released in aqueous solution). Similarly, aqueous solutions containing NaOH or KOH will also be conducting due to release of  $OH^-$  ions.



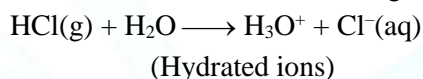
Bulb will not glow if glucose ( $C_6H_{12}O_6$ ) or ethyl alcohol ( $C_2H_5OH$ ) solution is kept in the beaker. This means that both of them will not give any ions in solution.

### Role of water in ionisation of acids and bases

(Acids do not show acidic behavior in absence of water)

Substances can act as acids and bases only in the presence of water (in aqueous solution). In dry state which is also called anhydrous state, these characters cannot be shown. Actually, water helps in the ionisation of acid or base by separating the ions. This is also known as dissociation and is explained on the basis of a theory called Arrhenius theory of acids and bases.

In the dry state, hydrochloric acid is known as hydrogen chloride gas i.e.  $HCl(g)$ . It is not in the position to give any  $H^+$  ions. The color of the litmus paper does not change. Therefore, the acidic character is not shown. Now, let us pass the gas through water taken in a beaker with the help of gas pipe. The colour of blue litmus changes to red.

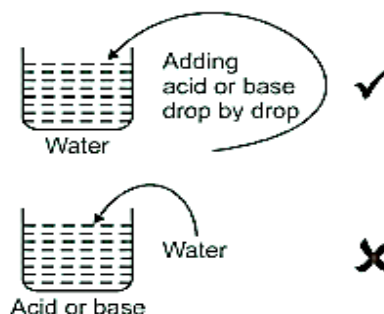


The electrical current is carried through these ions. The same applies to other acids as well as bases. Thus we conclude that -

- (i) Acids can release  $H^+$  ions only in aqueous solution.
- (ii) Base can release  $OH^-$  ions only in aqueous solution.
- (iii) Hydration helps in the release of ions from acids and bases.

### Dilution of Acids and Bases:

Acids and bases are mostly water soluble and can be diluted by adding the required amount of water. With the addition of water the amount of acid or base per unit volume decreases and dilution occurs. The process is generally exothermic in nature. When a concentrated acid like sulphuric acid or nitric acid is to be diluted with water, acid should be added dropwise to water taken in the container with constant stirring. Do not add water directly into acid or it will cause splash or explosion which is harmful.



**Comparison Between Properties of Acids and Base**

Acids
Sour in taste.
Change Colours of indicators e.g. litmus turns from blue to red, phenolphthalein remains colourless.
Show electrolytic conductivity in aqueous solution.
Acidic properties disappear when react with bases (Neutralisation)
Acids decompose carbonate salts.

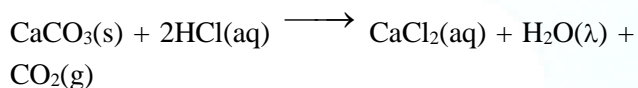
Bases
Bitter in taste.
Change colours of indicators e.g. litmus turns from red to blue phenolphthalein turns from colourless to pink.
Show electrolytic conductivity in aqueous solution
Basic properties disappear when react with acids (Neutralisation)
No decomposition of carbonate salts by bases

**Example 4:** Give one example each of a strong base and a weak base.

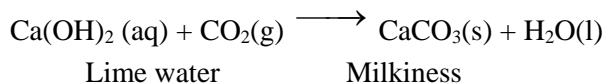
**Solution:** NaOH, NH<sub>4</sub>OH

**Example 5:** A substance 'X' is insoluble in water. When reacted with dilute HCl, it produces a gas which turns lime water milky. Predict the substance and give the reactions involved.

**Solution:** It is probably CaCO<sub>3</sub>.



Calcium carbonate                  Calcium chloride



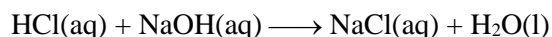
Lime water                  Milkiness

**FUNDAMENTAL UNLOCKED- (FU#2)**

- Q.1** All alkalis are bases, but all bases are not alkalis. Explain.
- Q.2** Sodium hydroxide is a monoacidic base. Give reason.

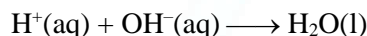
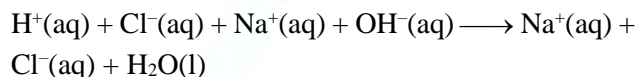
**Neutralisation**

It may be defined as a reaction between acid and base present in aqueous solution to form salt and water.



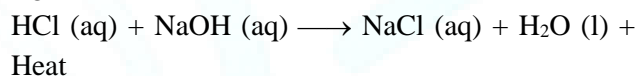
Basically neutralisation is the combination between H<sup>+</sup> ions of the acid with OH<sup>-</sup> ions of the base to form H<sub>2</sub>O.

e.g.

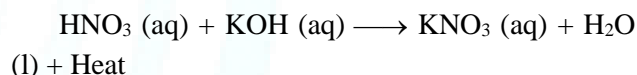


Neutralisation reaction involving an acid and base is of exothermic nature. Heat is evolved in all neutralization reactions. If both acid and base are strong, the value of heat energy evolved remains same irrespective of their nature.

e.g .

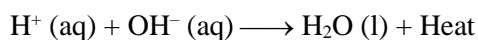


Strong acid                  Strong base



Strong acid                  Strong base

Strong acids and strong bases are completely ionised of their own in the solution. No energy is needed for their ionisation. Since the cation of base and anion of acid on both sides of the equation cancel out completely, the heat evolved is given by the following reaction -



- (i) Heat of neutralization of a strong acid and a strong base is a fixed value, i.e., -13.7kcal / mol or -57kJ / mol.

Here, (-) sign represents that the heat is released during the neutralization process and (13.7 or 57) represent the magnitude of that heat.

- (ii) Heat of neutralization for weak acids or weak bases by strong base or strong acid respectively is less than -13.7kcal / mol or -57kJ / mol. This is because some amount of heat is utilized in dissociation of weak component.



**Uses of Neutralization**

- (i) Slaked lime ( $\text{Ca}(\text{OH})_2$ ) is added to reduce the acidity of soil.
- (ii) Antacid tablets with  $\text{Mg}(\text{OH})_2$  is used to treat acidity by neutralising  $\text{HCl}$  in stomach.
- (iii) Sting of ants/bees containing  $\text{HCOOH}$  (formic acid) can be neutralised by rubbing soap.
- (iv) Sting of wasps that contains an alkali can be treated by neutralising it with  $\text{CH}_3\text{COOH}$  (Vinegar) or citric acid.
- (v) Lithium hydroxide ( $\text{LiOH}$ ) is used to neutralize  $\text{CO}_2$  exhaled by astronauts in spaceships.

**Indicators and pH scale**
**Indicators**

An indicator is a chemical compound which indicates the presence of acidic, basic or neutral substance either by change in colour or odour.

For Example,

Litmus is an indicator which is red in an acidic solution but it has blue colour in a basic solution. There are many other natural materials like red cabbage leaves, turmeric, coloured petals of some flowers such as Hydrangea, Petunia and Geranium, which indicate the presence of acid or base in a solution.

These are called acid-base indicators or sometimes simply indicators.

The indicators change colour when the nature of the solution is changed (from acidic to basic or vice versa). Therefore they are also known as visual indicators.

Some substances whose odour changes in acidic or basic solutions are called olfactory indicators. The commonly used olfactory indicators are raw onion, vanilla extract and clove oil.

**(A) Litmus:**

Litmus is a purple dye which is extracted from 'lichen' a plant belonging to variety Thallophyta. It can also be applied on paper in the form of strips and is available as blue and red strips. A blue litmus strip, when dipped in an acid solution acquires red colour. Similarly a red strip when dipped in a base solution becomes blue.

**(B) Phenolphthalein:**

It is also an organic dye and acidic in nature. In neutral or acidic solution, it remains colourless while in the basic solution, the colour of indicator changes to pink.

**(C) Methyl Orange:**

Methyl orange is an orange or yellow coloured dye and basic in nature. In the acidic medium the colour of indicator becomes red and in the basic or neutral medium, its colour remains unchanged.

**(D) Red Cabbage Juice:**

It is purple in colour in neutral medium and turns red or pink in the acidic medium. In the basic or alkaline medium, its colour changes to green.

**(E) Turmeric Juice:**

It is yellow in colour and remains as such in the neutral and acidic medium. In the basic medium its colour becomes reddish or deep brown.

**(F) China rose:** Extract of china rose (Gudhal) petals is of pink colour. It will change into dark pink (magenta) in acidic solution and green in basic solution.

**Note:** Litmus is obtained from LICHEN plant.

**Colour change of indicators in acidic, basic and neutral medium**

Indicator	Acid solution
Methyl orange	Red
Phenolphthalein	Colourless
Blue litmus solution	Red
Red litmus solution	No change
Red cabbage Juice	Red or pink
Turmeric Juice	Yellow
China Rose	Dark pink or Magenta

Basic solution	Neutral
Yellow	Orange
Pink	Colourless
No colour change	No change
Blue	No change
Green	Purple
Reddish or deep brown	Yellow
Green	Pink





## pH SCALE

According to Arrhenius theory, an acid releases  $H^+$  ion in aqueous solution. The concentration of these ions is expressed by enclosing  $H^+$  in square bracket i.e. as  $[H^+]$ . Thus, greater the  $[H^+]$  ions, stronger will be the acid. However, according to pH scale, lesser the pH value, stronger will be the acid. From the above discussion, we can conclude that pH value and  $H^+$  ion concentration are inversely proportional to each other. The relation between them can also be expressed as-

$$pH = -\log [H^+] = \log \left[ \frac{1}{H^+} \right]$$

So, negative logarithm of hydrogen ion concentration is known as pH.

On increasing  $[H^+]$  value, pH will decrease.

**Note:** On dilution pH of acidic solution increases.  
On dilution pH of basic solution decreases.

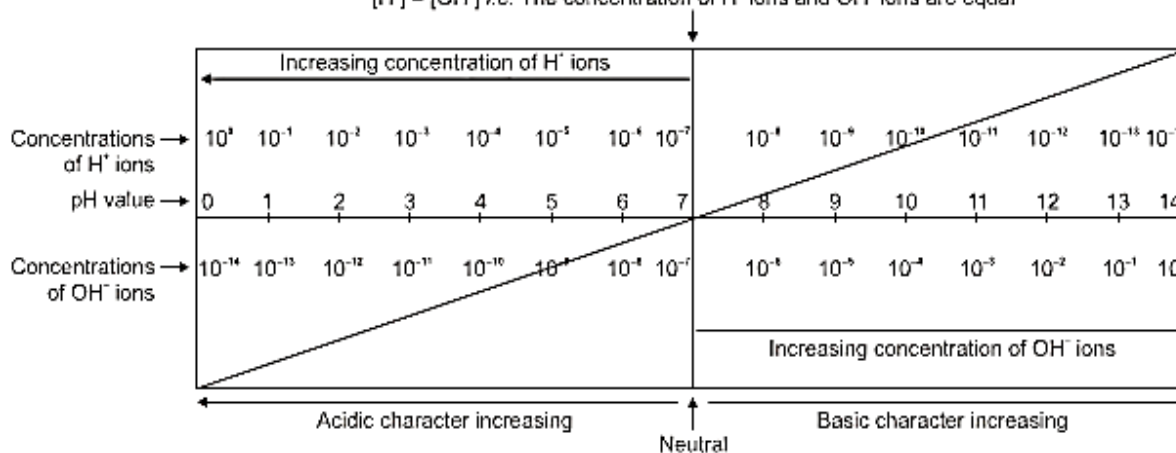
Just as the  $[H^+]$  of a solution can be expressed in terms of pH value, the  $[OH^-]$  can be expressed as pOH.

$$\text{Mathematically, } pOH = -\log [OH^-] = \log \frac{1}{[OH^-]}$$

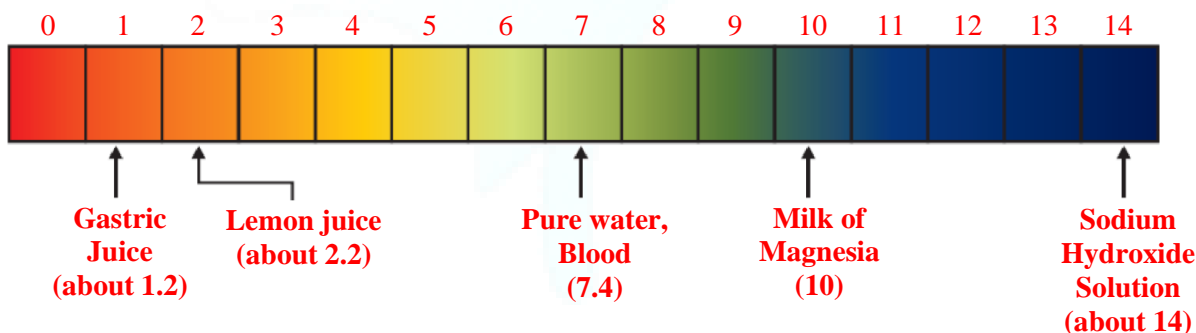
Moreover,  $pH + pOH = 14$ .

For pure water and neutral solution at  $25^\circ C$ , concentration of  $H^+$  ions is  $10^{-7} \text{ mol L}^{-1}$ .

$[H^+] = [OH^-]$  i.e. The concentration of  $H^+$  ions and  $OH^-$  ions are equal



Thus, if pH value of solution is known, its pOH value can be calculated.



### pH of some common substances on pH paper

#### Universal indicator:

An indicator is a substance that changes colour in different pH environments.

Universal indicator is a mixture of certain indicators in required proportions which show colour changes over a considerable pH range.

It is the brown coloured solution containing a mixture of indicator that can be added to any substance to determine its pH.

- For low pH → Red colour
- For neutral → Green colour





- For high pH  $\rightarrow$  Blue or violet
- For neutral solutions,  $[H^+] = [OH^-]$
- For acidic solutions,  $[H^+] > [OH^-]$
- For basic solutions,  $[H^+] < [OH^-]$

**Importance of pH value:**

- Greater the concentration of  $H^+$  ions, less will be the pH and more acidic is the solution.
- pH scale is important only for dilute acids or bases.
- pH of a solution depends upon the temperature

**Application of Neutralisation and Significance of pH in Daily Life:**

- pH in digestion:** People particularly of old age suffer from acidity problems in the stomach which is caused mainly due to release of excessive gastric juices containing HCl then the pH of the digestive system in the stomach will decrease. The acidity is neutralised by antacid tablets which contain sodium hydrogen carbonate (baking soda), magnesium hydroxide (milk of magnesia), Aluminium hydroxide etc. These antacids will bring the pH of the system back to its normal value. The pH of human blood varies between 7.36 to 7.42 It is maintained by the soluble bicarbonates and carbonic acid present in the blood.
- pH in plants and animals:** pH of our body works within the pH range of 7.0 to 7.8. Living organisms can survive only in a narrow range of pH change. When pH of rain water is less than 5.6, it is called acid rain. When acid rain flows into the rivers, it lowers the pH of the river water. The survival of aquatic life in such rivers becomes difficult.
- pH change leads to tooth decay :** The white enamel coating on our teeth is of insoluble calcium phosphate which is quite hard. It is not affected by water. However, when the pH in the mouth falls below 5.5 the enamel gets corroded. Water will have a direct access to the roots and decay of teeth will occur. The bacteria present in the mouth break down the sugar that we eat in one form or the other to acids, Lactic acid is one of

these. The formation of these acids causes decrease in pH. It is therefore advisable to avoid eating sugary foods and also to keep the mouth clean so that sugar and food particles may not be present. The tooth pastes contain in them some basic ingredients and they help in neutralising the effect of the acids and also increasing the pH in the mouth.

- Sting of ant and bees:** The stings of bees and ants contain formic acid. Its corrosive and poisonous effect can be neutralised by rubbing soap. Sodium hydroxide present in the soap neutralises acid injected in the body and thus brings the pH back to its original level bringing relief to the person who has been stung. Similarly, the effect of stings by wasps containing alkali is neutralised by the application of vinegar which is dilute solution of ethanoic acid (or acetic acid).
- pH of soil:** The growth of plants in a particular soil is also related to its pH. Actually, different plants prefer different pH range for their growth. It is therefore, quite important to provide the soil with proper pH for their healthy growth. Soils with high iron minerals or with vegetation tend to become acidic. The soil pH can reach as low as 4. The acidic effect can be neutralised by 'liming the soil' which is carried by adding calcium hydroxide. These are basic in nature and have neutralising effect. Similarly, the soil with excess of lime stone or chalk is usually alkaline. Sometimes, its pH reaches as high as 8.3 and is quite harmful for the plant growth. In order to reduce the alkaline effect, it is better to add some decaying organic matter (compost or manure). The soil pH is also affected by the acid rain and the use of fertilizers. Therefore soil treatment is quite essential.
- pH in plants:** Nettle is a herbaceous plant which grows in the wild. Its leaves have stinging hair which inject methanoic acid which cause painful stings when touched accidentally. A traditional remedy is rubbing the area with the leaf of the dock plant, which often grows beside the nettle in the wild.





- (vii) pH of soap is maintained according to the skin secretion.
- (viii) In dairy industry pH of different products. pH of milk is maintained to avoid spoilage.
- (ix) pH in brewing industry to manufacture various alcoholic beverages.
- (x) The tarnished surface of copper vessels (due to formation of basic copper carbonate) can be cleaned by rubbing with lemon (which is acidic in nature).

**Example 6:** Two solutions P and Q have pH 2 and 12. Which solution has more concentration of  $H^+$  ions?

**Solution:** The solution with pH 2 has more concentration of  $H^+$  (aq) ions as  $pH = \log_{10} \frac{1}{[H^+]}$

**Example 7:** Write differences between phenolphthalein and methyl orange.

**Solution:** In acidic solution, phenolphthalein remains colourless while in the basic solution, the colour of phenolphthalein changes to pink.

Methyl orange is an orange colour dye in the basic medium. In the acidic medium the colour of methyl orange becomes red.

#### FUNDAMENTAL UNLOCKED- (FU#3)

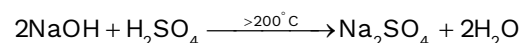
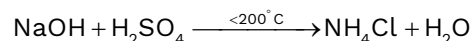
- Q.1** A tarnished copper vessel begins to shine again when rubbed with lemon. Why ?
- Q.3** How is concentration of hydronium ions ( $H_3O^+$ ) affected when the solution of an acid is diluted ?
- Q.3** What will be the action of the following substances on litmus paper? Dry HCl gas, Moistened  $NH_3$  gas, Lemon juice, Carbonated soft drink, Curd, Soap solution.

#### Salts

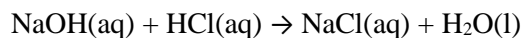
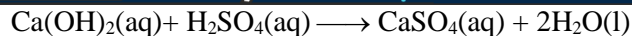
A substance formed by neutralization of an acid with a base is called a salt.

OR

Salt form due to total replacement or partial replacement of hydrogen atom by any metallic ion.



e.g.



#### Family of Salts

Salts having the same positive or negative radicals are said to belong to same family e.g.,

- (i) Family of sodium salts –  $NaCl$ ,  $Na_2SO_4$ ,  $NaNO_3$ , etc ...
- (ii) Family of chloride salts –  $NaCl$ ,  $KCl$ ,  $MgCl_2$ , etc

#### (a) Classification of Salts:

##### (ii) Classification of salt solutions based on pH values:

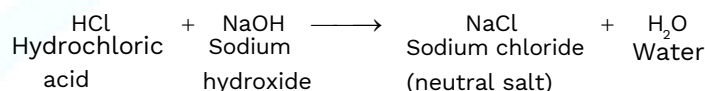
Salts are formed by the reaction between acids and bases. Depending upon the nature of the acids and bases or upon the pH values, the salt solutions are of three types.

**(A) Neutral salt solutions:** Salt solutions of strong acids and strong bases are neutral and have pH equal to 7.

e.g.  $NaCl$ ,  $KCl$ ,  $NaNO_3$ ,  $Na_2SO_4$  etc.



- (i) They do not change the colour of litmus solution.
- (ii) Hydrogen of acid is completely replaced by sodium ion.



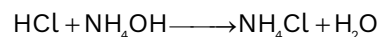
Hydrogen of acid is completely replaced by sodium ion. The pH of these salts is 7. e.g.,  $NaNO_3$ ,  $KCl$ ,  $K_2SO_4$  etc.

#### (B) Acidic salt solutions:

Salt solutions of strong acids and weak bases are of acidic nature and have pH less than 7. They change the colour of blue litmus solution to red.

e.g.  $(NH_4)_2SO_4$ ,  $NH_4Cl$  etc.

In both these salts, the base  $NH_4OH$  is weak while the acids  $H_2SO_4$  and  $HCl$  are strong.



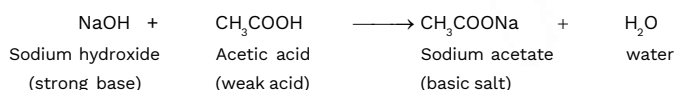
Other examples are  $FeCl_3$ ,  $AlCl_3$ ,  $(NH_4)_2SO_4$  etc.



**(C) Basic salt solutions:** Salt solutions of strong bases and weak acids are of basic nature and have pH more than 7. They change the colour of red litmus solution to blue.

e.g.  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_3\text{PO}_4$  etc.

In both the salts, bases  $\text{NaOH}$  and  $\text{KOH}$  are strong while the acids  $\text{H}_2\text{CO}_3$  and  $\text{H}_3\text{PO}_4$  are weak.



Other examples are

$\text{Na}_2\text{CO}_3$ ,  $\text{CH}_3\text{COOK}$ ,  $\text{NaHCO}_3$  etc.

#### FUNDAMENTAL UNLOCKED- (FU#4)

**Q.1** What will be the nature of salt solution of strong acid and weak base?

**Q.2** What will be the colour of methyl orange in sodium carbonate solution?



#### Some Commercially Important Chemical Compound Common Salt

**(1)  $\text{NaCl}$  (Sodium Chloride):**

**Common name:** Table Salt

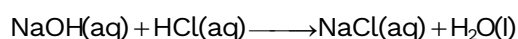
**Chemical name:** Sodium chloride

**Chemical formula:**  $\text{NaCl}$

Sodium chloride ( $\text{NaCl}$ ) also called common salt or table salt is the most essential part of our diet.

#### Preparation:

**Lab Scale:** Chemically it is formed by the reaction between solutions of sodium hydroxide and hydrochloric acid.



#### Large scale:

**Sea Water:** Sea water is the major source of sodium chloride where it is present in dissolved form along with other soluble salts such as chlorides and sulphates of calcium and magnesium. It is separated by some suitable methods.

**Underground deposits:** Deposits of the salts are found in different parts of the world and is known as rock salt. When pure, it is a white crystalline solid, however, it is often brown due to the presence of impurities.

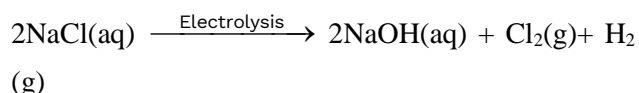
#### Uses:

- I.** In cooking of food.
- II.** In preservation of food material.
- III.** Manufacturing of soap
- IV.** In melting of ice.
- V.** Added in pickles as preservative
- VI.** Essential for life : Sodium chloride is quite essential for life. Biologically, it has a number of functions to perform such as in muscle contraction, in conduction of nerve impulse in the nervous system.
- VII.** It is used in leather industry for the leather tanning.
- VIII.** In severe cold, rock salt is spread on icy roads to melt ice.
- IX.** It is also used as a fertilizer for sugar beet.

**Raw material for chemicals:** Sodium chloride is also a very useful raw material for different chemicals. A few out of these are hydrochloric acid ( $\text{HCl}$ ), washing soda ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ), baking soda ( $\text{NaHCO}_3$ ) etc.

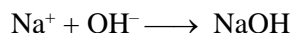
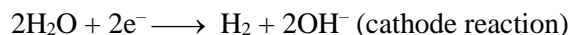
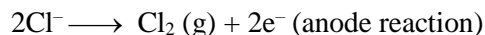
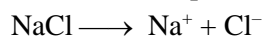
Upon electrolysis of a solution of the common salt (brine), sodium hydroxide, chlorine and hydrogen are obtained.

#### Electrolysis of aqueous solution of $\text{NaCl}$ (Electrolysis of brine):





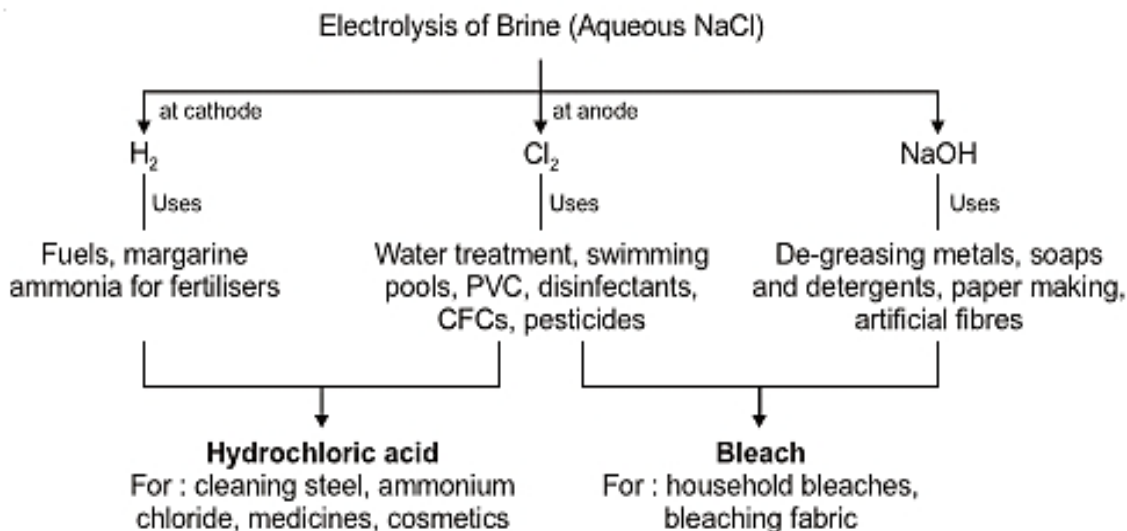
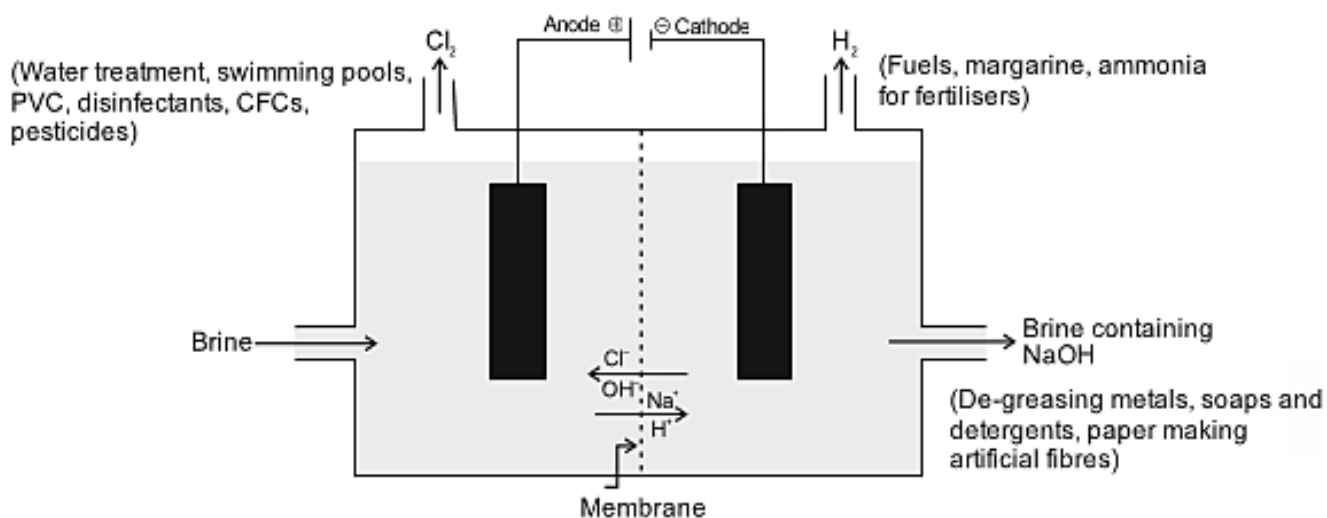
Reaction takes place as follows -



During electrolysis, chlorine gas is produced at anode while hydrogen gas is produced at cathode, Sodium hydroxide solution is produced near the cathode.

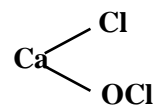
This process of electrolysis of NaCl solution is called chlor-alkali process because of the products formed, chlor for chlorine and alkali for sodium hydroxide.

### Diagram of electrolysis of brine with flowchart:



### (2) BLEACHING POWDER

Bleaching powder is commercially called 'chloride of lime' or 'chlorinated lime'. It is principally calcium oxychloride having the following formula :



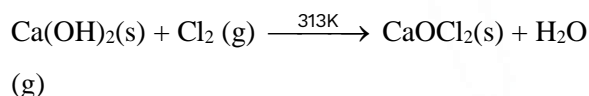
You have already come to know that chlorine is produced during the electrolysis of aqueous





sodium chloride (brine). This chlorine gas is used for the manufacture of bleaching powder. Bleaching powder is produced by the action of chlorine on dry slaked lime  $[\text{Ca}(\text{OH})_2]$ . Bleaching powder is represented as  $\text{CaOCl}_2$ , though the actual composition is quite complex.

Bleaching powder is prepared by passing chlorine over slaked lime at 313 K.



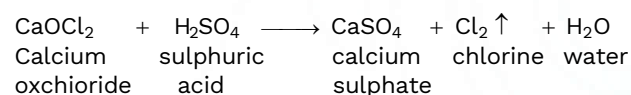
Slaked lime      Bleaching powder

Actually bleaching powder is not a compound but a mixture of compounds:



### Properties:

- Yellowish-white powder with a strong smell of chlorine.
- Soluble in cold water.
- It reacts with dilute acids to produce chlorine.



### Uses:

- It is commonly used as a bleaching agent in paper and textile industries.
- It is also used for disinfecting water to make it free from germs.
- It is used to prepare chloroform.
- It is also used to make wool shrink-proof.
- For bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories and for bleaching washed clothes in laundry; (ii) as an oxidising agent in many chemical industries

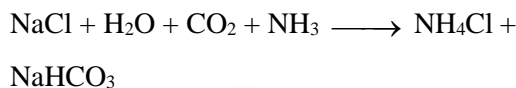
### (3) Baking Soda

Baking soda is sodium hydrogen carbonate or sodium bicarbonate ( $\text{NaHCO}_3$ ).

### Preparation:

It is obtained as an intermediate product in the preparation of sodium carbonate by Solvay process. In this process, a saturated solution of sodium chloride in water (30%  $\text{NaCl}$  solution known as brine solution) is saturated with

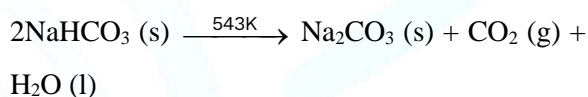
ammonia and then carbon dioxide gas is passed into the solution. Sodium chloride is converted into sodium bicarbonate which, being less soluble, separates out from the solution.



(Ammonium chloride)      (Sodium  
hydrogencarbonate)

### Properties:

- It is a white, crystalline substance that forms an alkaline solution with water. The aqueous solution of sodium bicarbonate gives pink colour with phenolphthalein.
- When heated above 543 K, it is converted into sodium carbonate.



### Uses:

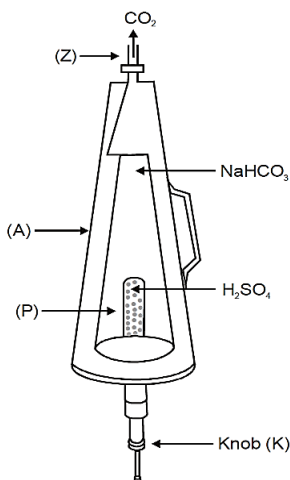
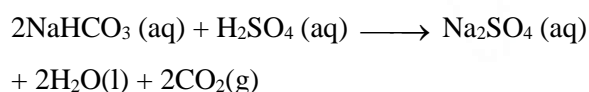
- It is used in the manufacture of baking powder. Baking Powder, is a mixture of baking soda (sodium hydrogencarbonate) and a mild edible acid such as tartaric acid. When baking powder is heated or mixed in water, the following reaction takes place –  

$$\text{NaHCO}_3 + \text{H}^+ (\text{From any acid}) \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Sodium salt of acid}$$
 Carbon dioxide produced during the reaction can cause bread or cake to rise making them soft and spongy.
- Sodium hydrogencarbonate is also an ingredient in antacids. Being alkaline, it neutralises excess acid in the stomach and provides relief.
- It is an important chemical in the textile, tanning, paper and ceramic industries.
- It is also used in soda-acid fire extinguishers. The following diagram shows a fire extinguisher that uses  $\text{NaHCO}_3$  and  $\text{H}_2\text{SO}_4$  to produce  $\text{CO}_2$  gas. The extinguisher consists of a conical metallic container (A) with a nozzle (Z) at one end. A strong solution of  $\text{NaHCO}_3$  is kept in the container. A glass ampoule (P) containing  $\text{H}_2\text{SO}_4$  is attached to a knob (K) and placed inside the





NaHCO<sub>3</sub> solution. The ampoule can be broken by hitting the knob. As soon as the acid comes in contact with the NaHCO<sub>3</sub> solution, CO<sub>2</sub> gas is formed. When enough pressure is built up inside the container, CO<sub>2</sub> gas rushes out through the nozzle (Z). Since CO<sub>2</sub> does not support combustion, a small fire can be put out by pointing the nozzle towards the fire. The gas is produced according to the following reaction.



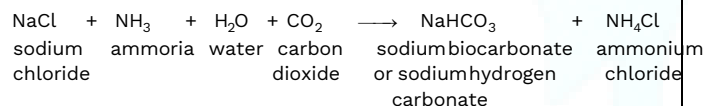
## Soda-Acid Fire Extinguisher

#### (4) Washing Soda

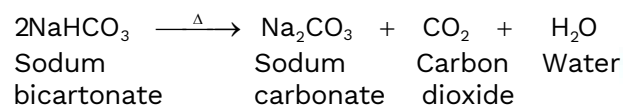
**Chemical name :** Sodium carbonate decahydrate

**Chemical formula :**  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

When NaCl reacts with ammonia, water and carbon dioxide, sodium hydrogencarbonate or sodium bicarbonate is obtained along with ammonium chloride.



Sodium bicarbonate is partially soluble in water and hence it is precipitated as a solid. It is filtered, dried and heated to obtain sodium carbonate as:

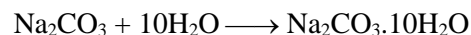


### Recrystallization of sodium carbonate:

Anhydrous sodium carbonate (soda ash) is dissolved in water and recrystallised to obtain washing soda crystals with 10 molecules of water

per formula unit, known as water of crystallization.

Sodium carbonate is recrystallized by dissolving in water to get washing soda.



Sodium carbonate	Washing Soda
------------------	--------------

### Properties:

- (1) Washing soda is a transparent crystalline solid.
- (2) It is a soluble carbonate.
- (3) Its aqueous solution is alkaline in nature.
- (4) It shows cleaning property by attacking dirt and grease to form water soluble products which are then washed away with water.
- (5) On heating, it forms anhydrous  $\text{Na}_2\text{CO}_3$  which is commonly known as soda ash.

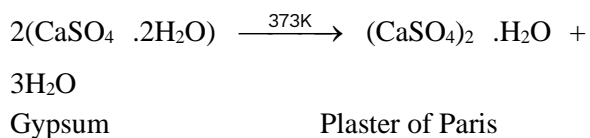
### Uses:

- (i) It is used as cleansing agent for domestic purposes.
- (ii) It is used in softening of hard water and controlling the pH of water. Use to remove permanent hardness of water.
- (iii) It is used in the manufacture of glass.
- (iv) Due to its detergent properties, it is used as a constituent of several dry soap powders.
- (v) It also finds use in photography, textile and paper industries etc.
- (vi) It is used in the manufacture of borax ( $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ ).

### (5) PLASTER OF PARIS

**Preparation:**

It is prepared by heating gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) at about 373 K in large steel pots with mechanical stirrer, or in a revolving furnace.



**OR**

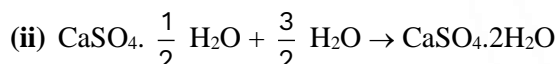


## Plaster of Paris



The temperature is carefully controlled, as at higher temperature gypsum is fully dehydrated. The properties of dehydrated gypsum are completely different from those of Plaster of Paris.

- (i) **Action with water:** When it is dissolved in water, it gets crystallized and forms gypsum. This property is called **setting of POP**.



When finely powdered plaster of Paris is mixed with water and made into a paste, it quickly sets into a hard mass. In the process, its volume also increases slightly. These properties find a number of uses. Addition of water turns plaster of Paris back into gypsum.

#### Properties

- (1) White powder.
- (2) Has the property of setting into a hard mass on wetting with water.

#### Uses:

- (i) It is used in the laboratories for sealing gaps where air tight arrangement is required.
- (ii) It is used for making toys, cosmetics and casts of statues.
- (iii) It is used as a cast for setting broken bones.
- (iv) It also finds use in making moulds in pottery.
- (v) It is used for making surfaces smooth and for making designs on walls and ceilings for supporting fractured bones in the right position.
- (vi) It is used in making surfaces smooth by painting them and making ornamental design on the ceilings of houses and buildings.
- (vii) Use to make fire proof materials.

#### Note:

Only half a water molecule is shown to be attached as water of crystallisation. How can you get half a water molecule? It is written in this form because two formula units of  $\text{CaSO}_4$  share one molecule of water.

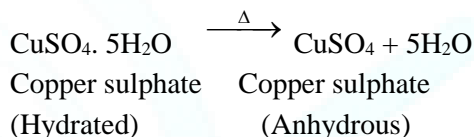
#### Hydrated Salts - Salts Containing Water of Crystallisation

Certain salts contain definite amount of some water molecules loosely attached to their own molecules. These are known as hydrated salts and are of crystalline nature. The molecules of water present are

known as 'water of crystallisation'.

In coloured crystalline and hydrated salts, the molecules of water of crystallisation also account for their characteristic colours. Thus, upon heating of hydrated salt, its colour changes since molecules of water of crystallization are removed and the salt becomes anhydrous.

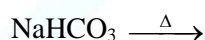
For example, take a few crystals of blue vitriol i.e. hydrated copper sulphate in a dry test tube or boiling tube. Heat the tube from below. The salt will change to a white anhydrous powder and water droplet will appear on the walls of the tube. Cool the tube and add a few drops of water again. The white anhydrous powder will again acquire blue colour.



**Example 8:** How does bleaching powder sterilise drinking water?

**Solution:** Chlorine evolved in the reaction sterilises drinking water due to oxidation.

**Example 9:** Complete and balance the following chemical reactions?



**Solution:**  $2\text{NaHCO}_3 \xrightarrow{\Delta} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

**Example 10:** Why baking soda is commonly used in the kitchen for making tasty crispy pakoras?

**Solution:** Baking soda is used to in kitchen to make crispy pakoras because on heating it release carbon dioxide making the pakodas crispy.



#### FUNDAMENTAL UNLOCKED- (FU#5)

- Q.1** What is the role of tartaric acid in baking powder?
- Q.2** Explain why-
- (i) Common salt becomes sticky during the rainy season?
  - (ii) Blue vitriol changes to white upon heating?



## ANSWER KEY

## FUNDAMENTAL UNLOCKED- (FU#1)

- Q.1** In both the test tubes hydrogen gas is formed.
- Q.2** Nitric Acid reacts with egg shell to form calcium nitrate, carbon dioxide and water.
- Q.3** The metals like Magnesium and Manganese reacts with dil.  $\text{HNO}_3$  producing  $\text{H}_2$  gas.

## FUNDAMENTAL UNLOCKED- (FU#2)

- Q.1** Many bases are insoluble - they do not dissolve in water. If a base does dissolve in water, we call it an alkali. Here are two examples: Copper oxide is a base because it will react with acids and neutralise them, but it is not an alkali because it does not dissolve in water.
- Q.2** When sodium hydroxide ( $\text{NaOH}$ ) breaks it forms one hydroxide ( $\text{OH}$ ) ion per molecule therefore it is called as monoacidic base

## FUNDAMENTAL UNLOCKED- (FU#3)

- Q.1** On rubbing a tarnished copper vessel with lemon, it begins to shine again. Lemon is acidic. Thus, on rubbing the tarnished copper vessel with lemon, the basic copper oxide or copper carbonate reacts with the acid (citric acid) present in the lemon to form a salt which is washed away with water.
- Q.2** The concentration of hydronium ions decreases when an acid is diluted because on adding water the  $\text{H}^+$  ions of the acid and hydroxyl ions of water react to form water molecules and the concentration of hydronium ions decreases. When an acid is diluted, then the concentration of hydronium ions decreases.
- Q.3** Dry  $\text{HCl}$  gas has no effect on the paper as they both don't contain water. Moistened  $\text{NH}_3$  gas turns red litmus blue.
- Lemon juice turns blue litmus red indicating its acidic presence.
- Carbonated soft drink turns blue litmus red.
- Curd turns blue litmus red.
- Soap solution turns red litmus blue.

## FUNDAMENTAL UNLOCKED- (FU#4)

- Q.1** The solution of such a salt is acidic in nature. The cation of the salt which has come from weak base is reactive. It reacts with water to form a weak base and  $\text{H}^+$  ions.
- Q.2** Sodium Carbonate is a base colour of methyl orange turns yellow.

## FUNDAMENTAL UNLOCKED- (FU#5)

- Q.1** Tartaric acid is produced from tomato, and it neutralizes the sodium bicarbonate in the baking powder which helps to bake the food quickly and easily with the process of heating.
- Q.2** Common salt become sticky during rainy season because during this season the air in the surroundings and in the atmosphere becomes humid and when this water in the atmosphere (Humidity In the Air) comes in contact with the salt particles, the salt becomes sticky.
- Q.3** Those 5 molecule of water simply constitute the crystal i.e, they are merely embedded in between  $\text{CuSO}_4$  atoms. When blue vitriol is heated, those water of crystallization escape out of the crystal and what's left is anhydrous copper sulphate or simply  $\text{CuSO}_4$ , without any water of crystallization.



**EXERCISE - I**
**Single Correct Type Questions**

- $\text{H}_2\text{CO}_3$  is a  
(A) strong acid (B) weak acid  
(C) strong base (D) weak base
- Which of the following is represented by the formula  $\text{NaHCO}_3$ ?  
(A) Sodium carbonate  
(B) Baking soda  
(C) Sodium acetate  
(D) Washing soda
- According to Arrhenius, acids gives  
(A)  $\text{H}^+$  in water (B)  $\text{OH}^-$  in water  
(C) Both (A) & (B) (D) None of these
- Which of the following is the weakest base?  
(A)  $\text{NaOH}$  (B)  $\text{NH}_4\text{OH}$   
(C)  $\text{KOH}$  (D)  $\text{Ca}(\text{OH})_2$
- Caustic soda is the common name for  
(A)  $\text{Mg}(\text{OH})_2$  (B)  $\text{KOH}$   
(C)  $\text{Ca}(\text{OH})_2$  (D)  $\text{NaOH}$
- Antacids contain  
(A) Weak base (B) Weak acid  
(C) Strong base (D) Strong acid
- pH of Blood is  
(A) 6.4 (B) 7.4 (C) 4.7 (D) 5.2
- A solution turns red litmus blue. Its pH is likely to be  
(A) 2 (B) 4 (C) 7 (D) 10
- A salt derived from strong acid and weak base will dissolve in water to give a solution which is  
(A) acidic (B) basic  
(C) neutral (D) none of these
- Which of the following is an example of basic salt solution?  
(A)  $\text{CH}_3\text{COONa}$  (aq) (B)  $\text{NH}_4\text{Cl}$  (aq)  
(C)  $\text{AlCl}_3$  (aq) (D)  $(\text{NH}_4)_2\text{SO}_4$  (aq)
- Nature of the aqueous solution of  $\text{NaCl}$  towards litmus is  
(A) acidic (B) basic  
(C) neutral (D) none
- One of the constituents of baking powder is sodium hydrogen carbonate, the other constituent is  
(A) hydrochloric acid  
(B) tartaric acid  
(C) acetic acid  
(D) sulphuric acid
- Materials used in the manufacture of bleaching powder are  
(A) lime stone and chlorine  
(B) quick lime and chlorine  
(C) slaked lime and  $\text{HCl}$   
(D) slaked lime and chlorine
- Bleaching powder gives smell of chlorine because it  
(A) is unstable  
(B) gives chlorine on exposure to atmosphere  
(C) is a mixture of chlorine and slaked lime  
(D) contains excess of chlorine
- The chemical name of marble is  
(A) calcium carbonate  
(B) magnesium carbonate  
(C) calcium chloride  
(D) calcium sulphate
- Which of the following salts when dissolved in water would give acidic solutions ?  
(A)  $\text{Na}_2\text{SO}_4$  (B)  $(\text{NH}_4)_2\text{SO}_4$   
(C)  $\text{CH}_3\text{COONa}$  (D)  $\text{KCl}$
- Common salt besides being used in kitchen can also be used as the raw material for making  
(i) washing soda (ii) bleaching powder  
(iii) baking soda (iv) slaked lime  
(A) (i) and (ii) (B) (i), (ii) and (iv)  
(C) (i) and (iii) (D) (i), (iii) and (iv)



18. Fresh milk has a pH of 6. On changing into curd, its pH becomes  
(A) more than 6 (B) less than 6  
(C) remains 6 (D) 7
19. When  $\text{CO}_2$  is passed through lime water, it turns milky. The milkiness is due to the formation of  
(A)  $\text{CaCO}_3$  (B)  $\text{Ca(OH)}_2$   
(C)  $\text{H}_2\text{O}$  (D)  $\text{CO}_2$
20. Metal carbonates and hydrogen carbonates react with acids to give  
(A) Carbon dioxide gas  
(B) Hydrogen gas  
(C) Sulphur dioxide gas  
(D) Carbon monoxide gas

**Very Short Answer Type Questions**

- The soil in a field is highly acidic. List any two materials which can be added to this soil to reduce its acidity. Give the reason for your choice.
- Name the acid present in the following.  
(i) Tomato (ii) Vinegar  
(iii) Tamarind
- 15 mL of water and 10 mL of sulphuric acid are to be mixed in a beaker.  
(i) State the method that should be followed with reason  
(ii) What is this process called?
- Which bases are called alkalies? Give an example of alkalies
- A student detected the pH of four unknown solution A, B, C and D as follows 11, 5, 7 and 2. Predict the nature of the solution
- How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?
- State the chemical name of Plaster of Paris. Write a chemical equation to show the reaction between Plaster of Paris and water.
- Classify the following salts into acidic, basic and neutral.  
Potassium sulphate, ammonium chloride, sodium carbonate, sodium chloride
- The pH of a sample of vegetable soup was found to be 6.5. How is this soup likely to taste?

10. What effect does an increase in the concentration of  $\text{H}^+$  (aq.) in a solution have on the pH of solution?

**Short Answer Type Questions**

- Answer the following questions:  
(i) State the colour of phenolphthalein in a soap solution  
(ii) Name the by-product of chlor-alkali process which is used for the manufacture of bleaching powder.  
(iii) Name one indicator which specifies the various levels of  $\text{H}^+$  ion concentration.
- (a) Define olfactory indicators. Name two substances which can be used as olfactory indicators.  
(b) Choose strong acids from the following:  
 $\text{CH}_3\text{COOH}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{CO}_3$ ,  $\text{HNO}_3$
- A white coloured powder is used by doctors for supporting fractured bones.  
(a) Write chemical name and formula of the powder  
(b) When this white powder is mixed with water a hard solid mass is obtained. Write balanced chemical equation for the change.
- Explain the action of dilute hydrochloric acid on the following with chemical equation:  
(i) Magnesium ribbon  
(ii) Sodium hydroxide  
(iii) Crushed egg shells
- (i) Give the constituents of baking powder.  
(ii) Why does cake or bread swell on adding baking powder? Write the chemical equation.
- Write the name given to the bases that are highly soluble in water. Give an example  
(a) How is tooth decay related to pH? How can it be prevented?  
(b) Why does bee sting cause pain and irritation? Rubbing of baking soda on the sting area give relief. How?
- A white powder is added while baking breads and cakes to make them soft and fluffy. Write the name of the powder. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking.



8. "Sodium hydrogencarbonate is a basic salt." Justify the statement. How is it converted into washing soda? Explain.
9. A gas 'X' reacts with lime water and forms a compound 'Y' which is used as a bleaching agent in chemical industry. Identify 'X' and 'Y'. Give the chemical equation of the reactions involved.
10. (i) Name the compound which is obtained from baking soda and is used to remove permanent hardness of water.  
(ii) Write its chemical formula.  
(iii) What happens when it is recrystallized from its aqueous solution?

### Long Answer Type Questions

1. (a) Identify the compound of calcium which is yellowish white powder and is used for disinfecting drinking water. Write its chemical name and formula. How is it manufactured? Write the chemical equation for the reaction involved. Also list two other uses of the compound.  
(b) Write the balanced chemical equation of chlor-alkali process.
2. State reasons for the following statements:
  - (i) Stain of curry on a white cloth becomes reddish brown when soap is scrubbed on it and turns yellow again when the cloth is washed with plenty of water,
  - (ii) Curd should not be kept in copper or brass vessels. What is done to protect it?
3. State the reason for the following statements:
  - (i) Tap water conducts electricity whereas distilled water does not
  - (ii) Dry hydrogen chloride gas does not turn blue litmus red whereas dilute hydrochloric acid does.
  - (iii) During summer season, a milk man usually adds a very small amount of baking soda to fresh milk.
  - (iv) For a dilution of acid, acid is added into water and not water into acid.
  - (v) Ammonia is a base but does not contain hydroxyl group.

4. (a) Write the chemical formula of hydrated copper sulphate and anhydrous copper sulphate. Giving an activity, illustrate how these are interconvertible.  
(b) Write chemical names and formula of Plaster of Paris and gypsum.
5. (a) State the chemical properties on which the following uses of baking soda are based.
  - (i) As an antacid.
  - (ii) As a soda acid fire extinguisher.
  - (iii) To make bread and cake soft and spongy.
 (b) How is washing soda obtained from baking soda? Write balanced chemical equation.
6. Equal length of magnesium ribbon are taken in two test tubes 'A' and 'B'.  $\text{H}_2\text{SO}_4$  is added to test tube 'A' and  $\text{H}_2\text{CO}_3$  in the test tube 'B' in equal amounts.
  - (a) Identify the test tube showing vigorous reaction
  - (b) Give reason to support your answer
  - (c) Name the gas liberated in both the tubes. How will you prove its liberation?
  - (d) Write chemical equations for both reactions.
  - (e) Out of the two acids taken above
    - (i) Which one will have lower pH value.
    - (ii) Lower  $\text{H}^+$  ion concentration respectively
7. (i) Explain why hydrochloric acid is a strong acid and acetic acid is, a weak acid. How can it be verified.  
(ii) Explain why aqueous solution of an acid conducts electricity.  
(iii) You have four solutions A, B, C and D. The pH of solution A is 6, B is 9, C is 12 and D is 7,
  - (a) Identify the most acidic and most basic solutions.
  - (b) Arrange the above four solutions in the increasing order of  $\text{H}^+$  ion concentration.
  - (c) State the change in colour of pH paper on dipping in solution C and D.
8. (i) Dry pellets of a base 'X' when kept in open absorbs moisture and turns sticky. The compound is also formed by chlor-alkali process. Write chemical name and formula





of X. Describe chlor-alkali process with balanced chemical equation. Name the type of reaction that occurs when X is treated with dilute hydrochloric acid. Write the relevant chemical equation.

### Case Based Question

Read the source given below and answer the following questions:

1. The growth of plants in a particular soil is also related to its pH. Different plants prefer different pH range for their growth. pH of a particular soil sample can be tested by adding water to the sample in a test tube. Shake it well and then filter it and add 2 drops of universal indicator to check the pH of soil.

- (I) How do you define pH?
- (II) The pH of soil A is 7.5 while that of soil B is 4.5. Which of the two soils A or B should be treated with powdered chalk to adjust its pH and why?
- (III) Name the chemical which is injected into the skin of a person:  
(a) During an ant's sting  
(b) During the nettle leaf sting  
How can the effect of these stings be neutralized?
- (IV) Explain how the pH change in the river water can endanger the lives of aquatic animals like fish?
- (V) A farmer treats the soil with quicklime or calcium carbonate. What is the nature of soil? Why does the farmer treat the soil with quicklime?

2. The neutralization reaction between an acid and a base results in the formation of a salt. Salts are basically ionic compounds made up of positively charged ions (cations) and negatively charged ions (anions). In the solid state, these ions are held together by electrostatic forces of attraction.

- (I) Name the salts formed in each case when  
(a) hydrochloric acid reacts with caustic soda  
(b) granulated zinc reacts with caustic soda.  
(c) carbon dioxide is passed into lime water.
- (II) Write a balanced chemical equation for the reaction between sodium carbonate and hydrochloric acid indicating the physical state of the reactants and the products.
- (III) State in brief the preparation of washing soda from baking soda. Write balanced chemical equation of the reaction involved.
- (IV) A student dropped a few pieces of marble in dilute HCl contained in a test tube. The evolved gas was passed through lime water.  
(i) What change would be observed in lime water on prolonged passage of the gas in lime water.  
(ii) Write balanced equation for the above change.
- (V) Crystals of a substance changed their colour on heating in a closed test tube but regained it after sometime when they were allowed to cool down. Name the substance. Write its formula and explain the phenomenon involved.





**EXERCISE - II**
**Fill In the Blanks**

- \_\_\_\_\_ gas is formed, when an acid reacts with a metal.
- The reaction between an acid and a base is called \_\_\_\_\_ reaction.
- \_\_\_\_\_ reacts with an acid to form a salt, water and carbon dioxide gas.
- \_\_\_\_\_ is formed when water mixes with  $\text{SO}_2$  gas present in the atmosphere.
- Lemon contains \_\_\_\_\_ acid.

**True and False**

- $\text{H}_2\text{SO}_4$  undergoes complete ionization in aqueous solution.
- $\text{HNO}_3$  is a very strong alkali.
- Liming of soil is done by adding milk of magnesia in soil.
- Sting of wasp contains alkali in it.
- Aqueous solution of washing soda is alkaline in nature.

**Multiple Correct Type Questions**

- Which of these can be used as olfactory indicator?  
(A) Vanilla (B) Onion  
(C) Clove (D) Red cabbage
- The indicators which turn red in acid solution are  
(A) Litmus (B) Methyl Orange  
(C) Phenolphthalein (D) Turmeric
- Which of the following are organic acids?  
(A) Ethanoic acid (B) Formic acid  
(C) Citric acid (D) Carbonic acid
- Which of the following contain water of crystallization?  
(A) Blue Vitriol (B) Washing soda  
(C) Baking soda (D) Borax

- Which of the following are inorganic acids?  
(A) Oxalic acid (B) Carbonic acid  
(C) Nitric acid (D) Nitrous acid
- Which of the following salts is basic in nature?  
(A)  $\text{NaCl}$  (B)  $\text{Na}_2\text{SO}_4$   
(C)  $\text{CH}_3\text{COONa}$  (D)  $\text{Na}_2\text{CO}_3$
- Which of the following is/are neutral oxides?  
(A)  $\text{CO}$  (B)  $\text{N}_2\text{O}$  (C)  $\text{SO}_2$  (D)  $\text{NO}$
- Which of these are strong bases?  
(A)  $\text{KOH}$  (B)  $\text{NaOH}$  (C)  $\text{LiOH}$  (D)  $\text{NH}_4\text{OH}$
- Which of the following is/are neutral salts?  
(A)  $\text{NaCl}$  (B)  $\text{CH}_3\text{COONa}$   
(C)  $\text{KCl}$  (D)  $\text{Na}_2\text{CO}_3$
- Which of the following are formed by chlor-alkali process?  
(A)  $\text{H}_2$  (B)  $\text{CH}_3\text{COOK}$   
(C)  $\text{Cl}_2$  (D)  $\text{KCl}$

**Match the Column Type Questions**
**1. Match the following**

	Column-I		Column-II
(A)	Butyric Acid	(P)	Tomatoes
(B)	Malic Acid	(Q)	Rancid Butter
(C)	Oxalic Acid	(R)	Apple
(D)	Stearic Acid	(S)	Fats

- (A) (A)-(P), (B)-(Q), (C)-(R), (D)-(S)  
 (B) (A)-(R), (B)-(P), (C)-(S), (D)-(Q)  
 (C) (A)-(Q), (B)-(R), (C)-(P), (D)-(S)  
 (D) (A)-(S), (B)-(R), (C)-(Q), (D)-(P)

**Assertion and Reason**

- Read the given statements carefully and choose the correct option.  
**Assertion (A):** Non-metallic oxides are generally acidic in nature.  
**Reason (R):** Non-metallic oxides react with an acid to give acidic solution.



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

### Comprehension

1. An indicator is a chemical compound which indicates the presence of acidic, basic or neutral substance either by change in colour or odour. The indicators change colour when the nature of the solution is changed. Therefore they are also known as visual indicators.

Some substances whose odour changes in acidic or basic solutions are called olfactory indicators. The commonly used olfactory indicators are raw onion, vanilla extract and clove oil.

- (I) What is colour change of china rose in acidic medium?  
 (A) Dark pink (B) Green  
 (C) Red (D) Blue
- (II) On introducing pH paper in the lemon juice, colour change observed is  
 (A) Green (B) Blue  
 (C) Red (D) Yellow
- (III) What is pH of blood?  
 (A) 7.9 (B) 1.2  
 (C) 10 (D) 7.4

### HOTS

1. Which of the following is incorrectly matched?

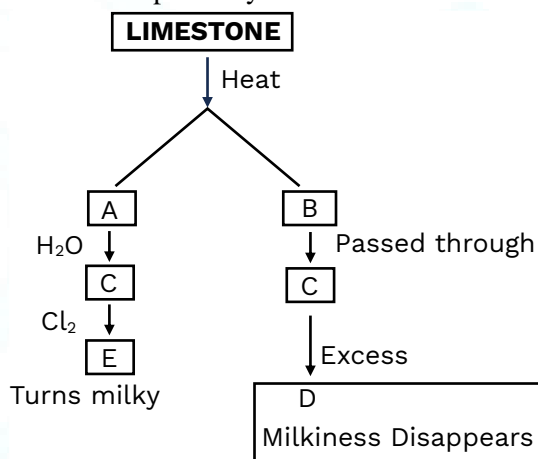
	Salt		Water of Crystallization
(A)	Alum (Potash alum)	-	24
(B)	Barium chloride	-	2
(C)	Borax	-	7
(D)	Glauber's salt	-	10

2. Acid produced in our stomach reacts with a compound 'X' to produce two products 'Y' and 'Z'. Compound 'X' is the hardest substance in human body and tooth enamel is made up of it. Identify 'Y' and 'Z' and choose the correct option.

	Y	Z
I	CaSO <sub>4</sub>	HCl
II	CaCl <sub>2</sub>	H <sub>3</sub> PO <sub>4</sub>
III	CaCO <sub>3</sub>	HCl
IV	CaCl <sub>2</sub>	H <sub>2</sub> SO <sub>4</sub>

- (A) (I) (B) (II) (C) (III) (D) (IV)

3. Complete the concept map and identify B, D and E respectively.



- (A) CaO, Ca(OH)<sub>2</sub>, Ca(HCO<sub>3</sub>)<sub>2</sub>  
 (B) CaO, Ca(OH)<sub>2</sub>, CaOCl<sub>2</sub>  
 (C) CO<sub>2</sub>, Ca(OH)<sub>2</sub>, Ca(HCO<sub>3</sub>)<sub>2</sub>  
 (D) CO<sub>2</sub>, Ca(HCO<sub>3</sub>)<sub>2</sub>, CaOCl<sub>2</sub>

4. Consider the following statements  
 (a) Brine is an aqueous solution of NaCl.  
 (b) Chlorine is used in swimming pools to disinfect water.  
 (c) H<sub>2</sub> is used as a fuel.  
 (d) During electrolysis of brine, chlorine is obtained at anode.  
 (e) Cl<sub>2</sub> is used for degreasing metals.  
 The correct statements are  
 (A) a, b, c and e (B) b, c, d and e  
 (C) a, c, d and e (D) a, b, c and d





5. Consider the following chemical equation  
 (a)  $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{X} + \text{Y}$   
 (b)  $2\text{Y} \xrightarrow{\text{Heat}} \text{Z} + \text{H}_2\text{O} + \text{CO}_2$   
 Now, identify 'X' 'Y' and 'Z' and choose the correct option.  
 (A)  $\text{X} = \text{NH}_4\text{Cl}$ ;  $\text{Y} = \text{Na}_2\text{CO}_3$ ;  $\text{Z} = \text{NaHCO}_3$   
 (B)  $\text{X} = \text{NaHCO}_3$ ;  $\text{Y} = (\text{NH}_4)_2\text{CO}_3$ ;  $\text{Z} = \text{Na}_2\text{CO}_3$   
 (C)  $\text{X} = \text{NH}_4\text{Cl}$ ;  $\text{Y} = \text{Na}_2\text{CO}_3$ ;  $\text{Z} = \text{NaOH}$   
 (D)  $\text{X} = \text{NH}_4\text{Cl}$ ;  $\text{Y} = \text{NaHCO}_3$ ;  $\text{Z} = \text{Na}_2\text{CO}_3$
6. Arrange the following in correct acidic order.  
 (A)  $\text{HI} > \text{HBr} > \text{HCl}$  (B)  $\text{HCl} = \text{HBr} > \text{HI}$   
 (C)  $\text{HCl} > \text{HBr} > \text{HI}$  (D)  $\text{HI} > \text{HBr} = \text{HCl}$
7. The pH value of the three solutions X, Y and Z are 6, 4 and 8 respectively. Which of the following is the correct order of increasing acidic strength ?  
 (A)  $\text{X} > \text{Y} > \text{Z}$  (B)  $\text{Z} > \text{Y} > \text{X}$   
 (C)  $\text{Z} < \text{X} < \text{Y}$  (D)  $\text{Y} > \text{X} > \text{Z}$
8. Farmers neutralize the effect of acidity of the soil by adding  
 (A) gypsum (B) slaked lime  
 (C) caustic soda (D) baking soda
9. When blue litmus is added to a solution of acetic acid, it turns red. When excess of NaOH is added to the above solution, it will be observed that the mixture  
 (A) remains red  
 (B) becomes colorless  
 (C) turns blue  
 (D) turns green
10. A student takes about 2 mL ethanoic acid in a dry test tube and adds a pinch of sodium hydrogen carbonate to it. He reports the following observations:  
 I. Immediately a colourless and odourless gas evolves with a brisk effervescence.  
 II. The gas turns lime water milky when passed through it.  
 III. The gas burns with an explosion when a burning splinter is brought near it.  
 IV. The gas extinguishes the burning splinter that is brought near it.  
 The correct observations are  
 (A) I, II and III (B) II, III and IV  
 (C) I, III and IV (D) I, II and IV





## EXERCISE - III

## Previous Year Questions

- Sodium bicarbonate on decomposition forms  
[NTSE Stage-I/15]  
(A)  $\text{NaHCO}_3$  (B)  $\text{Na}_2\text{CO}_3$   
(C)  $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$  (D)  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- Salt of strong acid and weak base have pH value  
[NTSE Stage-I/15]  
(A) Less than 7 (B) More than 7  
(C) Only 7 (D) Only 14
- Which one of the following types of medicines is used for treating indigestion?  
[NTSE Stage-1/2018]  
(A) Antibiotic (B) Analgesic  
(C) Antacid (D) Antiseptic
- Acid rain occurs, when pH value of rain water is less than  
[NTSE Stage-1/2018]  
(A) 6.5 (B) 5.6 (C) 7.2 (D) 2.7
- The formula of bleaching powder is  
[NTSE Stage-1/2018]  
(A)  $\text{CaSO}_4$  (B)  $\text{Na}_2\text{CO}_3$   
(C)  $\text{NaHCO}_3$  (D)  $\text{CaOCl}_2$
- The nature of calcium phosphate present in tooth enamel is  
[NTSE Stage-1/2018]  
(A) Basic (B) Amphoteric  
(C) Acidic (D) Neutral
- The pH value of pure water is  
[NTSE Stage-1/2018]  
(A) 0 (B) 14 (C) 1 (D) 7
- In which of the following, oxalic acid is found naturally?  
[NTSE Stage-1/2018]  
(A) Curd  
(B) Tamarind  
(C) Tomato  
(D) Lemon
- What will be the products formed, when acid reacts with metals [NTSE Stage-1/2018]  
(A) Water and hydrogen gas  
(B) Acid and hydrogen gas  
(C) Salt and hydrogen gas  
(D) Base and hydrogen gas
- What happens, when methyl orange solution is mixed with HCl? [NTSE Stage-1/2018]  
(A) Solution becomes Yellow  
(B) Solution becomes Red  
(C) Solution becomes Blue  
(D) Solution becomes pink
- Which of these salts will give acidic solution [NTSE Stage-1/2018]  
(A)  $\text{Na}_2\text{CO}_3$  (B)  $\text{NaCl}$   
(C)  $\text{NH}_4\text{Cl}$  (D)  $\text{HCOONa}$
- pH is defined as : [NTSE Stage-1/2018]  
(A)  $-\log[\text{H}_3\text{O}^+]$  (B)  $-\log[\text{H}_2\text{O}]$   
(C)  $-\log[\text{OH}^-]$  (D)  $-\log[\text{H}^+][\text{OH}^-]$
- The chemical formula of dead burnt plaster is [NTSE Stage-1/2018]  
(A)  $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$   
(B)  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$   
(C)  $\text{CaSO}_4 \cdot \text{H}_2\text{O}$   
(D)  $\text{CaSO}_4$
- The chemical formula of Plaster of Paris is [NTSE Stage-1/2018]  
(A)  $\text{CaSO}_4$  (B)  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$   
(C)  $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$  (D)  $\text{CaSO}_4 \cdot \text{H}_2\text{O}$
- Two solutions A and B have pH Value 2 and 5 respectively their nature will be:  
[NTSE Stage-1/2017]  
(A) A and B both are acidic  
(B) A alkaline, B acidic  
(C) B alkaline, A acidic  
(D) A and B both are alkaline





- |   |   |
|---|---|
| <p><b>16.</b> Which one of the following reaction is not possible? <b>[NTSE Stage-1/2017]</b></p> <p>(A) <math>\text{Ca} + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{H}_2</math></p> <p>(B) <math>\text{Cu} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{H}_2</math></p> <p>(C) <math>\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2</math></p> <p>(D) <math>\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2</math></p> | <p><b>19.</b> pH of a solution is zero. The nature of this solution is- <b>[NTSE Stage-I/15]</b></p> <p>(A) acidic</p> <p>(B) basic</p> <p>(C) neutral</p> <p>(D) amphoteric</p>  |
| <p><b>17.</b> Plaster of paris hardens by <b>[NTSE Stage-1/2017]</b></p> <p>(A) Losing <math>\text{CaCl}_2</math></p> <p>(B) Absorbing <math>\text{CO}_2</math></p> <p>(C) Absorbing water</p> <p>(D) Releasing water</p>   | <p><b>20.</b> The difference in number of molecules of water of crystallization in a molecule of gypsum and a molecule of plaster of Paris is <b>[NTSE Stage-I/15]</b></p> <p>(A) <math>\frac{5}{2}</math></p> <p>(B) 2</p> <p>(C) <math>\frac{1}{2}</math></p> <p>(D) <math>\frac{3}{2}</math></p> |
| <p><b>18.</b> What is the nature of solution when sodium carbonate is dissolved in water? <b>[NTSE Stage-I/15]</b></p> <p>(A) acidic                      (B) basic</p> <p>(C) neutral                      (D) amphoteric</p>  |   |



**ANSWER KEY****EXERCISE-I****Single Choice Questions**

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

**Fill in the blanks**

1.  $H_2$
2. Neutralisation
3. Metal Carbonate / Metal Hydrogen Carbonate
4. Acid Rain
5. Citric Acid

**True and False**

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

**EXERCISE-II****Multiple Choice Questions**

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

**Match the Column Type Questions**

1. (A)-(Q), (B)-(R), (C)-(P), (D)-(S)

**Assertion and Reason**

1. C

**Comprehension-1**

Que.	(I)	(II)	(III)
Ans.	A	D	D

**Hots**

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







## EXERCISE-III

## Previous Year Questions

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





# DPP

## Daily Practice Problems

**SUBJECT: CHEMISTRY****CLASS-10****DPP NO. 1****TOPIC: ACIDS, BASES AND SALTS (INTRODUCTION TO IMPORTANCE OF PH IN EVERYDAY LIFE)****Multiple Choices Questions**

1. A solution turns red litmus blue, its pH is likely to be  
(A) 1 (B) 4 (C) 5 (D) 10
2. A solution reacts with crushed egg-shells to give a gas that turns lime-water milky. The solution contains  
(A) NaCl (B) HCl (C) LiCl (D) KCl
3. Which one of the following types of medicines is used for treatment indigestion  
(A) Antibiotic (B) Analgesic (C) Antacid (D) Antiseptic
4. According to Arrhenius acid gives  
(A)  $H^+$  in water (B)  $OH^-$  in water (C) Both (A) & (B) (D)  $OH^-$  in acid medium
5. Milk of magnesia is an  
(A) Acid (B) Antacid (C) Alkali (D) Rock salt
6. Noble metals are dissolved in  
(A) Conc.  $HNO_3$  (B) Conc. HCl (C) Conc.  $H_2SO_4$  (D) Aqua-regia
7. Which of the following is not a strong acid?  
(A)  $H_2SO_4$  (B)  $CH_3COOH$  (C)  $HNO_3$  (D) HCl
8. Which of the following method is not used in preparing a base?  
(A) Burning of metal in air. (B) Adding water to a metal oxide.  
(C) Reaction between an acid and base. (D) Heating metal carbonates.
9. Which of the following statements is true for acids?  
(A) Bitter and change red litmus to blue (B) Sour and change red litmus to blue  
(C) Sour and change blue litmus to red (D) Bitter and change blue litmus to red
10. An aqueous solution turn red litmus solution blue. Excess addition of which of the following solution would reverse the change?  
(A) Baking powder (B) Lime  
(C) Ammonium hydroxide solution (D) Hydrochloric acid

11. To protect tooth decay, we are advised to brush our teeth regularly. The nature of the tooth pastes commonly used is  
(A) acidic (B) neutral (C) basic (D) corrosive
12. Which of the following statements is correct about an aqueous solution of an acid and a base?  
(i) Higher the pH, stronger the acid. (ii) Higher the pH, weaker the acid.  
(iii) Lower the pH, stronger the base. (iv) Lower the pH, weaker the base.  
(A) (i) and (iii) (B) (ii) and (iii) (C) (i) and (iv) (D) (ii) and (iv)
13. Which of the following phenomena occur, when a small amount of acid is added to water?  
(i) Ionisation (ii) Neutralisation (iii) Dilution (iv) Salt formation  
(A) (i) and (ii) (B) (i) and (iii) (C) (ii) and (iii) (D) (ii) and (iv)
14. Which of the following substance will not give carbon dioxide on treatment with dilute acid?  
(A) Marble (B) Limestone (C) Baking soda (D) Lime
15. Which of the following statement is not correct?  
(A) All metal carbonates react with acid to give a salt, water and carbon dioxide.  
(B) All metal oxides react with water to give salt and acid.  
(C) Some metals react with acids to give salt and hydrogen.  
(D) Some non-metallic oxides react with water to form an acid.
16. Which of the following is(are) true when  $\text{HCl(g)}$  is passed through water?  
(A) It does not ionise in the solution as it is a covalent compound.  
(B) It ionises in the solution.  
(C) It gives both hydrogen and hydroxyl ion in the solution.  
(D) It forms hydronium ion in the solution due to the combination.
17. The pair of the solutions which have pH value less than 7, is  
(A) solution of washing soda and solution of vinegar  
(B) solution of soap and solution of washing soda  
(C) solution of copper sulphate and solution of washing soda  
(D) solution of copper sulphate and vinegar
18. pH of soda water is  
(A) 7 (B)  $< 7$  (C)  $> 7$  (D) 0
19. About (i)  $\text{CsOH}$  (ii)  $\text{KOH}$  (iii)  $\text{Be(OH)}_2$  the correct statement is  
(A) All are bases  
(B) (ii) and (iii) are bases, (i) is acidic  
(C) (i) is acidic (ii) is basic (iii) is amphoteric  
(D) (ii) and (iii) are basic, (i) is amphoteric

In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as

- (A) If both assertion and reason are true and reason is the correct explanation of assertion.
- (B) If both assertion and reason are true but reason is not a correct explanation of assertion.
- (C) If assertion is true and reason is false.
- (D) If both assertion and reason are true.

20. **Assertion:** Phenolphthalein is an acid-base indicator.

**Reason:** Phenolphthalein gives different colours in acidic and basic medium.

### Very short answer type Questions

1. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid.
2. What are strong acids and weak acids. Give an example for each.
3. What do you mean by olfactory indicators?
4. What is neutralization reaction? Give one example.
5. Zinc is an amphoteric metal. Justify with reaction.

### Short answer type Questions:

1. Give the chemical names of acids present in  
(i) ants                      (ii) lemon                      (iii) milk                      (iv) tomato
2. Though the compounds such as glucose and alcohol have hydrogen atoms in their molecule yet they are not categorised as acids, why?
3. A milkman adds a very small amount of baking soda to fresh milk.  
(i) What is the effect of addition of baking soda to milk?  
(ii) Why does this milk take long time to set as curd?
4. Equal lengths of Mg ribbon are taken in test tubes A and B. Hydrochloric acid is added to test tube A. While acetic acid is added to test tube B. In which case the reaction would occur more vigorously and why? Write the chemical equations for reactions in test tube A and B.
5. You are provided with three test tubes A, B, C which contain distilled water, acidic and basic solutions. If you are given blue litmus paper only, how will you identify the nature of the solutions in three test tubes.

### Long answer type Questions:

1. Name the gas that liberates when an acid reacts with a metal. Illustrate your answer with an example giving the balanced equation for the reaction involved. How would you test the gas evolved?
2. Account for the following.
  - (a) Dry HCl gas does not change the colour of dry blue litmus paper.
  - (b) Antacid tablets are used by a person suffering from stomach pain.
  - (c) Toothpaste is used for cleaning teeth.
3. A dry pellet of a common base 'B' when kept in open absorbs moisture and turns sticky. The compound is also formed by Chloralkali process. Identify B. What type of reaction occurs when B is treated with dilute hydrochloric acid. Write the chemical equation.

### Case based Study

1. Madhu was asked to determine the melting point of a given organic solid. For this, she used a bath containing conc.  $\text{H}_2\text{SO}_4$ . When she was looking at the thermometer, she lost her concentration and became a little casual. The beaker containing boiling sulphuric acid fell on her clothes. Her clothes were burnt and she got severe burns on hands.  
Answer the following questions.
  - (I) Why did she get severe burns on her hands?
  - (II) What precautions do you suggest which she should take in future?
2. Rahul was playing with his friends. Suddenly, Rahul was stung by a honeybee and was in great pain. Immediately, his friends called his mother. She applied a coating of toothpaste on the affected area and then took him to the doctor.  
Read the above passage and answer the following questions.
  - (I) What could be the reason for this burning pain?
  - (II) Why did his mother apply toothpaste on the affected area?

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



# FOUNDATION

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CLASS-X

SAMPLE

MATHEMATICS

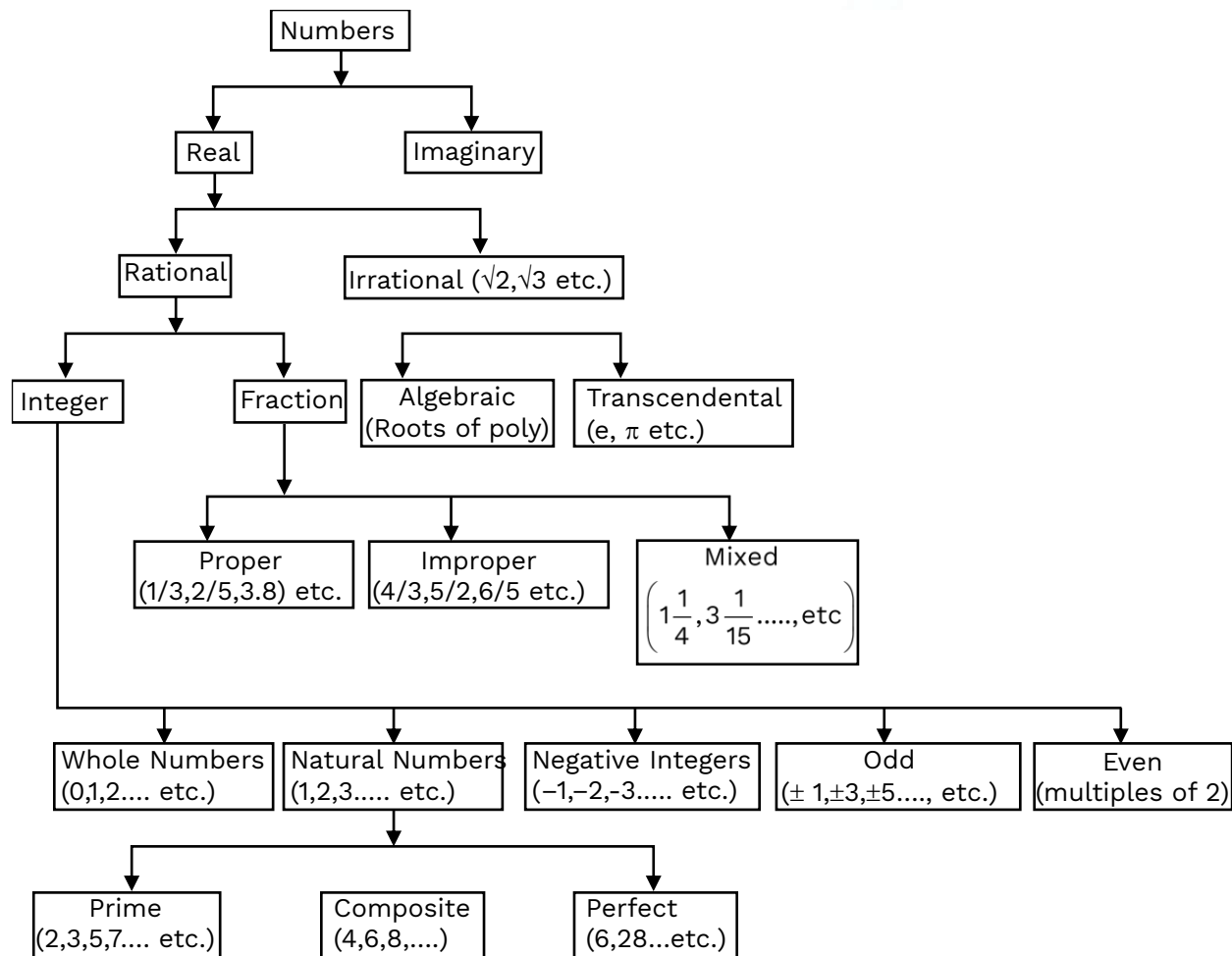


# REAL NUMBERS

## Introduction

Euclid known as Euclid Alexandria was a Greek Mathematician who is credited as being the “Father of Geometry”.

## System Of Numbers



### (a) Natural numbers

Counting numbers 1, 2, 3, 4, 5, ..... are known as natural numbers. The set of all natural numbers can be represented by  
 $N = \{1, 2, 3, 4, 5, \dots\}$

### (b) Whole numbers

If we include 0 among the natural numbers, then the numbers 0, 1, 2, 3, 4, 5 ..... are called whole numbers. The set of whole numbers can be represented by

$$W = \{0, 1, 2, 3, 4, 5, \dots\}$$

Clearly, every natural number is a whole number but 0 is a whole number which is not a natural number.

### (c) Integers

All counting numbers and their negatives including zero are known as integers. The set of integers can be represented by

$$Z \text{ or } I = \{\dots -4, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$$



**(d) Positive integers**

The set  $I^+ = \{1, 2, 3, 4, \dots\}$  is the set of all positive integers. Clearly, positive integers and natural numbers are synonyms.

**(e) Negative integers**

The set  $I^- = \{-1, -2, -3, \dots\}$  is the set of all negative integers.

0 is neither positive nor negative.

**(f) Non-negative integers**

The set  $\{0, 1, 2, 3, \dots\}$  is the set of all non-negative integers.

**(g) Non-positive integers**

The set  $\{\dots, -3, -2, -1, 0\}$  is the set of all non-positive integers.

**(h) Perfect numbers**

If sum of proper divisors of a number is the number itself then the number is known as perfect number.

e.g., 6, 28 ..... etc.

**(i) Prime numbers**

Except 1 each natural number which is divisible by 1 and itself only is called as prime number. e.g., 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, ..... etc.

- There are total 25 prime numbers up to 100
- There are total 46 prime numbers up to 200
- 2 is the only even prime number and the least prime number.
- 1 is neither prime nor composite number.
- There are infinite prime numbers.

**Test to find whether a given number is a prime**

**Step-1 :** Select a least positive integer  $n$  such that  $n^2 >$  given number.

**Step-2 :** Test the divisibility of given number by every prime number less than  $n$ .

**Step-3 :** The given number is prime only if it is not divisible by any of these primes.

**(j) Even numbers**

All those numbers which are exactly divisible by 2 are called even numbers,

e.g. 2, 6, 8, 10 etc.

**(k) Odd numbers**

All those numbers which are not exactly divisible by 2 are called odd numbers,

e.g. 1, 3, 5, 7 etc.

**(l) Co-prime Numbers**

If the H.C.F. of the given numbers (not necessarily prime) is 1 then they are known as co-prime numbers.

e.g. 4, 9 are co-prime as H.C.F. of (4, 9) = 1.

e.g. 3, 5 are co-prime as H.C.F. of (3, 5) = 1.

e.g. 4, 5 are co-prime as H.C.F. of (4, 5) = 1.

**(m) Composite numbers**

All natural numbers, which are not prime are composite numbers. If  $C$  is the set of composite number then  $C = \{4, 6, 8, 9, 10, 12, \dots\}$

**(n) Imaginary numbers**

All the numbers whose square is negative are called imaginary numbers.

e.g.  $3i, -4i, \dots$ ; where  $i = \sqrt{-1}$ .

**(o) Complex numbers**

The combined form of real and imaginary numbers is known as complex number.

It is denoted by  $Z = A + iB$ , where  $A$  is real and  $B$  is imaginary part of  $Z$  and  $A, B \in \mathbb{R}$ .

e.g.  $4 + 2i, 4 - 2i, -4 - 3i$  etc.

**(p) Twin primes**

Prime numbers differing by two are called twin primes,

e.g. (3, 5), (5, 7), (11, 13) etc, are called twin primes.

**(q) Prime triplet**

A set of three consecutive primes differing by 2, such as (3, 5, 7) is called a prime triplet

**(r) Rational numbers**

The rational numbers are all the numbers that can be expressed in the form of  $\frac{p}{q}$ , where  $p$  and  $q$  are integers and coprime and  $q \neq 0$ .

e.g.,  $\frac{2}{3}, -3, 0, 4.33$  etc.




**Rational numbers between two numbers**

One way to find a rational number between two rational numbers is to find their average, called mean.

To find a rational number between  $x$  and  $y$ , we will find the mean of  $x$  and  $y$ . i.e.  $\frac{x+y}{2}$  is a rational number lying between  $x$  and  $y$ . This number will be the mid-value of that two numbers.

**Decimal expansion of rational numbers**

Every rational number can be expressed as terminating decimal or non-terminating but repeating decimals.

**Terminating decimal (The remainder becomes zero)**

The word "terminate" means "end". A decimal that ends is a terminating decimal.

**OR**

A terminating decimal doesn't keep going. A terminating decimal will have finite number of digits after the decimal point.

$$\frac{3}{4} = 0.75, \frac{8}{10} = 0.8, \frac{5}{4} = 1.25, \frac{25}{16} = 1.5625$$

**Method to convert non-terminating decimal to the form  $p/q$ .**

It is a decimal representation in which all the digits after the decimal point are repeated.

Following are the steps to convert it in the form  $p/q$ .

**Step-1 :** Denote recurring decimal as  $x$ .

**Step-2 :** Write the number in decimal form by removing bar from top of repeating digits.

**Step-3 :** Count the number of digits having bar on their heads.

**Step-4 :** Multiply the repeating decimal by 10, 100, 1000, ... depending upon 1 place repetition, 2 place repetition, 3 place repetition and so on present in decimal number.

**Step-5 :** Subtract the number obtained in step 2 from a number obtained in step 4.

**Step-6 :** Find the value of  $x$  in the form  $p/q$ .

**(s) Irrational numbers**

A number is called an irrational number, if it cannot be written in the form  $p/q$ , where  $p$  &  $q$  are integers and  $q \neq 0$ . All Non-terminating & Non-repeating decimal numbers are Irrational numbers.

E.g.  $\sqrt{2}, \sqrt{3}, 3\sqrt{2}, 2 + \sqrt{3}, \sqrt{2 + \sqrt{3}}, \pi$ , etc ....

**Decimal expansion of irrational numbers**

Every irrational number can be expressed as non-terminating and non-repeating decimal.

e.g.  $\sqrt{2} = 1.4142135 \dots\dots$

**Remark :** Irrational number between two numbers  $a$  and  $b$  is  $\sqrt{ab}$ .

**(t) Real numbers**

The rational and irrational numbers combined together are called real numbers,

e.g.  $\frac{13}{21}, \frac{2}{5}, -\frac{3}{7}, \sqrt{3}, 4 + \sqrt{2}$ , etc. are real numbers.

The set of real numbers is denoted by  $R$ .

e.g.  $3 + \sqrt{2}, 4 - \sqrt{3}, \frac{2}{3} - \sqrt{5}, 4\sqrt{3}, -7\sqrt{5}$  are all irrational numbers.

**Operations on real numbers**

Following are some useful results on real numbers.

- (i) Negative of an irrational number is an irrational number.
- (ii) The sum or difference of a rational number and an irrational number is an irrational number.
- (iii) The product of a non-zero rational number and an irrational number is an irrational number.
- (iv) The sum, difference, product and quotient of two irrational numbers need not be an irrational number.

**Euclid's Division Lemma**
**(a) Lemma**

Lemma is a proven statement used to prove another statement or theorem.

**(b) Statement of Euclid's Division Lemma**

Let ' $a$ ' and ' $b$ ' be any two positive integers. Then, there exists unique integers ' $q$ ' and ' $r$ ' such that  $a = bq + r$ , where  $0 \leq r < b$ . If  $a|b$ , then  $r = 0$ .

This can easily be remembered as follows

$$\begin{array}{r} q \\ b \overline{)a} \\ \underline{\phantom{0}r} \end{array}$$

This can be restated as follows : Dividend = Divisor  $\times$  Quotient + Remainder.





**e.g.** Consider positive integer 47 and 4.

**Sol.**  $47 = 4 \times 11 + 3$

$$a = 47, b = 4, q = 11, r = 3$$

**e.g.** Consider positive integer 91 and 11.

**Sol.**  $91 = 11 \times 8 + 3$

$$a = 91, b = 11, q = 8, r = 3$$

**Remark :** In Division Lemma,  $q$  or  $r$  may be 0 but  $r$  is always less than  $b$ .

### Example 1:

Prove that any positive odd integer can be written in the form  $4q + 1$  or  $4q + 3$  where  $q$  is an integer.

#### Solution:

Let  $a$  be any positive odd integer. Taking 4 as a divisor, we can write  $a$  as,  $a = 4q + r$ , where  $0 \leq r < 4$  (division Lemma). Now let us put  $r = 0, 1, 2, 3$ .

$$\text{Then, } a = 4q \quad \dots (i)$$

$$a = 4q + 1 \quad \dots (ii)$$

$$a = 4q + 2 \quad \dots (iii)$$

$$a = 4q + 3 \quad \dots (iv)$$

(i) and (iii) give only even numbers.

Since  $a$  is odd, it must be of the form (ii) or (iv) namely  $4q + 1$  or  $4q + 3$ .

### Example 2:

Show that one and only one out of  $n, n + 2$  or  $n + 4$  is divisible by 3, where  $n$  is any positive integer.

#### Solution:

Let  $n$  is any positive integer of form  $3q + r$  where  $0 \leq r < 3$

**Case-I** When  $r = 0$

$n = 3q$ , which is divisible by 3.

$$n + 2 = 3q + 2$$

$\Rightarrow n + 2$  leaves remainder 2, when divided by 3

$\Rightarrow n + 2$  is not divisible by 3

$$n + 4 \Rightarrow 3q + 4 = 3(q + 1) + 1$$

$\Rightarrow n + 4$  is not divisible by 3

Thus,  $n$  is divisible by 3 but  $n + 2$  and  $n + 4$  is not divisible by 3.

**Case-II** When  $r = 1$

$$n = 3q + 1$$

$$n + 2 = 3q + 3$$

$$\text{and } n + 4 = 3q + 5$$

Thus  $n + 2$  is divisible by 3 but  $n$  and  $n + 4$  are not divisible by 3.

**Case-III** When  $r = 2$

$$n = 3q + 2$$

$$n + 2 = 3q + 4$$

$$\text{and } n + 4 = 3q + 6$$

Thus  $n + 4$  is divisible by 3 but  $n$  and  $n + 2$  is not divisible by 3.

### FUNDAMENTAL UNLOCKED- (FU#1)

- Q.1** Let 'a' and 'b' be any two positive integers. Then, there exists unique integers 'q' and 'r' such that  $a = bq + r$ . If  $b = 5$ , then find the possible values of  $r$ .
- Q.2** Check whether the number  $21q + 18$  is of the form  $7q + 4$ , for some integer  $q$ .
- Q.3** If  $n = 5q + 4$ , then check whether  $n^2 - 1$  is divisible by 5, for some integer  $q$ .
- Q.4** Show that cube of the number of the form  $4q + 3$  is of the form  $4q + 3$ , for some integer  $q$ .
- Q.5** Out of the numbers  $n, n + 1$  and  $n + 2$ , show that only one number is divisible by 3.

### Euclid's Division Algorithm

If 'a' and 'b' are positive integers such that  $a = bq + r$ , then every common divisor of 'a' and 'b' is a common divisor of 'b' and 'r', and vice-versa. The HCF of positive integers  $a$  and  $b$  where  $a > b$  is obtained as follows.

**Step 1:** Apply Euclid's division Lemma to  $a$  and  $b$ .

That is, find whole numbers  $q$  and  $r$  such that  $a = bq + r, 0 \leq r < b$

**Step 2:** If  $r = 0$ , then  $b$  is the HCF of  $a$  and  $b$ . If  $r \neq 0$ , apply division Lemma to  $b$  and  $r$ .

**Step 3:** Continue the process till  $r$  is 0. The divisor at this stage is the HCF of  $a$  and  $b$ .

### Example 3:

Use Euclid's division algorithm to find the HCF of 441, 567, 693.

**Solution:** In order to find the HCF of 441, 567 and 693, we first find the HCF of 441 and 567 by Euclid's division algorithm.

Using division algorithm, we get

$$567 = 441 \times 1 + 126$$

$$441 = 126 \times 3 + 63$$

$$126 = 63 \times 2 + 0$$







So,  $\text{HCF}(567, 441) = 63$   
 Now, we find the HCF of 63 and 693  
 $693 = 63 \times 11 + 0$   
 $\therefore \text{HCF}(63, 693) = 63$   
 Hence  $\text{HCF}(441, 567, 693) = 63$

**Example 4:**

144 cartons of coke cans and 90 cartons of pepsi cans are to be stacked in a canteen. If each stack is of same height and is to contain cartons of the same drink, what would be the greatest number of cartons each stack would have ?

**Solution:**

In order to arrange the cartons of the same drink in the same stack, we have to find the greatest number that divides 144 and 90 exactly. Using Euclid's division algorithm, to find the H.C.F. of 144 and 90.

$$144 = 90 \times 1 + 54$$

$$90 = 54 \times 1 + 36$$

$$54 = 36 \times 1 + 18$$

$$36 = 18 \times 2 + 0$$

So, the H.C.F. of 144 and 90 is 18.

Number of cartons in each stack = 18.

**FUNDAMENTAL UNLOCKED- (FU#2)**

- Q.1** Find the HCF of 2781 and 1242  
**Q.2** Find HCF of 13281 and 15844  
**Q.3** If the H.C.F. of 408 and 1032 is expressible in the form  $1032m - 408 \times 5$ , find m.  
**Q.4** 105 goats, 140 sheeps have to be taken across a river. There is only one boat which will have to make many trips in order to do so. The lazy boatman has his own conditions for transporting them. He insists that he will take the same number of animals in every trip and they have to be of the same kind. He will naturally like to take the largest possible number each time. Can you tell how many animals went in each trip.

**Fundamental Theorem Of Arithmetic**
**(a) Fundamental Theorem of Arithmetic**

Every composite number can be expressed as a product of primes, and this factorisation is unique, except for the order in which the prime factors occurs.

**(b) HCF and LCM of numbers**

HCF and LCM of numbers can be determined by prime factorization. This is nothing but an application of the fundamental theorem of arithmetic.

HCF = Product of the smallest power of each common factor.

LCM = Product of the largest power of each prime factor

Let a and b be natural numbers. Then their

$$\text{HCF} \times \text{LCM} = a \times b$$

**Remark :** LCM is always divisible by HCF.

**(i) Product of two numbers = LCM of the numbers  $\times$  HCF of the numbers.**

e.g. The HCF and the LCM of any two numbers are 63 and 1260, respectively. If one of the two numbers is 315, find the other number.

**Sol.** The required number

$$= \frac{\text{LCM} \times \text{HCF}}{\text{First number}} = \frac{1260 \times 63}{315} = 252$$

**(ii) To find the greatest number that will exactly divide x, y and z.**

**Required number = HCF of x, y, and z.**

e.g. Find the greatest number that will exactly divide 200 and 320.

**Sol.** The required greatest number

$$= \text{HCF of } 200 \text{ and } 320 = 40.$$

**(iii) To find the greatest number that will divide x, y, and z leaving remainders a, b, and c, respectively.**

Required number = HCF of  $(x - a)$ ,  $(y - b)$  and  $(z - c)$ .

e.g. Find the greatest number that will divide 148, 246 and 623 leaving remainders 4, 6 and 11, respectively.

**Sol.** The required greatest number

$$= \text{HCF of } (148 - 4), (246 - 6) \text{ and } (623 - 11),$$

i.e. HCF of 144, 240 and 612 = 12.

**(iv) To find the least number which is exactly divisible by x, y and z.**

**Required number = LCM of x, y and z.**





e.g. What is the smallest number which is exactly divisible by 36, 45, 63 and 80?

**Sol.** The required smallest number  
= LCM of 36, 45, 63 and 80 = 5040.

(v) To find the least number which when divided by  $x$ ,  $y$  and  $z$  leaves the remainders  $a$ ,  $b$  and  $c$  respectively, such that  $(x - a) = (y - b) = (z - c) = k$  (say).

$\therefore$  Required number = (LCM of  $x$ ,  $y$  and  $z$ ) -  $k$ .

e.g. Find the least number which when divided by 36, 48 and 64 leaves the remainders 25, 37 and 53, respectively.

**Sol.** Since  $(36 - 25) = (48 - 37) = (64 - 53) = 11$ , therefore the required smallest number  
(LCM of 36, 48 and 64) - 11 = 576 - 11 = 565.

(vi) To find the least number which when divided by  $x$ ,  $y$  and  $z$  leaves the same remainder  $r$  in each case.

Required number = (LCM of  $x$ ,  $y$ , and  $z$ ) +  $r$ .

e.g. Find the least number which when divided by 12, 16 and 18, will leave a remainder 5 in each case.

**Sol.** The required smallest number  
= (LCM of 12, 16 and 18) + 5 = 144 + 5 = 149.

(vii) To find the greatest number that will divide  $x$ ,  $y$  and  $z$  leaving the same remainder in each case.

(a) When the value of remainder  $r$  is given:

Required number = HCF of  $(x - r)$ ,  $(y - r)$  and  $(z - r)$ .

(b) When the value of remainder is not given:

Required number = HCF of  $|x - y|$ ,  $|y - z|$  and  $|z - x|$ .

e.g. Find the greatest number which will divide 772 and 2778 so as to leave the remainder 5 in each case.

**Sol.** The required greatest number  
= HCF of  $(772 - 5)$  and  $(2778 - 5)$   
= HCF of 767 and 2773 = 59.

e.g. Find the greatest number which on dividing 152, 277 and 427 leaves same remainder.

**Sol.** The required greatest number.  
= HCF of  $|x - y|$ ,  $|y - z|$  and  $|z - x|$   
= HCF of  $|152 - 277|$ ,  $|277 - 427|$  and  $|427 - 152|$   
= HCF of 125, 150 and 275 = 25.

(viii) To find the  $n$ -digit greatest number which, when divided by  $x$ ,  $y$  and  $z$

(a) leaves no remainder (i.e., exactly divisible)

Step-1 : LCM of  $x$ ,  $y$  and  $z = L$

Step-2 : 
$$\frac{L \overline{)n\text{-digit greatest number}}}{\text{Remainder} = R}$$

Step-3 : Required number =  $n$ -digit greatest number -  $R$

(b) leaves remainder  $K$  in each case

Required number = ( $n$ -digit greatest number -  $R$ ) +  $K$ .

e.g. Find the greatest number of 4 digits which, when divided by 12, 18, 21 and 28, leaves 3 as a remainder in each case.

**Sol.** LCM of 12, 18, 21 and 28 = 252.

$$\begin{array}{r} 252 \overline{)9999(39} \\ \underline{9828} \\ 171 \end{array}$$

$\therefore$  The required number =  $(9999 - 171) + 3 = 9931$ .

(ix) To find the  $n$ -digit smallest number which when divided by  $x$ ,  $y$  and  $z$

(a) leaves no remainder (i.e. exactly divisible)

Step-1 : LCM of  $x$ ,  $y$  and  $z = L$

Step-2 : 
$$\frac{L \overline{)n\text{-digit smallest number}}}{\text{Remainder} = R}$$

Step-3 : Required number =  $n$ -digit smallest number +  $(L - R)$ .

(b) leaves remainder  $K$  in each case.

Required number =  $n$ -digit smallest number +  $(L - R) + K$ .

e.g. (a) Find the least number of four digits which is divisible by 4, 6, 8 and 10.

**Sol.** LCM of 4, 6, 8, and 10 = 120.

$$\begin{array}{r} 120 \overline{)1000(8} \\ \underline{960} \\ 40 \end{array}$$

$\therefore$  The required number =  $1000 + (120 - 40) = 1080$ .

e.g. (b) Find the smallest 4-digit number, such that when divided by 12, 18, 21 and 28, it leaves remainder 3 in each case.

**Sol.** LCM of 12, 18, 21 and 28 = 252.





$$\begin{array}{r} 252 \overline{)1000(3} \\ \underline{756} \\ 244 \end{array}$$

$\therefore$  The required number =  $1000 + (252 - 244) + 3 = 1011$ .

**(x) HCF and LCM of fractions**

$$\begin{aligned} \text{HCF of } \frac{a}{b}, \frac{c}{d}, \frac{e}{f} &= \frac{\text{HCF of numerators}}{\text{LCM of denominators}} \\ &= \frac{\text{HCF}(a, c, e)}{\text{LCM}(b, d, f)} \end{aligned}$$

$$\begin{aligned} \text{LCM of } \frac{a}{b}, \frac{c}{d}, \frac{e}{f} &= \frac{\text{LCM of numerators}}{\text{HCF of denominators}} \\ &= \frac{\text{LCM}(a, c, e)}{\text{HCF}(b, d, f)} \end{aligned}$$

**Example 5:**

The numbers 525 and 3000 are both divisible only by 3, 5, 15, 25 and 75. What is HCF (525, 3000)? Justify your answer.

**Solution:**

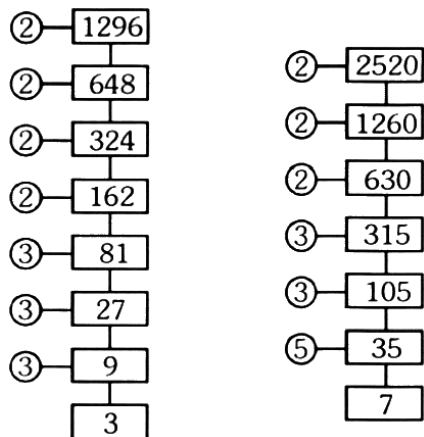
Since HCF of given numbers is the greatest number that divides each one of them exactly. Therefore,  $\text{HCF}(525, 3000) = 75$ .

**Example 6:**

Find the LCM and HCF of 1296 and 2520 by applying the fundamental theorem of arithmetic method i.e. using the prime factorisation method.

**Solution:**

$$\begin{aligned} 1296 &= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 = 2^4 \times 3^4 \\ 2520 &= 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 7 = 2^3 \times 3^2 \times 5 \times 7 \end{aligned}$$



$$\begin{aligned} \text{LCM} &= 2^4 \times 3^4 \times 5 \times 7 = 45360 \\ \text{HCF} &= 2^3 \times 3^2 = 72 \end{aligned}$$

**Example 7:**

Given that  $\text{HCF}(306, 657) = 9$ . Find  $\text{LCM}(306, 657)$ .

**Solution:**

$\text{HCF}(306, 657) = 9$  means HCF of 306 and 657 = 9

Required LCM (306, 657) means required LCM of 306 and 657.

For any two positive integers:

$$\text{their LCM}(a, b) = \frac{\text{Product of the numbers}}{\text{HCF}(a, b)}$$

$$\text{i.e., LCM}(306, 657) = \frac{306 \times 657}{9} = 22,338$$

**Example 8:**

Check whether  $6^n$  can end with the digit 0 for any natural number.

**Solution:**

Any positive integer ending with the digit zero is divisible by 5 and so its prime factorization must contain the prime 5.

$$6^n = (2 \times 3)^n = 2^n \times 3^n$$

$\Rightarrow$  The prime in the factorisation of  $6^n$  is 2 and 3.

$\Rightarrow$  5 does not occur in the prime factorisation of  $6^n$  for any  $n$ .

$\Rightarrow$   $6^n$  does not end with the digit zero for any natural number  $n$ .

**Example 9:**

In a morning walk three persons step off together, their steps measure 80 cm, 85 cm and 90 cm respectively.

What is the minimum distance each should walk so that they can cover the distance in complete steps?

**Solution:**

Required minimum distance each should walk so, that they can cover the distance in complete step is the L.C.M. of 80 cm, 85 cm and 90 cm

$$80 = 2^4 \times 5$$

$$85 = 5 \times 17$$

$$90 = 2 \times 3^2 \times 5$$

$$\text{LCM} = 2^4 \times 3^2 \times 5 \times 17$$

$$\text{LCM} = 16 \times 9 \times 5 \times 17$$

$$\text{LCM} = 12240 \text{ cm} = 122 \text{ m } 40 \text{ cm.}$$





**Example 10:**

Find the greatest number of six digits exactly divisible by 15, 24 and 36.

**Solution:**

We have :

$$15 = 3 \times 5; 24 = 2^3 \times 3; 36 = 2^2 \times 3^2$$

$$\text{LCM}(15, 24, 36) = 2^3 \times 3^2 \times 5 = 8 \times 9 \times 5 = 360$$

Now the greatest six-digit number is 999999.

If we divide 999999 by 360, then  $q = 2777$  and  $r = 279$

$$\therefore \text{Required number} = 999999 - 279 = 999720.$$

**FUNDAMENTAL UNLOCKED- (FU#3)**

- Q.1** Express the following numbers as a product of prime factors:  
(a) 1771 (b) 8232 (c) 10584
- Q.2** Find the HCF and LCM of the following pairs of numbers by prime factorization and verify that  $\text{LCM} \times \text{HCF} = \text{product of the numbers}$ .  
(a) 1080 and 252 (b) 252 and 294
- Q.3** If the LCM of two numbers is 252, HCF is 2 and one of the numbers is 28 find the other number.
- Q.4** Check whether  $4^n$  can end with the digit 0 for any natural number.
- Q.5** Leena has music class on alternate days, dance class once in 3 days and yoga once in 5 days. On the 1<sup>st</sup> of January she had all the three classes. When will she have all the 3 classes again?

**Proof Of Irrationality And Decimal Representation**

**Irrational Number :**

An irrational number is a real number that cannot be expressed as the ratio of two integer.

Eg. -  $\sqrt{2}, \sqrt{3}, \sqrt{5}, \sqrt{7}, \pi$  etc.

Decimal representation of irrational number is non terminating and non-repeating.

**Proving Irrationality Of Numbers**

In class IX, we have learnt about irrational numbers and their properties. We have also learnt about the existence of irrational numbers and their representation on the number line. Recall that a

number is an irrational number if it cannot be written in the form  $\frac{p}{q}$ , where  $p$  and  $q$  are integers and  $q \neq 0$

. For example,  $\sqrt{2}, \sqrt{3}, \sqrt{7}, \frac{\sqrt{2}}{\sqrt{5}}, \pi$  etc. are irrational numbers. In this section, we will prove that  $\sqrt{2}, \sqrt{3}, \sqrt{5}$  etc. are irrational numbers by using the Fundamental Theorem of Arithmetic. In fact, for any prime number  $p$ ,  $\sqrt{p}$  is an irrational number. In proving the irrationality of these numbers, we will use the result that if a prime  $p$  divides  $a^2$ , then it divides  $a$  also. We will prove the irrationality of numbers by using the method of contradiction. In class IX, we have also learnt that the sum or difference of a rational and an irrational number is an irrational number. Also, the product and quotient of a non-zero rational number and an irrational number is an irrational number.

**Decimal Representation Of A Rational Number**

- (i) Let  $x$  be a rational number whose decimal expansion terminates. Then,  $x$  can be expressed in the form  $\frac{p}{q}$ , where  $p$  and  $q$  are co-primes, and prime factorization of  $q$  is of the form  $2^m \times 5^n$ , where  $m, n$  are non-negative integers.

- (ii) Let  $x = \frac{p}{q}$  be a rational number, such that the prime factorisation of  $q$  is not of the form  $2^m \times 5^n$ , where  $m, n$  are non-negative integers. Then,  $x$  has a decimal expansion which is non-terminating repeating.

E.g. –

(a)  $\frac{189}{125} = \frac{189}{5^3} = \frac{189}{2^0 \times 5^3}$

we observe that the prime factorisation of the denominator of this rational number is of the form  $2^m \times 5^n$ , where  $m, n$  are non-negative integers. Hence,  $\frac{189}{125}$  has terminating decimal expansion.





(b)  $\frac{17}{6} = \frac{17}{2 \times 3}$

we observe that the prime factorisation of the denominator of this rational number is not of the form  $2^m \times 5^n$ , where m, n are non-

negative integers. Hence  $\frac{17}{6}$  has

non-terminating and repeating decimal expansion.

(c)  $\frac{17}{8} = \frac{17}{2^3 \times 5^0}$  So, the denominator 8 of  $\frac{17}{8}$  is

of the form  $2^m \times 5^n$ , where m, n are non-negative integers.

Hence  $\frac{17}{8}$  has terminating decimal expansion.

(d)  $\frac{64}{455} = \frac{64}{5 \times 7 \times 13}$

Clearly, 455 is not of the form  $2^m \times 5^n$ . So,

the decimal expansion of  $\frac{64}{455}$  is

non-terminating repeating.

**Example 11:**

Prove that  $\sqrt{2}$  is an irrational number.

**Solution:**

Let us assume on the contrary that  $\sqrt{2}$  is a rational number.

Then, there exists positive integer a and b such that

$\sqrt{2} = \frac{a}{b}$  where, a and b are coprime integers and b

$\neq 0$  i.e. their HCF is 1.

$$\Rightarrow (\sqrt{2})^2 = \left(\frac{a}{b}\right)^2 \Rightarrow 2 = \frac{a^2}{b^2}$$

$$\Rightarrow a^2 = 2b^2 \Rightarrow a^2 \text{ is a multiple of } 2$$

$$\Rightarrow a \text{ is a multiple of } 2 \dots (i)$$

$$a = 2c \text{ for some integer } c.$$

$$\Rightarrow a^2 = 4c^2 \Rightarrow 2b^2 = 4c^2$$

$$\Rightarrow b^2 = 2c^2 \Rightarrow b^2 \text{ is a multiple of } 2$$

$$\Rightarrow b \text{ is a multiple of } 2 \dots (ii)$$

From (i) and (ii), a and b have at least 2 as a common factor. But this contradicts the fact that a and b are co-prime. This means that  $\sqrt{2}$  is an irrational number.

**Example 12:** Prove that  $5\sqrt{3}$  is not rational

**Solution:** Let  $5\sqrt{3}$  be rational

Let  $5\sqrt{3} = \frac{a}{b}$  where a and b are coprime integers

and  $b \neq 0$

$$\sqrt{3} = \frac{a}{5b}$$

This means that  $\sqrt{3}$  which is irrational is equal

to a rational number  $\frac{a}{5b}$ . Which is not true.

$\therefore 5\sqrt{3}$  cannot be rational

**Example 13:**

Prove that  $3 - \sqrt{5}$  is an irrational number.

**Solution:**

Let us assume that on the contrary that  $3 - \sqrt{5}$  is rational.

Then, there exist co-prime positive integers a and b such that,  $b \neq 0$

$$3 - \sqrt{5} = \frac{a}{b} \Rightarrow 3 - \frac{a}{b} = \sqrt{5}$$

$$\Rightarrow \frac{3b - a}{b} = \sqrt{5}$$

$$\Rightarrow \sqrt{5} \text{ is rational, Which is false.}$$

$$[\because a, b \text{ are integer } \therefore \frac{3b - a}{b} \text{ is a rational number}]$$

Hence,  $3 - \sqrt{5}$  is an irrational number.

**Example 14:**

Prove that  $\sqrt{2} + \sqrt{5}$  is irrational.

**Solution:** Let us assume on the contrary that  $\sqrt{2} +$

$\sqrt{5}$  is a rational number, Then, there exist co-

prime positive integers a and b such that  $\sqrt{2} +$

$$\sqrt{5} = \frac{a}{b} \text{ and } b \neq 0$$

$$\Rightarrow \sqrt{5} = \frac{a}{b} - \sqrt{2}$$

Squaring both sides

$$\Rightarrow \left(\frac{a}{b} - \sqrt{2}\right)^2 = (\sqrt{5})^2$$





$$\Rightarrow \frac{a^2}{b^2} - \frac{2a}{b} \sqrt{2} + 2 = 5$$

$$\Rightarrow \frac{a^2}{b^2} - 3 = \frac{2a}{b} \sqrt{2}$$

$$\Rightarrow \frac{a^2 - 3b^2}{2ab^2} = \sqrt{2}$$

$$\Rightarrow \sqrt{2} \text{ is a rational number.}$$

$$[\because \frac{a^2 - 3b^2}{2ab^2} \text{ is a rational number}]$$

$$\Rightarrow \sqrt{2} \text{ is an irrational number.}$$

So, our assumption is wrong. Hence,  $\sqrt{2} + \sqrt{5}$  is irrational.

**Example 15:**

The decimal expansion of the rational number

$\frac{43}{(2^4)(5^3)}$  will terminate after how many places of decimals?

**Solution:**

$$\frac{43}{(2^4)(5^3)} = \frac{(43)(5)}{(2^4)(5^4)} = \frac{215}{10^4} = 0.0215$$

Given rational number will terminate after four places of decimals.

**FUNDAMENTAL UNLOCKED- (FU#4)**

**Q.1** Show that  $\sqrt{11}$  is an irrational number.

**Q.2** Show that  $4 - \sqrt{3}$  is an irrational number.

**Q.3** Show that  $2\sqrt{5}$  is an irrational number.

**Q.4** Show that  $\sqrt{5} - \sqrt{3}$  is an irrational number.

**Q.5** Without actually performing the long division, state whether  $\frac{343}{875}$  has terminating decimal expansion or not.

**ANSWER KEY**

**FUNDAMENTAL UNLOCKED- (FU#1)**

**Q.1** 0, 1, 2, 3, 4

**Q.2** Yes

**Q.3** Yes

**FUNDAMENTAL UNLOCKED- (FU#2)**

**Q.1** 27

**Q.2** 233

**Q.3** m=2

**Q.4** 35

**FUNDAMENTAL UNLOCKED- (FU#3)**

**Q.1** (a)  $7 \times 11 \times 23$  (b)  $2^3 \times 3 \times 7^3$  (c)  $7^2 \times 3^3 \times 2^3$

**Q.2** (a) 36 and 7560 (b) 42 and 1764

**Q.3** 18

**Q.4** No

**Q.5** 31<sup>st</sup> January






**EXERCISE - I**
**Single Correct Type Questions**

1. Which of the following numbers has terminating decimal expansion?

(A)  $\frac{37}{45}$  (B)  $\frac{21}{2^3 5^6}$  (C)  $\frac{17}{49}$  (D)  $\frac{89}{2^2 3^2}$

2. If a rational number  $x$  is expressed as  $x = \frac{p}{q}$ ,

where  $p, q$  are integer,  $q \neq 0$  and  $p, q$  have no common factor (except 1), then the decimal expansion of  $x$  is terminating if and only if  $q$  has a prime factorization of the form:

(A)  $2^m \cdot 5^n$  (B)  $2^m \cdot 3^n$  (C)  $2^m \cdot 7^n$  (D)  $5^m \cdot 3^n$

Where  $m$  and  $n$  are non-negative integers.

3. Which of the following numbers has non-terminating repeating decimal expansion?

(A)  $\frac{7}{80}$  (B)  $\frac{17}{320}$  (C)  $\frac{20}{100}$  (D)  $\frac{93}{420}$

4. The HCF of two numbers is 145 and their LCM is 2175. If one number is 725, then the other number is

(A) 415 (B) 425 (C) 435 (D) 445

5. If  $\text{HCF}(96, 404) = 4$ , then  $\text{LCM}(96, 404)$  is

(A) 9626 (B) 9696 (C) 9656 (D) 9676

6. Which of the following is not a rational number?

(A)  $\sqrt{3}$  (B)  $\sqrt{9}$  (C)  $\sqrt{16}$  (D)  $\sqrt{25}$

7. The  $[\text{HCF} \times \text{LCM}]$  for the number 50 and 20 is

(A) 10 (B) 1000 (C) 100 (D) 110

8. The product of two numbers is 960. If HCF is 8, then the numbers are

(A) 24, 40 (B) 8, 120 or 24, 40 (C) 8, 140  
(D) none of these

9. The HCF of two numbers is  $\frac{1}{5}$  of their LCM. If

the product of two numbers is 720, then the HCF of the numbers is

(A) 13 (B) 12 (C) 14 (D) 18

10. The LCM of two numbers is 39780 and their ratio is 13 : 15 then the numbers are

(A) 273, 315 (B) 2652, 3060  
(C) 516, 685 (D) none

11. The LCM of two numbers is 14 times of their HCF. The sum of LCM and HCF is 600. If one of the numbers is 80, then other is

(A) 280 (B) 218 (C) 25 (D) 45

12. The LCM of two numbers is 48. The numbers are in the ratio 2 : 3. The sum of the numbers is

(A) 28 (B) 32 (C) 40 (D) 64

13. The H.C.F. of  $2^2 \times 3^3 \times 5^5$ ,  $2^3 \times 3^2 \times 5^2 \times 7$  and  $2^4 \times 3^4 \times 5 \times 7^2 \times 11$  is

(A)  $2^2 \times 3^2 \times 5$   
(B)  $2^2 \times 3^2 \times 5 \times 7 \times 11$   
(C)  $2^4 \times 3^4 \times 5^5$   
(D)  $2^4 \times 3^4 \times 5^5 \times 7 \times 11$

14. The L.C.M. of  $2^3 \times 3^2 \times 5 \times 11$ ,  $2^4 \times 3^4 \times 5^2 \times 7$  and  $2^5 \times 3^3 \times 5^3 \times 7^2 \times 11$  is

(A)  $2^3 \times 3^2 \times 5$   
(B)  $2^5 \times 3^4 \times 5^3$   
(C)  $2^3 \times 3^2 \times 5 \times 7 \times 11$   
(D)  $2^5 \times 3^4 \times 5^3 \times 7^2 \times 11$

15. The decimal expansion of the rational number

$\frac{31}{2^2 \times 5}$  will terminate after :

(A) one decimal place  
(B) two decimal places  
(C) three decimal places  
(D) more than three decimal places

16. Which of the following is a non-terminating repeating decimal?

(A)  $\frac{35}{14}$  (B)  $\frac{14}{35}$  (C)  $\frac{1}{7}$  (D)  $\frac{7}{8}$





17. The decimal representation of  $\frac{27}{400}$  is :  
 (A) Terminating  
 (B) Non terminating recurring  
 (C) Non terminating non-recurring  
 (D) None of these
18. A rational number can be expressed as a terminating decimal if the denominator has factors  
 (A) 2 or 5 (B) 2, 3 or 5  
 (C) 3 or 5 (D) None of these
19.  $\frac{961}{625}$  is a  
 (A) Terminating decimal  
 (B) Nonterminating decimal  
 (C) Cannot be determined  
 (D) None of these
20. 28 mango trees, 42 apple trees and 21 orange trees have to be planted in rows such that each row contains the same number of trees of one variety only. The minimum number of rows in which the above trees may be planted  
 (A) 13 (B) 12 (C) 11 (D) 10

#### Very Short Answer Type Questions

- Find the  $[HCF \times LCM]$  for the numbers 105 and 120.
- If two positive integers  $a$  and  $b$  are written as  $a = x^3y^2$  and  $b = xy^3$ ;  $x, y$  are prime numbers, then find the HCF ( $a, b$ )
- If two positive integers  $p$  and  $q$  can be expressed as  $p = ab^2$  and  $q = a^3b$ ;  $a, b$  being prime numbers, then find the LCM ( $p, q$ )
- Find the least number that is divisible by all the numbers from 1 to 10 (both inclusive).
- The decimal expansion of the rational number  $\frac{14587}{1250}$  will terminate after how many decimal places ?
- Can two numbers have 18 as their HCF and 380 as their LCM? Give reasons.

- If least prime factor of  $a$  is 3 and the least prime factor of  $b$  is 7, the least prime factor of  $(a + b)$  is :
- Find the unit's digit in the product of the first 50 odd natural numbers.
- If  $x = 2^3 \times 3 \times 5^2$ ,  $y = 2^2 \times 3^3$ , then HCF ( $x, y$ ) is :
- The product of the HCF and LCM of the smallest prime number and the smallest composite number is :

#### Short Answer Type Questions

- Prove that  $\sqrt{3} + \sqrt{7}$  is irrational.
- Explain why  $3 \times 5 \times 7 + 7$  is a composite number.
- Without actually performing the long division, find if  $\frac{987}{10500}$  will have terminating or non-terminating (repeating) decimal expansion. Give reasons for your answer.
- It is terminating decimal.
- A rational number in its decimal expansion is 327.7081. What can you say about the prime factors of  $q$ , when this number is expressed in the form  $\frac{p}{q}$ ?
- Explain  $5 \times 4 \times 3 \times 2 \times 1 + 3$  is a composite number.
- Show that  $5^n$  can't end with the digit 2 for any natural number  $n$ .
- Check whether  $6^n$  can end with the digit 0 for any natural number  $n$ .
- Without actually performing the long division, state whether the following rational number will have a terminating decimal expansion or non-terminating decimal expansion :  
 (i)  $\frac{77}{210}$  (ii)  $\frac{15}{160}$





9. Find the HCF and LCM of following using Fundamental Theorem of Arithmetic method.  
(i) 426 and 576      (ii) 625, 1125 and 2125
10. Given that  $\text{HCF}(253, 440) = 11$  and  $\text{LCM}(253, 440) = 253 \times R$ . The value of R is :

### Long Answer Type Questions

1. Prove that  $\sqrt{7}$  is irrational.
2. Show that  $12^n$  cannot end with the digit 0 or 5 for any natural number n.
3. On a morning walk, three persons step off together and their steps measure 40 cm, 42 cm and 45 cm, respectively. What is the minimum distance each should walk so that each can cover the same distance in complete steps?
4. Prove that  $3 + \sqrt{2}$  is an irrational number
5. Prove that  $\sqrt{3} + \sqrt{5}$  is an irrational number
6. An army contingent of 616 members is to march behind an army band of 32 members in a parade. The two groups are to march in the same number of columns. What is the maximum number of columns in which they can march ?
7. There is a circular path around a sports field. Sonia takes 18 minutes to drive one round of the field, while Ravi takes 12 minutes for the same. Suppose they both start at the same point and at the same time, and go in the same direction. After how many minutes will they meet again at the starting point ?
8. Aakash, Kushal and Harish go for a morning walk. They step off together and their steps measure 40cm, 42cm and 45cm, respectively.  
(a) What is the minimum distance each should walk so that each can cover the same distance in complete steps?  
(b) How is morning walk useful?

### Case based Question

1. A seminar is being conducted by an Educational Organisation, where the participants will be educators of different subjects. The number of participants in Hindi, English and Mathematics are 60, 84 and 108 respectively.



- (I) In each room the same number of participants are to be seated and all of them being in the same subject, hence maximum number participants that can accommodated in each room are  
(A) 14  
(B) 12  
(C) 16  
(D) 18
- (II) What is the minimum number of rooms required during the event?  
(A) 11  
(B) 31  
(C) 41  
(D) 21
- (III) The LCM of 60, 84 and 108 is  
(A) 3780  
(B) 3680  
(C) 4780  
(D) 4680
- (IV) The product of HCF and LCM of 60,84 and 108 is  
(A) 55360  
(B) 35360  
(C) 45500  
(D) 45360





- (V) 108 can be expressed as a product of its primes as  
 (A)  $2^3 \times 3^2$   
 (B)  $2^3 \times 3^3$   
 (C)  $2^2 \times 3^2$   
 (D)  $2^2 \times 3^3$

2. A school is conducting an inter-school competition for students in three subjects, the number of participants in Mathematics, English and Science are 40, 50 and 60 respectively. The coordinator has made the arrangement such that in each room, the same number of participants are to be seated and all of them being in the same subject. Also, they allotted a separate room for all officials other than participants.

- (I) Find the LCM of 40, 50 and 60  
 (A) 600 (B) 300  
 (C) 60 (D) 200
- (II) Find the HCF of 40, 50 and 60  
 (A) 15 (B) 30  
 (C) 10 (D) 20
- (III) Find the minimum number of rooms required, if in each room, the same number of participants are to be seated and all of them in the same subject.  
 (A) 15 (B) 30  
 (C) 10 (D) 20




**EXERCISE - II**
**Multiple Correct Type Questions**

- Value of  $\frac{2^{100}}{2}$  is :  
(A) 1 (B)  $50^{100}$  (C)  $8^{33}$  (D)  $2^{99}$
- Which real number lies between 2 and 2.5  
(A)  $\sqrt{11}$  (B)  $\sqrt{8}$  (C)  $\sqrt{5}$  (D)  $\sqrt{4.5}$
- H.C.F. of 3240, 3600 and a third number is 36 and their L.C.M. is  $2^4 \times 3^5 \times 5^2 \times 7^2$ . Then the third number is  
(A)  $2^2 \times 3^5 \times 7^2$  (B)  $2^2 \times 5^3 \times 7^2$   
(C) 47628 (D) 24500
- Which of the following is a non-terminating repeating decimal ?  
(A)  $\frac{35}{14}$  (B)  $\frac{14}{35}$  (C)  $\frac{1}{7}$  (D)  $\frac{7}{9}$
- 3.24636363..... is  
(A) an integer  
(B) A rational number  
(C) an irrational number  
(D) Non-terminating repeating
- A rational number can be expressed as a terminating decimal if the denominator has factors  
(A) 2 or 5 (B) Only 2  
(C) Only 5 (D) None of these
- The value of  $23.\overline{43} + 5.\overline{2}$  is  
(A)  $\frac{2395}{990}$  (B)  $\frac{2527}{99}$  (C)  $\frac{5674}{198}$  (D)  $\frac{2837}{99}$
- If  $2 = x + \frac{1}{1 + \frac{1}{3 + \frac{1}{4}}}$ , then value of x is  
(A)  $\frac{12}{17}$  (B)  $\frac{13}{17}$  (C)  $\frac{42}{34}$  (D)  $\frac{21}{17}$

- Which one of the following is true ?  
(A)  $\pi$  is an irrational number.  
(B) All rational numbers are irrational numbers.  
(C) All real numbers can be represented on a number line.  
(D)  $\frac{\sqrt{7}}{8}$  is a rational number.
- Which is not an irrational number ?  
(A)  $5 - \sqrt{3}$   
(B)  $\sqrt{2} + \sqrt{5}$   
(C)  $4 + \sqrt{16}$   
(D)  $6 + \sqrt{9}$

**Match the Column Type Questions**

- Match the column -

Column- I		Column-II	
(A)	LCM of 15 and 25 is	(P)	2
(B)	HCF of 52 and 34 is	(Q)	Terminating decimal
(C)	$\frac{15}{3^1 \times 2^2 \times 5^3}$ is	(R)	Non-terminating recurring decimal
(D)	$\frac{17}{3^2 \times 5^1}$ is	(S)	75

**Assertion and Reason**

**Directions:** Each of the following questions contains an assertion followed by a reason. Read them carefully and answer the questions on the basis of the following options.

- Both assertion and reason are true and the reason is the correct explanation of assertion.
- Both assertion and reason are true but the reason is not the correct explanation of the assertion.
- Assertion is true and the reason is false.
- Assertion is false and the reason is true.





1. **Assertion:**  $\frac{23}{2^4 \times 3^1 \times 7^1}$  is non terminating recurring.

**Reason:** The denomination is not of the form  $2^m \times 5^n$  where m and n are whole numbers.

2. **Assertion:** The decimal expansion of  $\sqrt{2}$  is non terminating non-recurring.

**Reason:** It is an irrational number.

### Comprehension

1. Aadya has 143 stamps; she gives away 11 stamps and divides the remaining equally into groups. Sumit has 220 stamps; he gives away 11 stamps and divides the remaining equally into groups. They end up with the same number of groups.

- (I) What is the number of groups?  
 (II) What is the number of stamps in Aadya's and Sumit's groups?  
 (III) A number is multiplied by 5. Then, 40 is subtracted from the product. The result obtained is then multiplied by 2 and 50 subtracted from the product so obtained. The answer is a two-digit number.  
 What is the largest integer that can be used to get a two-digit number as the answer?

### Numerical Type Questions

1. V is product of first 41 natural numbers.  $A = V + 1$ . The number of primes among  $A + 1, A + 2, A + 3, A + 4, \dots, A + 39, A + 40$  is:  
 2. If  $a^2 - b^2 = 13$  where a and b are natural numbers, then value of a is :  
 3. The number of ordered pairs (a, b) of positive integers such that  $a + b = 90$  and their greatest common divisor is 6 equals.  
 4. What is the number in the units place of  $(763)^{84}$ ?

5. Find the greatest number that divides 59 and 54 leaving remainders 3 and 5 respectively.

6. Find the unit digit in the expansion of  $(44)^{44} + (55)^{55} + (88)^{88}$ .

7. The absolute value of  $25 - (25 + 10) + 25 \div 125 \times 25$  is

8.  $8 - 8 \times \frac{2\frac{1}{5} - 1\frac{2}{7}}{2 - \frac{1}{6 - \frac{1}{6}}}$  is equal to

9. Two ropes of length 28 m and 36 m are to be cut into bits of same length. The greatest possible length of each is

10. The remainder when  $7^{84}$  is divided by 342 is

### HOTS

1. The positive integers A, B,  $A - B$  and  $A + B$  are all prime numbers. The sum of these four primes is  
 2. The value of the digit d for which the number d456d is divisible by 18, is :  
 3. There is an N digit number ( $N > 1$ ). If the sum of digits is subtracted from the number then the resulting number will be divisible by :  
 4. If x is a positive integer such that  $2x + 12$  is perfectly divisible by 'x', then the number of possible values of 'x' is:  
 5. The least number which on division by 35 leaves a remainder 25 and on division by 45 leaves the remainder 35 and on division by 55 leaves the remainder 45 is :  
 6. One hundred monkeys have 100 apples to divide. Each adult gets three apples while three children share one. Number of adult monkeys are :  
 7. If n is a natural number, then  $9^{2n} - 4^{2n}$  is always divisible by





- |   |   |
|---|---|
| <p>8. If <math>1 \leq k \leq 25</math>, how many prime numbers are there which are of the form <math>6k + 1</math>?</p> <p>9. If <math>a, b, c</math> and <math>d</math> are four positive real numbers such that sum of <math>a, b</math>, and <math>c</math> is even and the sum of <math>b, c</math> and <math>d</math> is odd, then <math>a^2 - d^2</math> is necessarily</p> <p>10. Find the greatest four-digit number which when divided by 18 and 12 leaves a remainder of 4 in each case</p> <p>11. When simplified, the product <math>\left(1 - \frac{1}{3}\right)\left(1 - \frac{1}{4}\right)\left(1 - \frac{1}{5}\right) \dots \left(1 - \frac{1}{n}\right)</math> equals</p> | <p>12. Find the least multiple of 23, which when divided by 18, 21 and 24 leaves remainders 7, 10 and 13 respectively.</p> <p>13. If <math>a^2 + b^2 + c^2 + d^2 = 25</math>, then prove that <math>ab + bc + cd + da \leq 25</math></p> <p>14. If <math>2^x = 4^y = 8^z</math> and <math>\frac{1}{2x} + \frac{1}{4y} + \frac{1}{6z} = \frac{24}{7}</math>, then the value of <math>z</math> is -</p> <p>15. Four positive integers sum to 125. If the first of these numbers is increased by 4, the second is decreased by 4. The third is multiplied by 4 and the fourth is divided by 4 we find four equal numbers then four original integers are</p> |
|---|---|





EXERCISE - III

Previous Year Questions

- Raj wanted to type the first 200 natural numbers, how many times does he have to press the keys [NTSE Stage-1 2015]  
(A) 489 (B) 492  
(C) 400 (D) 365
- Which is the greatest among  $\sqrt[6]{100}$ ,  $\sqrt[3]{12}$  and  $\sqrt{3}$  [NTSE Stage-1 2015]  
(A)  $\sqrt{3}$   
(B)  $\sqrt[6]{100}$   
(C)  $\sqrt[3]{12}$   
(D) cannot be determined
- The traffic lights at three different signals change after 48 seconds, 72 seconds and 108. If they change at 7 a.m. simultaneously. How many times they will change between 7 a.m. to 7 : 30 a.m. simultaneously ? [NTSE Stage-1 2015]  
(A) 3 (B) 4 (C) 5 (D) 2
- If  $x = 2 + \sqrt{3}$  and  $xy = 1$  then  $\frac{x}{\sqrt{2} + \sqrt{x}} + \frac{y}{\sqrt{2} - \sqrt{y}} = \dots\dots\dots$  [NTSE Stage-1 2015]  
(A)  $\sqrt{2}$  (B)  $\sqrt{3}$   
(C) 1 (D) None of these
- Raj wanted to type the first 200 natural numbers, how many times does he have to press the keys [NTSE Stage-1 2016]  
(A) 489 (B) 492 (C) 400 (D) 365
- If a number  $m$  is divided by 5 leaves a remainder 2, while another number  $n$  is divided by 5 leaves a remainder 4, then the remainder, when  $(m + n)$  is divided by 5 is : [NTSE Stage-1 2016]  
(A) 1 (B) 2 (C) 3 (D) 4

- What is the square root of  $9 + 2\sqrt{14}$  ? [NTSE Stage-1 2016]  
(A)  $1 + 2\sqrt{2}$  (B)  $\sqrt{3} + \sqrt{6}$   
(C)  $\sqrt{2} + \sqrt{7}$  (D)  $\sqrt{2} + \sqrt{5}$
- $\sqrt[3]{1 - \frac{127}{343}}$  is equal to [NTSE Stage-1 2016]  
(A)  $\frac{5}{9}$  (B)  $1 - \frac{1}{7}$  (C)  $\frac{4}{7}$  (D)  $1 - \frac{2}{7}$
- What is the value of  $2.\bar{6} - 1.\bar{9}$  ? [NTSE Stage-1 2016]  
(A)  $0.\bar{6}$  (B)  $0.\bar{9}$  (C)  $0.\bar{7}$  (D) 0.7
- An equivalent expression of  $\frac{5}{7 + 4\sqrt{5}}$  after rationalizing the denominator is [NTSE Stage-1 2016]  
(A)  $\frac{20\sqrt{5} - 35}{31}$  (B)  $\frac{20\sqrt{5} - 35}{129}$   
(C)  $\frac{35 - 20\sqrt{5}}{31}$  (D)  $\frac{35 - 20\sqrt{5}}{121}$
- Four positive integers sum to 125. If the first of these numbers is increased by 4, the second is decreased by 4. The third is multiplied by 4 and the fourth is divided by 4 we find four equal numbers then four original integers are [NTSE Stage-1 2016]  
(A) 16, 24, 5, 80 (B) 8, 22, 38, 57  
(C) 7, 19, 46, 53 (D) 12, 28, 40, 45
- If  $a = \sqrt{6} + \sqrt{5}$ ;  $b = \sqrt{6} - \sqrt{5}$ , the find the value of  $2a^2 - 5ab + 2b^2$  [NTSE Stage-1 2016]  
(A) 36 (B) 37 (C) 39 (D) 41
- $\sqrt{m^4 n^4} \times \sqrt[6]{m^2 n^2} \times \sqrt[3]{m^2 n^2} = (mn)^k$ , then find the value of  $k$ . [NTSE Stage-1 2017]  
(A) 6 (B) 3 (C) 2 (D) 1





14. A positive integer  $n$  when divided by 9, gives 7 as remainder. What will be the remainder when  $(3n - 1)$  is divided by 9 ?

[NTSE Stage-I/18]

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

15. If Least Common Multiple (LCM) of  $a$  and 510 is 23460 and Highest Common Factor (HCF) of  $a$  and 510 is 2 then value of  $a$  is

[NTSE Stage-I/19]

(A) 92      (B) 910      (C) 52      (D) 500





# ANSWER KEY

## EXERCISE-I

### Single Choice Questions

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

### Very Short Answer Type Questions

1. 12600      2.  $XY^2$       3.  $a^3b^2$       4. 2520      5. Four  
 6. No      7. 2      8. 5      9. 12      10. 8

### Short Answer Type Questions

8. (i) non-terminating      (ii) terminating  
 9. (i) HCF = 6, LCM = 40896      (ii) HCF = 125, LCM = 95625  
 10. 40

### Long Answer Type Questions

3. 2520 cm      6. 8      7. 36 minutes  
 8. (a) 2520 cm      (b) It's good for health

### Case Study Questions

Case-1					
Que.	1	2	3	4	5
Ans.	B	D	A	D	D
Case-2					
Que.	1	2	3		
Ans.	A	C	A		

## EXERCISE-II

### Multiple Choice Questions

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

### Match the Column Type Questions

1. A-S, B-P, C-Q, D-R

### Assertion and Reason

1. (A)      2. (A)





Comprehension-1			
Que.	(I)	(II)	(III)
Ans.	11	12,19	22

**Numerical Type Questions**

1. 0    2. 7    3. 8    4. 1    5. 7    6. 7    7. 5  
 8. 4    9. 4    10. 1

Hots										
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	17	6	9	6	3455	25	5 and 13	16	Odd	9976
Que.	11	12	14	15						
Ans.	$\frac{2}{n}$	3013	$\frac{7}{48}$	15,24,5,80						

**EXERCISE-III**
**Previous Year Questions**

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



# DPP

## Daily Practice Problems

**SUBJECT: MATHEMATICS**

**COURSE: CLASS – 10**  
**TOPIC: REAL NUMBERS**

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## DPP NO. 1

## Multiple Choice Questions

1. Four bells toll at intervals of 10 sec., 15 sec., 20 sec. and 30 sec. respectively. If they toll together at 10:00 am, at what time will they toll together for the first time after 10 am?  
(A) 10 : 01 am                  (B) 10 : 02 am                  (C) 10 : 00 : 30 am              (D) 10 : 00 : 45 am
2.  $\sqrt{2}$  is –  
(A) An integer  
(B) A rational number  
(C) An irrational number  
(D) None of these
3.  $\pi = \frac{\text{Circumference of the circle}}{\text{Diameter of the circle}}$   
(A) A rational number  
(B) A whole number  
(C) A positive integer  
(D) None of these
4. HCF(p,q,r). LCM (p,q,r) =  
(A)  $\frac{pq}{r}$                   (B)  $\frac{qr}{p}$                   (C) p,q,r                  (D) None of these
5. If  $\sqrt[3]{32} = 2^x$  then x is equal to  
(A) 5                  (B) 3                  (C)  $\frac{3}{5}$                   (D)  $\frac{5}{3}$
6. If a is a positive integer and p be a prime number and p divides  $a^2$ , then  
(A) a divides p                  (B) p divides a                  (C)  $p^2$  divides a                  (D) None of these
7. If  $a,b,c \in R$  and  $a^2 + b^2 + c^2 = ab + bc + ca$ , then –  
(A)  $a = b = c$                   (B)  $a = b = c = 0$                   (C) a,b,c are distinct              (D) None of these
8. If x and y are positive real numbers, then –  
(A)  $\sqrt{x} + \sqrt{y} > \sqrt{x+y}$     (B)  $\sqrt{x} + \sqrt{y} < \sqrt{x+y}$     (C)  $\sqrt{x} + \sqrt{y} = \sqrt{x+y}$     (D) None of these



9. Between any two distinct rational numbers –  
 (A) There lie infinitely many rational numbers.  
 (B) There lies only one rational number.  
 (C) There lie only finitely many numbers.  
 (D) There lie only rational numbers.
10. The product of divisors of 7056 is –  
 (A)  $(84)^{48}$  (B)  $(84)^{44}$  (C)  $(84)^{45}$  (D) None of these
11. In how many ways can 576 be expressed as a product of two distinct factors ?  
 (A) 10 (B) 11 (C) 21 (D) None of these
12. If p and q are co-prime numbers, then  $p^2$  and  $q^2$  are  
 (A) Coprime (B) not coprime (C) even (D) odd
13. If  $a^{1/x} = b^{1/y} = c^{1/z}$ ,  $b^2 = ac$ , then find the value of  $\frac{x+z}{2y}$   
 (A) 1 (B) -1 (C) 2 (D) 3
14. The greatest number of five digits exactly divisible 279 is-  
 (A) 99603 (B) 99837 (C) 99882 (D) 99881
15. A number lies between 300 and 400. If the number is added to the number formed by reversing the digits, the sum is 888 and if the unit's digit and the ten's digit change places, the new number exceeds the original number by 9. Find the number.  
 (A) 339 (B) 341 (C) 378 (D) 345
16. Three numbers which are co-primes to each other are such that the product of the first two is 551 and that of the last two is 1073. The sum of the three numbers is  
 (A) 75 (B) 81 (C) 85 (D) 89
17.  $7 \times 11 \times 13 \times 15 + 15$  is a  
 (A) Prime number (B) Composite number  
 (C) Neither prime nor Composite (D) None of these
18. What is the greatest number that will divide 307 and 330 leaving remainder 3 and 7 respectively?  
 (A) 16 (B) 23 (C) 19 (D) 17
19. Which is the least number which when doubled will be exactly divisible by 12, 18, 21 and 30.  
 (A) 2320 (B) 1260 (C) 630 (D) 196

20. If the number  $2345p60q$  is exactly divisible by 3 and 5, then the maximum value of  $p + q$  is
- (A) 12                      (B) 13                      (C) 14                      (D) 15

**Very short answer type Questions:**

1. Explain why  $(17 \times 5 \times 11 \times 3 \times 2 + 2 \times 11)$  is a composite number?
2. The LCM of two numbers is 14 times their HCF. The sum of LCM and HCF is 600. If one number is 280, then find the other number.
3. Find the least number which when divided by 6, 15 and 18 leave remainder 4 in each case.
4. "The product of three consecutive positive integers is divisible by 6". Is this statement true and false? Justify your answer.
5. Determine the number nearest to 11000 but greater than 100000 which is exactly divisible by each of 8, 15, and 21.

**Short answer type Questions:**

1. Show that square of any positive integer cannot be of the form  $7q + 3$  or  $7q + 5$  or  $7q + 6$ , for any integer  $q$ .
2. The sum of LCM and HCF of two numbers is 1260. If their LCM is 900 more than their HCF, find the product of two numbers.
3. Let  $m, n, o, p$  be positive rational such that  $m + \sqrt{n} = o + \sqrt{p}$ , then either  $m=o$  and  $n=p$  or  $m$  and  $o$  are squares of rationals.
4. Show that there is no positive integer  $p$  for which  $\sqrt{p-1} + \sqrt{p+1}$  is rational.
5. Show that any positive odd integer of the form  $8m+1$  or  $8m+3$  or  $8m+5$  or  $8m+7$  where  $m$  is some integer.

**Long answer type Questions:**

1. Find the greatest numbers that will divide 445,572, and 699 leaving remainders 4, 5, and 6 respectively.
2. If  $d$  is the HCF of 56 and 72, find  $x$  and  $y$  satisfying  $d=56x+72y$ . Also, show that  $x$  and  $y$  are not unique.
3. Prove that if  $x$  and  $y$  are odd positive integers, then  $x^2+y^2$  is even but not divisible by 4.

### Case based Study

1. The department of Computer Science and Technology is conducting an international seminar. In the seminar, the number of participants in Mathematics, Science and computer Science are 60, 84 and 108 respectively. The coordinator has made the arrangement such that in each room, the same number of participants are to be seated and all of them being is of the same subject. Also they allotted the separate room for all the official other than participants.



- (I) The total number of participants is:  
 (A) 60 (B) 84 (C) 108 (D) 252
- (II) The minimum number of rooms required, if in each room, the same number of participants are to be seated and all of them being in the same subject is:  
 (A) 12 (B) 20 (C) 21 (D) None of these
2. Sandhya on the very first day of her job in a bank, noticed that there are six bells which keep on tolling at regular intervals. She noticed that toll of their intervals are 2, 4, 6, 8, 10, 12 minutes respectively. If all the six bells commence tolling together, at 10 a.m., then answer the following questions: Based on the given information, answer the following questions:
- (I) At what time will they again toll together?  
 (A) 12.00am (B) 1:00pm (C) 2.30pm (D) 3.00pm
- (II) How many times these bells will toll together during the working hours of Sandhya's job, if Sandhya works for 8 hours in a day?  
 (A) 2 hr (B) 4 hr (C) 3 hr (D) 6 hr

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

### Case based Study

1. (I) (D)  
 (II) (C)
2. (I) (A)  
 (II) (B)

# FOUNDATION

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CLASS-X

SAMPLE

BIOLOGY





# 1

## CONTROL AND COORDINATION

### Introduction

- The changes in the environment to which the organisms respond and react are called **stimuli**. The response of organisms to a stimulus is usually in the form of some movement of their body part.
  - Coordination** is the working together of the various organs in a systematic manner so as to produce a proper reaction to the stimulus.
  - All living organisms show sensitivity to changes in the environment. Stimulus are of two types  
**External:** Stimuli due to environmental factors, e.g. heat, light & water etc.  
**Internal:** It occurs within the organism. It may be due to hormones, acids & enzymes.
  - The working of one system is Co-ordinated with that of other systems, e.g. during eating our body performs several kinds of Co-ordinated activities. The nose differentiates the smell of food and hands serve as the organ of ingestion. The alimentary canal and glands help in the digestion of food. Thus, various organs perform Co-ordinated activities.
  - Control and co-ordination also help to maintain a steady state of stability and steady state within an organism in a constantly changing environment. The mechanism of maintaining internal steady state is called **homeostasis**.
  - The vital activities of an organism are controlled by the Endocrine system and Nervous system.
- (i) In animals both hormones and neurons (structural and functional unit of nervous system) are involved in regulating and Co-ordinating the various vital activities.
- (ii) In plants only chemical (phytohormones) co-ordination is present.

### A. Coordination in Plants

Plants do not have nervous systems like animals. Plants use only hormones for producing reactions to external stimulus. Thus, plants react to stimuli in a very limited way.

### (a) Movements in Plants

The plants are fixed at a place with their roots in the ground, so they cannot move from one place to another. That is plants do not show locomotion (movement of the entire body). However, movements of the individual parts or organs of a plant (like shoot, root, leaves, etc.) are possible when they are subjected to some external stimuli like light, force of gravity, chemical substances, water and touch etc.

**The plant movements made in response to external stimuli fall into two main categories:**

- (I) Tropic movement      (II) Nastic movement

### (I) Tropism (Tropic movement)

A growth movement of a plant part in response to an external stimulus in which the direction of stimulus determines the direction of response is called tropism. Thus, tropism is a directional movement of the part of a plant caused by its growth.

If the growth (or movement) of a plant is towards the stimulus, it is called Positive Tropism.

If the growth (or movement) of a plant part is away from the stimulus, then it is called Negative Tropism.

Stimulus	Types of tropism
Light	Phototropism
Gravity	Geotropism
Chemical	Chemotropism
Water	Hydrotropism
Touch	Thigmotropism

- (i) **Phototropism:** The response of a plant to light is called phototropism. If the plant part moves towards light, it is called positive phototropism. The stem (or shoot) of a growing plant bends towards light, so the stem (or shoot) of a plant shows positive phototropism.

**Experiment to Show Phototropism:** Plants respond to light by growing towards it. Plants also turn their leaves towards the sun to ensure that the leaves get maximum sunlight. This phenomenon can be explained by an experiment.





Take 2 potted plants. Place one plant in the open so that it receives the sunlight coming from above. Place the other plant in a room near the window in such a way that it receives sunlight from one side only, i.e. through the window.

After some days by observing both plants we come to know that the first plant has grown up straight towards light and second plant has grown by bending towards the light. Thus, the stem of the plant responds to light by showing growth movement towards light (positive phototropism)

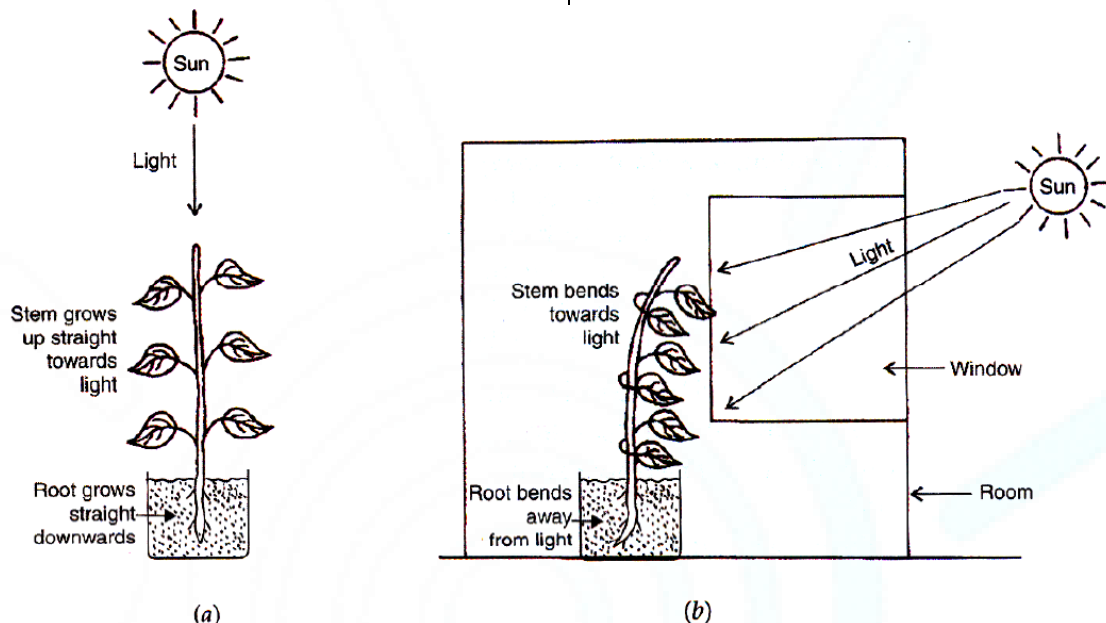


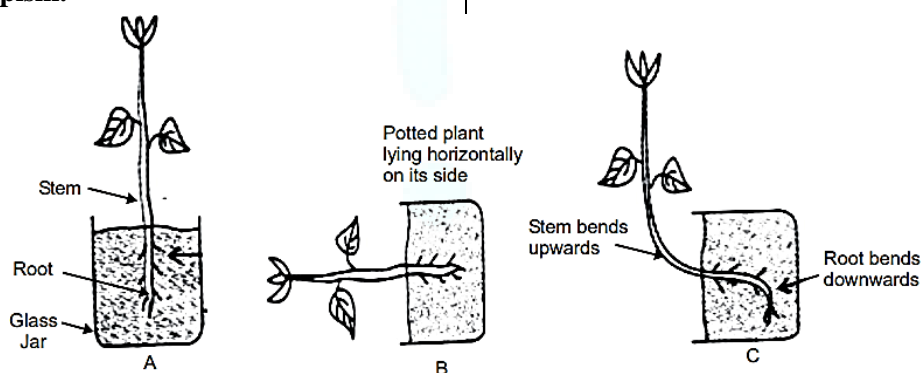
Fig. To show the response of a plant to light (or phototropism).

(ii) **Geotropism:** Response of a plant to gravity is called Geotropism. If the plant part moves in the direction of gravity, it is called Positive Geotropism. The roots of a plant move downwards in the direction of gravity, so the roots of a plant show positive geotropism. The stem (or shoot) of a plant moves upwards against the direction of gravity, so the stem (or shoot) of a plant shows negative geotropism.

### Experiment to Show Geotropism

The plant part responds to gravity by either moving towards or away from earth. This phenomenon is called **geotropism**.

To prove this, take 2 potted plants in a transparent jar. Keep the potted plant growing in transparent jar straight on the ground. Observe that stem growing upwards and roots downwards. Now place this potted plant horizontally on its side on the ground and observe the position of growing stem and the root. Keep the plant in this position for a few days. After a few days we can observe that stem and root are parallel to the ground. Now growing according to its nature means stem bent upward away from earth and root bent downwards towards earth.



Experiment to show the response of a plant to gravity (Geotropism)





(iii) **Chemotropism:** It is due to the chemical stimulus e.g. growth of pollen tube. The response of a plant to chemical stimulus is called chemotropism. If the plant part shows movement (or growth) towards the

chemical, it is called Positive Chemotropism. The pollen tube grows towards the sugary substance (chemical) secreted by the carpel in the flower.

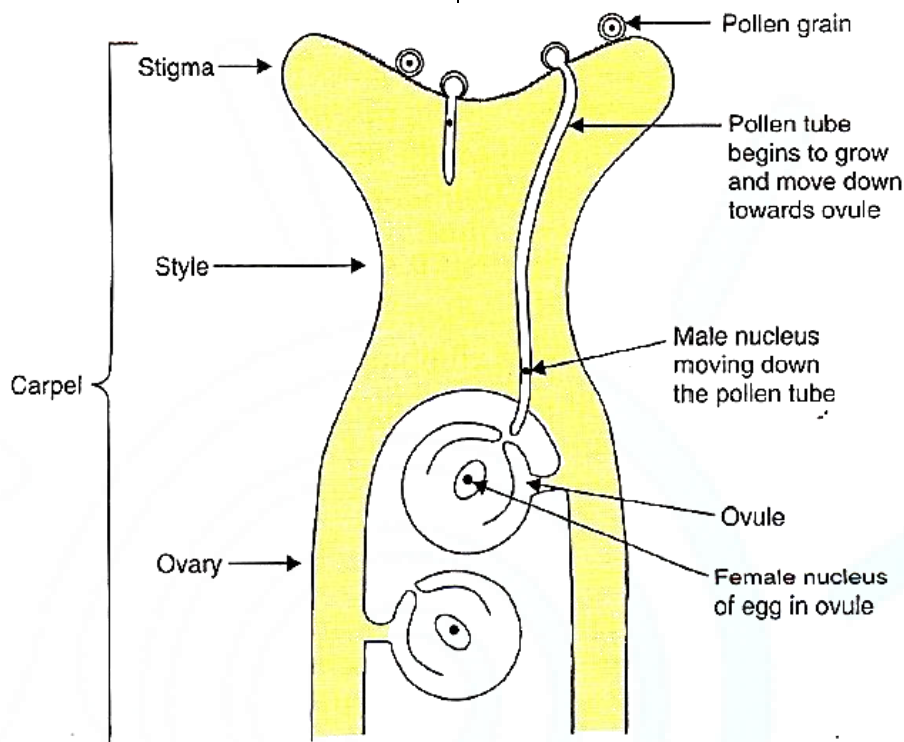


Fig. To show the response of a plant part 'pollen' to chemical secreted by Carpel.

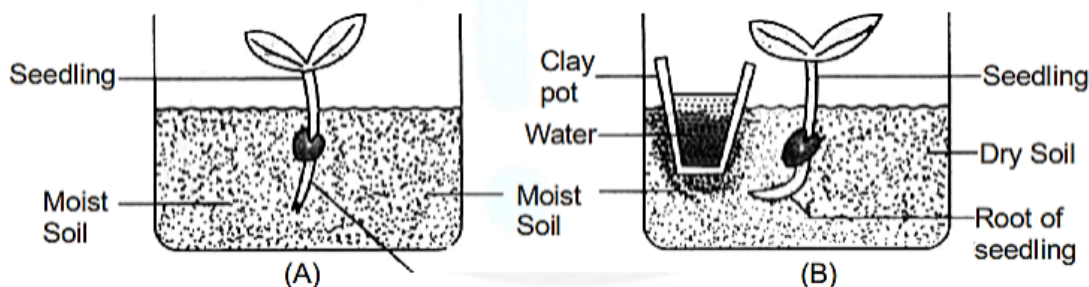
(iv) **Hydrotropism:** The response of a plant part to water is called Hydrotropism. If the plant part moves towards water, it is called Positive Hydrotropism. The roots of a plant always go towards water, so roots are Positively Hydrotropic.

**Experiment to Show Hydrotropism:** The root of plant moves towards water and therefore depict positive hydrotropism. Such type of response can be demonstrated by an experiment.

Take 2 glass trough A and B and fill them with soil upto two-third level. Plant a tiny seedling in each trough. Now place a small clay pot in soil in trough B. Water soil daily in trough A uniformly.

However, in trough B put water daily in clay pot only. After few days, carefully dig up the seedling in both glasses.

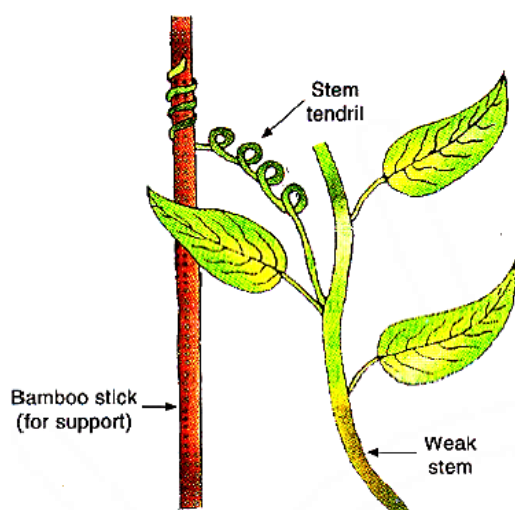
You will notice that in trough A, the root of seedling is straight. However, in trough B, the root of seedling is bent towards the direction of clay pot containing water.



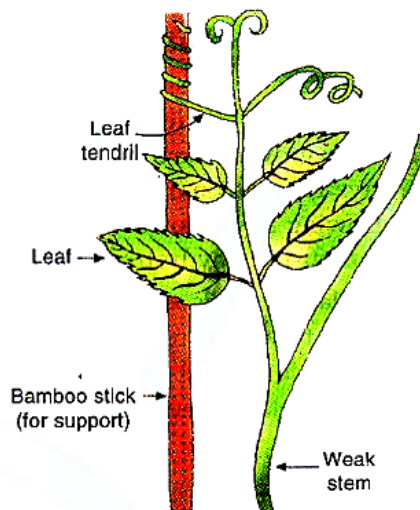
Experiment to reveal the response of root to water (hydrotropism)



- (v) **Thigmotropism:** The climbing parts of plants such as tendrils grow towards any support which happens to touch around that support. So, tendrils of plants are Positively **Thigmotropic**.



(a) Stem tendrils help the plant to climb up a support



(b) Leaf tendrils also help the plant to climb up a support

**Fig. Show the response of a plant part ‘tendrils’ to the touch of an object (here a bamboo stick).**

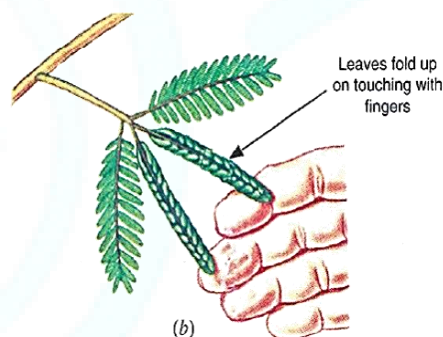
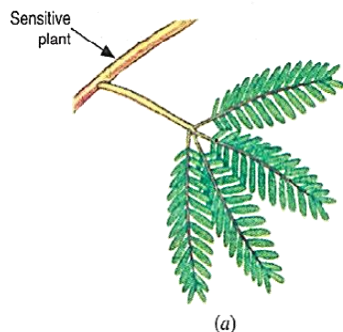
- (II) **Nasties / Nastic movements:** The movement of a plant part in response to an external stimulus in which the direction of response is not determined by the direction of stimulus is called nastic movement.

The folding up of the leaves of a sensitive plant (*Mimosa pudica*) on touching.

The opening up of the petals of dandelion flowers in morning in bright light and closing in the evening when the light fades.

The closing of the petals of moonflower in the morning in bright light and opening at dark when the light fades.

- (i) **Thigmonasty:** The non-directional movement of a plant part in response to the touch of an object is called Thigmonasty. Leaves of ‘touch-me-not’ plant (*Mimosa pudica*) drops rapidly when touched.



**Fig. To show the nastic movements in the leaves of sensitive plant (*Mimosa pudica*) caused by ‘touch’.**

- (b) **Plant Hormones (Phytohormones)**

Plant hormones or phytohormones (‘phyto’ means plant) are naturally occurring organic chemical substances present in plants which bring about control and coordination of various activities in them. They do so by controlling one or the other aspect of growth of the plant. Therefore, plant hormones are also known as. Plant growth substances or plant growth regulators.

Besides growth, various other activities such as promotion of dormancy, breaking of dormancy, opening, and closing of stomata, falling of leaves, fruit growth, fruit ripening, ageing in plants, tropisms and nastic movements etc. are controlled by various phytohormones.





These phytohormones are synthesized in minute quantities in one part of the plant body and these simply diffuse to another part where they influence specific physiological processes.

Now a days, several manufactured chemicals (synthetic plant hormones) are also available. They resemble phytohormones in molecular structure and physiological action. These are called **growth regulators**.

On the basis of their effect, plant hormones (phytohormones) can be divided into **two groups**:

- (i) **Growth Promoters:** These stimulate plant growth, Example auxins, gibberellins and cytokinin's.
- (ii) **Growth Inhibitors:** These inhibit or retard the plant growth, Example abscisic acid (ABA) and ethylene. The synthesis and action of various plant hormones are influenced by internal stimuli. Some prominent actions of these plant hormones are mentioned below.

**Table: Plant hormones and their functions**

S. No	Plant Hormones	Functions
1.	Auxins (naturally occurring auxin is indole three acetic acid)	<ul style="list-style-type: none"> <li>These promote cell enlargement and cell differentiation in plants</li> <li>These also promote stem and fruit growth.</li> <li>These regulate important plant movements, i.e., tropisms.</li> <li>These induce parthenocarp (i.e., the formation of seedless fruits without fertilization) in number of plants.</li> </ul>
2.	Gibberellins (Gibberellic acid)	<ul style="list-style-type: none"> <li>These promote cell enlargement and cell differentiation in plants in the presence of auxins.</li> <li>These also promote growth in stems and fruits.</li> <li>Rosette plants (i.e., plants that show profuse leaf developments but reduced internode growth) show bolting and flowering when treated with gibberellins.</li> <li>Break dormancy of seeds.</li> <li>These also induce parthenocarp in many plants.</li> </ul>
3.	Cytokinin	<ul style="list-style-type: none"> <li>These promote cell division in plants.</li> <li>These play vital role in the morphogenesis in plants.</li> <li>These help in breaking the dormancy of seeds and buds.</li> <li>These delay the ageing in leaves.</li> <li>These promote the opening of stomata</li> </ul>
4.	Ethylene	<ul style="list-style-type: none"> <li>Ethylene is a volatile gas.</li> <li>Has inhibitory effects on growth (prevents elongation of stem and roots).</li> <li>Promotes fruit growth and ripening.</li> <li>Promotes abscission of leaves, flowers and fruits</li> </ul>
5.	Absciscic Acid (ABA)	<ul style="list-style-type: none"> <li>It promotes the dormancy in seeds and buds and thus inhibits growth.</li> <li>It also promotes the closing of stomata and thus effects wilting of leaves.</li> </ul>





### Auxin:

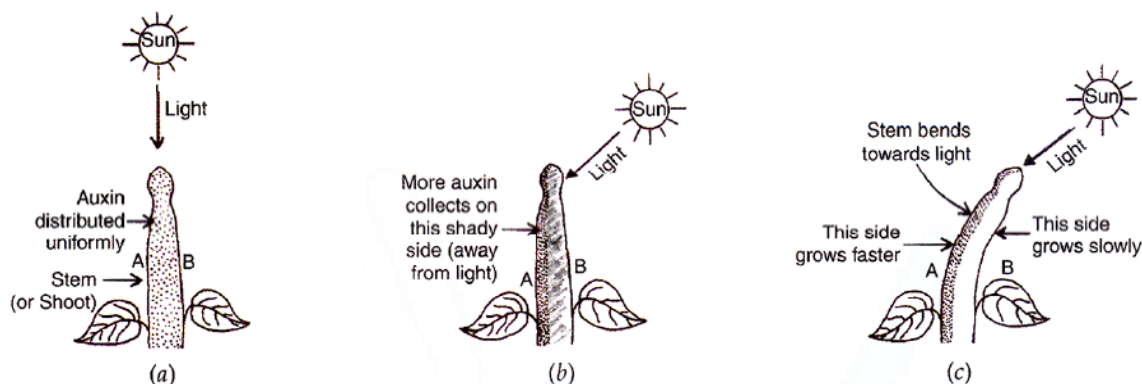


Fig. The bending of plant stem (or shoot) towards light by the action of Auxin Hormone.

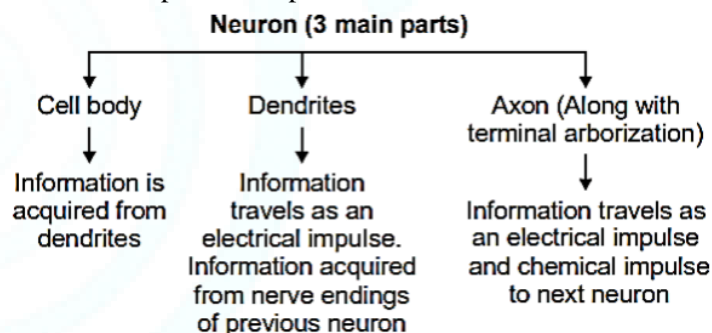
### FUNDAMENTAL UNLOCKED- (FU#1)

- Q.1 Define Tropism?
- Q.2 Define Thigmonasty?
- Q.3 What are phytohormones.
- Q.4 Which hormone is responsible for closing of stomata?
- Q.5 Which hormone helps in cell division?
- Q.6 Write the functions of hormone gibberellins.

### B. Nervous Co-Ordination in Human

- Unicellular organisms respond to environmental stimuli by moving towards or away from the source of stimulus.
  - The responses of multicellular animals to stimuli, however, are not as simple. The evolution of multicellularity in animals necessitated the development of some system for the control and coordination of the activities of various cells of the body.
  - In lower multicellular animals, the coordination takes place through the nervous system. However, in higher animals, coordination takes place through two types of control systems: **Nervous system and Endocrine system.**
- 1. Nervous system:** The nervous system is composed of specialized cells called **neurons** (nerve cells) which exercise control by sending electrical signals called **nerve impulses**. The nervous control is speedy and flexible, but its effect is localized.
  - 2. Endocrine system:** The endocrine system consists of specialized glands (**endocrine glands**) which bring about control by sending chemical messengers termed hormones. The hormonal control is usually slow acting, and its effect is diffuse.

- (i) **Structure of neuron:** Neuron is the structural and functional unit of nervous system. It has a special structure to receive, conduct and transmit impulses. But it varies greatly in size and shape. Neurons are, in fact, the longest cells present in the human body, sometimes reaching 90 – 100 cm. A neuron consists of **three** prominent parts.



- (a) **Cell body:** The cell body of a neuron is also called **cyton or soma**. It has abundant cytoplasm, called **neuroplasm** and a relatively large, spherical **nucleus**. The cytoplasm has mitochondria, Golgi apparatus, neurofibrils and special granules called **Nissl's granules**. These Nissl's granules are characteristic of nerve cells. Nissl's granules are modified form of Rough Endoplasmic Reticulum. Centrioles are however, absent in neurons. The cell body is concerned with metabolic maintenance and growth. It also receives nerve impulses from dendrites and transmits them to axons.
- (b) **Dendrites (singular dendron):** These are several short, tapering, much branched protoplasmic processes stretching out from the cell body of a neuron. Dendrites are the parts of neurons where sensation (information) is acquired. The information then travels as an electric impulse towards the cell body. Dendrites also contain Nissl's granules and neurofibrils.





(c) **Axon:** It is a single, very long cylindrical protoplasmic process (nerve fibre) of uniform diameter arising from the cell body. At its terminal end, axon is highly branched. Axon terminals are often knob-like and these may end in nerve fibres (forming neuromuscular junction) or glands or form synapses with dendrites of other neurons. The axon conducts nerve impulses away from the cell body.

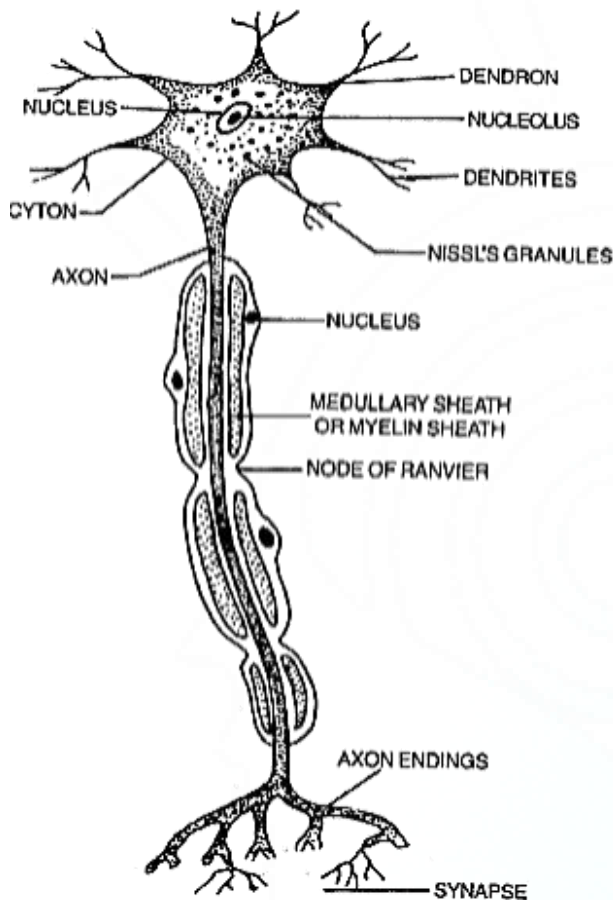


Fig. Neuron

The cell membrane of the axon is called **axolemma** and its cytoplasm is termed **axoplasm**. It lacks Nissl's granules. However, neurofibrils are present. The single sheath present over the axon is made of **Schwann cells** and is called **neurilemma**. The axon may have an additional insulating and protective sheath of **myelin** around it, such neurons are called as myelinated neuron. The neuron without this sheath is termed **non-myelinated nerve fibers**. Myelinated nerve fibers possess unmyelinated areas called **nodes of Ranvier**.

#### Functions of Neuron

- To receive the information from environment
- To receive information from various body parts.

(c) To act accordingly through muscles and glands.

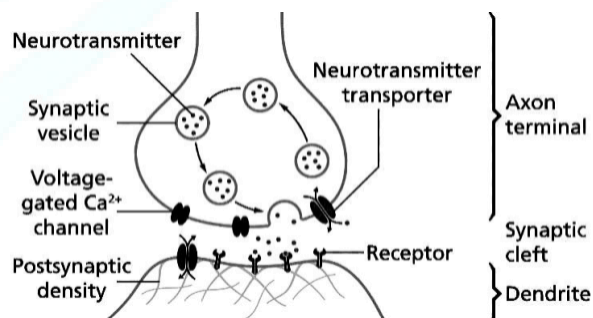
**Stimulus:** Any change in environment or within that bring about the reaction e.g. touching a hot plate.

**Response:** The reaction of our body to these changes. e.g. withdrawal of our hand

**Neurons:** Transmit messages in the form of nerve impulses. They have following special properties.

- They do not divide.
- Form shortly after birth, new neurons do not develop.
- They are not repaired, when injured.
- They use only glucose as a respiratory substrate.
- They die, if deprived of oxygen for over 5 minutes.

(ii) **Synapse:** The neurons are not connected. There is a very minute gap between terminal portion of axon of one neuron and the dendrite of another neuron. This minute gap is called synapse. Axon terminal expands to form **pre-synaptic knob**. As the nerve impulse reaches the presynaptic knob, the synaptic vesicles get stimulated to release neurotransmitter in the synaptic cleft (the gap between two neurons). The neurotransmitter molecule diffuses across the minute gap to come in contact with post-synaptic membrane. In this way, nerve impulse passes across the minute gap to stimulate dendrites of other neuron.



Neuromuscular junction

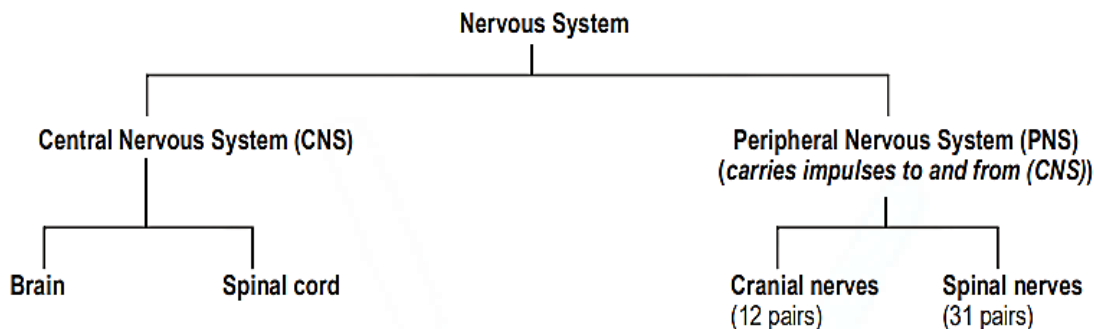
#### FUNDAMENTAL UNLOCKED- (FU#2)

- What are the three main parts of neuron?
- What is the function of dendrites?
- Write the functions of neuron.
- What is a synapse?
- Explain Neuromuscular Function.



## Human Nervous System

Human nervous system consists of two parts:



### (a) Central Nervous System

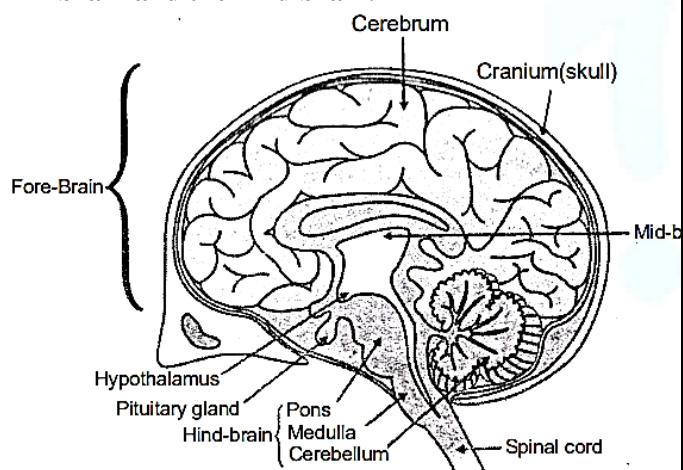
The central nervous system is made up of the brain and spinal cord.

#### (i) Brain

- It is the part of the central nervous system that is present in the head and protected by the **cranium**.
- Brain is also protected by three layers of membrane called as **meninges**. The layers of meninges from outer to inner are –
  - Duramater
  - Arachnoid
  - Piamater

**Cerebrospinal fluid (CSF):** It is a clear, colorless fluid that surrounds the brain and the spinal cord of all vertebrates. It provides protection and acts as a mechanical barrier against any shock or damage. This fluid acts as a cushion and lowers the force of impact. It provides a medium for exchange of food materials, gases, waste, etc.

- It has three main regions the **fore brain, the mid brain and the hind brain**.



- (a) Fore Brain:** It is made up of cerebrum, thalamus, hypothalamus and olfactory lobes.

#### Cerebrum

- It is the largest and main thinking part of the brain and is made up of two hemispheres called the cerebral hemispheres.
- It controls the action of the voluntary muscles.
- Cerebrum is responsible for the intelligence, memory, consciousness and will power.

#### Thalamus

- Thalamus serves as a relay centre for sensory and motor impulses from spinal cord and medulla oblongata to cerebrum.
- It recognizes sensory impulses of heat, cold, pain.

#### Hypothalamus

- It possesses control centres for hunger, thirst, thermoregulation, sleep, sex, stress etc.
- Hypothalamus is an important link between nervous system and endocrine function.
- It secretes hormones called neurohormones called as inhibiting hormones or releasing hormones which control the actions of pituitary gland.

#### Olfactory Lobes

- They are pair of small, solid, cube shape bodies they are fully covered by cerebrum. They receive impulse for smell (olfaction).

- (b) Mid Brain:** It provides a passage for the different neurons going in and coming out of the cerebrum. It consists of center for visual and auditory reflex.





(c) **Hind Brain:** It consists of **cerebellum**, **pons varolii** and **medulla oblongata**.

### Cerebellum

- It is the second largest part of the brain and largest part of hind brain. It is also called as Little brain.
- It is responsible for maintaining the body posture as well as balance while walking, swimming, picking up a pencil, riding etc.

### Pons

- It lies above the medulla oblongata it controls some aspects of respiration along with medulla.

### Medulla Oblongata

- Medulla oblongata is the posterior main part of the brain which lie below the cerebellum.
- It also controls involuntary activities such as sneezing, coughing, swallowing, salivation and vomiting.
- It has both breathing and cardiovascular centres.
- It controls rate of heartbeat and expansion & contraction of blood vessels to regulate blood pressure.

(ii) **Spinal Cord:** Spinal cord is a cylindrical structure. The spinal cord begins in continuation with medulla and extends downwards. It is enclosed in a bony cage called vertebral column. Spinal cord is also surrounded by membranes called meninges just like brain. The spinal cord is concerned with spinal reflex actions and conduction of nerve impulse to and from the brain.

(b) **Peripheral Nervous System (PNS):** It includes cranial nerves and spinal nerves.

It mainly controls the voluntary activities of the body. Cranial nerves also called cerebral nerves arise from the brain.

There are 12 pair of cranial nerves in man and 31 pair of spinal nerves which arise from spinal cord.

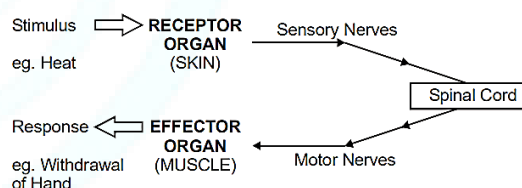
**Autonomic Nervous System (ANS):** 'Autonomic nervous system' means 'self-governing nervous system'. It controls and regulates the functions of the internal organs of our body involuntarily such as heart, blood vessels, glands & smooth muscles of alimentary canal & uterus. It is subdivided into:

**Sympathetic & Parasympathetic System:** Organs receive nerves from both sympathetic and parasympathetic nerve fibres. They have opposite effects on the organs if one is stimulatory, the other is inhibitory.

**Reflex Action:** A reflex action may be defined as a spontaneous, automatic, and mechanical response to a stimulus, acting on a specific receptor, without the will of an animal.

**Examples:** Withdrawal of hand or foot every time if it is suddenly pinched or pricked with a needle or touched by a hot object, coughing, yawning, sneezing etc. are all reflex actions.

**Reflex Arc:** In reflex action fine tips (dendrites) of receptors (sensory neurons) quickly relay a message (electric impulse) via sensory nervous to spinal cord. The spinal cord then sends information (impulse) via motor nerves to effectors (muscles or glands) which show response. The path taken by nerve impulse in a reflex action is called reflex arc.



**Reflex arc - Schematic Representation**

### It Consists of Five Parts

**Receptor:** It is a specialised tips of the neurons of which receive a stimulus and set up a sensory impulse. These receptors are usually located in sense organs such as ear, eye, nose, tongue and so on.

- **Gustatory receptors** : These detect taste.
- **Olfactory receptors** : These detect smell.
- **Photoreceptors:** These detect light.
- **Phonoreceptors** : These detect sound.

**Sensory (afferent) Nerve:** It carries sensory impulse from the receptor to the central nervous system.

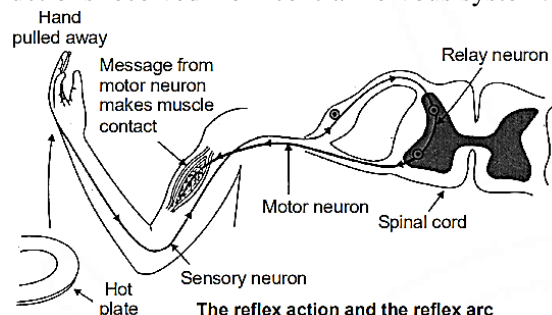
**Spinal Cord:** Its neurons analyse and interpret the sensory impulse and set up an appropriate motor impulse.





**Motor (efferent) Nerve:** It carries motor impulse from the central nervous system to specific effectors (muscle fibres or gland cells).

**Effector:** It may be muscle fibres or gland cells. Here, impulse terminates, and response occurs as per instructions received from central nervous system.



**Mechanism of Reflex Arc:** When our hand accidentally touches a hot object, the heat is sensed by thermoreceptors present in the skin of hand. The stimulus triggers nerve impulse in sensory (receptor) neuron. It transmits messages to the spinal cord. In the spinal cord, impulse is passed on to the relay (connector) neuron which, in turn, passes it to the motor neuron. The motor neuron transmits the instruction to a muscle in our arm. The arm muscle contracts and pulls our hand away from the hot object.

## Significance of Reflex Action

- It checks overloading and overtaxing of brain.
- It results in quick response to otherwise harmful stimuli without the processing done by coordinating centres of central nervous system.
- It has a survival value.

**Table: Difference between Reflex Action and Walking**

S.No.	Reflex Action	Walking
1.	It is inborn (inherited) and present in the individual since birth.	It is not inherited and is acquired through learning.
2.	It is automatic and occurs without the will of individual	It is under the control of cerebellum part of brain and occurs with the will of individual.
3.	It is controlled by spinal cord.	It is controlled by brain.

## FUNDAMENTAL UNLOCKED- (FU#3)

- Q.1 Write the functions of cerebrum and cerebellum?
- Q.2 Which part of the brain controls involuntary activities of the body.
- Q.3 What is the function of thalamus and hypothalamus?
- Q.4 What is the functions of midbrain?
- Q.5 What is a neurotransmitter?
- Q.6 Define reflex action?

## C. Chemical Co-Ordination in Humans

The control and coordination in higher animals called vertebrates (including human beings) takes place through nervous system as well as hormonal system called endocrine system.

Any chemical substance which is formed in the tissues of endocrine glands are carried by the blood to other parts of the body for its specific actions is termed as hormone.

## Characteristics of Hormones

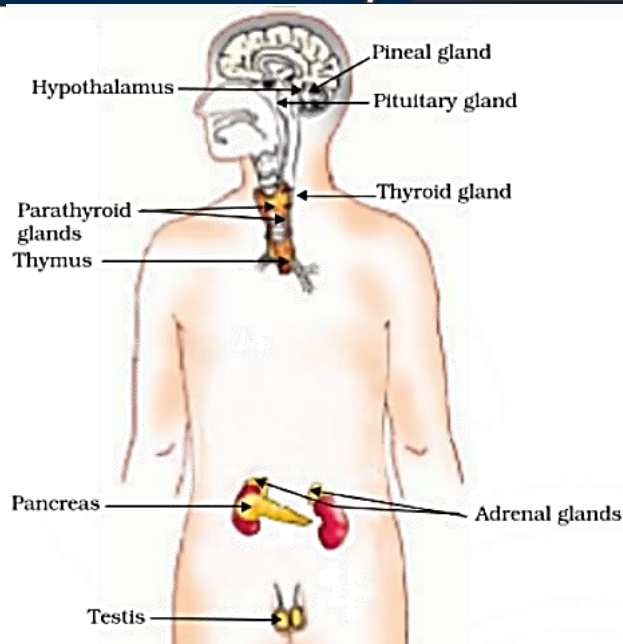
- They are the secretions of endocrine glands.
- They are produced at a place and act on target organs which are mainly away from their source.
- They are poured directly into the blood stream.
- They are required in very small quantities.

## The Hormones Produced by Various Endocrine Glands Present in Human Body Are

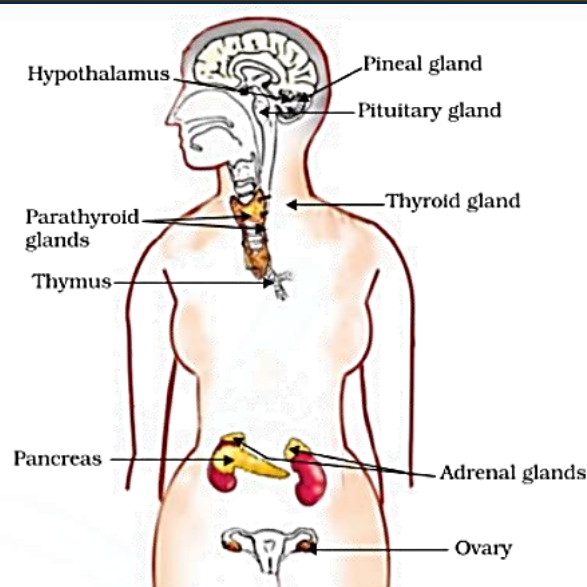
- |                               |                     |
|-------------------------------|---------------------|
| (a) Hypothalamus gland        | (b) Pituitary gland |
| (c) Pineal gland              | (d) Thyroid gland   |
| (e) Parathyroid glands        | (f) Thymus          |
| (g) Adrenal glands            | (h) Pancreas        |
| (i) Ovaries (only in females) |                     |
| (j) Testes (only in males)    |                     |

The hormones produced by endocrine glands act as messengers between the nervous system and the organs of our body.





(a)



(b)

Fig. The position of endocrine glands in the human body.

**(a) Hypothalamus**

Hypothalamus gland is present in the brain. The function of hypothalamus is to regulate the secretions of hormones from pituitary gland. It secretes inhibitory and releasing hormones.

**(b) Pituitary Gland (Hypophysis)**

- It is a small ovoid structure attached to the base of brain (hypothalamus) by a short stalk called **Infundibulum**.
- Pituitary gland is also known as the master gland as it controls other endocrine glands.
- This gland consists of three lobes-anterior, middle and posterior.
- Each lobe of the pituitary gland secretes different sets of hormones.

**(I) Hormones of Anterior Pituitary**

- (i) Growth Hormone (GH):** This hormone promotes and regulates the process of growth in the body. Its deficiency during childhood leads to dwarfism and over secretion leads to **gigantism**.

The hyper secretion of Growth Hormone after puberty results in a condition called as **acromegaly**.

- (ii) Thyroid Stimulating Hormone (TSH):** It controls the functioning of thyroid gland. It stimulates thyroid gland to secrete thyroxine.

- (iii) Follicle Stimulating Hormone (FSH):** It stimulates the production of gametes.

- (iv) Luteinizing Hormone (LH):** LH plays an important role in sexual development and functioning. In women, LH helps control the menstrual cycle. It also triggers the release of an egg from the ovary. In males it promotes the release of testosterone.

**(II) Hormones of Posterior Pituitary**

- (i) Vasopressin or Antidiuretic Hormone (ADH):** This causes the reabsorption of water into the blood from the collecting tubules of the kidneys, thereby concentrating the urine and reducing its volume. The deficiency of ADH results in Diabetes insipidus.

- (ii) Oxytocin:** This hormone stimulates uterus contractions at the time of child birth and causes release of milk from mammary glands. It is also known as **birth hormone and milk ejecting hormone**.

- (c) Pineal Gland:** It is a small gland reddish-grey in colour, about the size of a pea, attached to the roof of the brain. It releases a hormone named as Melatonin.



- It contributes in regulating gonadal development and biological clock (Circadian rhythm).
  - (d) **Thyroid Gland:** The thyroid gland consists of two lobes joined together by an isthmus.
    - It is situated in the lower part of the neck and when enlarged it forms **goitre**. Hormones produced by thyroid gland are:
  - (i) **Thyroxine:** It is the principal hormone secreted by the thyroid gland.
    - Its main role is to increase the metabolic rate of the organs and tissues of the whole body.
    - Iodine deficiency causes simple **goitre** as iodine is required to form thyroxine.
  - (ii) **Calcitonin:** This Hormone is also produced by thyroid gland it lowers blood calcium level.
  - (e) **Parathyroid:** This gland lives on the posterior surface of thyroid gland it produces parathormone (Collip's Hormone). It increases the blood calcium level.
  - (f) **Thymus Gland:** This gland is situated in the thorax region it secretes a hormone namely thymosin. It helps in the maturation of T lymphocytes. It helps in producing antibodies.
  - (g) **Adrenal Gland**
    - These are two small semilunar structures lying one each on upper part of the kidneys. That is why they are also known as **supra renal glands**.
    - Each gland consists of two structurally & physiologically separate parts.  
**Cortex:** Cortex secretes three different kinds of hormones known as corticosteroids. It helps in glucose metabolism sodium reabsorption. It also secretes sex hormones (androgen and estrogen).
- Adrenal Medulla** secretes two hormones
- (i) **Adrenaline:** It is a stress hormone that causes increase in systolic blood pressure, dilation of coronary blood vessels, increase sweating and increase in metabolic rate.

- (ii) **Noradrenaline:** It is a general vasoconstrictor, increases both systolic and diastolic pressures. Both of these hormones are helpful in emergency conditions. Thus, are called as “**FIGHT OR FLIGHT RESPONSE**”.
- (h) **Pancreas:** Pancreas is the only heterocrine gland in the human body.
  - It acts as **exocrine gland** as it secretes pancreatic juice which is poured into the duodenum with the help of pancreatic duct.
  - The **endocrine** tissue of the pancreas is in the form of clumps of secretory cells known as the **islets of Langerhans**.
  - The islet cells are of different types like **alpha, beta and delta** etc. secreting different respective types of hormones. Important hormones secreted by pancreas are:
- (i) **Glucagon** is secreted by the alpha cells of pancreas, the metabolic effects of which are opposite to those of insulin. It causes the breakdown of liver glycogen, thereby releasing glucose into the blood stream.
- (ii) Insulin is secreted by the beta cells and like other hormones, passes directly into the blood. It lowers the blood glucose level.
  - Insulin is required to convert glucose into glycogen (glycogenesis) and store it in liver.
  - Deficiency of insulin is due to defect in islets of Langerhans results in diabetes mellitus, a condition in which blood glucose is high and is passed in the urine.
- (i) **Ovaries:** Ovaries secrete three hormone -
- (i) **Oestrogen:** This hormone effects the development of female secondary sex characters.
- (ii) **Progesterone:** Progesterone prepares the uterus for receiving the embryo. This hormone is essential for the maintenance of pregnancy and is therefore called **pregnancy hormone**.
- (iii) **Relaxin:** This hormone is secreted during later stages of pregnancy and leads to relaxation of muscles of the pelvic area to enable easy child birth and reduce the pressure on the foetus.



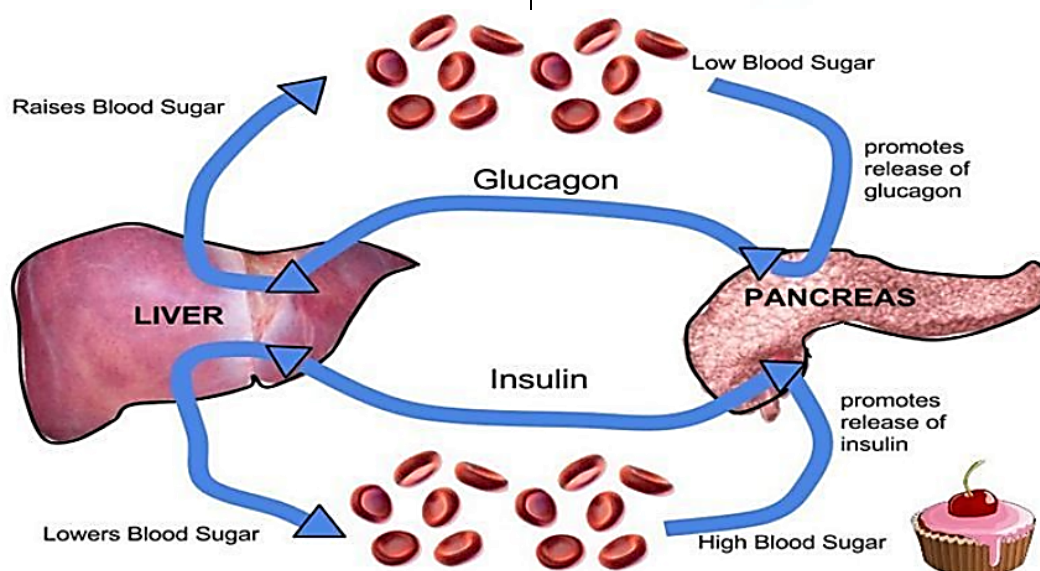


(j) Testes

- It releases hormone testosterone.  
Testosterone is the main testicular hormone secreted by interstitial cells of the testes.
- It is mainly concerned with the development and maintenance of male secondary sex characters and enhancing the process of spermatogenesis (sperm formation).

Feedback Mechanism

It is so important that hormones should be secreted in precise quantities, we need a mechanism through which this is done. The timing and amount of hormones released are regulated by feedback mechanisms. For example, if the sugar levels in blood rise, they are detected by the cells of the pancreas which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.



FUNDAMENTAL UNLOCKED- (FU#4)

- Q.1** Write 4 common features of hormones.
- Q.2** Write name and functions of hormones of anterior pituitary.
- Q.3** Which hormone regulates the biological clock?

- Q.4** Which hormone is known as stress hormone in humans.
- Q.5** Name the different hormone produced by pancreas.



EXERCISE - I

Single Correct Type Questions

1. The movement of plant organs in response to the force of gravity is called -  
(A) hydrotropism (B) geotropism  
(C) heliotropism (D) phototropism
2. Movement of pollen tube towards ovule is:  
(A) Chemotropism (B) Hydrotropism  
(C) Thigmotropism (D) Phototropism
3. Phytohormones are -  
(A) hormones regulating growth from seed to adulthood  
(B) hormones regulating secondary growth  
(C) growth regulators synthesized by plants and influencing physiological processes  
(D) hormones regulating flowering
4. Which of the following breaks the dormancy of seeds?  
(A) Auxins (B) Gibberellin  
(C) Ethylene (D) ABA
5. Cytokinin  
(A) is a hormone whose main function is to induce the cell division  
(B) is the process of cell division  
(C) retards cell division  
(D) causes dormancy
6. A plant bends towards the source of light when exposed to the light on only one side. Which of the following is the best explanation of the phenomena?  
(A) It needs light for photosynthesis  
(B) The apices of their stems are attracted by light  
(C) Some auxin accumulates on the shaded side to induce greater cell elongation on that side  
(D) Light stimulates the cells on the illuminated side to increase in length
7. Which of the following is a growth inhibitor hormone?  
(A) Cytokinin (B) Gibberellin  
(C) Auxin (D) Absciscic acid
8. Cytokinins are known to -  
(A) inhibit cytoplasmic movement  
(B) help in retention of chlorophyll  
(C) helps in fruit ripening  
(D) promote abscission layer formation
9. Ethylene is a  
(A) solid hormone  
(B) gaseous hormone  
(C) gaseous enzyme  
(D) liquid gas mixture
10. The roots of a plant is  
(i) positively phototropic but negatively geotropic  
(ii) positively geotropic but negatively phototropic  
(iii) negatively phototropic but positively hydrotropic  
(iv) negatively hydrotropic but positively phototropic  
(A) (i) and (ii) (B) (ii) and (iii)  
(C) (iii) and (iv) (D) (i) and (iv)
11. The movement of a shoot towards light is  
(A) geotropism (B) hydrotropism  
(C) chemotropism (D) phototropism
12. The hormone that promotes reabsorption of water from glomerular filtrate is -  
(A) oxytocin  
(B) relaxin  
(C) vasopressin (ADH)  
(D) calcitonin
13. In human body which is the master gland?  
(A) Adrenal (B) Pancreas  
(C) Pituitary (D) None of the above







14. The fight, flight and fright hormone is -  
 (A) Glucagon (B) Insulin  
 (C) Oxytocin (D) Adrenaline
15. Failure or reduced insulin production causes  
 (A) Diabetes insipidus  
 (B) Diabetes mellitus  
 (C) both A and B  
 (D) Cretinism
16. Reflex action in a body is not  
 (A) inborn  
 (B) automatic and quick  
 (C) voluntary  
 (D) protective in nature
17. Synapse is a close proximity of -  
 (A) two veins (B) two arteries  
 (C) two lymphatics (D) two neurons.
18. The largest part of brain is  
 (A) Corpora quadrigemia  
 (B) Medulla oblongata  
 (C) Cerebellum  
 (D) Cerebrum
19. The centre for the sense of smell in brain is -  
 (A) cerebellum (B) cerebrum  
 (C) midbrain (D) olfactory lobes
20. Part of the brain is involved in muscular movement.  
 (A) Fore brain (B) Pons  
 (C) Sensory area (D) Cerebellum
21. Electrical impulse travels in a neuron from  
 (A) dendrite → axon → axon end → cell body  
 (B) cell body → dendrite → axon → axon end  
 (C) dendrite → cell body → axon → axon end  
 (D) axon end → axon → cell body → dendrite

22. Which of the following helps in maintaining posture and balance of the human body?  
 (A) Cerebellum (B) Cerebrum  
 (C) Medulla (D) Pons
23. In reflex action the reflex arc is formed by  
 (A) brain → spinal cord → muscles  
 (B) receptor → spinal cord → muscles  
 (C) muscle → receptor → brain  
 (D) muscles → spinal cord → receptor
24. Which of the following is not an involuntary action?  
 (A) Vomiting (B) Chewing  
 (C) Heart beat (D) Salivation
25. Which one is not secreted by pituitary?  
 (A) Thyroxine (B) FSH  
 (C) GH (D) ACTH

#### Very Short Answer Type Questions

1. Name various plant hormones.
2. What are the major parts of the brain?
3. What is chemotropism? Give one example.
4. Name any two plant hormones & mention their functions.
5. What is 'Phototropism'? How does it occur in plants?
6. Which hormone is responsible for the development of moustache and beard in men.
7. Define hormones.
8. Name the part of hind brain which takes part in regulation of respiration.
9. What is reflex action and reflex arc?
10. What will happen if intake of iodine in our diet is low?





## Short Answer Type Questions

- What is a tropic movement? Explain with an example.
- Draw the structure of a neuron and explain its function
- How does chemical coordination take place in animals?
- “Nervous and hormonal systems together perform the function of control and coordination in human beings.” Justify the statement?
- What do you mean by tropic and nastic movements? Give one example of each.
- Write down the source, site of action and functions of the following hormones / substances.  
(i) Growth Hormone (ii) Thyroxine  
(iii) Adrenaline (iv) Insulin
- Name the different types of hormones secreted by posterior pituitary. Also mention their functions.
- How are involuntary actions and reflex actions different from each other?
- What is the difference between sensory and motor neurons? Which parts of human brain are responsible for auditory reception and sensation of smell?
- We suddenly withdraw our hand when a pin pricked. Name the type of response involved in this action.
- Mention one function for each of these hormones:  
(a) Calcitonin  
(b) Glucagon  
(c) Oxytocin  
(d) Progesterone  
(e) Testosterone.
- Why pancreas are regarded as heterocrine gland explain in detail the function of insulin and glucagon? Also justify that they function opposite of one another.
- Give a reason to explain why:  
(i) Adrenaline helps in dealing with emergency situations.  
(ii) Secretions of growth hormone should be specific in the human body.  
(iii) Some patients of diabetes are treated by giving injections of insulin.
- What is hydrotropism? Write an experiment to demonstrate hydrotropism.
- What is phototropism. Which hormone is responsible for phototropism. How does it occur in plants.
- Define ‘nerve impulse’. Which structure in neurons helps to conduct a nerve impulse?  
(i) Towards the cell body  
(ii) Away from the cell body

## Case Based Question

- The chemical substance P is made and secreted by the meristematic tissue at the tip of stem (or shoot) of a plant. The chemical substance P is responsible for a phenomenon Q in plants in which the stem bends towards a source of light. The same chemical substance P has an opposite effect on the root of a plant. It causes the root of a plant to bend away from the source of light in a process called R.  
(I) What is the chemical substance P?  
(II) State whether P prefers to remain in the sunlight side of a stem or in shade.

## Long Answer Type Questions

- Draw the structure of a Human Brain and explain the function.
- Answer the following:  
(a) Name the endocrine gland associated with brain?  
(b) Which gland secretes digestive enzymes as well as hormones?  
(c) Name the endocrine gland associated with kidneys?  
(d) Which endocrine gland is present in males but not in females.





**(III)** What is the effect of substance P on the rate of growth of (i) a root, and (ii) a stem?

**(IV)** What is the name of process (i) Q, and (ii) R?

**(V)** What is the general name of chemical substances like P? Name another substance which belongs to this class of chemical substances.

**2.** The gland A is attached to the wind pipe in the human body. The gland A makes and secretes a hormone B which controls the metabolism of carbohydrates, fats and proteins in the body. The non-metal element C is necessary for the formation of hormone B. The deficiency of C in

the diet can cause a deficiency of hormone B in the body leading to a disease D in which the neck of a person appears to be swollen. People are advised to use salt E in cooking food so as to avoid disease D.

**(I)** Name (i) gland A, and (ii) hormone B.

**(II)** What is the element C?

**(III)** Name one type of food which can provide sufficient C in the diet of a person.

**(IV)** Name (i) disease D, and (ii) salt E.





EXERCISE - II

Match the Column Type Questions

1. Match the column

(A)	Adrenaline	(P)	Neuron
(B)	Testosterone	(Q)	Cell division
(C)	Cerebellum	(R)	Emergency hormone
(D)	Axon	(S)	Male sex hormone
(E)	Cytokinin	(T)	posture of the body

Assertion and Reason

The following questions consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

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

1. **Assertion(A):** Insulin regulates blood sugar level.

**Reason (R):** Insufficient secretion of insulin will cause diabetes mellitus.

2. **Assertion(A):** Phototropism is determined by the direction of light.

**Reason (R):** In phototropism stems are negatively phototropic.

HOTS

- 1. Luteinizing hormone in female.
  - (A) helps in the appearance of secondary sexual characters
  - (B) stimulates ovary to secrete estrogen
  - (C) helps in release of the ovum from the ovary
  - (D) control of blood pressure

2. What will happen if the thyroid is removed from a tadpole?

- (A) The tadpole will grow into a dwarf frog
- (B) The larva will produce giant frog
- (C) It will continue indefinitely in larva stage
- (D) The larva will die

3. Which part of the brain act as Relay centre -

- (A) hypothalamus (B) cerebrum
- (C) cerebellum (D) thalamus

4. Two halves of the cerebrum are connected through

- (A) cerebral hemispheres
- (B) medulla oblongata
- (C) corpus callosum
- (D) pons varolii

5. Choose the right from the following.

- i. In light, hormone auxin, helps the cells to grow longer in plants.
- ii. Plant hormone gibberellins helps in growth of a stem.
- iii. Cytokinin is inhibits cell division.
- iv. Absciscic acid promote growth in plants.

- (A) i and iii are correct
- (B) ii and iv are correct
- (C) i and ii are correct
- (D) i and iv are correct

6. If a person cannot walk in a straight line or cannot balance a ride on bicycle, probably which part of his brain is not working properly?

- (A) Cerebrum (B) Cranium
- (C) Cerebellum (D) Hypothalamus

7. Choose the correct alternate in which the type of tropism exhibited by plants is correctly matched with the stimulus to which they respond

Tropsin	Stimulus
1. Hydrotropsim	i. Earth
2. Geotropism	ii. Light
3. Chemotropism	iii. Water
4. Phototropism	iv. Chemical



- (A) 1 – ii, 2 – i, 3 – iv, 4 – iii  
 (B) 1 – iii, 2 – i, 3 – iv, 4 – ii  
 (C) 1 – iv, 2 – iii, 3 – i, 4 – ii  
 (D) 1 – iii, 2 – i, 3 – ii, 4 – iv

- 8.** The two hormones secreted by adrenal glands which regulates the rate of metabolism and the concentration of salts in blood and prepares the body to face the emergency are .....and .....
- (A) Insulin and Glucagon  
 (B) Testosterone and Estrogen  
 (C) Cortisol and Dopamine  
 (D) Cortisol and Adrenaline

- 9.** The correct order of the parts of a nerve cell through which a nerve impulse is transmitted is.  
 (A) Nerve endings-dendrites-axon-cell body  
 (B) Cell body-axon-dendrites -nerve endings  
 (C) Dendrites-nerve endings-cell body axon  
 (D) Dendrites - cell body-axon-nerve endings
- 10.** The contraction of pupil of the eye in the presence of bright light is an example of –  
 (A) Voluntary reflex  
 (B) Spinal reflex  
 (C) Cerebral reflex  
 (D) Adrenal reflex





EXERCISE - III

Previous Year Questions

1. Which of the following is not a plant hormone -  
(NTSE Stage-1-2013)  
(A) Auxin (B) Gibberellins  
(C) Cytokinin (D) Adrenaline
2. Lack of Melanin synthesis may cause the genetic disorder.  
(NTSE Stage-1-2007)  
(A) Colour blindness (B) Haemophilia  
(C) Albinism (D) Hypertrichosis
3. The essential hormone for ripening of fruits is :  
(NTSE Stage-1-2006)  
(A) Auxin (B) Cytokinin  
(C) Ethylene (D) Gibberellin
4. Cut leaves remain green for longer time if dipped in :  
(NTSE Stage-1-2013)  
(A) Auxins (B) Cytokinins  
(C) Ethylene (D) Gibberellins
5. Neurons have a unique property that makes them to communicate with other cells via:  
(NTSE Stage-1-2013)  
(A) Nerve cords (B) Glial cells  
(C) Synapses (D) Schwann cells
6. One of the basic characteristics of living organisms which is well developed in nervous system is :  
(NTSE Stage-1-2013)  
(A) Movement (B) Growth  
(C) Irritability (D) Nutrition
7. If a person cannot walk in a straight line or cannot balance a ride on bicycle, probably which part of his brain is not working properly?  
(NTSE Stage-1-2013)  
(A) Cerebrum  
(B) Cranium  
(C) Cerebellum  
(D) Hypothalamus
8. The functional junction between two neurons is called  
(NTSE Stage-1-2013)  
(A) synapse (B) axon  
(C) dendrites (D) none of these
9. Which of the following ion is needed for nerve conduction?  
(A) Ca (B) Zn  
(C) Mg (D) Mn
10. When we smell a flower, which one of the following first receives the scent?  
(NTSE Stage-1-2013)  
(A) Dendrite of motor neuron  
(B) Dendrite of sensory neuron  
(C) Axon of motor neuron  
(D) Axon of sensory neuron
11. Which one of the following is secreted by pituitary gland?  
(NTSE Stage-1-2013)  
(A) Insulin (B) Estrogen  
(C) Adrenaline (D) Growth hormone
12. Which two of the following are growth promoting hormones in plant? (NTSE Stage-1-2013)  
(A) Auxin and Cytokinin  
(B) Gibberelin and Ethylene  
(C) Absciscic acid and Auxin  
(D) Cytokinin and Ethylene
13. Which part of the brain controls co-ordinated movements of our body, such as riding a bicycle?  
(NTSE Stage-1-2013)  
(A) Cerebrum (B) Cerebellum  
(C) Medulla (D) Pons
14. Which is the largest endocrine gland in human beings.  
(NTSE Stage-1-2013)  
(A) Pituitary (B) Adrenal  
(C) Thyroid (D) Parathyroid
15. The systematic regulation of various activities means:  
(NTSE Stage-1-2013)  
(A) Control (B) Co-ordination  
(C) Taming (D) Randomness







- |   |   |
|---|---|
| <p>16. Which is the hormone that brings about changes in girls during puberty:<br/>(NTSE Stage-1-2013)</p> <p>(A) Estrogen (B) Adrenaline<br/>(C) Testosterone (D) Thyroxine</p>  | <p>18. In plants abscisic acid controls<br/>(NTSE Stage-1-2005)</p> <p>(A) growth in shoot (B) flower formation<br/>(C) cell division (D) fall of leaf</p>  |
| <p>17. If the apical parts of the negative geotropic roots of mangrove plant are pasted with wax, which function of these roots will be affected?<br/>(NTSE Stage-1-2005)</p> <p>(A) Exchange of <math>O_2</math> and <math>CO_2</math><br/>(B) Water absorption<br/>(C) Fixation of plant<br/>(D) Photosynthesis</p> | <p>19. How many pairs of nerves arise from spinal cord?<br/>(NTSE Stage-1-2013)</p> <p>(A) 21 (B) 31 (C) 41 (D) 51</p> <p>20. An enzyme secreted by an endocrine gland which is present in an exocrine gland –<br/>(NTSE Stage-1-2013)</p> <p>(A) Parathormone (B) Thyroxin<br/>(C) Glucagon (D) Adrenaline</p> |





## ANSWER KEY

### EXERCISE-I

#### Single Choice Questions

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

### EXERCISE-II

#### Match the Column Type Questions

1. A-R, B-S, C-T, D-P, E-Q

#### Assertion and Reason

1. (A) 2. (C)

#### Hots

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

### EXERCISE-III

#### Previous Year Questions

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





# DPP

## Daily Practice Problems

**SUBJECT: BIOLOGY****CLASS-10****DPP NO. 1****TOPIC: CONTROL AND COORDINATION****Multiple Choices Questions**

1. If the tip of a seedling is cut off, growth as well as bending ceases because it hampers  
(A) perception of light stimulus (B) transpiration  
(C) respiration (D) photosynthesis
2. A plant bends towards the source of light when exposed to the light on only one side. Which of the following is the best explanation of the phenomena?  
(A) It needs light for photosynthesis  
(B) The apices of their stems are attracted by light  
(C) Some auxin accumulates on the shaded side to induce greater cell elongation on that side  
(D) Light stimulates the cells on the illuminated side to increase in length
3. The movement of plant organs in response to the force of gravity is called  
(A) hydrotropism (B) phototropism (C) heliotropism (D) geotropism
4. A high concentration of synthetic auxins is generally used for  
(A) weed control  
(B) enhancing root initiation  
(C) controlling of cell enlargement  
(D) preventing the growth of the lateral buds
5. Movement of pollen tube towards ovule is:  
(A) Chemotropism (B) Hydrotropism (C) Thigmotropism (D) Phototropism
6. Cytokinins are known to  
(A) inhibit cytoplasmic movement (B) help in retention of chlorophyll  
(C) influence water movement (D) promote abscission layer formation
7. Ethylene is a  
(A) solid hormone (B) gaseous enzyme (C) gaseous hormone (D) liquid gas mixture

8. The hormone that promotes reabsorption of water from glomerular filtrate is  
(A) oxytocin (B) relaxin (C) vasopressin (D) calcitonin
9. In the human body which is the master gland?  
(A) Adrenal (B) Pancreas (C) Pituitary (D) None of the above
10. Hypersecretion of growth hormone in a period of growth leads to  
(A) Midget (B) Anaemia (C) Acromegaly (D) Cushing syndrome
11. Failure or reduced insulin production causes  
(A) Diabetes insipidus (B) Diabetes mellitus (C) Both A and B (D) Cretinism
12. Reflex action in a body is not  
(A) inborn (B) automatic & quick  
(C) voluntary (D) protective in nature
13. Synapse is a close proximity of  
(A) two veins (B) two arteries (C) two lymphatics (D) two neurons.
14. The largest part of brain is  
(A) Corpora quadrigemina (B) Medulla oblongata  
(C) Cerebellum (D) Cerebrum
15. The study of nervous system and its disorders is called  
(A) neurogenesis (B) hematology (C) neuroglia (D) neurology
16. In reflex action the reflex arc is formed by  
(A) brain → spinal cord → muscles (B) receptor → spinal cord → muscles  
(C) muscle → receptor → brain (D) muscles → spinal cord → receptor
17. The sensation of sight in human brain is perceived by  
(A) optic lobe (B) occipital lobe (C) frontal lobe (D) parietal lobe
18. Abscission layer is formed by  
(A) ABA (B) Auxin (C) Cytokinin (D) Gibberellin
19. Hormone that promotes the development of secondary sexual characters in male.  
(A) Testosterone (B) Progesterone (C) Estrogen (D) MSH
20. The part of the brain that maintains balance and posture of body.  
(A) Cerebellum (B) Pons (C) Hypothalamus (D) Medulla Oblongata

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**Very short answer type Questions:**

1. Define hormones. Name the hormones secreted at puberty in males and females?
2. What do you mean by tropic and nastic movements? Give one example of each
3. Name the part of hind brain which takes part in regulation of respiration.
4. What is reflex action and reflex arc?
5. How are involuntary actions and reflex actions different from each other?

**Short answer type Questions:**

1. Differentiate between endocrine and exocrine glands.
2. Name the parts of the endocrine system called the master gland, also write the names of the hormones produced by it.
3. Describe an activity to demonstrate phototropism.
4. Describe the structure of neurons with the help of a well labelled diagram.
5. What is the difference between sensory and motor neurons?

**Long answer type Questions:**

1. Write the functions of the hormones produced by the following glands/organs  
(i) Thyroid gland      (ii) Pancreas      (iii) Ovary      (iv) Testes      (v) Kidney
2. What is hydrotropism? Describe an experiment to demonstrate ‘hydrotropism’
3. Write down the source, site of action and functions of the following hormones.  
(i) Auxins      (ii) gibberellins      (iii) Adrenaline      (iv) Ethylene      (v) LH

**Case based Study**

1. Some plants like the pea plant climb up other plants or fences by means of tendrils. These tendrils are sensitive to touch. When they come in contact with any support, the part of the tendril in contact with any support, the part of the tendril in contact with the object does not grow as rapidly as the part of the tendril away from the object. This causes the tendril to circle around the object and thus cling to it. More commonly, plants respond to stimuli slowly by growing in a particular direction. Because this growth is directional, it appears as if the plant is moving.

- (I) What is the difference between movement shown by touch me not plant and plant bending towards light
- (II) Name of a Phyto hormone which  
 (i) Inhibits growth (ii) Promotes growth
2. Adrenaline is secreted directly into the blood and carried to different parts of the body. The target organs or the specific tissues on which it acts include the heart. As a result, the heart beats faster, resulting in supply of more oxygen to our muscles. The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs. This diverts the blood to out skeletal muscles. The breathing rate also increases because of the contractions of the diaphragm and the rib muscles. All these responses together enable the animal body to be ready to deal with the situation. Such animal hormones are part of the endocrine system which constitutes a second way of control and coordination in out body.
- (I) Which hormone is called as 3F hormone  
 (A) Adrenaline (B) Thyroxine (C) Progesterone (D) Estrogen
- (II) Adrenaline is produced by  
 (A) Pituitary gland (B) Thyroid gland (C) Adrenal gland (D) Parathyroid gland

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

### Case based study

2. (I) (A)  
 (II) (C)



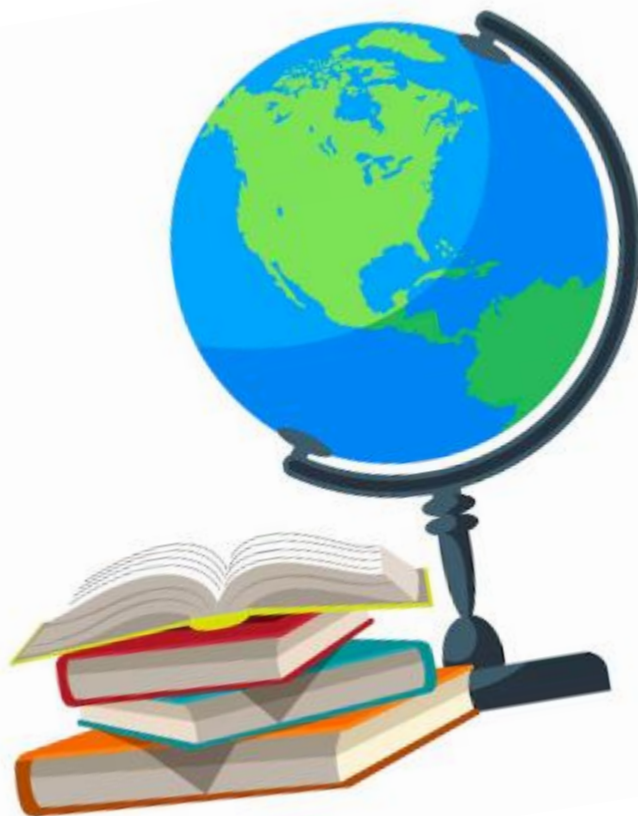
# FOUNDATION

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CLASS-X

SAMPLE

SOCIAL SCIENCE



# 1

## THE RISE OF NATIONALISM IN EUROPE

### The Theme of Frederic Sorrieu's Painting



*The Dream of Worldwide Democratic and Social Republics - The Pact Between Nations, a print prepared by Frédéric Sorrieu, 1848.*

- (i) In 1848, Frederic Sorrieu, a French artist, prepared a series of four prints visualizing his dream of a world made up of 'democratic and social Republics', as he called them.
- (ii) The first print of the series shows the people of Europe and America - men and women of all ages and social classes marching in a long train and offering homage to the statue of Liberty as they pass by it.
- (iii) A female figure was shown with the torch of Enlightenment in one hand and the Charter of the Rights of Man in the other.
- (iv) On the earth in the foreground of the image lie the shattered remains of the symbols of absolutist institutions.
- (v) In Sorrieu's utopian vision, the peoples of the world are grouped as distinct nations, identified through their flags and national costume.

### The French Revolution and The Idea of The Nation

France was a full-fledged territorial state in 1789 under the rule of an absolute monarch. The political and constitutional changes that came in the wake of

French Revolution led to the transfer of sovereignty from the monarchy to a body of French citizens. The revolution proclaimed that it was the people who would hence forth constitute the nation and shape its destiny.

### Steps Taken by French Revolutionaries:

- (i) The ideas of **La Patrie (the fatherland)** and **Le Citoyen (the citizen)** emphasized the notion of a united community enjoying equal rights under a constitution.
- (ii) A new French **flag, the tricolour**, was chosen to replace the former royal standard. New **hymns** were composed, **oaths** taken, and martyrs commemorated, all in the name of a **nation**.
- (iii) The Estates General was elected by the body of active citizens and renamed the **National Assembly**.
- (iv) A **centralised administrative system** was put in place and it formulated **uniform** laws for all citizens within its territory.
- (v) Internal customs duties and dues were abolished and a **uniform system of weights and measures** was adopted.

- (vi) Regional dialects were discouraged and French, as it was spoken and written in Paris, became the common language of the nation.
- (vii) The revolutionaries further declared that it was the mission and the destiny of the French nation to liberate the peoples of Europe from despotism.

### Civil Code of 1804:

- (i) Though a return to monarchy Napoleon had, no doubt, destroyed democracy in France, but in the administrative field he had incorporated revolutionary principles in order to make the whole system more rational and efficient.
- (ii) The civil code of 1804-usually known as the Napoleonic code did away with all privileges

based on birth, established equality before the law and secured the right to property.

- (iii) This code was exported to the regions under French Control.
- (iv) In the Dutch Republic in Switzerland, in Italy and Germany. Napoleon abolished the feudal system and freed peasants from serfdom and manorial dues.
- (v) In the towns too guild restrictions were removed.
- (vi) Transport and communication systems were improved
- (vii) Peasants, artisans, workers, and new businessmen enjoyed a new-found freedom.



*Europe after the Congress of Vienna, 1815.*



*Europe after the Congress of Vienna, 1815.*



*The courier of Rhineland loses all that he has on his way home from Leipzig. Napoleon here is represented as a postman on his way back to France after he lost the battle of Leipzig in 1813. Each letter dropping out of his bag bears the names of the territories he lost.*

## The Making of Nationalism In Europe :

In the mid-eighteenth century, Germany, Italy and Switzerland were divided into Kingdoms, duchies and cantons whose rulers had their autonomous territories. Eastern and Central Europe were under autocratic monarchies within the territories of which lived diverse people. They did not see themselves as sharing a collective identity or a common culture. Such differences did not easily promote a sense of political unity. The only tie binding these diverse groups together was common allegiance to the emperor.



**Some important dates:**

- 1797 Napoleon invades Italy; Napoleonic wars begin.
- 1814-1815 Fall of Napoleon; the Vienna Peace Settlement.
- 1821 Greek struggle for independence begins.
- 1848 Revolutions in Europe; artisans, industrial workers and peasants revolt against economic hardships; middle classes demand constitutions and representative governments; Italians, Germans, Magyars, Poles, Czechs, etc. demand nation-states.
- 1859-1870 Unification of Italy.
- 1866-1871 Unification of Germany. 1905 Slav nationalism gathers force in the Habsburg and Ottoman Empires.



**(i) The Aristocracy and the New Middle Class:**

- (1) The members of this class were united by a common way of life that cut across regional diversions. They owned castles in the countryside and also town houses. This powerful autocracy was however, numerically a small group. The majority of the population was made up of the peasantry.
- (2) Industrialisation began in England in the second half of the 18th century, but in France and parts of the German states it occurred only during the 19th century.
- (3) In its make new social groups came in to being a working class population and middle classes made up to industrialists, businessmen, professionals. It was among the educated, liberal middle classes that ideas of national unity following the abolition of aristocratic privileges gained popularity.

### (ii) What did Liberal Nationalism Stand for?

- (1) The term 'Liberalism' derives from the Latin root 'liber' meaning free. For the new middle classes liberalism stood for freedom for the individual and equality of all before the law. Politically it emphasized the concept of government. Since the French Revolution, liberalism had stood for the end of autocracy and clerical privileges a constitutional and representative government through parliament.
- (2) In the economic sphere, liberalism stood for the freedom of markets and the abolition of state imposed restrictions on the movement of goods and capital. During the 19th century this was a strong demand of the emerging middle classes.
- (3) Napoleon's administrative measures had created out of countless small principalities a confederation of 39 states. Each of these possessed its own currencies, and weights and measures. Which involved time-consuming calculations?
- (4) In 1834, a customs union of Zollverein was formed by the initiative of Prussia and joined by most of the German states. The union abolished tariff barriers and reduced the number of currencies from over thirty to two. The creation of network of railways further stimulated mobility, harnessing, and economic interests to national unification. According to Prof, Rierdich List, the aim of the Zollverein was to bind the Germans economically into a nation.

### (iii) A New Conservatism after 1815:

After the death of Napoleon in 1815 European governments were driven in a spirit of conservatism. It means a political philosophy that stressed the importance of tradition established institution and customs and preferred gradual development to quick change. In 1815 representatives of the European powers Britain, Russia, Prussia and Austria, Who had collectively defeated Napoleon met at Vienna to draw up a settlement for Europe.

- (1) The Bourbon dynasty, which had been deposed during the French revolution, was restored to power, and France lost the territories it had annexed under, Napoleon.



- (2) A series of states were set up on the boundaries of France to prevent French expansion in future. Thus the kingdom of the Netherlands, which included Belgium, was set up in the north and Geneva was added to Piedmont in the South.
- (3) Prussia was given important territories on its western frontiers, while Austria was given control of northern Italy. But the German confederation of 39 states that had been set up by Napoleon was left untouched. Russia was given part of Poland while Prussia was given a portion of Saxony. The main intention was to restore the monarchies that had been overthrown by Napoleon and create a new conservative order in Europe.

#### (iv) The Revolutionaries:

After 1815, the fear of repression drove many liberal nationalists underground. Secret societies sprang up in many European states to train revolutionaries and spread their ideas. To be revolutionary at this time meant a commitment to oppose monarchical forms that had been established after the Vienna Congress and to fight for liberty and freedom. Most of these revolutionaries also saw the creation of nation states as a necessary part of this struggle for freedom.



Fig. — Giuseppe Mazzini and the founding Young Europe in Berne 1833.  
Print by Giacomo Mantegazza.

**Giuseppe Mazzini:** One such was the Italian revolutionary Giuseppe Mazzini. Born in 1807. At the age of 24 he was sent on exile in 1831 for attempting

revolution in Liguria. He became a member of the secret society of the Carbonari. He subsequently founded two more underground societies first, Young Italy in Marseilles and Young Europe in Berne whose members were like minded. Mazzini believed that God had intended to be the natural interest of man kind.

#### The Age of Revolutions (1830-1848)

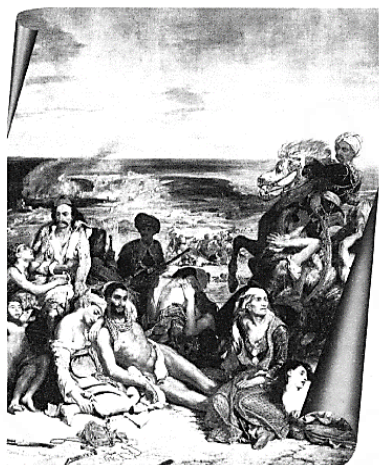
- (1) The first revolt took place in France in July 1830. The kings who had been restored to power during the conservative's reaction after 1815, were now overthrown by liberal revolutionaries' who installed a constitutional monarchy with Louis Philip. **'When France Sneezes'** Metternich one remarked 'the rest of Europe catches Cold'.
- (2) **Uprising in Brussels:** The July Revolution sparked an uprising in Brussels which led to Belgium breaking away from the United Kingdom of the Netherlands.
- (3) **Uprising in Greece:** Greece had been part of the Ottoman Empire since the fifteenth century. The growth of revolutionary nationalism in Europe sparked off a struggle for independence amongst the Greeks which began in 1821. Nationalists in Greece got support from other Greeks living in exile and also from many West Europeans who had sympathies for ancient Greek culture. Poets and artists lauded Greece as the cradle of European civilisation and mobilised public opinion to support its struggle against a Muslim empire. The English poet Lord Byron organised funds and later went to fight in the war, where he died of fever in 1824. Finally, the Treaty of Constantinople of 1832 recognised Greece as an independent nation.

**Ottoman Empire.**  
Turkish empire ruled by the Caliph—  
The spiritual and temporal head of the Muslims.





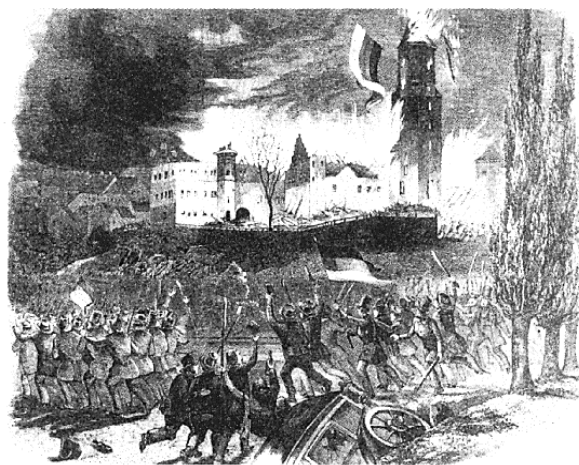
**(i) The Romantic Imagination and National Feeling:**



**Fig. — The Massacre at Chios, Eugène Delacroix, 1824.**  
The French painter Delacroix was one of the most important French Romantic painters. This huge painting (4.19m x 3.54m) depicts an incident in which 20,000 Greeks were said to have been killed by Turks on the island of Chios. By dramatising the incident, focusing on the suffering of women and children, and using vivid colours, Delacroix sought to appeal to the emotions of the spectators, and create sympathy for the Greeks.

- (1) Romanticism, a cultural movement which sought to develop a particular form of nationalist sentiment.
- (2) Romantic artists and poets generally criticised the glorification of reason and science and focused instead on emotions, intuition and mystical feelings. Their effort was to create a sense of shared collective heritage of common cultural past.
- (3) The other Romantics as the German philosopher to hear G. Herder claimed that true German culture was to be discovered among the common people. It was through folk songs, folk poetry and folk dances that the true spirit of the nation was popularised.
- (4) The Emphasis on Vernacular language and the collection of local folklore was not just to recover an ancient national spirit, but also to carry the modern nationalist message to large audiences who were mostly illiterate.
- (5) Karol Kurpinski, for example, celebrated the national struggle through his operas and music, turning folk dances like the polonaise and mazurka into nationalist symbols.
- (6) Language too played an important role in developing nationalist sentiments. After Russian occupation, the Polish language was forced out of schools and the Russian language was imposed everywhere.

**(ii) Hunger, Hardship and Popular Revolt:**



**Fig. — Peasants' uprising, 1848.**

- (1) The 1830s were years of great economic hardship in Europe. Population from rural areas migrated to the cities to live in over crowded slums. Europe where the aristocracy still enjoyed power, peasants struggled under the burden of feudal dues and obligations.
- (2) The year 1848 was one such year. Food shortage and widespread unemployment brought the population of Paris out on the roads. Barricades were erected and Louis Philippe was forced to leave National Assembly proclaimed a Republic, granted suffrage to all adult males above 21 and granted the right to work. National workshops to provide employment were set up.
- (3) On 4 June at 2 P.M. a large crowd of weavers emerged from their homes and marched in Paris up to the intention of their contractor demanding higher wages. They were treated with scorn and threats alternately. Following this a group of them forced their way into the house, smashed its window panes; furniture proclaimed. The contractor fled with his family to a neighbouring village, which however refused to shelter such a person. He returned 24 hours later having requested the army. In the exchange that followed eleven weavers were shot.

**(iii) 1848 : The Revolution of the Liberals :**

Parallel to the revolts of the poor, unemployed and starving peasants and workers in many European countries in the year 1848 , a revolution led by the





educated middle classes was under way. Events of February 1848 in France had brought about the abdication of the monarch and a republic based on universal male suffrage had been proclaimed. In other parts of Europe where independent nation States did not yet exist such as Germany, Italy, Poland, the Austro Hungarian Empire men and women unification. They took advantage of the growing popular unrest to push their demands for the creation of a nation-state on parliamentary principles a constitution, freedom of the Press and freedom of association.

### Frankfurt Parliament:

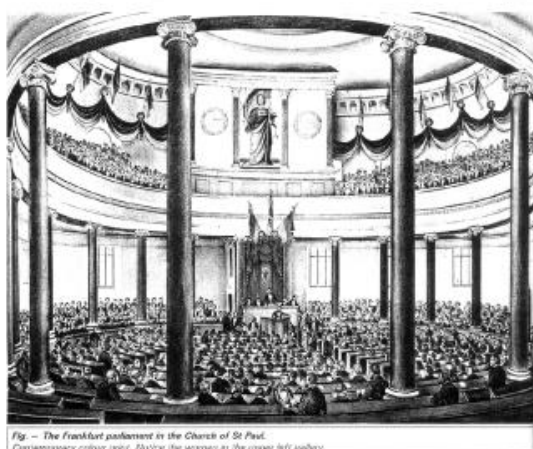


Fig. – The Frankfurt parliament in the Church of St Paul.  
Contemporary colour print. Notice the women in the upper left gallery.

In the German regions a large number of political associations came together in the city of Frankfurt and decided to vote for an all-German National Assembly. On 18 May 1848, 831 elected representatives marched in a festive procession to take their places in the Frankfurt parliament convened in the Church of St. Paul. They drafted a constitution for a German nation to be headed by a monarchy subject to a parliament.

### Obstacles:

- (1) Friedrich Wilhelm IV, King of Prussia rejected it and joined other monarchs to oppose the elected assembly.
- (2) While the opposition of the aristocracy and military became stronger, the social basis of parliament eroded. The parliament was dominated by the middle classes who resisted the demands of workers and artisans and consequently lost their support.

- (3) Issue of extending political rights to women was a controversial one within the liberal movement, they were denied suffrage rights during the election of the Assembly.

### Outcomes:

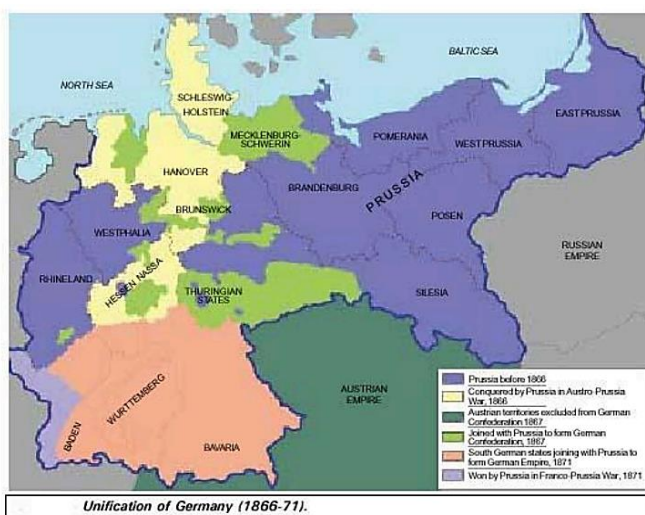
- (1) Though conservative forces were able to suppress liberal movements in 1848, they could not restore the old order.
- (2) In the years after 1848, the autocratic monarchies of Central and Eastern Europe began to introduce the changes that had already taken place in Western Europe before 1815.
- (3) The Habsburg rulers granted more autonomy to the Hungarians in 1867.

### The Making of Germany and Italy

#### (i) Germany - Can the Army be the Architect of nation?

- (1) Nationalist feelings were spreading among middle class Germans, who in 1848 tried to unite the different regions of the German confederation into a nation state governed by an elected parliament.
- (2) This liberal initiative to nation building was however, repressed by the combined forces of the monarchy and the military supported by the large land owners (called Junkers) of Prussia. From then on Prussia took on the leadership of the movement for national unification.
- (3) Its Chief Minister Otto van Bismarck was the architect of this process carried out with the help of Prussian army. 3 wars over 7 years with Austria Denmark and France were fought between 1866 to 1871 ended in the Prussian victory and completed the task of unification of Germany in 1871 Prussian king Williams I proclaimed themselves the king.
- (4) The nation building process in Germany had demonstrated the dominance of Prussian state power. The new state placed a strong emphasis on modernising the currency, banking, legal and judicial system in German Prussian measures and procedures often became a model for the rest of Germany.





## (ii) Italy unified:



Mazzini

Cavour



Garibaldi

Victor Emmanuel II

- (1) During the middle of the 19th Century, Italy was divided into seven states of which only one Sardinia piedmont was ruled by an Italian princely house. The north was under Austrian Habsburgs, the centre was ruled by the Pope and the southern regions were under the domination of the Bourbon Kings of Spain. Even the Italian

language had not acquired one common form and still had much regional and local verification.

- (2) Chief Minister Cavour who led the movement to unify the regions of Italy was neither a revolutionary nor a democrat. Like many other wealthy and educated members of the Italian elite, he spoke French better than he did Italian.
- (3) Through a tactful diplomatic alliance with France engineered by Cavour, Sardinia Piedmont succeeded in defeating the Austrian forces in 1859. Apart from regular troops a large number of armed volunteers under the leadership of Giuseppe Garibaldi joined the fray in 1860, they marched into south Italy and the kingdom of the Two Sicilies and succeeded in winning the support of the local peasants in order to drive out the Spanish rulers.
- (4) In 1861 Victor Emmanuel was proclaimed king of united Italy. However, much of the Italian population, among whom rates of illiteracy were very high, remained bliss fully unaware of liberal nationalist ideology. The peasant masses who had supported Garibaldi in Southern Italy had never heard of 'Italia' and believed that 'La Italia' was Victor Emmanuel's wife.







**Italy after unification.**  
The map shows the year in which different regions (seen in Fig 14(a)) become part of a unified Italy.

### (iii) The strange case of Britain:

- (1) In Britain the formation of the nation state was not the result of sudden upheaval or revolution. It was the result of a long draw-out process. There was no British nation prior to the 18th century. The primary identities of the people who inhabited the British ideas were ethnic ones—such as English, Welsh, Scot or Irish. All of these ethnic groups had their own cultural and political traditions.
- (2) But as the English nation steadily grew in wealth, importance and power, it was able to extend its influence over the other nations of the islands. The English Parliament, which had seized power from the monarchy in 1688 at the end of a protected conflict, was the instrument through which a nation state with England at its centre, came to be forged.
- (3) The Act of union (1707) between England and Scotland that resulted in the formation of the 'United Kingdom of Great Britain' meant in effect, that England was able to impose its influence on Scotland. The British Parliament was hence forth dominated by its English members.

- (4) Ireland suffered a similar fate. It was a country deeply divided between Catholics and Protestants. The English helped the Protestants of Ireland to impose their dominance over a largely catholic country. Catholic revolts against British dominance were brutally suppressed. After a failed revolt led by Wolfe Tone and his United Irishmen (1798). Ireland was forcibly incorporated into the United Kingdom in 1801. A new 'British nation' was forged through the propagation of dominant English culture.

### Visualising The Nation

- (1) Artists in the 18th and 19th centuries found a way out by personifying nation. In other words they represented a country as if it were a person.
- (2) Nations were then portrayed as female figures. The nation did not stand for any particular woman in real life, rather it sought to give the abstract idea of the nation a concrete form.
- (3) That is, the female figure became an allegory of the nation. After this so many countries used the same symbol (female) like Marianne in France and Germania in Germany.
- (4) Similarly, Germania became the allegory of the German nation. In visual representations, Germania wears a crown of oak leaves, as the German oak stands for heroism.



Postage stamps of 1850 with the figure of Marianne representing the Republic of France.





**Germania, Philip Veit, 1848.**  
The artist prepared this painting of Germania on a cotton banner, as it was meant to hang from the ceiling of the Church of St Paul where the Frankfurt parliament was convened in March 1848.

## Nationalism and Imperialism

- (1) The most serious source of nationalist tension in Europe after 1871 was the area called the Balkans. The Balkans was region of geographical and ethnic variation comprising modern day Romania, Bulgaria, Albania, Greece, Macedonia,

Croatia, Bosnia-Herzegovina, Slovenia, Serbia and Montenegro whose inhabitants were broadly known as the Slavs.

- (2) A large parts of the Balkans was under the control of the Ottoman Empire.
- (3) The spread of the ideas of romantic nationalism in the Balkans together with the disintegration of the Ottoman Empire made this region very explosive.
- (4) All through the 19th century the Ottoman Empire had sought to strengthen itself through modernization and internal reforms but with very little success. One by one its European subject nationalities broke away from its control and declared independence.
- (5) The Balkan people asked their claims for independence or political rights on nationalistic and used history to prove that they had once been independent but had subsequently been subjugated by foreign powers.
- (6) Hence the rebellions nationalities in the Balkans thought of their struggles as attempts to win back their long-lost independence.





## EXERCISE - I

## MULTIPLE CORRECT TYPE QUESTIONS

- Who made the famous remark, 'When France sneezes, the rest of Europe catches a cold'?  
(A) Metternich (B) Mazzini  
(C) Garibaldi (D) Louis Philippe
- The Treaty of Constantinople was signed in\_\_\_\_\_.  
(A) 1835 (B) 1735 (C) 1834 (D) 1832
- The famous Italian Revolutionary Giuseppe Mazzini was born in\_\_\_\_\_ in 1807.  
(A) Turin (B) Rome (C) Genoa (D) Atlanta
- Giuseppe Mazzini founded the secret underground society named 'Young Europe' in\_\_\_\_\_.  
(A) Marseilles (B) Berne  
(C) Vienna (D) Brussels
- \_\_\_\_\_believed that established, traditional institutions of state and society should be preserved.  
(A) Conservatives (B) Liberals  
(C) Democrats (D) None of the above
- The Bourbon dynasty, which had been deposed during the French Revolution, was restored to power after signing the Treaty of\_\_\_\_\_.  
(A) Vienna (B) Constantinople  
(C) Marseilles (D) Prussia
- \_\_\_\_\_regimes-imposed censorship laws to control what was said in newspapers, books, plays and songs and reflected the ideas of liberty and freedom.  
(A) Liberal (B) Conservative  
(C) Democratic (D) Secular
- A large part of the Balkans was under the control of the\_\_\_\_\_ empire, which witnessed the most serious source of nationalist tensions in Europe after 1871.  
(A) Greek (B) Russian  
(C) Prussian (D) Ottoman
- Artists of the time of the French Revolution personified\_\_\_\_\_ as a female figure.  
(A) Socialism (B) Liberty  
(C) Autocracy (D) None of the above
- During the nineteenth century,\_\_\_\_\_ emerged as a force that brought about sweeping changes in the political and mental world of Europe.  
(A) Nationalism (B) Secularism  
(C) Monarchy (D) Religion
- The idea of La Patrie means\_\_\_\_\_.  
(A) Motherland (B) Fatherland  
(C) Citizens (D) Monarchy
- The Estates General was elected by the body of active citizens and renamed the\_\_\_\_\_.  
(A) Provincial Assembly  
(B) State Assembly  
(C) National Assembly  
(D) None of the above
- Which of the following statements about the Civil Code of 1804, usually known as the Napoleonic Code, are true?  
(A) Secured the Right to Property  
(B) Established Equality before the Law  
(C) Removed all privileges based on birth  
(D) All of the above
- Which of the following resulted in hostility towards the French armies in Europe?  
(A) Forced conscription into the French armies  
(B) Censorship  
(C) Uniform Laws  
(D) Options (A) & (B)
- The Habsburg Empire consisted of regions.  
(A) Italian-speaking provinces of Lombardy and Venetia  
(B) The Alpine regions - the Tyrol, Austria and the Sudetenland  
(C) Options (A) & (B)  
(D) None of the above
- In Galicia, the aristocracy spoke\_\_\_\_\_language.  
(A) German (B) Italian  
(C) French (D) Polish
- The first political experiment in liberal democracy took place in\_\_\_\_\_.  
(A) Germany (B) France  
(C) Italy (D) Great Britain





18. Which of the following is true about Liberalism?  
(A) Abolition of state-imposed restrictions  
(B) Freedom of markets on the movement of goods and capital  
(C) Options (a) and (b)  
(D) None of the above
19. Which of the following is true about elle?  
(A) It was known as the measurement of cloth  
(B) An elle of textile material in different regions will give different measurements of cloth  
(C) Such difference in measurement was viewed as an obstacle to economic exchange  
(D) All of the above
20. A secret society named Young Italy was established in\_\_\_\_\_.  
(A) Marseilles (B) Berne  
(C) Zurich (D) Genoa
21. Which of the following statements about the 'French Revolution' are correct?  
(i) After the end of the French Revolution it was proclaimed that it was the people who would henceforth constitute the nation and shape its destiny.  
(ii) France will have a constitutional monarchy and the new republic will be headed by a member of the royal family.  
(iii) A centralised administrative system will be put in place to formulate uniform laws for all citizens.  
(iv) Imposition of internal custom duties and dues will continue to exist in France  
(A) (ii) and (iii) (B) (ii) and (iv)  
(C) (i) and (iii) (D) (iii) and (iv)
22. The French revolutionaries declared that the mission and destiny of the French nation was  
(A) to conquer the people of Europe  
(B) to liberate the people of Europe from despotism.  
(C) to strengthen absolute monarchies in all the countries of Europe.  
(D) to propagate the ideals of liberty, equality, and fraternity in every part of the world.
23. The Civil Code of 1804 in France is usually known as:  
(A) The French Revolutionary Code  
(B) Napoleonic Code  
(C) European Imperial Code  
(D) The French Civil Code
24. The Napoleonic Code was exported to which of the following regions?  
(A) England (B) Spain  
(C) Regions under French control (D) Poland
25. The liberal nationalism stands for:  
(A) freedom for the individual and equality before law.  
(B) preservation of autocracy and clerical privileges.  
(C) freedom for only male members of society and equality before law.  
(D) freedom only for senior citizens.
26. Who among the following formed the secret society called 'Young Italy'?  
(A) Otto von Bismarck  
(B) Giuseppe Mazzini  
(C) Metternich  
(D) Johann Gottfried Herder
27. The term 'Universal Suffrage' means:  
(A) the right to vote and get elected, granted only to men.  
(B) the right to vote for all adults.  
(C) the right to vote and get elected, granted exclusively to property owning men.  
(D) the right to vote and get elected, granted only to educated men and women.
28. Which of the following is not a feature or belief of 'Conservatism'?  
(A) Conservatives believe in established, traditional institutions of state and policy.  
(B) Conservatives stressed the importance of tradition and preferred gradual development to quick change.  
(C) Conservatives proposed to return to the society of pre-revolutionary days and were against the ideas of modernisation to strengthen monarchy.  
(D) Conservatives believed in the monarchy, church, and other social hierarchies.







29. The Treaty of recognized Greece as an independent nation:  
 (A) Vienna 1815  
 (B) Constantinople 1832  
 (C) Warsaw 1814  
 (D) Leipzig 1813
30. Who said 'When France sneezes, the rest of Europe catches cold'?  
 (A) Garibaldi (B) Bismarck  
 (C) Marzini (D) Duke Metternic

### FILL IN THE BLANKS

- Nationalism played a pivotal role in the unification of \_\_\_\_\_ and \_\_\_\_\_ during the 19th century.
- The nationalist movements in Italy were led by prominent figures such \_\_\_\_\_ and \_\_\_\_\_.
- Otto Von Bismarck, the Chancellor of \_\_\_\_\_ utilized nationalist sentiments to achieve German unification.
- The rise of nationalism in Europe led to the weakening of multi-national empires such as the \_\_\_\_\_ and \_\_\_\_\_.
- The positive effects of nationalism in Europe included the creation of unified nation-states, fostering a sense of identity and pride among \_\_\_\_\_.

### MATCH THE COLUMN

1. Match the following

(A)	Absolutist	(P)	Vision of a society which is too ideal to be fulfilled
(B)	Utopian	(Q)	A customs union formed by Prussia
(C)	Nation	(R)	A region in East Europe comprising many ethnic groups.
(D)	Balkans	(S)	Authoritarian rule or government without restraint.
(E)	Zollverein	(T)	A State having people with a sense of common identity and shared history.

### TRUE AND FALSE

- Find the True statements:
  - In the middle of the 19th century, Italy was divided into seven states.
  - During the 1830 s, Giuseppe Mazzini began a program for the unification of the Italian Republic.
  - Sardinia-Piedmont and its monarch King Victor Emmanuel II were given the responsibility of bringing the Italian nations together through war.
  - Sardinia-Piedmont and its monarch King Victor Emmanuel II were given the responsibility to break the Italian nations and rule over there.

(A) a,b,c,d (B) a,b,c (C) b,c (D) a,d
- Mark the correct statements
  - The formation of Great Britain was most the result of any revolution. The formation of Great Britain was not the result of any revolution.
  - The formation of Great Britain was the result of Great revolution.

(A) a is true b is false.  
 (B) a is false b is true.  
 (C) both are true.  
 (D) both are false.
- Which of the following statements are true:
  - Culture played a crucial role in creating the idea of a nation, such as art and poetry, stories and music, which helped express and shape nationalist feelings.
  - Romanticism was a cultural movement which was brought into the limelight to develop and shape a particular form of nationalist sentiment.

(A) a is true b is false.  
 (B) a is false b is true.  
 (C) Both are true  
 (D) Both are false.
- The unification of Germany was primarily led by Otto von Bismarck.
 

(A) True  
 (B) False





5. The unification of Italy was achieved through peaceful means.  
(A) True  
(B) False
6. The French Revolution of 1789 had a significant impact on the rest of Europe,  
(A) True  
(B) False
7. Nationalism in Europe was a unifying force that brought people together.  
(A) True  
(B) False

### ASSERTION AND REASON

**Direction:** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

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

1. **Assertion:** Giuseppe Mazzini worked with the conservatives for the monarchy.  
**Reason:** Italy had to continue to be a patchwork of small states and kingdoms.  
Mark the option which is most suitable:
2. **Assertion:** Italy was divided into seven states, of which only one was ruled by an Italian princely house.  
**Reason:** The north was under the domination of the Bourbon kings of Spain.  
Mark the option which is most suitable:

3. **Assertion:** Germany, Italy and Switzerland were divided into kingdoms, duchies and cantons whose rulers had their autonomous territories.  
**Reason:** They were closely bound to each other in spite of their autonomous rule.  
Mark the option which is most suitable:
4. **Assertion:** Culture played an important role in creating the idea of the nation.  
**Reason:** Weavers in Silesia had led a revolt against contractors who supplied raw material and gave them orders for finished textiles but drastically reduced their payments.  
Mark the option which is most suitable:
5. **Assertion:** On 18 May 1848, 831 elected representatives revolted in the Frankfurt parliament.  
**Reason:** The elected representatives revolted against the issue of extending political rights to women.  
Mark the option which is most suitable:
6. **Assertion:** The Scottish Highlanders were forbidden to speak their Gaelic language or wear their national dress, and large numbers were forcibly driven out of their homeland.  
**Reason:** The English helped the Protestants of Ireland to establish their dominance over a largely Catholic country.  
Mark the option which is most suitable:
7. **Assertion:** From the very beginning, the French revolutionaries introduced various measures and practices like the idea of ha parties and le citizen.  
**Reason:** This was done to create a sense of collective identity amongst the French people.  
Mark the option which is most suitable:



**EXERCISE – II****VERY SHORT ANSWER TYPE QUESTIONS**

1. What is "Statue of Liberty"? What does the statue signify?
2. How is Germania depicted?
3. In the context of pre-revolutionary France's What is referred to as the Estates General.
4. What are the national symbols of the New Britain?
5. What does liberalism stand for?
6. What is the importance of Act of union, 1707?
7. Name four European powers who collectively defeated Napoleon.
8. With what aim was the Treaty of Vienna (1815) signed?
9. Name two secret societies set up in Italy in early 19th century.
10. When and under whom was the constitutional monarchy setup in France?
11. Name the treaty which recognised Greece as an independent nation.
12. What was the main feature of European Romanticism?
13. Why did the weavers in Silesia rise in revolt against the contractor?
14. Name the four ethnic groups which inhabit England.
15. Name two European states which were unified into nation states in the later half of 19th century Name one leader of each of these two countries.

**SHORT ANSWER TYPE QUESTIONS**

1. Why was Zollverien set up in Prussia in 1834? What was its significance?
2. Examine reasons for the nationalistic upsurge in 19th century Europe?
3. Why are allegories used to generate nationalism? Give two examples of allegories used in France and Germany.
4. What are the most important achievements of the French Revolution of 1789?
5. Who was Garibaldi? Examine his contribution in the unification of Italy.
6. What was the significance of the Napoleonic code?
7. How was Ireland incorporated in the United Kingdom?
8. Examine the reasons for the political disunity in Habsburg empire of Austria and Hungary.

9. How was Cavour? Examine any two of his contributions.
10. Examine the liberal ideology imbibed by the revolutionary leader after French revolutions.
11. What was the significance of the Frankfurt Parliament (1848)? Why did it fail?
12. What was the impact of Treaty of Vienna (1815) on European people?
13. Examine the events leading to the formation of the France Republic in 1848.
14. How do folklore and vernacular language help in developing nationalist sentiments?
15. Examine the effects of revolutionary upheaval in France in 1830.

**LONG ANSWER TYPE QUESTIONS**

1. What area was known as the Balkans. Name the major powers that were involved in the Balkan conflict and what reason which made it explosive?
2. Discuss the importance of language and popular traditions in the creation of national identity.
3. Examine the process of unification of Italy?
4. What were the major proposals of the Vienna Congress?
5. Briefly trace the process of the unification of Germany and that of Britain.
6. Explain in brief the uprising in Greece?
7. Who was Frederic Sorrieu? Explain in brief the theme of his painting.

**CASE BASED QUESTION**

**Read the source given below and answer the following questions:**

1. Frederic Sorrieu prepared a series of four prints visualizing his dream of a world made up of 'democratic and social Republics', as he called them. The first print of the series shows the peoples of Europe and America - men and women of all ages and social classes - marching in a long train, and offering homage to the Statue of Liberty as they pass by it. Artists of the time of the French Revolution personified Liberty as a female figure. She bears the torch of Enlightenment in one hand and the Charter of the Rights of Man in the other.





On the earth in the foreground of the image lie the shattered remains of the symbols of absolutist institutions. In Sorrieu's utopian vision, the peoples of the world are grouped as distinct nations, identified through their flags and national costume. Leading the procession, way past the Statue of Liberty, are the United States and Switzerland, which by this time were already nation-states. France, identifiable by the revolutionary tricolor, has just reached the statue. She is followed by the peoples of Germany, bearing the black, red and gold flag.

**(I)** Who was Frederic Sorrieu?

- (A) French artist      (B) German Artist  
(C) Italian Artist      (D) British Artist

**(II)** In which year did Frederic Sorrier prepare a series of four prints?  
(A) 1845 (B) 1843 (C) 1848 (D) 1841

**(III)** Which of the following statements correctly describes "absolutist"?

- (A) Monarchical Government  
(B) Democratic Government  
(C) Centralised Government  
(D) Bureaucratic Government

**(IV)** Which of the following is correct with respect to "utopian vision"?

- (A) Homogenous society  
(B) Monarchical society  
(C) Ideal society  
(D) All are correct





## ANSWER KEY

## EXERCISE – I

## MULTIPLE CHOICE QUESTIONS

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

## FILL IN THE BLANKS

- Italy and Germany
- Giuseppe Garibaldi, Count Camillo di Cavour
- Prussia
- Austro-Hungarian Empire, Ottoman Empire
- Citizens

## MATCH THE COLUMN TYPE QUESTIONS

- A-S, B-P, C-T, D-R, E-Q

## TRUE AND FALSE

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

## ASSERTION AND REASON

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







# DPP

## Daily Practice Problems

**SUBJECT: HISTORY****CLASS-10****DPP NO. 1****TOPIC : THE RISE OF NATIONALISM IN EUROPE****Multiple Choice Questions:**

- Which of the following countries did not attend the Congress of Vienna -  
(A) Britain (B) Russia (C) Prussia (D) Switzerland
- Who said "When France sneezes, the rest of Europe catches cold" ?  
(A) Garibaldi (B) Mazzini (C) Metternich (D) Bismark
- Which treaty recognised Greece as an independent nation ?  
(A) Treaty of Versailles (B) Treaty by Vienna  
(C) Treaty of Constantinople (D) None of these
- Who was responsible for the unification of Germany ?  
(A) Bismarck (B) Cavour (C) Mazzini (D) Garibaldi
- Following image is the personification of Germany commonly associated with the Romantic Era and the Revolutions of 1848. Identify its name from among the following options.



- (A) Marianne (B) Germania (C) Philip Viet (D) La Italia
- Where was Zollverein setup?  
(A) Austria (B) Russia (C) Japan (D) Prussia
  - When was the Act of Union signed?  
(A) 1705 (B) 1707 (C) 1709 (D) 1710
  - Garibaldi is one of the most celebrated freedom fighter of \_\_\_\_\_.  
(A) Japan (B) Italy (C) German (D) France

- 
9. Sorrieu's vision of society which is so idealistic that it is unlikely to exist is called  
(A) Democratic (B) Absolutist (C) Conservatist (D) Utopian
10. The civil code introduced by Napoleon is  
(A) 1802 (B) 1804 (C) 1806 (D) 1808

**Very short answer type Questions:**

1. What is "Statue of Liberty"? What does the statue signify?
2. What does liberalism stand for?
3. Why was Zollverein set up in Prussia in 1834? What was its significance?
4. Name two secret societies set up in Italy in early 19th century
5. What was the main aim of the French revolutionaries?

**Short answer type Questions:**

1. What are the most important achievements of the French Revolution of 1789 ?
2. What was the impact of Treaty of Vienna (1815) on European people ?
3. What was indicated by Metternich's remark "If France sneezes, rest of Europe catches cold"?
4. What was the significance of the Frankfurt Parliament (1848) ? Why did it fail ?
5. Who was Cavour ? Examine any two of his contributions.

**Long answer type Questions:**

1. Mention the main factors responsible for the rise of nation state.
2. Discuss the importance of language and popular traditions in the creation of national identity.
3. Briefly trace the process of the Unification of Germany and Unification of Italy.

**Case based Study**

**Read the following passages and answer the questions that follow :**

1. Other Romantics such as the German philosopher Johan Gottfried Herder (1744-1803) claimed that true German culture was to be discovered among the common people -das volk. It was through folk songs, folk poetry and folk dances that the true spirit of the nation (volksgeist) was popularized. So collecting and recording these forms of folk culture was essential to the project of nation-building. The emphasis on vernacular language and the collection of local folklore was not just to recover an ancient national spirit, but also to carry the modern nationalist message to large audience who were mostly illiterate.
-

- (I) Which of the following statement best describes the Romantic Movement ?  
 (A) It was about the emotions of patriotism towards one's state.  
 (B) It was a cultural movement which sought to develop nationalist sentiments.  
 (C) It was a literary movement to focus on vernacular languages.  
 (D) Both (b) and (c)
- (II) Who among the following celebrates nationalism through opera music ?  
 (A) Garibaldi (B) Grimm Brothers (C) Karol Kurpinski (D) Mazzini
- (III) Define Volksgeist.  
 (A) Spirit of the self (B) Patriotic emotions  
 (C) Tendency to follow the rules (D) Spirit of the nation
- (IV) **Assertion (A) :** It was through folk songs, folk poetry and folk dances that the true spirit of the nation true spirit of the nation was popularised.  
**Reason (R) :** Recording these forms of folk culture was essential to the project of nation building.  
 (A) Both (A) and (R) are true and (R) is the correct explanation of (A).  
 (B) Both (A) and (R) are true but (R) is not the correct explanation of (A).  
 (C) (A) is correct but (R) is wrong.  
 (D) (A) is wrong but (R) is correct.
2. The first half of the nineteenth century saw an enormous increase in population all over Europe. In most countries there were more seekers of jobs than employment. Population from rural areas migrated to the cities to live in overcrowded slums. Small producers in towns were often faced with stiff competition from imports of cheap machine-made goods from England, where industrialisation was more advanced than on the continent.
- (I) Who ruled France in 1830s and was forced to flee after unemployment caused workers to revolt on roads?
- (II) Were people guaranteed rights after they came out on roads on revolt in France in 1830s? If yes, name one such right.
- (III) Why was 1830 the year of great economic hardship in Europe?

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