

CHAPTER-10

LIGHT-REFLECTION AND REFRACTION

Light: It is a form of energy which produces the sensation of sight.

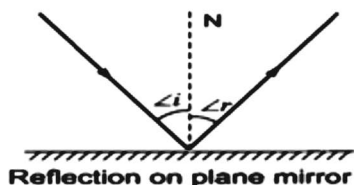
- Light exhibits dual nature i.e. wave as well as particle nature.
- It travels with a speed of 3×10^8 m/s in vacuum. However speed is inversely proportional to optical density of the medium.

Reflection: When light falls on a surface, it bounces back to the medium. The phenomena is called reflection.

Beam: A beam is a bundle of rays, which originates from a common source and travels in the same direction.

LAWS OF REFLECTION

- Incident ray: Ray of light coming from a source towards the reflecting surface.
- Reflected ray: Ray of light which is reflected back by a reflection surface.
- Normal: Perpendicular drawn to the reflecting surface.
- Angle of incidence: The angle between incident ray and normal at the point of incidence.
- Angle of reflection: The angle between reflected ray and normal at the point of reflection



Laws:

- The angle of incidence is equal to the angle of reflection.
- The incident ray, the normal to the mirror at the point of incidence and reflected ray, all lie in the same plane.

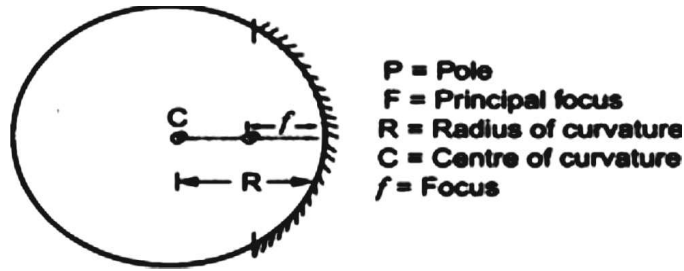
These laws of reflection are applicable to all types of reflecting surfaces including spherical surfaces.

- **Types of mirror** Plane mirror Spherical mirror
- Concave mirror
- Convex mirror
- Concave Mirror: A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the centre of sphere, is called a concave mirror.
- Convex Mirror: A spherical mirror whose reflecting surface is curved outwards, is called a convex mirror.

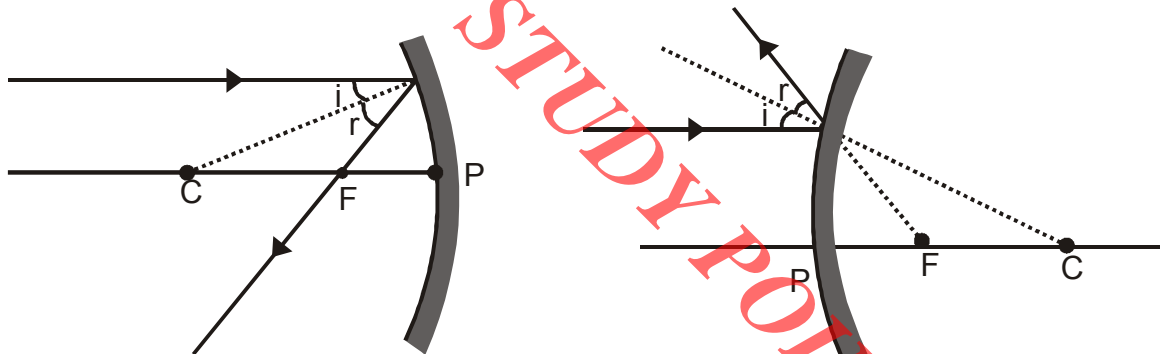


Basic terms of Spherical Mirrors:

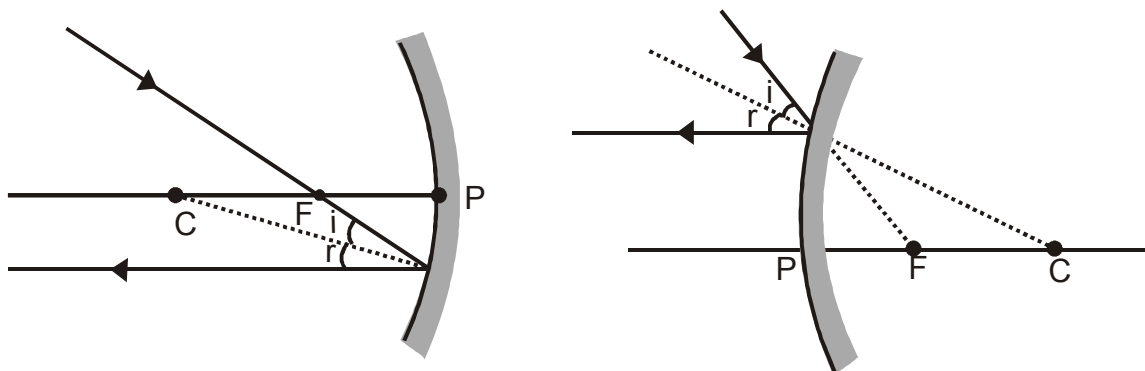
- **Centre of curvature:** The centre of a hollow sphere of which the curved or spherical mirror forms a part is called centre of curvature.
- **Radius of curvature (R):** The radius of sphere of which the reflecting surface of a spherical mirror forms a part is called the radius of curvature of the mirror.
- **Pole:** The centre of the reflecting surface of spherical mirror. The pole is usually represented by the letter P.
- **Principal axis:** Its an imaginary line passing through the centre of curvature and pole.
- **Aperture:** The diameter of the reflecting surface of the spherical mirror is called its aperture.
- **Principal focus:** A point on the principal axis of a spherical mirror where the rays of light parallel to the principal axis meet or appear to meet after reflection from the spherical mirror is called principal focus.
- **Focal length (f):** The distance between the pole and principal focus (F) of a spherical mirror is called the focal length of the mirror. It is denoted by f.
- $f=R/2$



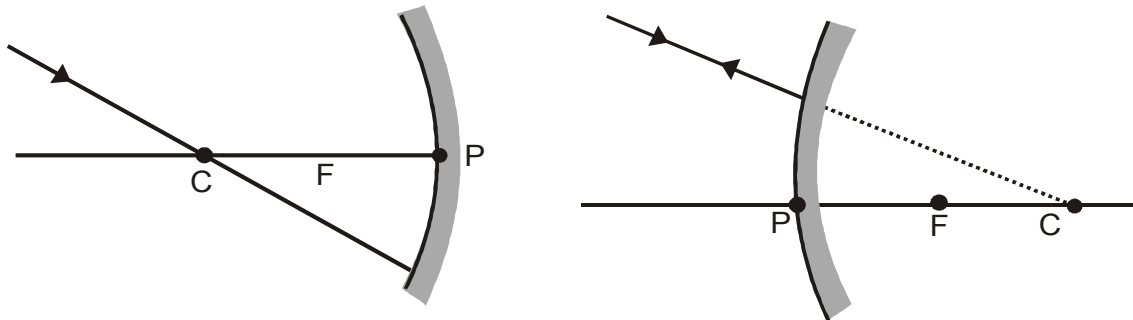
- Representation of images formed by spherical mirror using ray diagrams:
- In order to locate the image of an object, an arbitrarily large number of rays emanating from a point could be considered.
- The intersection of reflected ray gives the position of image.
- **Rules for obtaining image:**
 - (i) A ray parallel to the principal axis, after reflection, will pass through the principal focus in case of concave mirror or appear to diverge from the principal focus in case of a convex mirror.



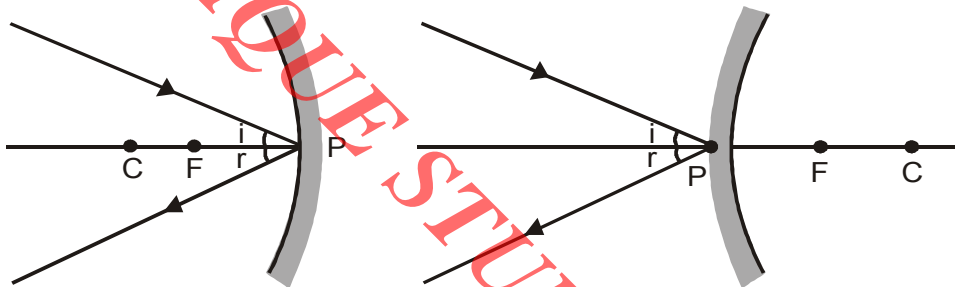
- (ii) A ray passing through principal focus of a concave mirror or a ray which is directed towards the principal focus of a convex mirror after reflection will emerge parallel to the principal axis.



- (iii) A ray passing through the centre of curvature of a concave mirror or directed in the direction of the centre of curvature of a convex mirror after reflection, is reflected back along the same path.



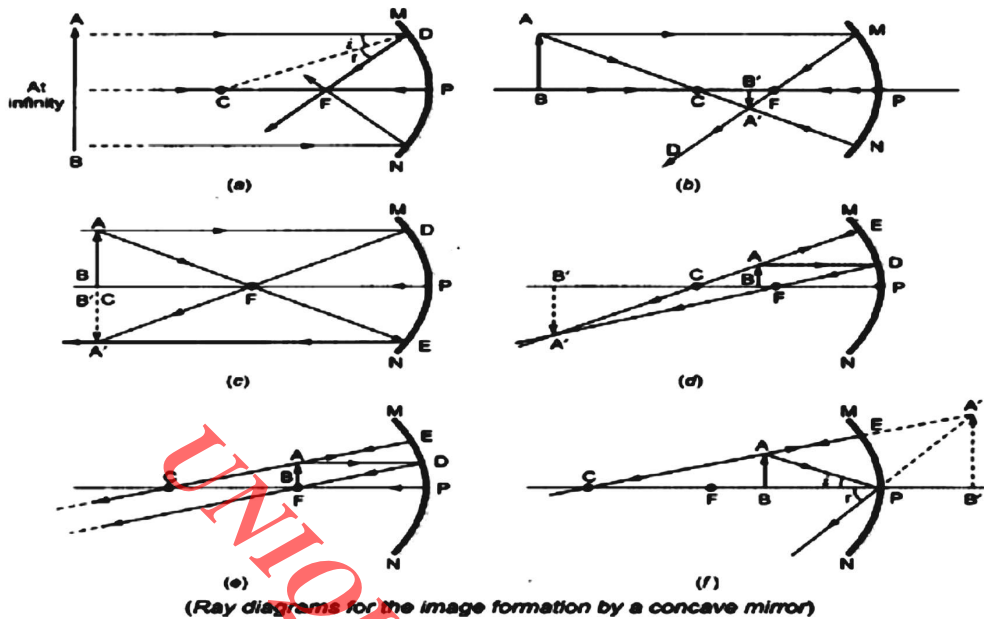
- (iv) A ray incident obliquely to the principal axis, towards point P (pole of the mirror) on the concave or convex mirror is reflected obliquely.



• **Image formation by a concave mirror for different positions of the object-**

S.No.	Position of the object	Position of the image	Size of the image	Nature of the image
(a)	At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
(b)	Beyond C	Between F and C	Diminished	Real and inverted
(c)	At C	At C	Same size	Real and inverted
(d)	Between C and F	Beyond C	Enlarged	Real and inverted
(e)	At F	At infinity	Highly enlarged	Real and inverted
(f)	Between P and F	Behind the mirror	Enlarged	Virtual and erect

• **Ray diagram for the image formation by a concave mirror**

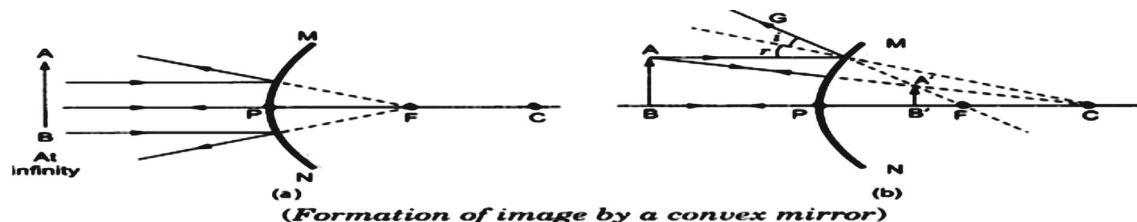


• **Formation of image by a convex mirror**

Nature, position and relative size of the image formed by a convex mirror-

S.No.	Position of the object	Position of the image	Size of the image	Nature of the image
(a)	At infinity	At the focus F, behind the mirror	Highly diminished, point-sized	Virtual and erect
(b)	Between infinity and the pole P of the mirror	Between P and F, behind the mirror	Diminished	Virtual and erect

Ray diagram for image formation by convex mirror



Uses of mirrors-

(a) **Uses of concave mirrors:**

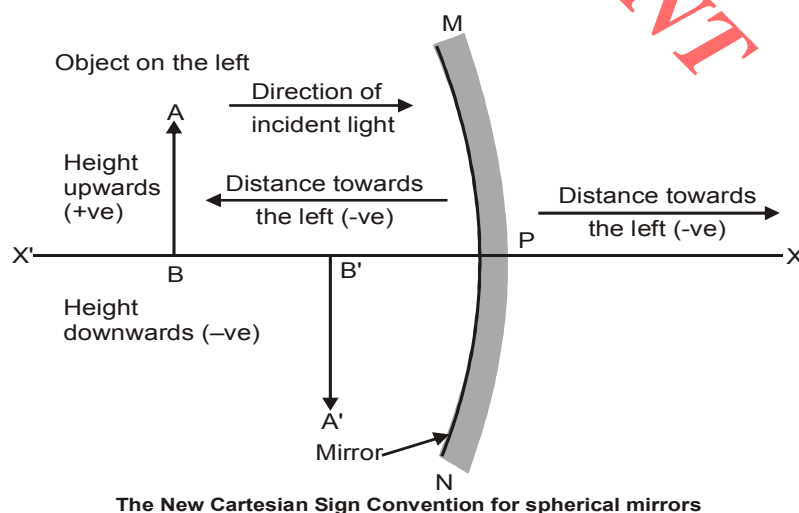
- Concave mirrors are commonly used in torches, search lights and vehicles headlights to get powerful beam of light.
- It is used in shaving mirrors to see large image of the face.
- The dentists use concave mirror to see large images of the teeth of patients.
- Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.

(b) Uses of convex mirrors:

- Convex mirrors are used as rear-view (wing) mirrors in vehicles.
- Convex mirrors are used as street reflectors because they are able to spread light over a bigger area.

Sign convention for reflection by spherical mirrors

- The object is always placed to the left of the mirror. This implies that the light from the object falls on the mirror from the left-hand side.
- All distances parallel to the principal axis are measured from the pole of the mirror.
- All the distances measured to the right of the origin (along + x-axis) are taken as positive while those measured to the left of the origin (along - x- axis) are taken as negative.
- Distances measured perpendicular to and above the principal axis (along +y-axis) are taken as positive, (u)



Mirror formula Mirror formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

- u is the Object distance
- v is the Image distance
- f is the Focal Length

Magnification

Magnification produced by a spherical mirror gives the relative extent to which the image of an object is magnified with respect to the object size. It is expressed as the ratio of the height of the image to the height of the object. It is usually represented by the letter m. If h is the height of the object and h₂ is the height of the image, then the magnification m produced by a spherical mirror is given by –

$$m = \frac{\text{Height of the image (h}_2\text{)}}{\text{Height of the object (h)}} \quad m = \frac{h_2}{h}$$

The magnification m is also related to the object distance (u) and image distance (v). It can be expressed as: Magnification (m) = $\frac{h'}{h} = -\frac{v}{u}$ m(+ve) then virtual & erect image

m(-ve) then real & inverted image

REFRACTION

Refraction of Light: The bending of light at the interface of two different mediums is called Refraction of light.

- If the velocity of light in medium is more, then medium is called optical rarer. Example, air or vacuum is more optical rarer.
- If the velocity of light in medium is less, then medium is called optical denser. Example, glass is more denser than air.
- **Refractive Index:** It represents the amount or extent of bending of light when it passes from one medium to another.

There are two types of refractive index

- Relative refractive index and
- Absolute refractive index.

Refractive index of medium with respect to other medium is called **Relative Refractive Index**.

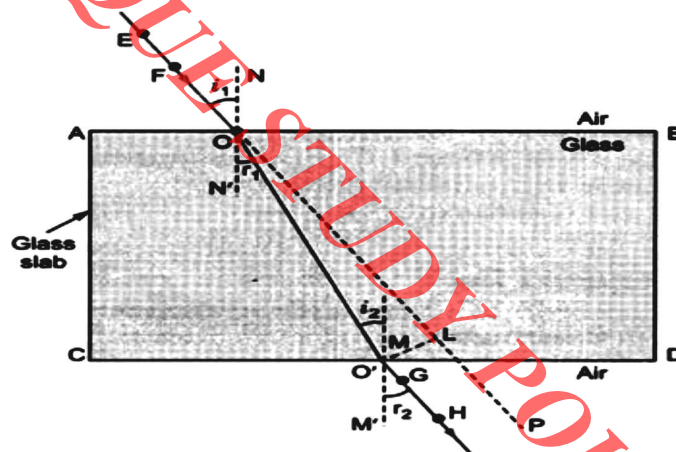
Refractive index of medium 1 with respect to medium 2 = Speed of light in medium 2(v_2)/Speed of light in medium 1(v_1) **Absolute Refractive Index.**

Refractive index of medium with respect to air or vacuum is called Absolute Refractive Index.

Absolute refractive index of medium (m) = Speed of light in air(c)/Speed of light in medium (v_m)

Laws of refraction-

- i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
- ii) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for a light of given colour and for a given pair of media.
 $\sin i / \sin r = \text{constant}$ (**Snell's Law**)



Refraction of Light through glass slab

Lens: The transparent refracting medium bounded by two surfaces in which at least one surface is curved is called lens.

Lenses are mainly two types

- Convex lens
- Concave lens.

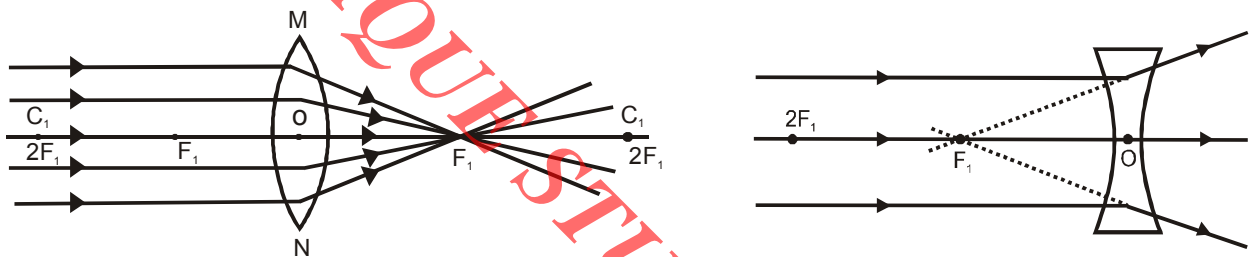


Convex lens:

- A lens may have two spherical surfaces, bulging outwards. Such a lens is called a double convex lens or convex lens.
- It is thicker at the middle as compared to the edges.
- Convex lens converges light as shown in Figure above. Hence, convex lenses are called converging lens.

Concave lens:

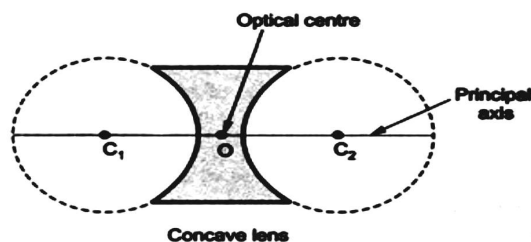
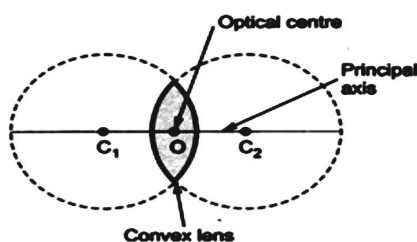
- A double concave lens is bounded by two spherical surface curved inwards.
- It is thicker at the edges than in the middle.
- Concave lens diverges light and is called diverging lens.



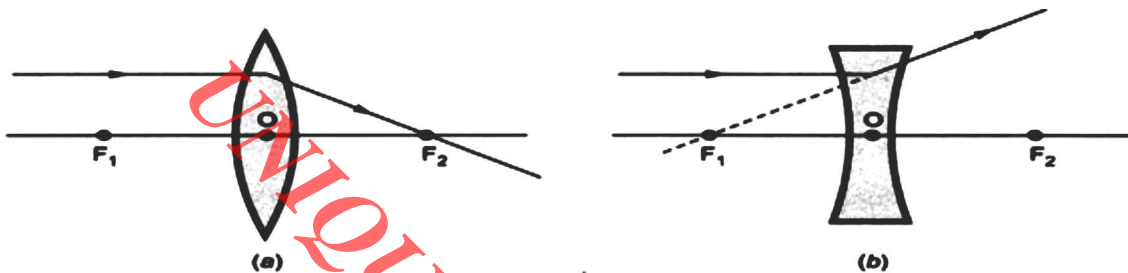
Converging action of convex lens and diverging action of concave lens

BASIC TERMS OF SPHERICAL LENS

- **Principal axis:** A line joining the centre of curvatures of two spherical surfaces forming a lens is called principal axis. The line joining C_1 and C_2 is the principal axis (see figure below).
- **Principal focus:** A point on the principal axis of a lens where all rays of light parallel to the principal axis meet
- **Optical centre:** The central point of a lens (O) through which a ray of light pass undeviated is called optical centre.



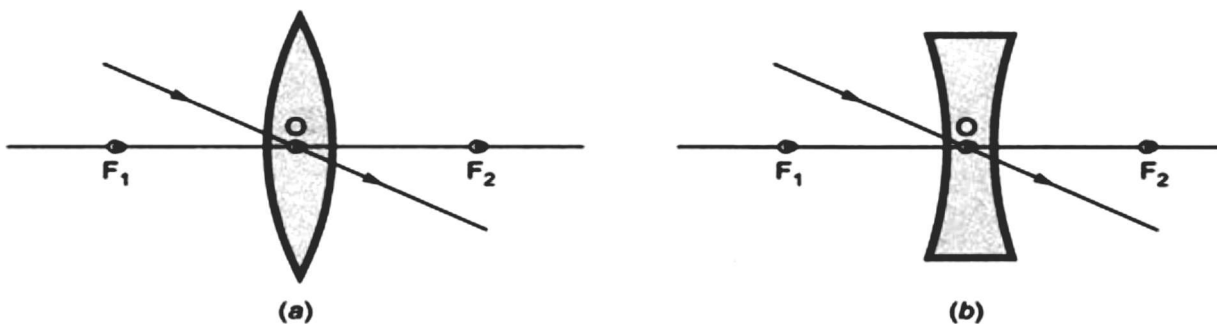
- Focal length: The distance between the principal focus and optical centre of a lens is called focal length of lens. It is denoted by f .
- Aperture of lens: The effective diameter of circular outline of a spherical lens is called its aperture.
- **Rules for making ray diagram-**
 1. A ray of light from the object, parallel to the principal axis, after refraction from a lens passes through the principal focus or appears to diverge from the principal focus



2. A ray of light passing through the principal focus or appearing to meet at the principal focus after refraction, will emerge parallel to the principal axis.



3. A ray of light passing through the optical centre of lens will emerge without any deviation.



- **Image formation by convex lens.** Nature, position and relative size of the image formed by a convex lens for various positions of the object.

S.No	Position of the object	Position of the image	Relative size of the image	Nature of the image
(a)	At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
(b)	Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
(c)	At $2F_1$	At $2F_2$	Same size	Real and inverted
(d)	Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
(e)	At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
(f)	Between focus F_1 and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

- **Ray diagram for the image formation by convex lens:-**

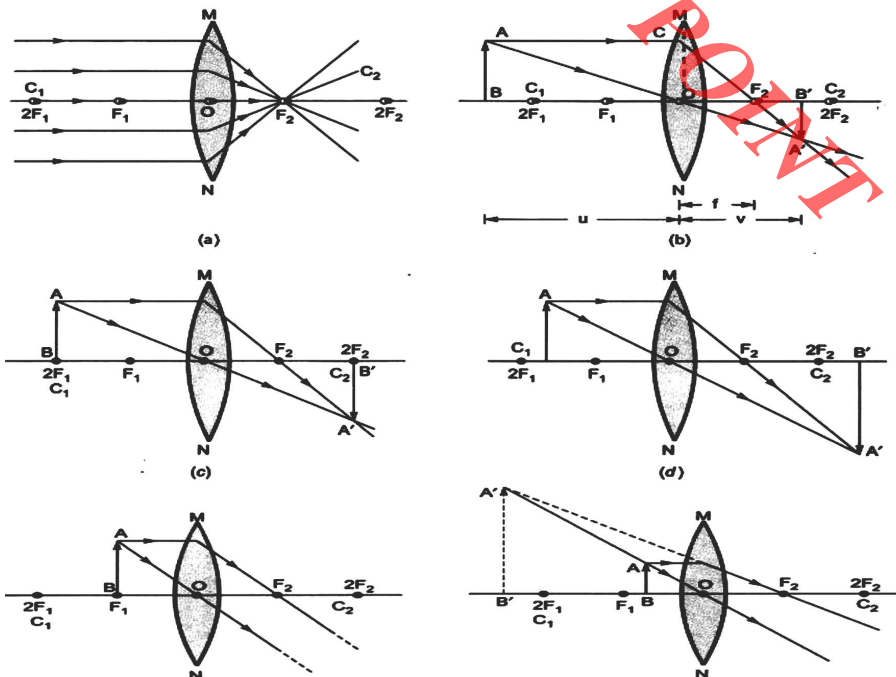
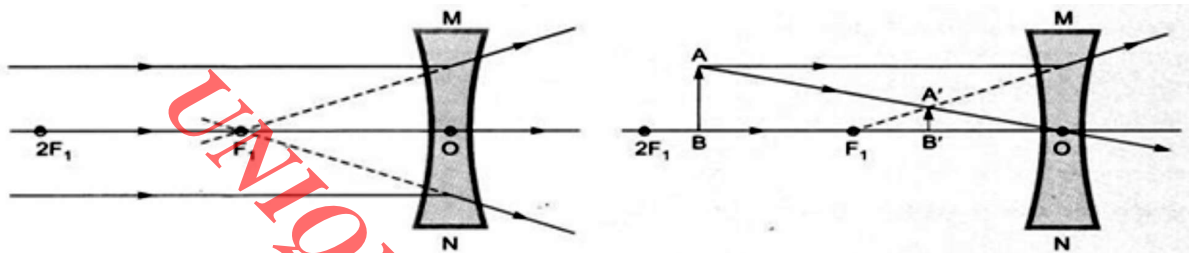


Image formation by concave lens:-

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At Focus F ₁	Highly diminished and point sized	Virtual and erect
Between infinity and optical centre O of the lens	Between Focus F ₁ and optical centre O	Diminished	Virtual and erect



Nature, position and relative size of the image formed by a concave lens for various positions of the object

- **Sign convention of spherical lens:**
- All distances, object distance (u), image distance (v) and focal length f are measured from the optical centre.
- The distances measured in the direction of incident ray are taken as positive and distances measured against the direction of incident ray are taken as negative.
- All distances (heights) of objects and images above principal axis are taken as positive and those below the principal axis are taken as negative.

- **Lens formula and magnification:** $1/v + 1/u = 1/f$

u = object distance

v = image distance

f = focal length

- **Magnification (m):**

Magnification is defined as the ratio of the height of image to the height of object.

$$m = \text{Height of the image} / \text{Height of the object} = h'/h = v/u$$

h' = height of image

h = height of object

$m(+ve)$ then virtual & erect image

$m(-ve)$ then real & inverted image

- **Power of a lens:**

The power of a lens is defined as reciprocal of its focal length.

$$P = 1/f$$

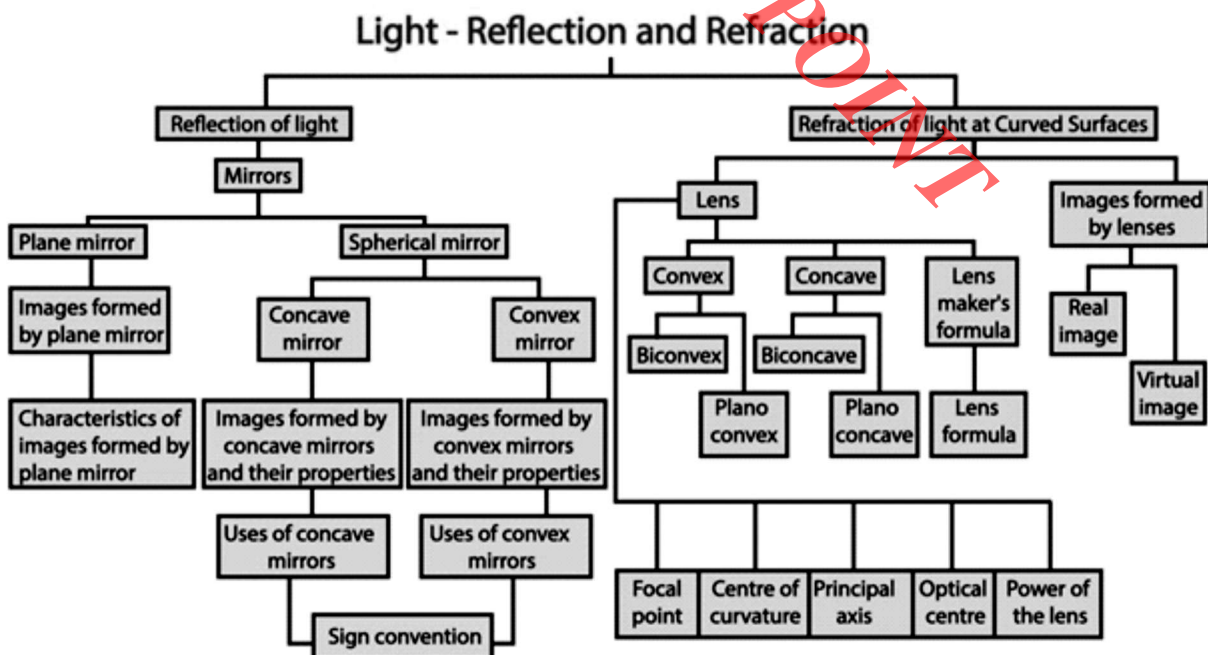
f = focal length (in metre)

- The SI unit of power is 'diopetre'. It is denoted by the letter D.
- 1 diopetre is the power of a lens whose focal length is 1 metre, $1 D = 1 m^{-1}$
- Power of convex lens is positive and concave lens is negative.
- **Combination of lens:** $P = P_1 + P_2$
 $1/f = 1/f_1 + 1/f_2$

f = Net focal length f_x = focal length of lens 1 f_2 = focal length of lens 2
 P net = Power of combination (p)

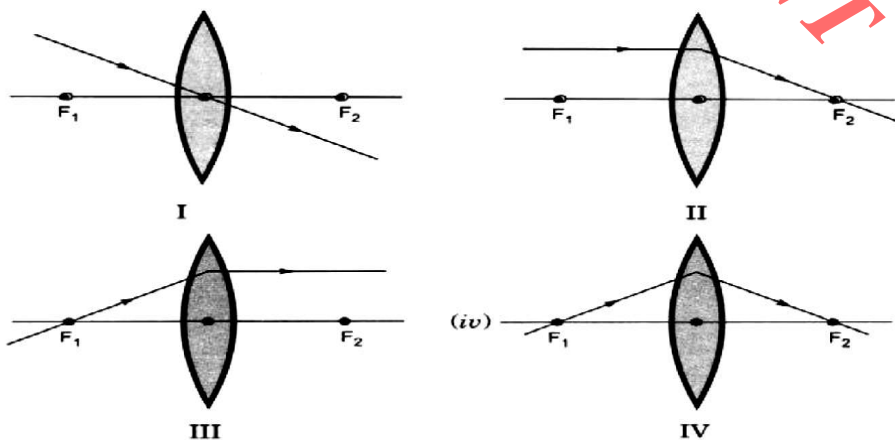
P_1 = Power of lens 1

P_2 = Power of lens 2.



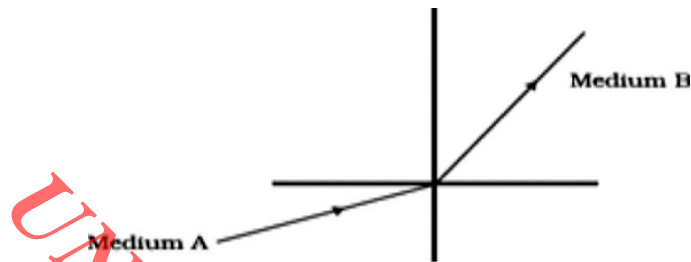
MULTIPLE CHOICE QUESTIONS(1 MARK)

- Which of the following can make a parallel beam of light when light from a point source is incident on it?
 - Concave mirror as well as convex lens
 - Convex mirror as well as concave lens
 - Two plane mirrors placed at 90° to each other
 - Concave mirror as well as concave lens
- A 10 mm long awl pin is placed vertically in front of a concave mirror. A 5 mm long image of the awl pin is formed at 30 cm in front of the mirror. The focal length of this mirror is
 - 30 cm
 - 20 cm
 - 40cm
 - 60 cm
- Under which of the following conditions a concave mirror can form an image larger than the actual object?
 - When the object is kept at a distance equal to its radius of curvature
 - When object is kept at a distance less than its focal length
 - When object is placed between the focus and centre of curvature
 - When object is kept at a distance greater than its radius of curvature
- The diagrams showing the correct path of the ray after passing through the



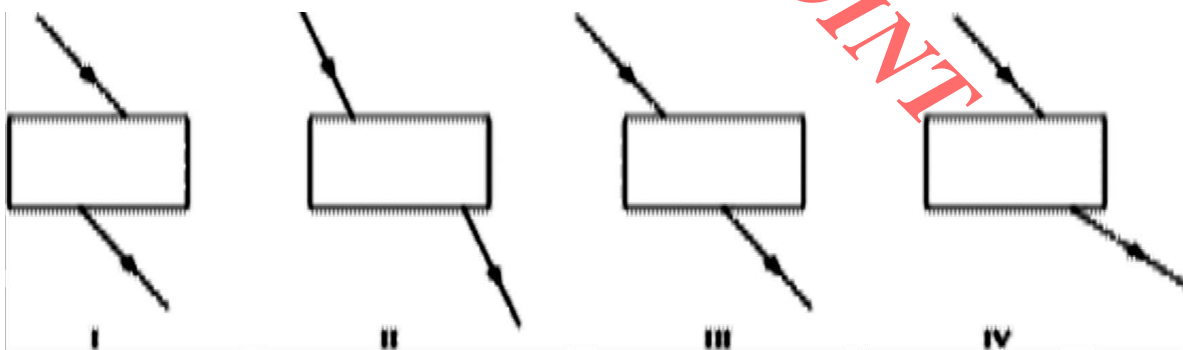
- (a) II and III only
- (b) I and II only
- (c) I, II and III
- (d) I, II and IV

5. A light ray enters from medium A to medium B as shown in Figure. The refractive index of medium B relative to A will be



- (a) greater than unity
 - (b) less than unity
 - (c) equal to unity
 - (d) zero
6. Which of the following statements is true?
- (a) A convex lens has 4 dioptr power having a focal length 0.25 m
 - (b) A convex lens has -4 dioptr power having a focal length 0.25 m
 - (c) A concave lens has 4 dioptr power having a focal length 0.25 m
 - (d) A concave lens has -4 dioptr power having a focal length 0.25 m.
7. Magnification produced by a rear view mirror fitted in vehicles
- (a) is less than one
 - (b) is more than one
 - (c) is equal to one
 - (d) can be more than or less than one depending upon the position of the object in front of it.
8. A full length image of a distant tall building can definitely be seen by using
- (a) a concave mirror
 - (b) a convex mirror
 - (c) a plane mirror
 - (d) both concave as well as plane mirror

9. In torches, search lights and headlights of vehicles the bulb is placed
- (a) between the pole and the focus of the reflector
 - (b) very near to the focus of the reflector
 - (c) between the focus and centre of curvature of the reflector
 - (d) at the centre of curvature of the reflector
10. The laws of reflection hold good for
- (a) plane mirror only
 - (b) concave mirror only
 - (c) convex mirror only
 - (d) all mirrors irrespective of their shape
11. Rays from Sun converge at a point 15 cm in front of a concave mirror. Where should an object be placed so that size of its image is equal to the size of the object?
- (a) 15 cm in front of the mirror
 - (b) 30 cm in front of the mirror
 - (c) between 15 cm and 30 cm in front of the mirror
 - (d) more than 30 cm in front of the mirror
12. The path of a ray of light coming from air passing through a rectangular glass slab traced by four students are shown as I,II,III,IV in figure. Which one of them is correct?



- (a) I
- (b) II
- (c) III
- (d) IV

13. You are given water, mustard oil, glycerin and kerosene. In which of these media a ray of light incident obliquely at same angle would bend the most?
- (a) Kerosene
 - (b) Water
 - (c) Mustard oil
 - (d) Glycerin
14. The image formed by the plane mirror is always
- a) Virtual, erect and diminished
 - b) Virtual, erect and magnified
 - c) Virtual, erect and of the same size
 - d) Real, erect and of the same size
15. The mirror formula is given by, a) $1/f = 1/u - 1/v$
- b) $1/f = 1/u + 1/v$
 - c) $1/v = 1/f + 1/u$
 - d) $1/u = 1/f + 1/v$
16. The magnification m if the image is real then
- a) Negative
 - b) Positive
 - c) Both a and b
 - d) None
17. Clay cannot be used to make lens because it is totally
- a) Transparent
 - b) Optical
 - c) Opaque
 - d) Both a and b
18. The SI unit of power of lens is
- a) Joule
 - b) Watt
 - c) Dioptre
 - d) J/s
19. Total internal reflection is observed in

- a) Prism
b) Grating
c) Glass
d) Diamond
20. When we insert a coin to a glass half filled with water then coin appears as raised slightly which is due to
- a) Reflection
b) Refraction
c) Diffraction
d) Dispersion
21. The refractive index of the medium is given by,
- a) $\mu = v/c$
b) $\mu = c/v$
c) $c = v/\mu$
d) $\mu = cv$
22. A ray of light traveling from rarer medium to denser medium bends
- a) Towards the normal
b) Away from the normal
c) Both a and b
d) None
23. In which of the following, the image of an object placed at infinity will be highly diminished and point sized?
- (a) Concave mirror only
(b) Convex mirror only
(c) Convex lens only
(d) Concave mirror, convex mirror, concave lens and convex lens
24. When the ray is incident at an angle of incidence 90° then
- a) There will be reflection
b) There will be no reflection
c) Both a and b
d) Can't say

25. When the object is placed between C and F in case of concave mirror then the image formed will be at
- At C
 - At infinity
 - Beyond C
 - At F

ASSERTION-REASONING TYPE QUESTIONS(1 MARK)

DIRECTION : In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- Assertion (A) is true but reason (R) is false.
- Assertion (A) is false but reason (R) is true.

1. **Assertion(A)** : Keeping a point object fixed, if a plane mirror is moved, the image will also move.

Reason(R) : In case of a plane mirror, distance of object and its image is equal from any point on the mirror.

2. **Assertion (A)**: Large concave mirrors are used to concentrate sunlight to produce heat in solar cookers.

Reason (R) : Concave mirror converges the light rays falling on it to a point.

3. **Assertion (A)** : Plane mirror may form real image.

Reason (R) : Plane mirror forms virtual image, if objects is real.

4. **Assertion (A)** : If a spherical mirror is dipped in water, its focal length remains unchanged.

Reason (R) : A laser light is focused by a converging lens. There will be a significant chromatic aberration.

5. **Assertion (A)** : If the rays are diverging after emerging from a lens; the lens must be concave.

Reason (R) : The convex lens can give diverging rays.

6. **Assertion (A)** : Refractive index has no units.
Reason (R) : The refractive index is a ratio of two similar quantities.
7. **Assertion(A)** : When the object moves with a velocity 2 m/s, its image in the plane mirror moves with a velocity of 4 m/s.
Reason (R) : The image formed by a plane mirror is as far behind the mirror as the object is in front of it.
8. **Assertion (A)**: The focal length of the convex mirror will increase, if the mirror is placed in water.
Reason (R) : The focal length of a convex mirror of radius R is equal to, $f = R/2$
9. **Assertion (A)**: The height of an object is always considered positive.
Reason (R) : An object is always placed above the principal axis in this upward direction.
10. **Assertion (A)**: The image formed by a concave mirror is certainly real if the object is virtual.
Reason (R): The image formed by a concave mirror is certainly virtual if the object is real.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. Find the power of a concave lens of focal length 2 m.
2. An object is placed at a distance of 30 cm in front of a convex mirror of focal length 15 cm. Write four characteristics of the image formed by the mirror
3. Define focal length of a lens.
4. State the relation between the height of an object (h), height of image (h), object distance (u) and image distance (v) in case of a lens.
5. A convex lens is placed in contact with a concave lens so that the power of the combination is positive. Name the type of the lens, this combination of lenses behaves.
6. A lens X has focal length 20 cm and lens Y has focal length 40 cm. Which lens would you select to obtain a more convergent beam of light and why?

7. "The magnification produced by a spherical mirror is -3 ". List four information you obtain from this statement about the mirror/ image.
8. If the speed of light in vacuum is $3 \times 10^8 \text{ m s}^{-1}$, find the speed of light in a medium of absolute refractive index 1.5.
9. List two properties of the images formed by convex mirrors.
10. A real image $\frac{2}{3}$ rd of the size of an object is formed by a convex lens when the object is at a distance of 12 cm from it. Find the focal length of the lens.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

1. List two possible ways in which a concave mirror can produce a magnified image of an object placed in front of it. State the difference if any between these two images.
2. The linear magnification produced by a spherical mirror is $+1/3$. analyzing this value state the (i) type of mirror and (ii) position of the object with respect to the pole of the mirror. Draw any diagram to justify your answer.
3. Mention the types of mirrors used as (i) rear view mirrors, (ii) shaving mirrors. List two reasons to justify your answer in each case.
4. What is meant by power of a lens? Write its SI unit. A student uses a lens of focal length 40 cm and another of -20 cm. Write the nature and power of each lens.
5. The image formed by a lens for all positions of the object placed in front of it is always virtual, erect and diminished, state the type of the lens. Draw a ray diagram in support of your answer. If the numerical value of focal length of such a lens is 20 cm, find its power in new Cartesian sign conventions.
6. Define the following terms in the context of spherical mirrors:
 - (i) Pole
 - (ii) Centre of curvature
 - (iii) Principal axis
7. Name the type of mirror used in the following situations
 - (i) Headlights of a car
 - (ii) Rear-view mirror of vehicle
 - (iii) Solar furnace
8. State the laws of refraction of light. What is the SI unit of power of lens?

9. State three uses of a concave mirror
10. A 5 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 30 cm. Find the position, nature and size of the image formed.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. At what distance from a concave lens of focal length 20 cm a 6 cm tall object be placed so as to obtain its image at 15 cm from the lens? Also calculate the size of the image formed. Draw a ray diagram to justify your answer for the above situation and label it.
2. Explain the following terms related to spherical lenses:
 - (i) optical centre
 - (ii) centres of curvature
 - (iii) principal axis
 - (iv) aperture
 - (v) principal focus
3. A student wants to project the image of a candle flame on the walls of school laboratory by using a mirror.
 - (a) Which type of mirror should he use and why?
 - (b) At what distance in terms of focal length 'f' of the mirror should he place the candle flame so as to get the magnified image on the wall?
 - (c) Draw a ray diagram to show the formation of image in this case.
 - (d) Can he use this mirror to project a diminished image of the candle flame on the same wall.
4.
 - a) A security mirror used in a big showroom has radius of curvature 5 m. If a customer is standing at a distance of 20 m from the cash counter, find the position, nature and size of the image formed in the security mirror.
 - (b) Neha visited a dentist in his clinic. She observed that the dentist was holding an instrument fitted with a mirror. State the nature of this mirror and reason for its use in the instrument used by dentist.
5. An object of 2 cm high is placed at a distance of 64 cm from a white screen on placing a convex lens at a distance of 32 cm from the object it is found that a distant image of the object is formed on the screen. What is the focal length of the convex lens and size of the image formed on the screen? Draw

a ray diagram to show the formation of the image in this position of the object with respect to the lens.

CASE STUDY BASED QUESTIONS (4 MARKS)

1. The curved surface of a spoon can be considered as a spherical mirror. A highly smooth polished surface is called mirror. The mirror whose reflecting surface is curved inwards or outwards is called a spherical mirror. Inner part works as a concave mirror and the outer bulging part acts as a convex mirror. The center of the reflecting surface of a mirror is called pole and the radius of the sphere of which the mirror is formed is called radius of curvature. (i).When a concave mirror is held towards the sun and its sharp image is formed on a piece of carbon paper for some time, a hole is burnt in the carbon paper. What is the name given to the distance between the mirror and carbon paper?
- (a) Radius of curvature (b) Focal length
(c) Principal focus (d) Principal axis
- (ii) The distance between pole and focal point of a spherical mirror is equal to the distance between
- (a) pole and center of curvature
(b) focus point and center of curvature
(c) pole and object
(d) object and image
- (iii) The focal length of a mirror is 30 cm. The radius of curvature is
- (a) 15 cm (b) 30 cm
(c) 45 cm (d) 60 cm
- (iv) The normal at any point on the mirror passes through
- (a) focus (b) pole
(c) center of curvature (d) any point
2. The lenses forms different types of images when object placed at different locations. When a ray is incident parallel to the principal axis, then after refraction, it passes through the focus or appears to come from the focus. When a ray goes through the optical centre of the lens, it passes without any deviation. If the object is placed between focus and optical center of the convex lens, erect and magnified image is formed. As the object is brought closer to the convex lens from infinity to focus, the image moves away from the convex lens from focus to infinity. Also the size of image goes

on increasing and the image is always real and inverted. A concave lens always gives a virtual, erect and diminished image irrespective to the position of the object.

- (i) The location of image formed by a convex lens when the object is placed at infinity is
- (a) at focus
 - (b) at $2F$
 - (c) at optical center
 - (d) between F and $2F$
- (ii) When the object is placed at the focus of convex lens, the image formed is
- (a) real and inverted
 - (b) virtual and inverted
 - (c) virtual and smaller
 - (d) real and erect
- (iii) The size of image formed by a convex lens when the object is placed at the focus of convex lens is
- (a) small
 - (b) point in size
 - (c) highly magnified
 - (d) same as that of object
- (iv) When the object is placed at $2F$ in front of convex lens, the location of image is
- (a) at F
 - (b) at $2F$ on the other side
 - (c) at infinity
 - (d) between F and optical center

3. The relation between distance of an object from the mirror (u), distance of image from the mirror (v) and the focal length (F) is called mirror formula. This formula is valid in all situations for all spherical mirrors for all positions of the object. The size of image formed by a spherical mirror depends on the position of the object from the mirror. The image formed by a spherical mirror can be bigger than the object, equal to the object or smaller than the object. The size of the image relative to the object is given by the linear magnification (m). Thus, the magnification is given by the ratio of height of

image to the height of object. If magnification is negative, image is real and if it is positive, image is virtual.

- (i) What is the position of an image when an object is placed at a distance of 20 cm from a concave mirror of focal length 20 cm?
- (a) 5 cm
 - (b) 20 cm
 - (c) 10 cm
 - (d) infinity
- (ii) If the magnification of an image is -2, the characteristic of image will be
- (a) real and inverted
 - (b) virtual and enlarged
 - (c) virtual and inverted
 - (d) real and small
- (iii) The mirror formula holds for
- (a) concave mirror
 - (b) convex mirror
 - (c) plane mirror
 - (d) all of these
- (iv) A parallel beam of light is made to fall on a concave mirror. An image is formed at a distance of 7.5 from the mirror. The focal length of the mirror is
- (a) 15 cm
 - (b) 7.5 cm
 - (c) 3.75 cm
 - (d) 10 cm

4. When the rays of light travels from one transparent medium to another, the path of light is deviated. This phenomena is called refraction of light. The bending of light depends on the optical density of medium through which the light pass. The speed of light varies from medium to medium. A medium in which the speed of light is more is optically rarer medium whereas in which the speed of light is less is optically denser medium. Whenever light goes from one medium to another, the frequency of light does not change however, speed and wavelength change. It concluded that change in speed of light is the basic cause of refraction.

- (i) When light travels from air to glass, the ray of light bends
- (ii)
- (a) towards the normal (b) away from normal
(c) anywhere (d) none of these
- (iii) A ray of light passes from a medium A to another medium B. No bending of light occurs if the ray of light hits the boundary of medium B at an angle of
- (a) 0° (b) 45°
(c) 90° (d) 120°
- (iv) When light passes from one medium to another, the frequency of light
- (a) increases (b) decreases
(c) remains same (d) none of these
- (v) When light passes from glass to water, the speed of light
- (a) increases
(b) decreases
(c) Remains same
(c) First increases and then decrease

ANSWER KEY MULTIPLE-CHOICE QUESTIONS (1 MARK)

1. (a) Concave mirror as well as convex lens
2. (b) -20 cm
3. (c) When object is placed between the focus and centre of curvature
4. (c) I, II and III
5. (a) greater than unity
6. (a) A convex lens has 4 dioptre power having a focal length 0.25 m
7. (a) is less than one
8. (b) a convex mirror
9. (b) very near to the focus of the reflector
10. (d) all mirrors irrespective of their shape
11. (b) 30 cm in front of the mirror
12. (d) IV

13. (d) Glycerin
14. (c) Virtual, erect and of the same size
15. (b) $1/f = 1/u + 1/v$
16. (a) Negative
17. (c) Opaque
18. (c) Dioptre
19. (d) Diamond
20. (b) Refraction
21. (b) $\mu = c/v$
22. (a) Towards the normal
23. (d) Concave mirror, convex mirror, concave lens and convex lens
24. (b) There will be no reflection
25. (c) Beyond C

ASSERTION-REASONING TYPE QUESTIONS (1MARK)

1. (c) Assertion (A) is true but reason (R) is false.
2. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
3. (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
4. (c) Assertion (A) is true but reason (R) is false.
5. (d) Assertion (A) is false but reason (R) is true.
6. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
7. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
8. (d) Assertion (A) is false but reason (R) is true.
9. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

10. (c) Assertion (A) is true but reason (R) is false.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. Focal length of concave lens, $f = 2 \text{ m}$

Here, negative sign arises due to the divergent nature of concave lens.

Hence, the power of the given concave lens is "0.5 D.

2. Four characteristics of the image formed by the given convex mirror are :

(i) Virtual

(ii) Erect

(iii) Diminished

(iv) Image is always formed behind the mirror between pole and focus.

3. The distance between the optical centre and principal focus of a lens is called the focal length of the lens.

4. $h'/h=v/u=m$

5. Power of a convex lens is positive and the power of a concave lens is negative. Since the power of combination of lenses is positive, so the combination of lenses behaves as a convex lens.

6. Power of lens, $P = \frac{100}{f(\text{in cm})}$.

Thus, a lens of less focal length has large power of converging a parallel beam (in cm) of light. Therefore, lens X will be used to obtain a more convergent beam of light.

7. Negative sign of magnification indicates that the image is real and inverted. Since the image is real and inverted, the mirror is concave and magnification of -3 indicates that the image is magnified

8. The speed of light in vacuum = $2 \times 10^8 \text{ m/s}$

Absolute refractive index = 1.5

∴ The speed of light in a medium

$$\begin{aligned} &= \frac{\text{Speed of light in vacuum}}{\text{Absolute refractive index}} = \frac{3 \times 10^8 \text{ m/s}}{1.5} \\ &= 2 \times 10^8 \text{ m/s} \end{aligned}$$

9. It form virtual and erect images.
10. Given, $h' = 2/3h$, $u = -12$ cm

$$\text{Magnification, } m = \frac{h'}{h} = \frac{v}{u}$$

$$\Rightarrow v = \frac{h'}{h} \times u = \frac{-\frac{2}{3}h}{h} \times (-12) = 8 \text{ cm}$$

$$\text{Using lens formula, } \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = \frac{1}{8} - \frac{1}{-12} = \frac{3+2}{24} \Rightarrow f = 4.8 \text{ cm}$$

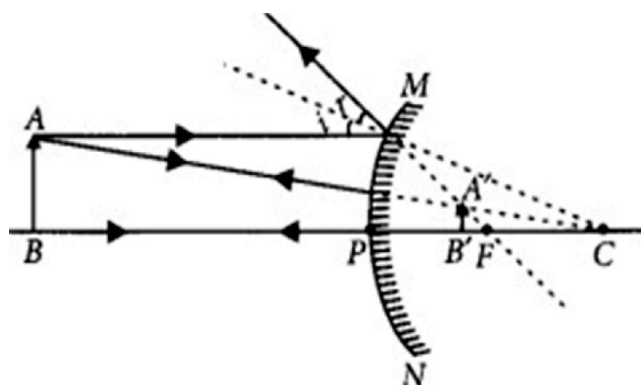
∴ Focal length of the convex lens = 4.8 cm

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

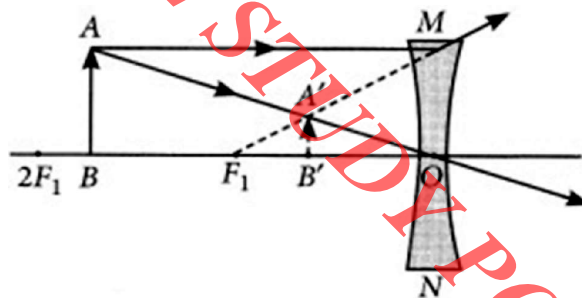
1. A concave mirror can produce a magnified image of an object when object is placed:
- (1) In between its pole and its focus
 - (2) In between its focus and its centre of curvature. Difference between these two images:

The image produced in first case will be virtual and erect. The image produced in second case will be real and inverted.

2. (i) Convex mirror
(ii) Between infinity and the pole of the mirror.



3. (i) Convex mirror is used as rear view mirror because
- (a) it gives erect image.
 - (b) it gives diminished image thus provides wider view of traffic behind the vehicle.
- (ii) Concave mirror is used as shaving mirror because
- (a) it gives erect image when mirror is close to the face.
 - (b) it gives enlarged image of the face so that a person can shave safely.
4. Power is the degree of convergence or divergence of light rays achieved by a lens.
- It is defined as the reciprocal of its focal length. i.e., $P = 1/f$
5. A is converging. Lens B is diverging.
6. Concave lens always forms virtual, erect and diminished image for all positions of the object.



Focal length of the concave lens

$$f = -20 \text{ cm} = -20/100 \text{ m}$$

$$\text{Power of the lens, } P = 1/f(\text{in m}) = -100/20 \text{ m} = -5\text{D}$$

7. (i) Pole : The centre of the reflecting surface of a spherical mirror is a point called the pole. It lies in the surface of the mirror and is represented by the letter P.
- (ii) Centre of curvature: The reflecting surface of a spherical mirror is a part of a sphere which has a centre. This point is called the centre of curvature of spherical mirror and is represented by the letter C.
- (iii) Principal axis : An imaginary line passing through the pole and the centre of curvature of a spherical mirror and normal to the mirror at its pole is called principal axis.

8. a) Laws of refraction of light:
- The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
 - The ratio of sine of angle of incidence to the sine of the angle of refraction is constant, for the light of a given colour and for the given pair of media.

This law is also known as Snell's law of refraction. $\frac{\sin i}{\sin r} = \text{constant}$, where i is the angle of incidence and r is the angle of refraction.

b) Diopetre

9. Reflector

Shaving and make up mirror

Solar Cooker

10. a) Given, $h = 5$ cm, $f = 20$ cm, $u = -30$ cm

Using lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f} = -\frac{1}{30} + \frac{1}{20} = -\frac{2}{60} + \frac{3}{60} = \frac{1}{60}$$

$$\Rightarrow v = 60 \text{ cm}$$

Now, magnification, $m = \frac{h_2}{h} = \frac{v}{u}$

$$\Rightarrow h' = \frac{v}{u} \times h = \frac{60}{-30} \times 5 = -10 \text{ cm}$$

Hence, the image formed at 60 cm, which is real and magnified.

LONG ANSWER QUESTIONS (5 MARKS)

1. Focal length of concave lens, $f = -20$ cm

Height of the object, $h = 6$ cm

Image distance, $v = -15$ cm

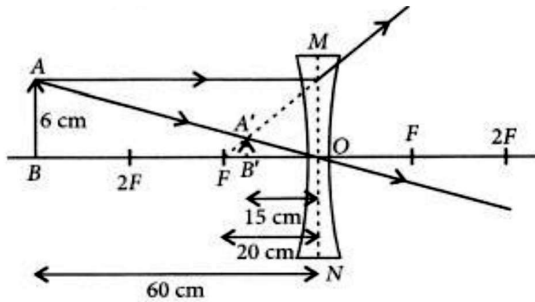
From lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-15} - \frac{1}{u} = \frac{1}{-20}$$

$$\Rightarrow -\frac{1}{u} = -\frac{1}{20} + \frac{1}{15} = \frac{1}{60} \Rightarrow u = -60 \text{ cm}$$

$$\text{Magnification, } m = \frac{h'}{h} = \frac{v}{u}$$

$$\Rightarrow h' = h \left(\frac{v}{u} \right) = 6 \times \left(\frac{-15}{-60} \right) = \frac{3}{2} \text{ cm} \Rightarrow h' = 1.5 \text{ cm}$$

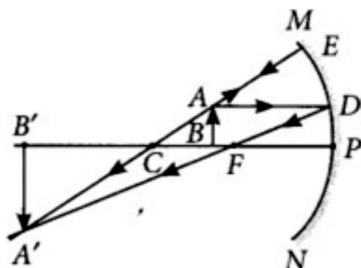


2. (i) Optical centre : The centre point of a lens is known as the optical centre. It always lies inside the lens. A light beam passing through the optical centre without any deviation.
- (ii) Centre of curvature : It is defined as the centre of the sphere of which the lens is originally a part of. Because the spherical lens consists of two spherical surfaces, the lens has two centre of curvature.
- (iii) Principal axis : A straight line passing through the optical centre and principal focus of a spherical lens. This line is called the principal axis.
- (iv) Aperture : The diameter of the reflecting surface of spherical lens is called its aperture.
- (v) Principal focus : A number of rays parallel to the principal axis are falling on a lens.

These rays, after refraction from the lens, are appearing to converge to or diverge from a point on the principal axis. This point on the principal axis is called the principal focus of the lens.

3. (a) He should use concave mirror to get image of candle flame on the walls of school laboratory. Because concave mirror is a converging mirror and produce real image.
- (b) He should place the candle flame in between centre of curvature C and principal focus F of the mirror to get the magnified image on the wall.

(c)



- (d) Yes, he can use concave mirror to project a diminished image of the candle flame on the same wall

4. Given radius of curvature of the mirror, $R = 5 \text{ m}$

∴ Focal length, $f = R/2 = 2.5 \text{ m}$ (convex mirror) and $u = -20 \text{ m}$ From mirror formula,

$$1/f = 1/v + 1/u \text{ or } 1/v = 1/f - 1/u$$

$$= 1/2.5 - 1/-20$$

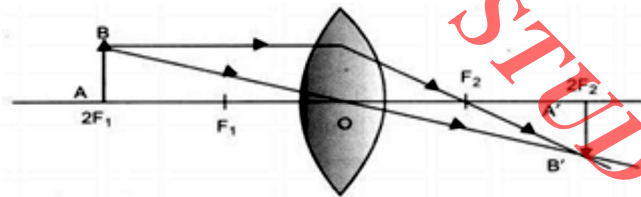
$$v = 2.22 \text{ m}$$

Thus, the image is formed 2.22 m behind the mirror. The image is diminished, virtual and erect.

(c) Concave mirrors are used by dentist. Dentist use it as it is a converging mirror and when used at close range forms a highly enlarged, virtual and erect image of the object.

(d)

5. The object-screen distance is double of object-lens separation, the object is at a distance of 2 from lens and the image should be of the same size of the object.



$$\text{So } 2f = 32 \Rightarrow f = 16 \text{ cm}$$

$$\text{Height of image} = \text{Height of object} = 2 \text{ cm}$$

CASE STUDY QUESTIONS (4MARKS)

1. (i) (b) (ii) (b)
 (iii) (d) (iv) (c)
2. (i) (a) (ii) (a)
 (iii) (c) (iv) (b)
3. (i) (d) (ii) (a)
 (iii) (d) (iv) (b)
4. (i) (a) (ii) (C)
 (iii) (c) (iv) (a)

CHAPTER - 11

THE HUMAN EYE AND THE COLOURFUL WORLD

THE HUMAN EYE

Human eye resembles a camera. It is a spherical ball of diameter about 2.3 cm. Its essential parts are described below-

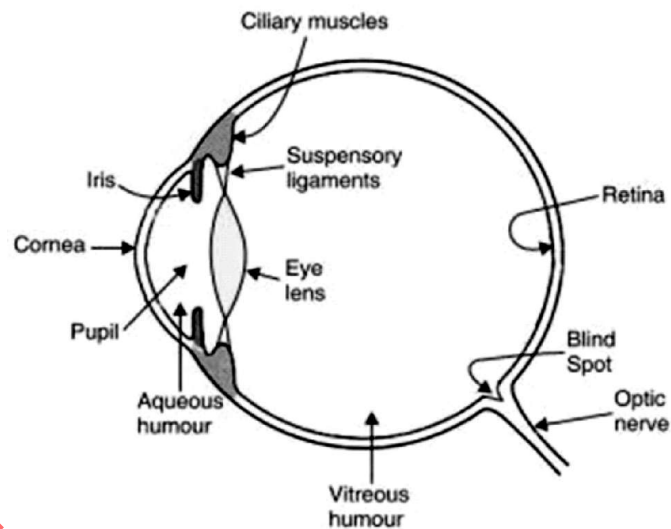
- **Cornea:** Thin, transparent front membrane of eye through which light enters the eye and gets refracted. It refracts most of the light rays into the eye.
- **Iris:** It is a dark muscular diaphragm that controls the size of the pupil.
- **Pupil:** Small hole in the iris appears black because no light is reflected from it. Pupil regulates and controls the amount of light entering the eye.
- **Eye lens:** Transparent crystalline lens, made up of fibres, jelly like material, convex in nature.
- **Ciliary muscles :** It holds the lens and can modify the lens curvature. When these muscles contracts, the focal length of the lens decreases. On the other hand, when they expand (relaxes), they exert inward pressure on the eye lens and increase the focal length of the lens.
- **Retina:** It is a screen in the eye, delicate membrane with lot of light sensitive cells called rods and cones. These cells get activated on illumination and produce electrical signals.
- **Optic nerve:** It is a nerve connecting eye and brain. It sends the electrical signals to brain.
- **Blind spot:** The point where optic nerve enters the eye ball. It is the area on the retina which does not have light sensitive cells (rods and cones). So, if the image is formed on this spot, then no signal is sent to brain and as a result the object is not visible to the eye.
- **Light sensitive cells**

RODS

1. Respond to intensity of light.
2. Enables to see in dim light.
3. Cannot distinguish various colours.

CONES

1. Respond to colour.
2. Become active in bright light.
3. Can distinguish between various colours.



POWER OF ACCOMODATION

The ability of the eye lens to see far and near objects by adjusting its focal length. It occurs through following mechanism:

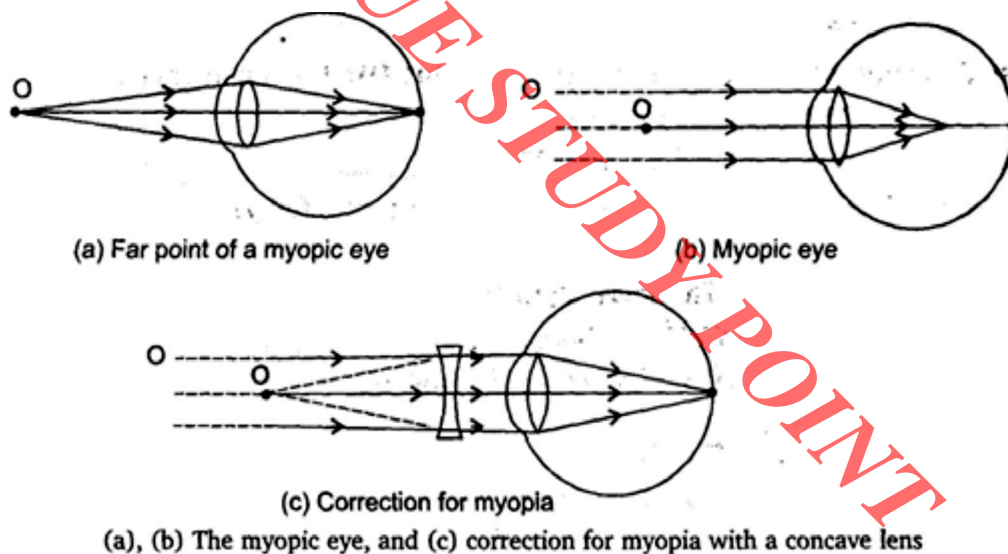
- **Relaxation of ciliary muscles:** Lens becomes thin, focal length of eye lens increases. One can see distant objects clearly.
- **Contraction of ciliary muscles:** Lens becomes thick, focal length of eye lens decreases. One can see near objects clearly.
- **Least distance of distinct vision (The near point):** The minimum distance at which objects can be seen most distinctly without strain. For normal vision in young adult, 25 cm.
- **The far point:** The farthest point (for normal vision it is at infinity) up to which the eye can see objects clearly.
- **Persistence of vision:** The image formed on retina remains for about 1/10th of a second and is called persistence of vision.
- Sequence of showing 24 images or more per second, appears to be in motion.

DEFECTS OF VISION AND THEIR CORRECTION

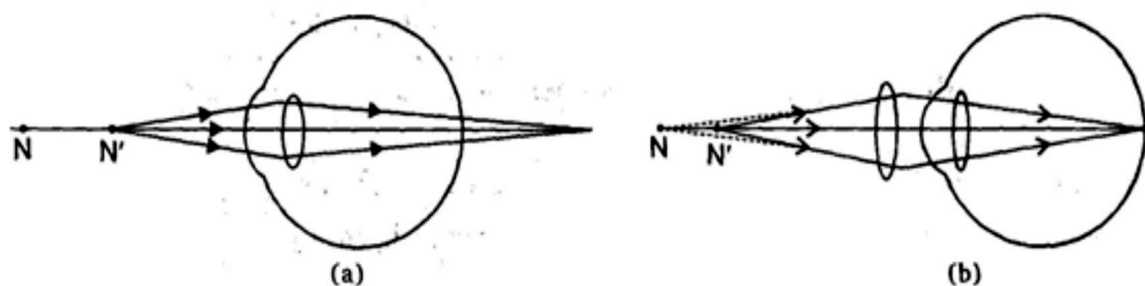
- Myopia
- Hypermetropia
- Presbyopia

	MYOPIA	HYPERMETROPIA	PRESBYOPIA
SYMPTOMS	-Cannot see distant objects clearly. -Image is formed in front of retina.	-Cannot see nearby objects clearly. -Image is formed behind retina.	-Power of accommodation decreases with ageing.
CAUSES	-Due to thickening of lens. -Eye ball may be elongated.	-Eye lens may be thinner. -Eye ball may be small.	-Due to the gradual weakening of the ciliary muscles.
CORRECTION	-Use of concave lens with appropriate focal length.	-Use of convex lens with appropriate focal length.	-Can be corrected by using bifocal lenses.

Myopic eye, correction for myopia with concave lens



Hypermetropic eye, correction with convex lens

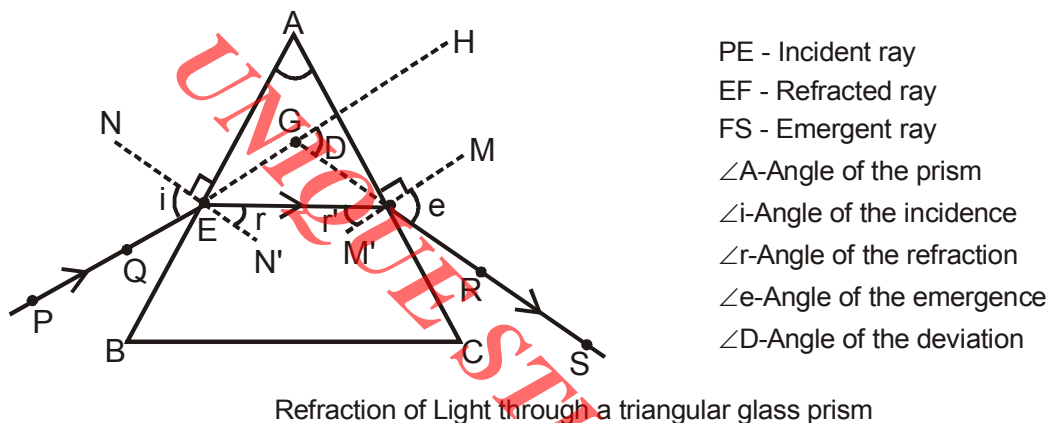


Cataract- The crystalline lens of some old people becomes hazy or even opaque due to the development of a membrane over it, which leads to the loss of vision of eye. It can be corrected by surgery.

DISPERSION OF LIGHT BY A GLASS PRISM

Prism has two triangular bases and three rectangular lateral surfaces. The surfaces are inclined to each other.

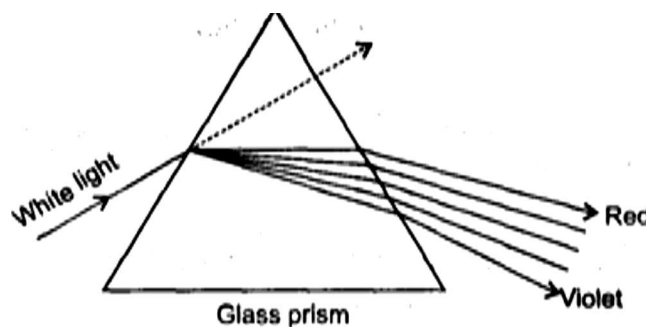
The angle between two lateral faces is called the angle of prism.



Incident ray enters the prism, gets refracted, it bends towards the normal and when it moves out of the prism, it now bends away from the normal and forms emergent ray. The peculiar shape of the prism makes the emergent ray bend at an angle to the direction of the incident ray. This angle formed is called angle of deviation.

Dispersion- The splitting of white light into its components due to different bending ability for colours when it passes through prism is called dispersion.

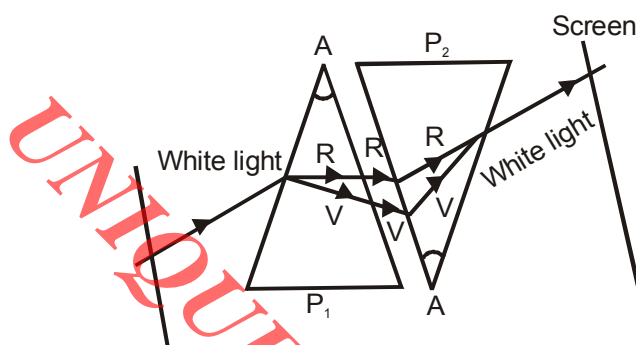
Dispersion of white light



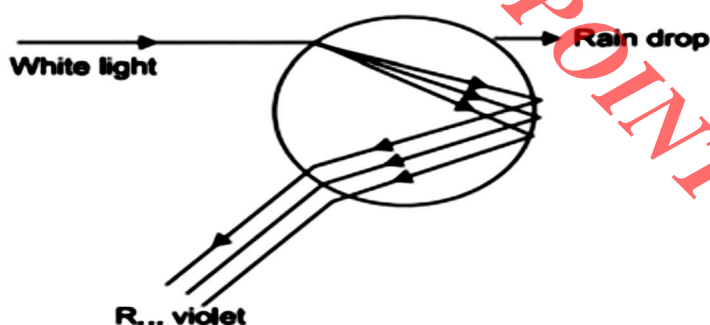
Spectrum- The band of seven colours obtained due to splitting of light is called spectrum. The red colour light bends the least and the violet colour light bends the maximum.

Recombination of colours of spectrum to give white light

Isaac Newton placed a second identical prism in an inverted position with respect to the first prism, and allowed the spectrum to pass through the second prism and found that a beam of white light emerging from the other side of the second prism.



Rainbow formation- Rainbow is a natural spectrum that appears in the sky after rain shower. The water droplet present in the atmosphere behaves as a glass prism and hence splits light into its constituent seven colours (VIBGYOR).

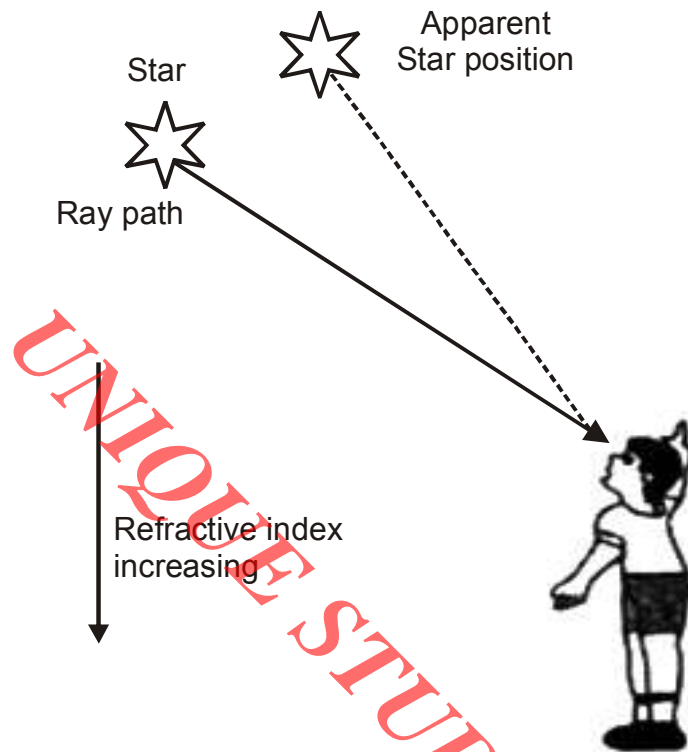


ATMOSPHERIC REFRACTION

Refraction of light by the Earth's atmosphere.

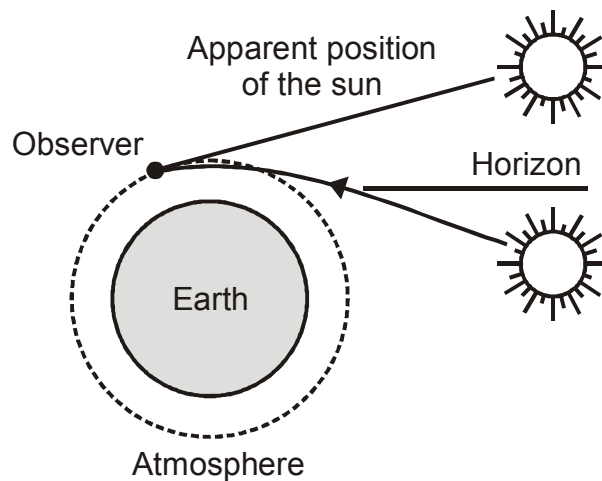
Twinkling of stars- The light of star when enters Earth's atmosphere undergoes refraction, the light bends towards the normal as light travels from rarer to denser medium so the position of star spotted in sky is different from its actual position.

Star is a point sized source of light and the amount of light entering air changes. Sometimes it appears brighter and at some time hazier as the light travels from far distant and the atmosphere is not same always.



Advance sunrise and delayed sunset

Sun is visible 2 minutes before actual sunrise and about 2 minutes after the actual sunset because of atmospheric refraction.



SCATTERING OF LIGHT

When sunlight enters the atmosphere of the earth, the atoms and molecules of different gases present in the atmosphere absorb and re-emit the light in all directions. This process is known as scattering of light.

Tyndall effect

The phenomenon of scattering of light by dust, smoke and tiny water droplets suspended in air is known as Tyndall effect.

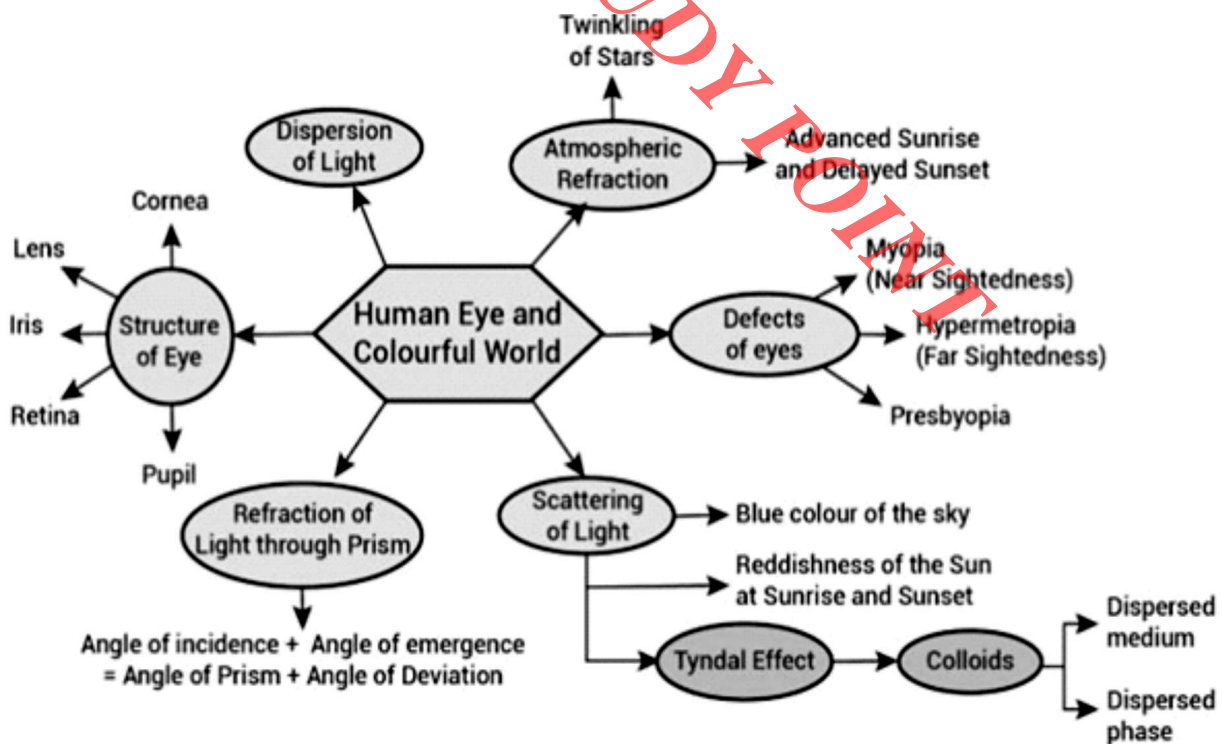
Examples of Tyndall effect are –

- When a beam of sunlight enters a dusty room through a window, then path becomes visible to us.
- When sunlight comes down through the clouds.

Why is the colour of the clear sky blue ?

The small sized particles of air scatter blue light (shorter wavelength) the most, that enter our eyes.

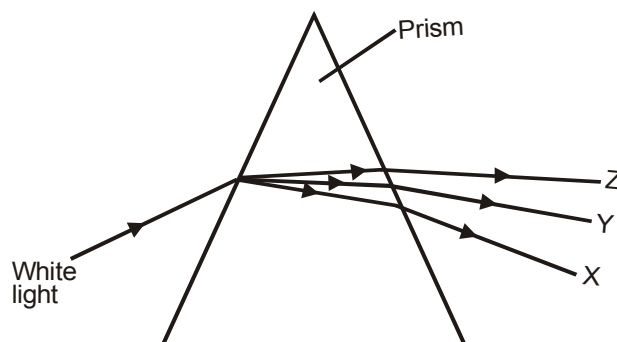
Sky appears black- When there is no atmosphere (space), the scattering does not take place.



MULTIPLE-CHOICE QUESTIONS (1 MARK)

1. The least distance of distinct vision for a young adult with normal vision is
 - (a) 25 m
 - (b) 2.5 cm
 - (c) 25 cm
 - (d) 2.5 m
 - (e)
2. Focal length of eye lens is
 - (a) Fixed
 - (b) Variable
 - (c) Sometimes fixed and sometimes variable
 - (d) None of these
3. Electric impulse from retina to brain is carried via
 - (a) Optic nerve
 - (b) Blind spot
 - (c) Ciliary muscles
 - (d) Pupil
4. A person cannot distinguish between different colours. There is a problem with his
 - (a) Cornea
 - (b) Ciliary muscles
 - (c) Rods
 - (d) Cones
5. The size of the pupil of the eye is adjusted by
 - (a) Cornea
 - (b) Retina
 - (c) Iris
 - (d) Blind spot
6. When we go out in bright sunlight, the pupil of the eye
 - (a) Contracts
 - (b) Expands

- (c) Sometimes contracts and sometimes, expands
(d) Neither contracts nor expands
7. 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 of eye
(c) Near – sightedness
(d) Far – sightedness
8. The crystalline lens of people at old age becomes milky and cloudy. This condition is called
- (a) Myopia (b) Hypermetropia
(c) Presbyopia (d) Cataract
9. Dispersion of light by glass prism takes place because
- (a) The lights of different colours have different intensities.
(b) The lights of different colours have different speed in a medium.
(c) Different colours have same frequencies.
(d) The lights of different colours have different energies.
10. The colour of light which is deviated the least by a prism in the spectrum of white light is
- (a) Red
(b) Green
(c) Violet
(d) Yellow
11. The image shows the dispersion of the white light in the prism. What will be the colours of the X, Y and Z?



What will be the colours of the X, Y and Z?

- (a) X: red; Y: green; Z: violet
 - (b) X: violet; Y: green; Z: red
 - (c) X: green; Y: violet; Z: red
 - (d) X: red; Y: violet; Z: green
12. A person cannot see objects distinctly kept beyond 2 m. This defect can be corrected by using a lens of power
- (a) + 0.5 D
 - (b) – 0.5 D
 - (c) + 0.2 D
 - (d) – 0.2 D
13. A student sitting on the last bench can read the letters written on the blackboard but is not able to read the letters written in his textbook. Which of the following statements is correct?
- (a) The near point of his eyes has receded away.
 - (b) The near point of his eyes has come closer to him.
 - (c) The far point of his eyes has come closer to him.
 - (d) The far point of his eyes has receded away.
14. Which colour has maximum speed in glass?
- (a) Violet
 - (b) Red
 - (c) Yellow
 - (d) Green
15. Coloured band of light obtained by dispersion of white light is called
- (a) Mirage
 - (b) Spectrum
 - (c) Shadow
 - (d) Image
16. The clear sky appears blue because
- (a) Blue light gets absorbed in the atmosphere.
 - (b) Ultraviolet radiations are absorbed in the atmosphere.

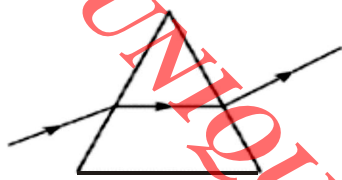
- (c) Blue light gets scattered more than lights of the other colours by the atmosphere.
- (d) Light of all other colours is scattered more than the violet and blue colour lights by the atmosphere.

17. To an astronaut in a spaceship, the colour of earth appears

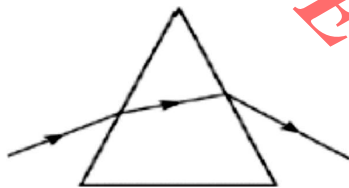
- (a) Red
- (b) Blue
- (c) White
- (d) Black

18. Which image shows the deviation of light in a prism?

(a)



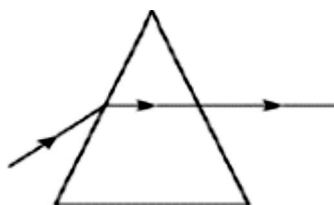
(b)



(c)



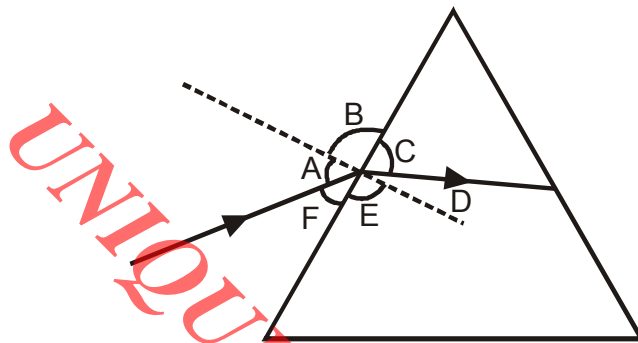
(d)



19. Twinkling of stars is due to

- (a) Reflection
- (b) Dispersion
- (c) Atmospheric refraction
- (d) None of these

20. The air layer of atmosphere whose temperature is less than the hot layer behave as optically
- (a) Denser medium
 - (b) Rarer medium
 - (c) Inactive medium
 - (d) Either denser or rarer medium
21. The image shows a light ray incident on a glass prism.



The various angles are labeled in the image. Which angle shows the angle of incidence and angle of refraction, respectively?

- (a) A and D
 - (b) B and E
 - (c) C and F
 - (d) D and F
22. The black opening between the aqueous humour and the lens is called
- (a) Retina
 - (b) Iris
 - (c) Cornea
 - (d) Pupil
23. Which of the following phenomena of light are involved in the formation of a rainbow?
- (a) Reflection, refraction and dispersion
 - (b) Refraction, dispersion and total internal reflection
 - (c) Refraction, dispersion and internal reflection
 - (d) Dispersion, scattering and total internal reflection

24. Why do stars appear to twinkle at night?
- (a) Because the light of stars travels in different medium
 - (b) Because the distance of star varies when earth rotates
 - (c) Because the star changes its position relative to earth
 - (d) Because the atmosphere reflects the light at different angles
25. At noon the sun appears white as
- (a) Light is least scattered.
 - (b) All the colours of the white light are scattered away.
 - (c) Blue colour is scattered the most.
 - (d) Red colour is scattered the most.
26. Which of the following statements is correct regarding the propagation of light of different colours of white light in air?
- (a) Red light moves faster.
 - (b) Blue light moves faster than green light.
 - (c) All the colours of the white light move with the same speed.
 - (d) Yellow light moves with the mean speed as that of the red and violet light.
27. When light enters the eye, most of the refraction occurs at the
- (a) Crystalline lens
 - (b) Outer surface of the cornea
 - (c) Iris
 - (d) Pupil
28. Reason behind advance sunrise and delayed sunset.
- (a) Atmospheric refraction
 - (b) Total internal reflection
 - (c) Dispersion
 - (d) Reflection
29. Myopia may arise due to
- (a) Excessive curvature of the eye lens.
 - (b) Elongation of the eye ball.
 - (c) Both (a) and (b)
 - (d) None of these

30. The farthest point of a normal eye
- (a) 25 cm
 - (b) 50 cm
 - (c) 75 cm
 - (d) Infinity

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

Directions: 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 assertion is false but reason is true.

1. **Assertion (A)** : A normal eye can clearly see all the objects beyond certain minimum distance.

Reason (R) : The human eye has capacity of adjusting the focal length of eye lens.

2. **Assertion (A)** : Myopia is the defect of the eye in which only nearer objects are seen by the eye.

Reason (R) : The eye ball is elongated.

3. **Assertion (A)** : Hypermetropia is a defect of the eye in which only farther objects are seen.

Reason (R) : Hypermetropia is corrected by using converging lens.

4. **Assertion (A)** : White light is dispersed into its seven-color components by a prism.

Reason (R) : Different colours of light bend through different angles with respect to the incident ray as they pass through a prism.

5. **Assertion (A)** : The light of violet color deviates the most and the light of red colors the least, while passing through a prism.

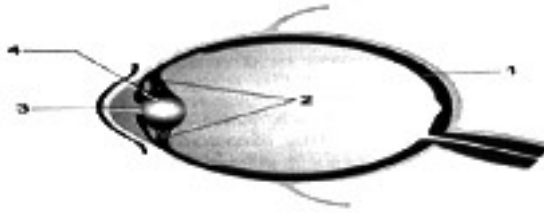
Reason (R) : For a prism material, refractive index is highest for red light and lowest for the violet light.

6. **Assertion (A)** : The rainbow is seen when the sun is behind the observer.
Reason (R) : Rainbow is produced due to dispersion of white light by small rain drops hanging in the air after the rain.
7. **Assertion (A)** : The sky looks dark and black instead of blue in outer space.
Reason (R) : No atmosphere containing air in the outer space to scatter sunlight.
8. **Assertion (A)** : The stars twinkle while the planets do not.
Reason (R) : The stars are much bigger in the size than the planets.
9. **Assertion (A)** : The phenomenon of scattering of light by the colloidal particles gives rise to Tyndall effect.
Reason (R) : The colour of the scattered light depends on the size of the scattering particles.
10. **Assertion (A)** : A rainbow is seen in the sky during the rain, and is always formed in a direction opposite to that of the sun.
Reason (R) : The water droplets refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. What is meant by least distance of distinct vision? How does this vary for a person suffering from presbyopia?
2. A child sitting in a classroom is not able to read clearly the writing on the blackboard.
 - (a) Name the type of defect from which his eye is suffering.
 - (b) With the help of a ray diagram show how this defect can be remedied.
3. A person can see distant signboards clearly but cannot read clearly a book which is at 25 cm from his eye. Giving reason identify the defect. Draw a labeled ray diagram to illustrate this defect and its correction.
4. Is the position of a star as seen by us in its true position? Justify your answer.
5. What is dispersion of white light? Name the component of white light that deviates the most.

6. Why does the sky appear dark to astronauts?
7. A person is advised to wear spectacles with convex lenses. What type of defect of vision is he suffering from?
8. Describe an experiment to discuss the recombination of dispersed light.
9. (i) Name the four parts labeled as 1, 2, 3 and 4 in the given diagram.
(ii) At which place is the image of an object formed?



10. In the given figure, a narrow beam of white light is shown to pass through a triangular glass prism. After passing through the prism it produces a spectrum XY on a screen.



- (i) State the colour seen at X and Y.
- (ii) Why do different colours of white light bend through different angles with respect to the incident beam of light?

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

1. List the part of the human eye that control the amount of light entering into it. Explain how image take place at retina?
2. What is meant by power of accommodation of the eye? Explain the term - near point and far point?
3. A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?
4. What is presbyopia? Write its causes and correction.

5. What is dispersion of white light? What is the cause of such dispersion? Draw a diagram to show dispersion of white light by prism.
6. Draw a neat diagram to show the refraction of a light ray through a glass prism, and label on it the angle of incidence and angle of deviation.
7. With the help of a diagram, explain the formation of a rainbow in the sky.
8. Explain why stars twinkle while planets do not?
9. What is meant by scattering of light? Mention the factor on which it depends. Explain why the colour of the sky is blue?
10. The far point of a myopic person is 150 cm in front of the eye. Calculate the focal length and the power of the lens required to enable him to see distant objects clearly.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

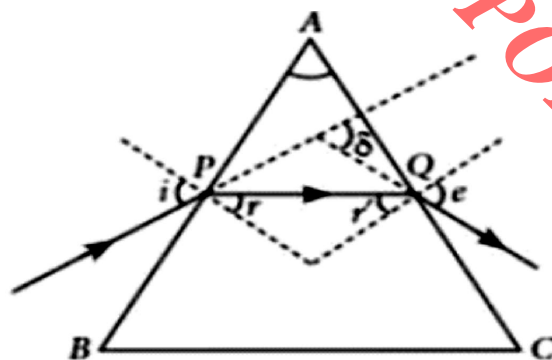
1. The rainbow is a natural spectrum appearing in the sky after a rain shower. Is it correct to say that a rainbow is always formed in a direction opposite to sun? Can it be seen on a sunny day? With the help of a diagram, explain the formation of a rainbow in the sky.
2.
 - i) Demonstrate an activity with a well labelled diagram to prove that white light is made up of seven colours.
 - ii) Which colour of light bends least and which one the most while passing out from the prism? Also, state the reason for the same.
3. A person can see distant signboards clearly but cannot read clearly a book which is at 25 cm from his eye. Giving reason identify the defect. List the two possible causes of this defect. Draw a labelled ray diagram to illustrate this defect and its correction.
4. Why does the sun seem to rise two minutes before the actual sunrise and set two minutes after the actual sunset? Explain with the help of labelled diagram.

CASE STUDY BASED QUESTIONS (4 MARKS)

1. The hotter air is lighter (less dense) than the cooler air above it and has a refractive index slightly less than that of the cooler air. Since the physical condition of the refracting medium (air) is not stationary, therefore, the light goes from rarer medium to denser medium in atmosphere. This phenomenon is called atmospheric refraction.

- (i) Stars appear to twinkle because of
- (a) Scattering of light
 - (b) Atmosphere refraction
 - (c) Both (a) and (b)
 - (d) None of these
- (ii) Which of the following is not caused because of atmospheric refraction?
- (a) Apparent image of sun is formed closer to the Earth.
 - (b) Sunrise or sunset are formed.
 - (c) Sun can be seen 2 minutes before actual sunrise and two minutes after actual sunset.
 - (d) Clouds look white
- (iii) Due to atmospheric refraction, how much the duration of the day changes?
- (iv) What will be the colour of the sky if there is no atmospheric refraction?

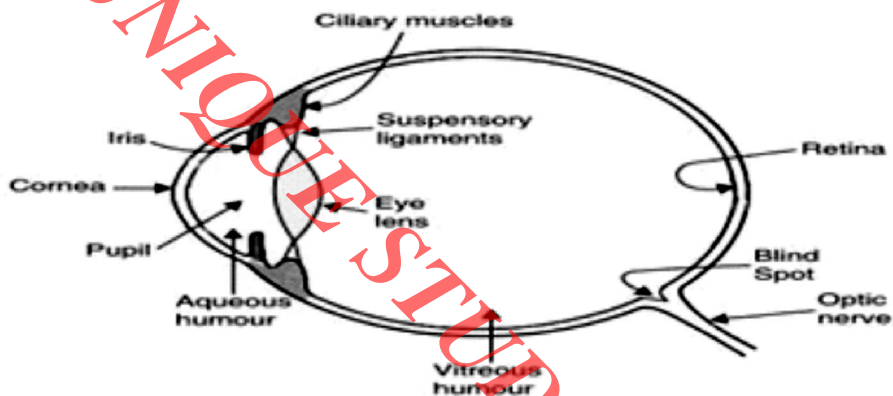
2. A prism is a transparent refracting medium bounded by two plane surfaces inclined to each other at a certain angle. The refraction of light through a prism follows the laws of refraction. In the prism, refraction takes place on its refracting surface it means when the light enters the prism and when the light leaves the prism. Here, A is the angle of prism, $\angle i$ is the angle of incidence and $\angle e$ is the angle of emergence.



- i. The angle between the two refracting surfaces of a prism is called
- (a) Angle of prism
 - (b) Angle of incidence
 - (c) Angle of deviation
 - (d) Angle of emergence

- ii. The angle between the incident ray and emergent ray is
- (a) Angle of emergence
 - (b) Angle of deviation
 - (c) Angle of incidence
 - (d) None of these
- iii. Is the angle of incidence is equal to the angle of refraction? Why?
- iv. What is known as dispersion of light?
3. The earth's atmosphere is a heterogenous 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 beam becomes visible. The light reaches us after being reflected diffusely by these particles. The phenomenon of scattering of light by the colloidal particle is known as Tyndall effect.
- Tyndall effect can also be observed when sunlight passes through a canopy of dense forest. The colour of the scattered particle's light depend upon size of scattering particles.
- i. The phenomenon of scattering of light by colloidal particles is called
- (a) Corona effect
 - (b) Tyndall effect
 - (c) Dispersion effect
 - (d) None of these
- ii. The colour of the scattering light depends upon
- (a) Volume of particles
 - (b) Nature of particles
 - (c) Size of particles
 - (d) None of these
- iii. When does the scattered light appears white?
- iv. Why the sky appears blue?
4. Human eye resembles a camera. It is a spherical ball of diameter about 2.3 cm. Cornea is the thin, transparent front membrane of eye through which light enters the eye first and gets refracted. It refracts most of the light rays into the eye. Iris is a dark muscular diaphragm that controls the size of the pupil. Pupil is a small hole in the iris appears black because no light is reflected from it. Pupil regulates and controls the amount of light entering the eye. Eye

lens is the transparent crystalline lens, made up of fibres, jelly like material, convex in nature. The ciliary muscles holds the lens and can modify the lens curvature. When these muscles contracts, the focal length of the lens decreases. On the other hand, when they expand, they exert inward pressure on the eye lens and increase the focal length of the lens. Retina is a screen in the eye, delicate membrane with lot of light sensitive cells called rods and cones. These cells get activated on illumination and produce electrical signals. Optic nerve is a nerve connecting eye and brain. It sends the electrical signals to brain. Blind spot is the point where optic nerve enters the eye ball. It is the area on the retina which does not have light sensitive cells (rods and cones). So, if the image is formed on this spot, then no signal is sent to brain and as a result the object is not visible to the eye.

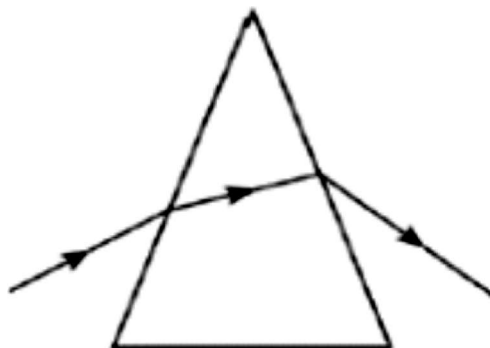


- i. The fluid between the retina and the lens is called
 - (a) Aqueous humour
 - (b) Vitreous humuor
 - (c) Aqua
 - (d) Humour
- ii. The part of the eye where optic nerve enters the eye
 - (a) Pupil
 - (b) Ciliary muscles
 - (c) Retina
 - (d) Blind spot
- iii. Where is the image formed in the eye?
- iv. The focal length of the eye lens changes due to the contraction and relaxation of.

ANSWER KEY

MULTIPLE-CHOICE QUESTIONS (1 MARK)

- 1 (c) 25 cm
- 2 (b) Variable
- 3 (a) Optic nerve
- 4 (d) Cones
- 5 (c) Iris
- 6 (a) Contracts
- 7 (b) Accommodation of eye
- 8 (d) Cataract
- 9 (b) The lights of different colours have different speed in a medium.
- 10 (a) Red
- 11 (b) X : violet; Y : green; Z : Red 12 (b) — 0.5 D
- 13 (a) The near point of his eyes has receded away. 14 (b) Red
- 15 (b) Spectrum
- 16 (c) Blue light gets scattered more than lights of the other colours by the atmosphere.
- 17 (d) Black
- 18 (b)



- 19 (c) Atmospheric refraction 20 (a) Denser medium

- 21 (a) A and D
- 22 (d) Pupil
- 23 (b) Refraction, dispersion and total internal reflection
- 24 (a) Because the light of stars travels in different medium
- 25 (a) Light is least scattered
- 26 (c) All the colours of the white light move with the same speed
- 27 (b) Outer surface of the cornea
- 28 (a) Atmospheric refraction 29 (c) Both (a) and (b)
- 30 (d) Infinity

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

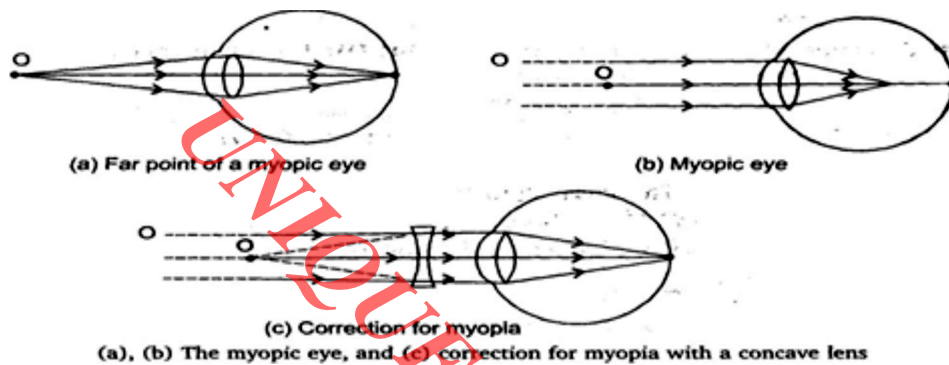
- 1 (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- 2 (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- 3 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- 4 (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- 5 (c) If assertion is true but reason is false.
- 6 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- 7 (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- 8 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- 9 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- 10 (a) If both assertion and reason are true and reason is the correct explanation of assertion.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

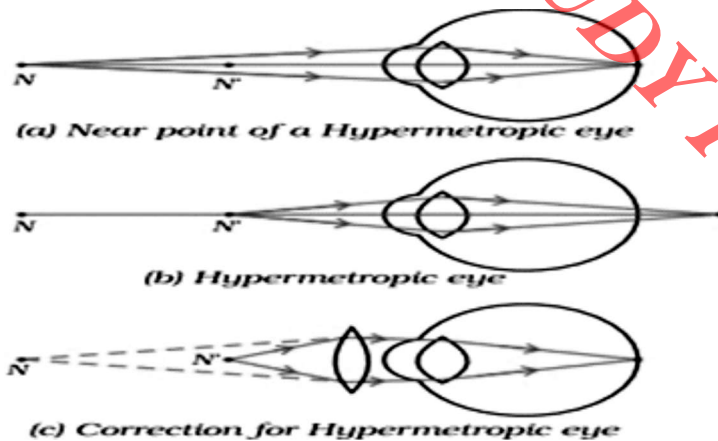
1. Least distance of distinct vision - Minimum distance between eye and object to see it clearly.

For a person suffering from presbyopia it is more as the ciliary muscles weakened gradually with age.

2. a. Myopia
b.



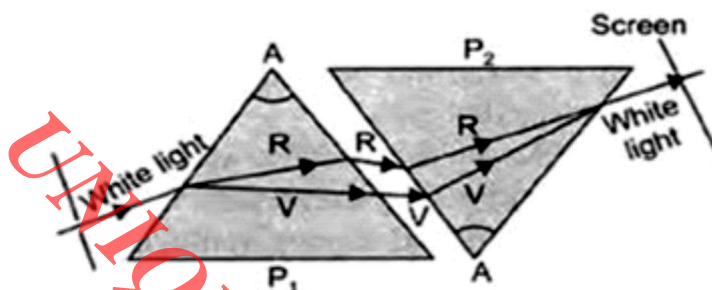
3. Hypermetropia



4. No, light from stars undergoes atmospheric refraction, which occurs in the medium of gradually changing refractive index. So, we see the apparent position of the star after refraction by atmosphere.
5. Dispersion: When white light is passed through a prism it splits into its constituent colours. Splitting of white light into its constituent colours is known as dispersion.

Violet colour deviates the most while passing through the glass prism.

6. For scattering of light, particles are required. Since there are no particles in space, the sky appears dark to astronauts.
7. Far-sightedness/Hypermertopia.
8. If another identical prism is placed in inverted position in front of a prism then dispersed colours obtained from first prism get recombine to produce white light.



9. (i) 1. Retina 2. Ciliary muscles 3. Pupil 4. Crystalline lens
(ii) Retina
10. (i) X – Violet ; Y – Red
(ii) Different colours of white light when enters in prism, bend through different angles with respect to the incident beam of light due to difference in speed of light of different wavelengths.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

1. **Iris.** **Eye lens** forms an inverted real image if the object on the retina. The light-sensitive cells get activated upon illumination and generate electrical signals. The retina send these signals to the brain via the optic nerve and gives rise to the sensation of vision.
2. The ability of the eye lens to see far and near objects by adjusting its focal length. Least distance of distinct vision : The minimum distance at which objects can be seen most distinctly without strain. For normal vision in young adult, 25 cm.

The far point : The farthest point (for normal vision it is at infinity) upto which the eye can see objects clearly.

3. –Myopia

-Concave lens

-Due to thickening of lens, eye ball may be elongated.

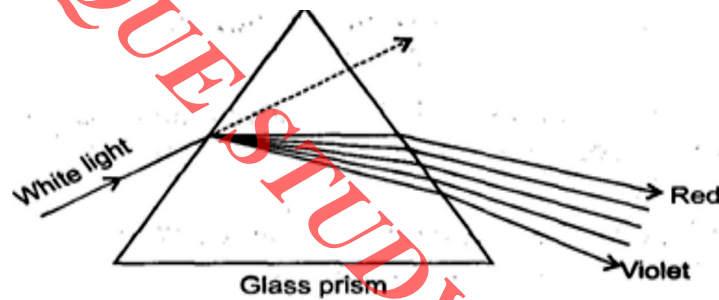
4. The power of accommodation of the eye decreases with ageing. For most people, the near point gradually recedes and the far point comes closer. This defect is called presbyopia.

Causes- Arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens.

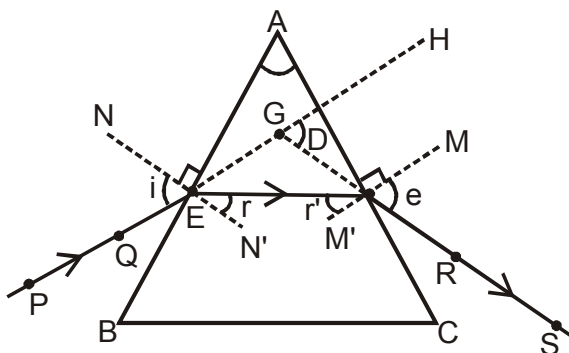
Correction - by using a bifocal lens.

5. Dispersion - The splitting of white light into its components due to different bending ability for colours when it passes through prism is called dispersion. Causes - Different colours of light have different wavelength, hence different refractive index.

Dispersion of light

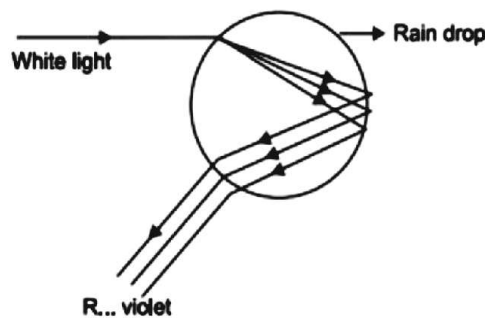


6.



$\angle i$ = Angle of incidence, $\angle D$ = Angle of deviation

7. Rainbow is a natural spectrum that appears in the sky after rain shower. The water droplet present in the atmosphere behaves as a glass prism and hence splits light into its constituent seven colours (VIBGYOR).



8. Since the stars are very distant and point - sized sources of light, the path of rays of light coming from the stars goes on varying slightly due to atmospheric refraction , the apparent position of the star fluctuates, and the amount of starlight entering the eye flickers.

The planets are much closer to the earth, and are thus considered as a collection of a large number of point-sized sources of light, the total variation in the amount of light entering our eye from all the point sized sources will average out to zero, thereby nullifying the twinkling effect.

9. Scattering is the phenomenon by which a beam of light is redirected in many different directions when it strikes minute particles in the atmosphere

The scattering of light and the color of the scattered light depends upon the size of the particles.

When a white light (from sun) enters the earth's atmosphere, it gets scattered away due to the atmospheric particles. Since, blue colour has the minimum wavelength, so blue colour scatters the most and thus the sky appears blue.

For myopic person

$$u = \infty, v = -150 \text{ cm}$$

$$f = ?$$

From lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$= \frac{1}{-150} - \frac{1}{\infty} = -\frac{1}{150}$$

$$P = \frac{100}{f(\text{cm})} = -\frac{100}{150} = -0.66 \text{ D}$$

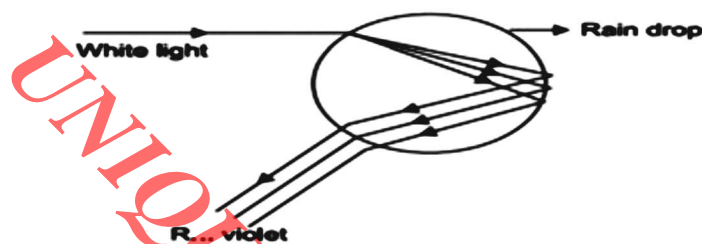
$$= -0.66 \text{ D}$$

10.

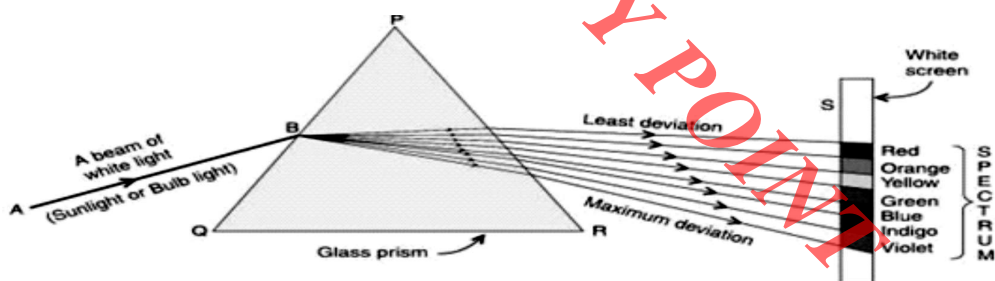
LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. Yes, a rainbow is always formed in a direction opposite to sun as a rainbow is just the sunlight which has been refracted and reflected. Yes, it can be seen on a sunny day if the sun's rays passing through the droplets of water suspended in the atmosphere, reaches the observer's eye.

The water droplets in the atmosphere act like small prisms. These droplets refract and disperse the incident sunlight, then reflect it internally and finally refract it again when it comes out of the rain drop. Due to dispersion of sunlight and internally reflection, different colours reach to the observer.



- 2) i) The phenomenon of splitting of a beam of white light into its seven constituent colours when passed through a transparent medium is known as dispersion, which was first discovered by Issac Newton in 1666. To understand this phenomenon,



Let us take a thick sheet of cardboard and make a small hole or narrow slit in its middle allow sunlight to fall on the slit. This gives a narrow beam of white light. Now, take a glass prism and allow this white light to fall one of its faces as shown in figure. Turn the prism slowly until the light that comes out of it appears on a nearby screen. We see a beautiful band of seven colours on the screen called visible spectrum. The sequence of colours seen from the lower part of the screen is violet (V), indigo (I), blue (B), green (G), yellow (Y), orange

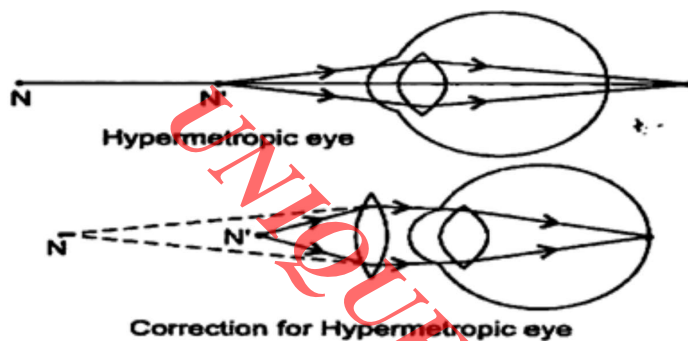
(O) and red (R). The acronym for this is VIBGYOR.

ii) In a transparent medium except air and vacuum, red light having the largest wavelength suffers the least deviation while violet light having the least wavelength bends the most.

3. Eyes defect is hypermetropia as the person cannot see nearby object but can clearly see far away objects. Its causes are due to :

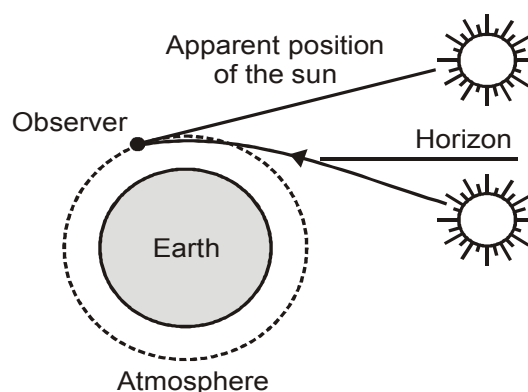
- a. short eye ball
- b. increase in focal length of eye lens.

Hypermetropia can be corrected by using convex lens



4. Advance sunrise and delayed sunset. Apparent shift in the position of sun at sunrise and sunset: The sun is visible before actual sunrise and after actual sunset, because of atmospheric refraction. With altitude, the density and hence refractive index of air-layer decreases. As shown in the light rays starting from the sun travel from rarer to denser layers. They bend more and more towards the normal.

To an observer on the earth, the sun which is actually in below the horizon, appears in position above the horizon. Thus the sun appears to rise early by about two minutes and for the same reason, it appears to set late by about two minutes. This increases the length of the day by about four minutes.



CASE STUDY BASED QUESTIONS (4 MARKS)

1.
 - (i) (b) Atmospheric refraction
 - (ii) (d) Clouds look white
 - (iii) Due to atmospheric refraction, apparent length of the day increases by 4 minutes.
 - (iv) Black, dark

2.
 - (i) (a) Angle of prism
 - (ii) (b) Angle of deviation
 - (iii) No, angle of refraction will be lesser as the refracted ray bends towards the normal after it enters the prism.
 - (iv) The splitting of white light into its components due to different bending ability for colours when it passes through prism is called dispersion.

3.
 - (i) (b) Tyndall effect
 - (ii) (c) Size of particles
 - (iii) If the size of the particles are large enough then the scattered light appears white.
 - (iv) Sky appears blue as the blue color is scattered the most.

4.
 - (i) (b) Vitreous humour
 - (ii) (d) Blind spot
 - (iii) Retina
 - (iv) Ciliary muscles.

CHAPTER-12_ELECTRICITY

ATOMIC STRUCTURE

- An atom has a positively charged nucleus and negatively charged electrons revolving around it.
- Valence electrons in metals are free to move within the conductor and constitute an electric current.
- The charge is an intrinsic property of matter by virtue of which it can exert electromagnetic force. Charge is denoted by the symbol Q and its SI unit is Coulomb (C).
- Charge on an electron is -1.6×10^{-19} C.

CONDUCTORS AND INSULATORS

- A substance which offers comparatively less opposition to the flow of current is known as conductors
- Substances which offer larger opposition to the flow of electric current are insulators.

ELECTRIC CURRENT

- The rate of flow of electric charge is called electric current.
- Electric current is denoted by 'I'
- $I = Q / t$
- The direction of flow of electric current is from positive terminal to negative terminal, i.e., opposite to the direction of flow of electrons.
- SI Unit of electric current is Ampere(A).
- 1 Ampere is the current constituted by the flow of 1C charge in 1s.
- An Ammeter is used to measure electric current.

ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE

- The electric potential at a point is defined as work done in bringing a unit positive charge from infinity to that point
- The potential difference between two points is defined as the difference in electric potentials between the two given points. It is denoted by the symbol 'V'

$$V=W/Q$$

SI unit of potential difference is Volt(V)

- 1 Volt is the potential difference between two points when 1J of work done is required to move a charge of one Coulomb across them.
- A Voltmeter is used to measure potential difference .

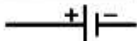
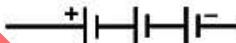




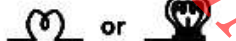

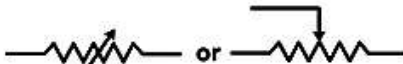


BATTERY

A battery is device which is a combination of two or more cells.

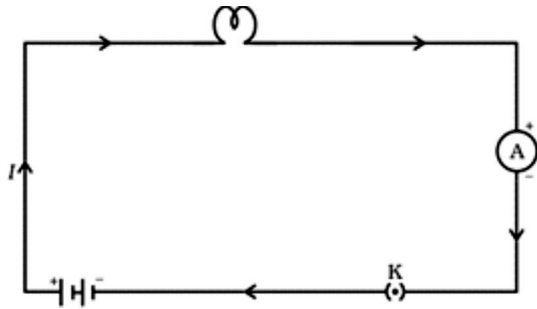
Cell : A cell is a source of potential difference, which is created inside it due to internal chemical reactions between the electrodes.

ELECTRIC CIRCUIT AND CIRCUIT DIAGRAM

Symbols Of Components Used In Circuit Diagram.

S. No.	Components	Symbols
1	An electric cell	
2	A battery or a combination of cells	
3	Plug key or switch (open)	
4	Plug key or switch (closed)	
5	A wire joint	
6	Wires crossing without joining	
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or rheostat	
10	Ammeter	
11	Voltmeter	

- A closed-loop path which a current take is called an **Electric Circuit**.
- Representation of an electric circuit through symbols is called a schematic circuit diagram.



Resistance and Ohm's Law

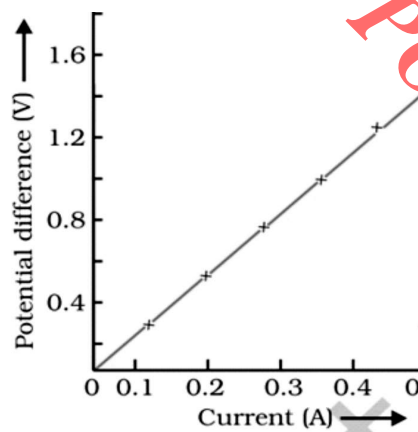
Ohm's Law

The potential difference, V , across the ends of a given metallic wire in an electric circuit is directly proportional to the current flowing through it, provided its temperature remains the same. For the current I flowing through a conductor having potential difference V across its ends, we have:

$$V \propto I$$

$$V = IR$$

- Here R is the constant of proportionality and known as the resistance of the conductor.
- Value of resistance do not change on changing electric current or potential difference.



RESISTANCE

Resistance is a measure of the opposition offered to the current flow in an electric circuit.

SI unit of resistance is ohm (Ω)

Factors affecting Resistance

Resistance is:

- directly proportional to the length of the conductor.
 $R \propto l$
- inversely proportional to the cross-sectional area of the conductor.
 $R \propto 1/A$

Combining the two we have

$$R \propto l/A$$

$$R = \rho l/A$$

- Here ρ is the constant of proportionality and known as resistivity or specific resistance. Since, resistivity depends on temperature and material of the conductor
So resistance also depends on
- temperature
- material of the conductor

RESISTIVITY

The electrical resistance offered by a substance of unit length and unit cross-sectional area is called resistivity.

SI unit of resistivity is ohm meter (Ω)

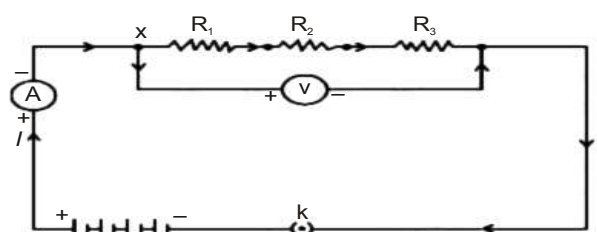
resistivity depends on

- temperature
- material of the conductor

Combination of Resistors

COMBINATION OF RESISTORS AND EQUIVALENT RESISTANCE

Resistors in series



Two or more resistors are said to be combined in series if they carry the same current. In this circuit the following applies.

$$I_1 = I_2 = I_3 = I$$

$$V_T = V_1 + V_2 + V_3$$

where V_1, V_2, V_3 are potential difference across respective resistances.

Using ohm's law $V=IR$

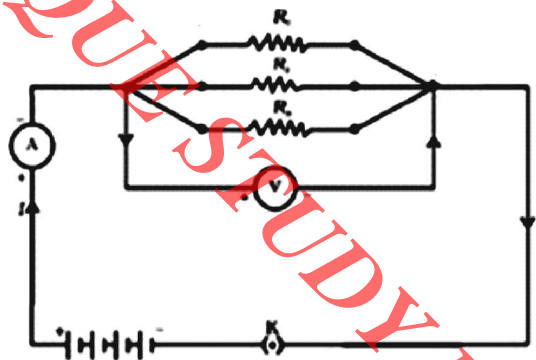
$$IR_S = IR_1 + IR_2 + IR_3$$

$$IR_S = I(R_1 + R_2 + R_3)$$

$$\text{So } R_S = R_1 + R_2 + R_3$$

So the resultant resistance of the combination of the resistors in the series is the sum of all resistances.

Resistors in parallel



- Two or more resistors are said to be combined in parallel if the same potential difference is applied to them.

In this circuit,

$$I = I_1 + I_2 + I_3$$

Using ohm's law $V=IR \Rightarrow I=V/R$

$$V/R_p = V/R_1 + V/R_2 + V/R_3$$

$$V/R_p = V(1/R_1 + 1/R_2 + 1/R_3)$$

$$1/R_p = 1/R_1 + 1/R_2 + 1/R_3$$

HEATING EFFECT OF CURRENT

When current passes through a conductor, it produces heat. This phenomenon is called heating effect of electric current. The amount of heat produced can be given by Joules law.

By definition

Power $P = \text{work done } W/\text{time } t$

$$P=W/t$$

$P=H/t$ (work done = energy and heat are a form of energy)

$$H=PX t$$

$$H=VIt \quad (P=W/t = VQ/t = VI)$$

$$H=I^2Rt \quad (V=IR)$$

Joule's Law:

- Heat (H) a square of the current (I).
- H a Resistance of the given circuit.
- H a Time (t) for which current flows through the conductor.
- So, $H=I^2Rt$

When a potential difference is established, it causes electrons to move, i.e. flow of current.

PRACTICAL APPLICATIONS OF HEATING EFFECT

1. Examples of devices which work on this effect
 - a. Toaster
 - b. Oven
 - c. Heating iron
 - d. Room Heater
2. Electric bulb produces light due to heating effect by heating up tungsten (Tungsten is the filament in the bulb). It has a high melting point and is covered by a glass bulb. Inert atmosphere is provided by filling the bulb with nitrogen or argon (Inert gases) to prevent oxidation of the metal.
3. Fuse: a low-melting point wire connected in series with electric devices for safety used in electric circuits) works on this effect.

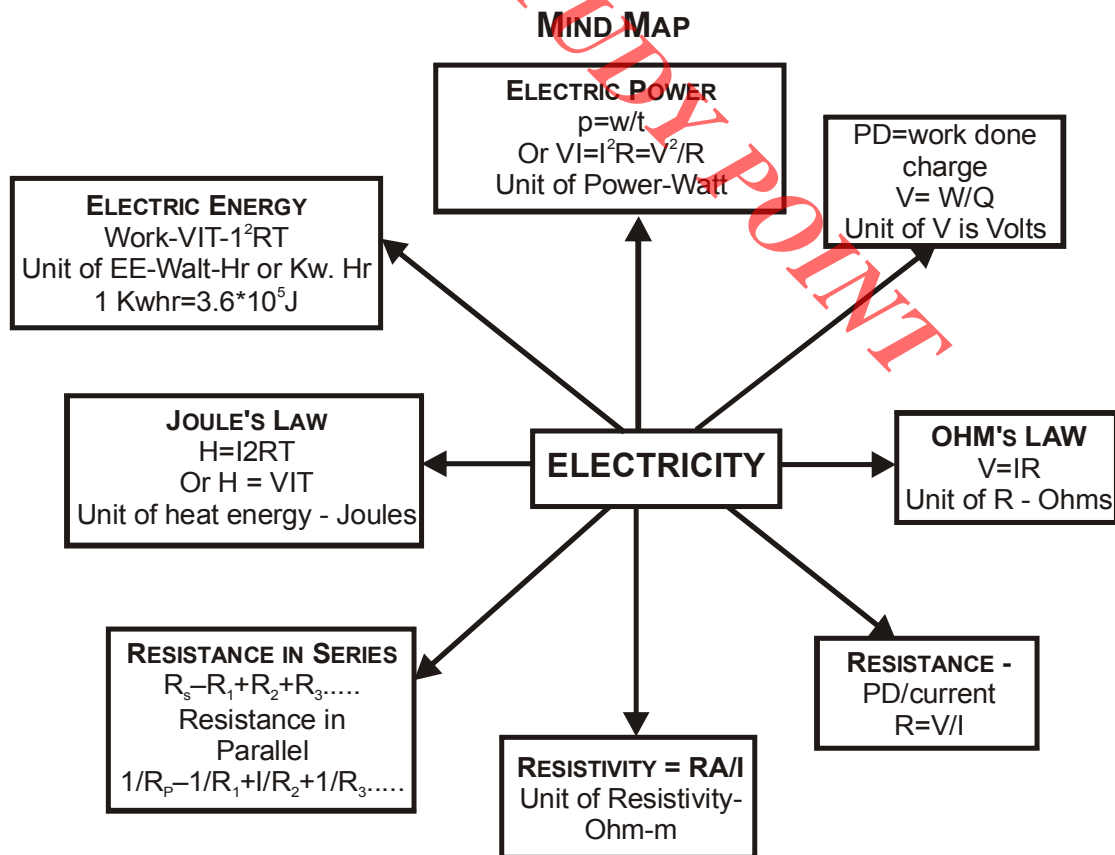
ELECTRIC POWER

- The rate of doing work or rate of consumption of electrical energy is called Electric Power.
- If W is work done in time t , then $P=W/t$.

- $P = VQ/t$ ($V=W/Q \Rightarrow W=VQ$)
- $P = VI$ ($Q/t = I$)
- $P = I^2R$ ($V=IR$)
- $P = V^2/R$ ($I=V/R$)
- S.I unit of power is Watt(W) Joule/sec
- One watt of power is consumed when 1 A of current flows at a potential difference of 1 V.

ELECTRICAL ENERGY

- SI unit of Energy is Joule(J)
- The commercial unit of electrical energy is a kilowatt-hour (kWh).
- $1\text{kWh} = 3,600,000\text{J} = 3.6 \times 10^6 \text{ J}$
- One kilowatt-hour is defined as the amount of energy consumed when 1kW of power is used for 1 hour

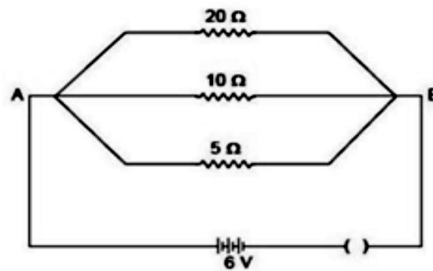


MULTIPLE-CHOICE QUESTIONS (1 MARKS)

- A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R' , then the ratio R/R' is
 - $1/25$
 - $1/5$
 - 5
 - 25
- Two resistors of resistance $2\ \Omega$ and $4\ \Omega$ when connected to a battery will have
 - same current flowing through them when connected in parallel
 - same current flowing through them when connected in series
 - same potential difference across them when connected in series
 - different potential difference across them when connected in parallel
- What is the commercial unit of electrical energy?
 - Joules
 - Kilojoules
 - Kilowatt-hour
 - Watt-hour
- Electrical resistivity of a given metallic wire depends upon
 - its length
 - its thickness
 - its shape
 - nature of the material
- The resistivity does not change if
 - the material is changed
 - the temperature is changed
 - the shape of the resistor is changed
 - both material and temperature are changed
- In an electrical circuit two resistors of $2\ \Omega$ and $4\ \Omega$ respectively are connected in series to a $6\ \text{V}$ battery. The heat dissipated by the $4\ \Omega$ resistor in $5\ \text{s}$ will be

- (a) 5 J
- (b) 10 J
- (c) 20 J
- (d) 30 J

7. Calculate the current flow through the $10\ \Omega$ resistor in the following circuit.



- (a) 1.2 A
- (b) 0.6 A
- (c) 0.2 A
- (d) 2.0 A

8. If the amount of electric charge passing through a conductor in 10 minutes is 300 C, the current flowing is:

- (a) 30 A
- (b) 0.3 A
- (c) 0.5 A
- (d) 5 A

9. Which of the following represents voltage?

- (a) Work done/(Current \times Time)
- (b) Work done \times Charge
- (c) (Work done \times Time) / Current
- (d) Work done \times Charge \times Time

10. An electric kettle consumes 1 kW of electric power when operated at 220 V. A fuse wire of what rating must be used for it?

- (a) 1 A
- (b) 2 A
- (c) 4 A
- (d) 5 A

11. Unit of electric power may also be expressed as
- (a) volt ampere
 - (b) kilowatt hour
 - (c) watt second
 - (d) joule /second
12. What is the maximum resistance which can be made using five resistors each of $1/5\Omega$?
- (a) $1/5$ W
 - (b) 10 W
 - (c) 5 W
 - (d) 1 W
13. What is the minimum resistance which can be made using five resistors each of $1/5\Omega$?
- (a) $1/5$ W
 - (b) $1/25$ W
 - (c) $1/10$ W
 - (d) 25 W
14. If the current I through a resistor is increased by 100% (assume that temperature remains unchanged), the increase in power dissipated will be
- (a) 100 %
 - (b) 200 %
 - (c) 300 %
 - (d) 400 %
15. In an electrical circuit three incandescent bulbs A, B and C of rating $40\ \Omega$, $60\ \Omega$ and $100\ \Omega$ respectively are connected in parallel to an electric source. Which of the following is likely to happen regarding their brightness?
- (a) Brightness of all the bulbs will be the same
 - (b) Brightness of bulb A will be the maximum
 - (c) Brightness of bulb B will be more than that of A
 - (d) Brightness of bulb C will be less than that of B
16. Electric current is measured by
- (a) A voltmeter

- (b) An ammeter
(c) rheostat
(d) A potentiometer
17. Unit of electric energy may also be expressed as
(a) volt ampere
(b) kilowatt hour
(c) watt second
(d) joule /second
18. One coulomb charge is equivalent to the charge contained in:
(a) 2.6×10^{19} electrons
(b) 6.2×10^{19} electrons
(c) 2.65×10^{18} electrons
(d) 6.24×10^{18} electrons
19. If the current through a floodlamp is 5 A, what charge passes in 10 seconds?
(a) 0.5 C
(b) 2 C
(c) 5 C
(d) 50 C
20. The resistance of a wire of length 300 m and cross-section area, 1.0 mm^2 made of material of resistivity $1.0 \times 10^{-7} \Omega$ is.
(a) 2Ω
(b) 3Ω
(c) 20Ω
(d) 30Ω

ASSERTION-REASONING TYPE QUESTIONS(1 MARK)

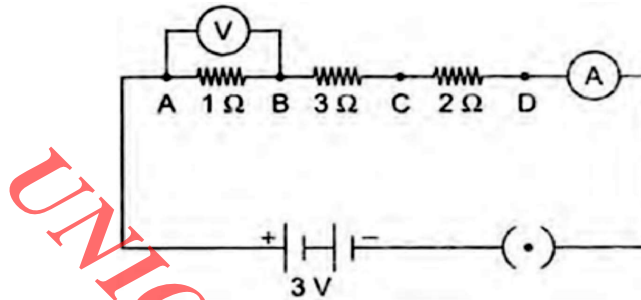
Following questions consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (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.

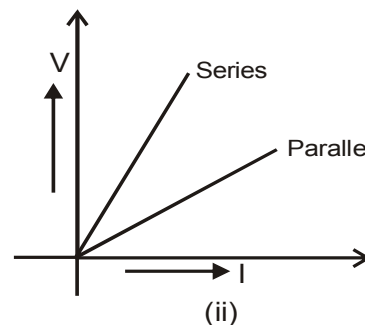
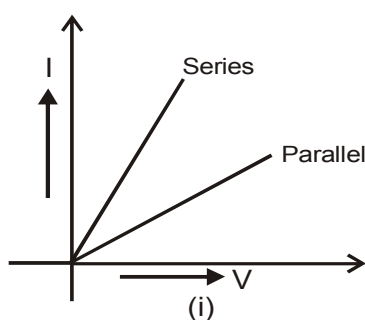
1. **Assertion (A)** : Longer wires have greater resistance and the smaller wires have lesser resistance.
Reason (R) : Resistance is inversely proportional to the length of the wire.
2. **Assertion (A)** : Tungsten metal is used for making filaments of incandescent lamps.
Reason (R) : The melting point of tungsten is very low.
3. **Assertion (A)** : Alloys are commonly used in electrical heating devices, like electrical iron, toasters etc.
Reason (R) : Alloys do not oxidize (burn) readily at high temperatures.
4. **Assertion (A)** : Bending a wire does not affect electrical resistance.
Reason (R) : Resistance of a wire is proportional to resistivity of material.
5. **Assertion (A)** : When the resistances are connected between the same two points, they are said to be connected in parallel.
Reason (R) : In case the total resistance is to be decreased, then the individual resistances are connected in parallel.
6. **Assertion (A)** : The coil of a heater is cut into two equal halves and only one of them is used into heater. The heater will now require half the time to produce the same amount of heat.
Reason (R) : The heat produced is directly proportional to square of current.
7. **Assertion (A)** : The 200 W bulbs glow with more brightness than 100 W bulbs.
Reason (R) : 100 W bulb has more resistance than 200 W bulb.
8. **Assertion (A)** : Silver is not used to make electric wires.
Reason (R) : Silver is a bad conductor.
9. **Assertion (A)** : If a graph is plotted between the potential difference and the current flowing, the graph is a straight line passing through the origin.
Reason (R) : The current is directly proportional to the potential difference.
10. **Assertion (A)** : : Electric appliances with metallic body have three connections, whereas an electric bulb has a two pin connection.
Reason (R) : Three pin connections reduce heating of connecting wires.

SHORT ANSWER TYPE QUESTIONS (TWO MARK).

1. A bulb is rated at 5.0 V, 100 mA. Calculate its
 - (a) power and
 - (b) resistance.
2. How would the reading of voltmeter (V) change, if it is connected between B and C? Justify your answer.



3. Calculate the number of electrons that would flow per second through the cross-section of a wire when 1 A current flows in it.
4. How much current will an electric bulb of resistance 1100 Ω draw from a 220 V source? If a heater of resistance 100 Ω is connected to the same source instead of the bulb, calculate the current drawn by the heater.
5. Define the following terms:
 - (a) one ampere
 - (b) one volt.
6. Keeping the potential difference constant, the resistance of a circuit is doubled. By how much does the current change?
7. Two students perform experiments on series and parallel combinations of two given resistors R₁ and R₂ and plot the following V-I graphs.



Which of the graphs is (are) correctly labelled in terms of the words 'Series and parallel'? justify your answer.

8. What is the better way of connecting lights and other electrical appliances in domestic wiring? Why?
9. How much work is done in moving a charge of magnitude 3 C across two points having a potential difference of 12 V?
10. What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistance 4Ω , 8Ω , 12Ω , 24Ω ?

SHORT ANSWER TYPE QUESTIONS (3MARK)

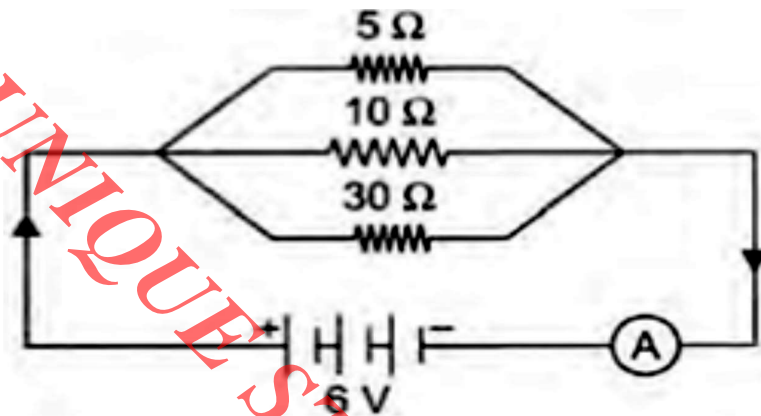
1. A piece of wire of resistance 6Ω is connected to battery of 12 V. Find the amount of current flowing through it. Now, the same wire is redrawn by stretching it to double its length. Find the resistance of the new (redrawn) wire.
2. Draw a schematic diagram of an electric circuit consisting of a battery of five 2 V cells, a 20Ω resistor, a 30Ω resistor, a plug key, all connected in series. Calculate the value of current flowing through the 20Ω resistor and the power consumed by the 30Ω resistor.
3. A torch bulb is rated 5 V and 500 mA. Calculate its: (i) power (ii) resistance and (iii) energy consumed when it is lighted for 4 hours.
4. (a) Define potential difference between two points in a conductor.
(b) Name the instrument used to measure the potential difference in a circuit. How is it connected?
(c) A current of 2 A passes through a circuit for 1 minute. If potential difference between the terminals of the circuit is 3 V, what is the work done in transferring the charges?
5. (a) What is the heating effect of current? List two electrical appliances which work on the basis of this effect.
(b) A 9 Volt battery is connected a resistor having a resistance of 10Ω . What is the current and power across the resistor?

LONG ANSWER TYPE QUESTIONS (5 MARK)

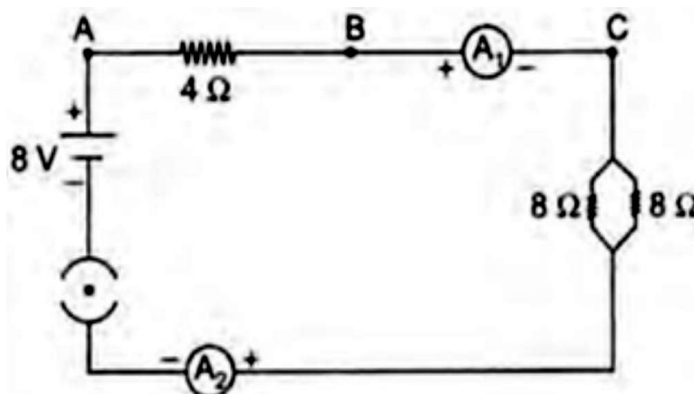
1. (a) State the commercial unit of electric energy and find its relation with its SI unit.
(b) The current through a resistor is made three times its initial value. Calculate how it will affect the heat produced in the resistor.

(c) Find the increase in the amount of heat generated in a conductor if another conductor of double resistance is connected in the circuit keeping all other factors unchanged.

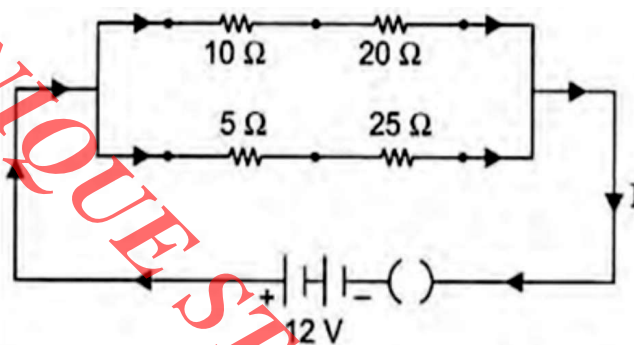
2. (a) For the circuit shown in the diagram, calculate:
- value of current through the $30\ \Omega$ resistor.
 - total resistance of the circuit.
- (b) Give two advantages of connecting electrical devices in parallel with battery.



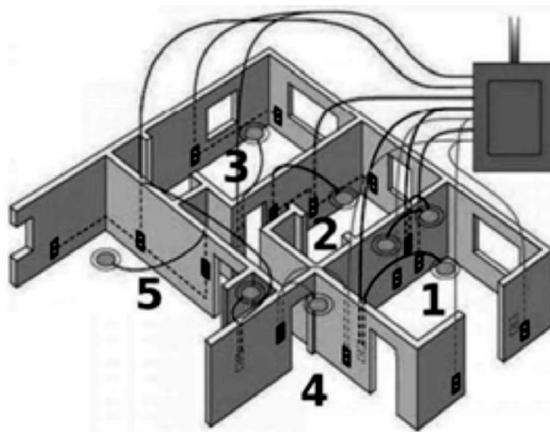
3. Find out the following in the electric circuit given in figure:
- Effective resistance of two $8\ \Omega$ resistors in the combination.
 - Current flowing through $4\ \Omega$ resistor.
 - Potential difference across $4\ \Omega$ resistor.
 - Power dissipated in $4\ \Omega$ resistor.
 - Difference in ammeter readings, if any.



4. What is meant by electric current? Name and define its SI unit. In a conductor electrons are flowing from B to A. What is the direction of conventional current? Give justification for your answer. A steady current of 1 ampere flows through a conductor. Calculate the number of electrons that flows through any section of the conductor in 1 second. (Charge on electron 1.6×10^{-19} coulomb).
5. If a 12 V battery is connected to the arrangement of resistances given below, calculate:
- (a) The total effective resistance of the arrangement.
- (b) The total current flowing in the circuit.



CASE STUDY BASED QUESTIONS (4 MARKS)



1.

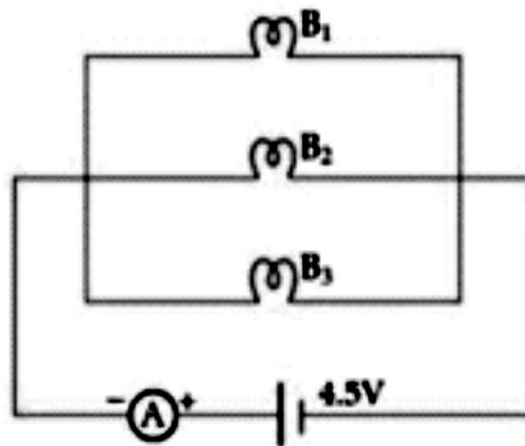
The diagram above is a schematic diagram of a household circuit. The house shown in the above diagram has 5 usable spaces where electrical connections are made. For this house, the mains have a voltage of 220 V and the net current coming from the mains is 22A.

- (i) What is the mode of connection to all the spaces in the house from the mains?
 - (ii) The spaces 5 and 4 have the same resistance and spaces 3 and 2 have respective resistances of 20Ω and 30Ω . Space 1 has a resistance double that of space 5. What is the net resistance for space 5.
 - (iii) What is the current in space 3?
 - (iv) What should be placed between the main connection and the rest of the house's electrical appliances to save them from accidental high electric current?
2. Ram wants to buy an electric heater, however he needs to know how much heat it produces per hour. The electric heater is rated at 1500 W. Use this information to answer the following questions:
- (i) What is the S.I. unit of power.
 - (ii) The electric heater is rated at 1500 W. How much heat it generates in one hour?
 - (iii) The amount of energy consumed depends on the power of the device. Justify
 - (iv) What is the commercial unit of electric energy?
3. Potential difference is defined as the work done required to a unit positive charge move from one point to another point. Potential difference of a conductor is measured in volts. Priya wants to know as to how much work will be done in moving a charge of 1C from one point to another on a charged conductor. The potential of the conductor is 10V. she calculated that the work done in this case is 10J. Use this information to answer the questions below.
- (i) What is the SI unit of work done?
 - (ii) What is the mathematical relation between potential difference, work done and charge.
 - (iii) If charge to be moved is increased keeping the potential difference constant, then the work done will
 - (a) increases
 - (b) decreases
 - (c) remain unchanged
 - (iv) What will be the work done if a charge of 2C is moved across the same potential difference?

4. Electrical resistivities of some substances, at 20°C are given below in the table. Study the table and answer the given questions

Silver	$1.60 \times 10^{-8} \Omega\text{m}$
Copper	$1.62 \times 10^{-8} \Omega\text{m}$
Tungsten	$5.2 \times 10^{-8} \Omega\text{m}$
Mercury	$94 \times 10^{-8} \Omega\text{m}$
Iron	$10 \times 10^{-8} \Omega\text{m}$
Nichrome	$100 \times 10^{-6} \Omega\text{m}$

- (i) Which is a better conductor of electric current?
- (a) Silver
 - (b) Copper
 - (c) Tungsten
 - (d) Mercury
- (ii) Which element will be used for electrical transmission lines?
- (a) Iron
 - (b) Copper
 - (c) Tungsten
 - (d) mercury
- (iii) Nichrome is used in the heating elements of electric heating device because:
- (a) It has high resistivity
 - (b) It does not oxidize readily at high temperature
 - (c) Both of the above
 - (d) None of the above
- (iv) Series arrangement is not used for domestic circuits because:
- (a) Current drawn is less
 - (b) Current drawn is more
 - (c) Neither of the above
 - (d) Both of the above
5. In the given circuit, three identical bulbs B1, B2 and B3 are connected in parallel with a battery of 4.5 V. Study the diagram and answer the questions given below:



- (i) What will happen to the other two bulbs if the bulb B3 gets fused ?
- (a) They will also stop glowing.
 - (b) Other bulbs will glow with same brightness.
 - (c) They will glow with low brightness.
 - (d) They glow with more brightness.
- (ii). If the wattage of each bulb is 1.5 W, how much readings will the ammeter A show when all the three bulbs glow simultaneously?
- (a) 1 A
 - (b) 2.1 A
 - (c) 1.5 A
 - (d) None of the above
- (iii) Find the total resistance of the circuit.
- (a) 1.0 Ω
 - (b) 4.5 Ω
 - (c) 1.5 Ω
 - (d) 2.0 Ω Ans.
- (iv) How many resistors of 88 Ω are connected in parallel to carry 10 A current on a 220 V line?
- (a) 2 resistors
 - (b) 1 resistors
 - (c) 3 resistors
 - (d) 4 resistors

ANSWER KEY

MULTIPLE-CHOICE QUESTIONS(1 MARK)

Correct option is D)

Step 1: Resistance of each part after cutting

We know that, Resistance $R = \rho \frac{l}{A}$

Since, R is directly proportional to length of the wire.

Therefore the resistance of every part after cutting the wire in 5 parts is

$$R_1 = R_2 = R_3 = R_4 = R_5 = \frac{R}{5}$$

Step 2: Equivalent Resistance

When all the resistances are connected in parallel, let R' be the equivalent resistance

So,
$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

$$\Rightarrow \frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R}$$

$$\Rightarrow R' = \frac{R}{25}$$

$$\Rightarrow \frac{R}{R'} = 25$$

1. (d) 25
2. (b) same current flowing through them when connected in series.
3. (c) Kilowatt-hour.
4. (d) nature of the material.
5. (c) the shape of the resistor is changed
6. (c) 20J (total resistance = $2\Omega + 4\Omega = 6\Omega$, $I = V/R = 6/6 = 1A$,
 $H = I^2Rt = 1^2 \times 4 \times 5 = 20J$)
7. (b) 0.6 A ($I = V/R = 6/10 = 0.6A$)
8. (c) 0.5A ($I = Q/t = 300/10 \times 60 = 0.5A$)

9. (a) work done/ (current x time) $\{V=W/Q, Q= I \times t \text{ So } V=W/It\}$
10. (d) 5A ($P=VI$ So $I=P/V =1000/220=4.54$ hence fuse should have rating more than 4.54 A)
11. (a) volt-ampere
12. (d) 1Ω ($1/5+1/5+1/5+1/5+1/5=5/5=1$)
13. (b) $1/25\Omega$
14. (a) 100% ($P=VI$)
15. (b) Brightness of bulb A will be the maximum (parallel connection so $P=V^2/R$ so bulb with least resistance will have maximum brightness)
16. (b) An ammeter
17. (c) watt second
18. (d) 6.24×10^{18} electrons
19. (d) 50C ($Q=It=5 \times 10=50C$)
20. (d) 30Ω ($R=\rho l/A=1.0 \times 10^{-7} \times 300/10^{-6} =30\Omega$)

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

1. (c) A is true but R is false.
2. (c) A is true but R is false.
3. (a) Both A and R are true and R is the correct explanation of A.
4. (b) Both A and R are true but R is not the correct explanation of A.
5. (b) Both A and R are true but R is not the correct explanation of A.
6. (d) A is false but R is true.
7. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
8. (c) Assertion (A) is true but reason (R) is false.
9. (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
10. (c) Assertion (A) is true but reason (R) is false.

SHORT ANSWER TYPE QUESTIONS (2 MARKS).

- Rating of bulb, $V = 5.0$ Volt, $I = 100 \text{ mA} = 100 \times 10^{-3} \text{ A} = 0.1 \text{ A}$
 - Power of bulb $P = V \times I$ or $P = 5.0 \times 0.1 = 0.5 \text{ W}$
 - $V = IR$ or $R = V/I = 5/0.1 = 50 \Omega$
- R_1, R_2 and R_3 are connected in series. $R_S = R_1 + R_2 + R_3 = 1 + 3 + 2 = 6 \Omega$
 $I = V/R = 3/6 = 1/2 \text{ A}$

Current in each resistance is same, i.e. $1/2 \text{ A}$. Voltage across B & C ($V = IR$) = $1/2 \times 3 = 3/2 \text{ Volt}$.
- $Q = I \times T = 1 \text{ A} \times 1 \text{ s} = 1 \text{ Coulomb}$ $Q = ne$, $n = Q/e$, $n = 1 \text{ C} / 1.6 \times 10^{-19} \text{ C} = 6.25 \times 10^{18}$ electrons.
- Resistance of bulb, $R = 1100 \Omega$
 $V = 220 \text{ volt}$
 $V = IR$ or $I = V / R$
 $I = 220/1100 = 1/5 \text{ A}$

When heater is connected with the same source then
 $I = V/R = 220/100 = 2.2 \text{ A}$.
- One Ampere : The SI unit of electric current is ampere (A). One ampere is the electric current when one coulomb of charge flows through a conductor in one second.

One Volt: The SI unit of potential difference is volt (V). One volt is the potential difference between two points in an electric circuit when one joule of work is done to move a charge of one coulomb from one point to the other.
- $V = IR$ or $V/R = I$,

Since the resistance and the current are inversely proportional, the current will become half.
- In case of series combination, the effective resistance = $R_1 + R_2$ is more, hence slope of $V - I$ graph will be more. It is otherwise in case of $I - V$ graph. So, series and parallel are correctly marked in graph (ii).
- The better way of connecting lights and other electrical appliances in domestic wiring is parallel connection because of the following advantages:
 - In parallel circuit, if one appliance stops working due to some defect, then all other appliances keep working normally.

- In parallel circuit, each electrical appliance has its own switch due to which it can be turned on or off, without affecting other appliances.
- In parallel circuit, each electrical appliance gets the same voltage (220 V) as that of the power supply line.
- In parallel circuit, the overall resistance of the domestic circuit is reduced due to which the current from the power supply is high.

9. Given: $Q = 3 \text{ C}$, $V = 12 \text{ V}$

To find: W , as $V = W/Q$ or $W = VQ = 12 \times 3 = 36 \text{ J}$.

Ans 10 (a) If the four resistors are connected in series, their total resistance will be the sum of their individual resistances and it will be the highest. The total equivalent resistance of the resistors connected in series will be $4 \Omega + 8 \Omega + 12 \Omega + 24 \Omega = 48 \Omega$.

(b) If the resistors are connected in parallel, then their equivalent resistances will be the lowest.

Their equivalent resistance connected in parallel is

$$R = \frac{1}{\frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24}} = \frac{24}{12} = 2 \Omega$$

Hence, the lowest total resistance is 2Ω .

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

$$I = \frac{V}{R} = \frac{12}{6} \text{ A} \Rightarrow I = 2 \text{ A}$$

When length becomes twice = $2L$

area of cross-section = A_2

then $L_1 A_1 = L_2 A_2$

or $LA_1 = 2LA_2$

or $\frac{A_2}{A_1} = \frac{1}{2}$

$$R_1 = \rho \frac{L}{A_1}$$

$$R_2 = \rho \frac{2L}{A_2} \Rightarrow \frac{R_2}{R_1} = 2 \times \frac{A_1}{A_2}$$

$$\frac{R_2}{R_1} = 2 \times 2 = 4$$

$$R_2 = 4R_1$$

New resistance becomes four times.



$$R_{eq} = 20 + 30 = 50 \Omega$$

Here, $V = 5 \times 2 \text{ V} = 10\text{V}$, Total Resistance, $R = 20\Omega + 30\Omega = 50\Omega$ Current through both 20Ω and $30 \Omega = I = V/R = 10/50 \text{ A} = 0.2 \text{ A}$ Power consumed by $30\Omega = I^2R = (0.2)^2 \times 30 = 1.2\text{W}$

3. Given: $5\text{V} - 500 \text{ mA}$

(i) Power = $V \times I = 5 \times 500 \times 10^{-3} = 2.5\text{W}$

(ii) Resistance $V/I = 5 / 500 \times 10^{-3} = 10\Omega$

Energy consumed in four hrs. = $2.5 \times 4 \times 60 \times 60 = 10 \times 3600 \text{ W.s} = 3.6 \times 10^4 \text{ J}$

4. (a) Electric potential is the amount of work done in bringing a unit positive charge from one point to another.

(b) Voltmeter. It is connected in parallel in the circuit.

(c) $I = 2\text{A}$, $t = 1 \text{ min} = 60\text{s}$, $V = 3 \text{ V}$, $W = VQ = V It$, $W = 360 \text{ J}$

5. (a) When an electric current flows through a high resistance conducting wire, heat is produced in the conducting wire. This is called the heating effect of electric current.

Devices- Electric iron, Room heater, bulb

(b) $I = V/R = 9/10 = 0.9 \text{ A}$

$P = VI = 9 \times 0.9 = 8.1 \text{ J/s or } 8.1 \text{ W}$

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1 (a) Commercial unit of electric energy = kWh, $1\text{kWh} = 3.6 \times 10^6 \text{ J}$

(b) Initial heat generated in the resistor = $I^2 R t$

$H^2 = (3I)^2 R t = 9I^2 R t$, thus if current is three times the initial current, the heat generated is 9 times.

(c) If another conductor of resistance $2R$ is connected in series, then total resistance is = $R + 2R = 3R$

$H = I^2 R t = I^2 (3R) t = 3 I^2 R t$, thus heat generated is three times.

2. (a) Potential across each resistor = 6 V.
 (i) I in 30 Ω resistor, $V/R = 6/30 = 1/5\text{A} = 0.2\text{ A}$
 (ii) All in parallel, $R = 30/10 = 3\ \Omega$
 (b) (i) Voltage across each appliance remains same
 (ii) If any appliance fails to work other appliances continue to work.

3.
$$n = \frac{1\text{C}}{1.6 \times 10^{-19}\text{ C}} = \frac{10^{19}}{1.6}$$

$$= 6.25 \times 10^{18}\text{ electrons}$$

- (a) 8 Ω and 8 Ω resistors are in parallel, therefore $R_P = 8 \times 8 / (8+8) = 4\ \Omega$
 (b) Total resistance of the circuit = $(4+4) = 8\ \Omega$, Current in 4 Ω resistor, $I = 8/8 = 1\text{A}$.
 (c) Potential difference across 4 Ω resistor $V = IR = 1 \times 4 = 4\text{ Volt}$.
 (d) Power dissipated in 4 Ω resistor $P = I^2 R = (1)^2 \times 4 = 4\text{W}$.
 (e) Both the ammeters are in series in the circuit so current will be same in both ammeters. Hence no difference in the reading of two ammeter.
4. Electric Current: The amount of charge 'Q' flowing through a particular area of cross section in unit time 't' is called electric current, i.e.

Electric current, $I = Q/t$

- SI unit of electric current is ampere.
 - One ampere of current is that current which flow when one Coulomb of electric charge flowing through a particular area of cross-section of the conductor in one second, i.e. $1\text{A} = 1\text{ Cs}^{-1}$.
 - The direction of conventional current is A to B, i.e. opposite to the direction of flow of electrons. In a metal, flow of electrons carrying negative charge constitutes the current. Direction of flow of electrons gives the direction of electronic current by convention, the direction of flow of positive charge is taken as the direction of conventional current. Charge = q = n e for q=1C
5. (a) 10 Ω and 20 Ω are in series $R_U = 10+20 = 30\ \Omega$; 5 Ω and 25 Ω are in series $R_D = 5+25 = 30\Omega$. 30 Ω and 30 Ω are in parallel, Therefore $1/R_T = 1/30 + 1/30$, $R_T = 30/2 = 15\Omega$
 (b) $I = V/R = 12/15 = 0.8\text{ A}$

CASE STUDY BASED QUESTIONS (4 MARKS)

1. (a) All spaces are connected in parallel.
- (b) Let Resistance of Space 5 and 4 be R ohms respectively. Resistance of Space 1 = 2 R ohms Resistance of Space 2 = 30 ohms Resistance of Space 3 = 20 ohms Current = 22 A V= 220 V
Total Resistance= $V/I=220/22 = 10$ ohms. $1/2R + 1/30 + 1/20 + 1/R + 1/R = 1/10$
 $5/2R = 2/60=1/30$
 $R=150/2 = 75$ ohms
- (c) Resistance in space 3= 20Ω, V=220V I=V/R=220/20=11A
- (d) Electric fuse or circuit breaker.
- 2 (a) Watt
- (b) $P=1500$ W, $T=1$ HR =60X60s =3600s.
We know that $E=P \times t= 1500 \times 3600= 5.4 \times 10^6$ J
- (c) $E = P \times t$. so higher the power higher the energy will be consumed.
- (d) Commercial unit of electric energy = kWh
- 3 (a) joule
- (b) potential difference = work done/ charge.
- (c) i) increase
- (d) $W=VQ=10 \times 2 =20$ J
4. (i) (a) Silver is a better conductor because it has lower resistivity.
- (ii) (b) Copper, because it is economical, less oxidative than other metals and has low resistivity.
- (iii) (c) Both of the above. Nichrome, as it has very high resistivity / as it is an alloy, it does not oxidize readily at high temperature.
- (iv) (a) In series arrangement, same current will flow through all the appliances which is not required and the equivalent resistance becomes higher, hence the current drawn becomes less.
5. (i) (b) Other bulbs will glow with same brightness because glowing of bulbs depends upon power and potential difference, and resistance remain same for other bulbs.
- (ii) (a) When the bulbs are in parallel, wattage will be added (4.5 W) and the ammeter reading would be, $I = P/V = 4.5 /4.5 = 1$ A
- (iii) (b) Ammeter reading = 1 A, V = 4.5 V, $R = V/I = 4.5/1 = 4.5\Omega$
- (ii) (d) Ohm's law, $V = I R_p$, $220 =10 \times R_p$, $R_p = 220/10 =22 \Omega$ For parallel connection $1/ R_p =1/ R_1+1/ R_2+1/ R_3+ \dots + 1/ R_n$ Here $R_1 = R_2=R_3 \dots = R_n$ ie, $1/ R_p= n/R$, $R_p=R/n$, $22 = 88/n$, $n=4$ resistors.

CHAPTER - 13

MAGNETIC EFFECTS OF ELECTRIC CURRENT

MAGNET

- A magnet is a material that attracts materials of magnetic nature.
- Metals having magnetic nature are iron, cobalt and nickel.

Properties of a magnet

- A magnet always has two poles: North pole and South pole.
- Like poles repel each other whereas unlike pole attract each other.
- A freely suspended bar magnet always rests in north-south direction.

Bar Magnet

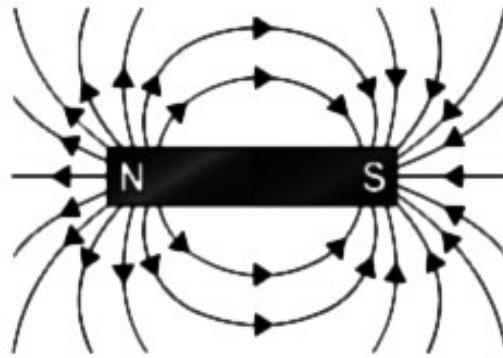
- A bar magnet is a rectangular object made up of iron which shows magnetic properties.
- It has two different poles, North and South pole.

Magnetic Compass

- It is a device used to find direction.
- It consists of a magnetized needle which is pivoted to move freely.
- The needle of a compass gets deflected when a bar magnet is brought near it.
- The needle points towards north-south direction.

MAGNETIC FIELD AND FIELD LINES

- The area around a magnet where a magnetic force is experienced is called the magnetic field.
- It is a quantity that has both direction and magnitude, (i.e., Vector quantity).
- The direction and strength of a magnetic field are represented by magnetic lines of force. Strength of magnetic field is highest at poles and lowest at centre of bar magnet.
- Magnetic field lines are imaginary lines round the magnet.



Properties of magnetic field lines

- Magnetic field lines originate from north pole and enter into south pole outside a magnet and from south pole to north pole inside a magnet.
- Magnetic field lines always form continuous closed loops.
- The closer or denser the magnetic field lines, greater is the magnetic field's strength.
- There is no intersection between the magnetic field lines because at the point of intersection, there will be two direction for magnetic field which is not possible.

MAGNETIC FIELD DUE TO A CURRENT CARRYING CONDUCTOR

Hans Christian Oersted (1777-1851) discovered the magnetic effect of electric current.

Magnetic effect of electric current.

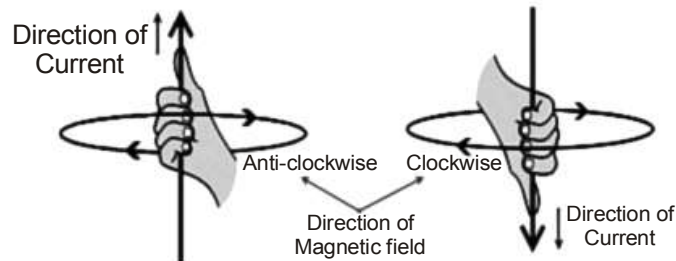
- When electric current flows through a current carrying conductor, it produces a magnetic field around it.
- On increasing the current, increase in deflection in the compass needle is seen.
- If the direction of current is reversed, the direction of deflection is also reversed.

(a) Magnetic field due to a straight current carrying conductor

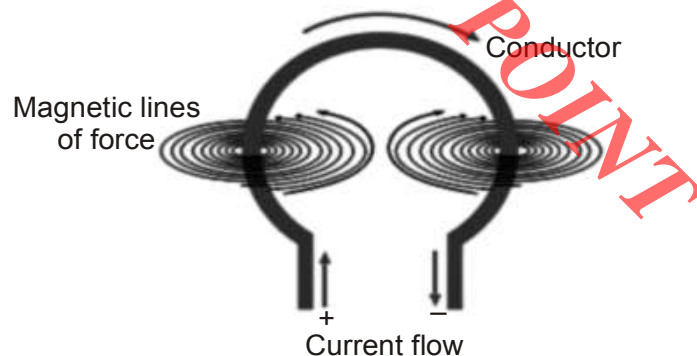
- The magnetic field around a current carrying straight conductor is in concentric circles.

Right Hand Thumb Rule

- Imagine to hold the straight wire carrying current in your right hand such that thumb points towards the direction of current, then your folded fingers around the conductor will show the direction of magnetic field.

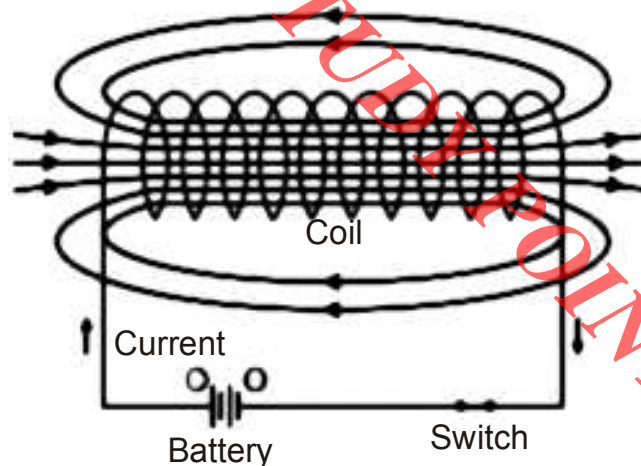


- This rule is also called **Maxwell's Corkscrew rule**.
- (b) Magnetic Field due to Current through a circular Loop.
- Circular loop comprises of several small straight segments.
 - Every point on the wire carrying current gives rise to a magnetic field that appears as straight lines at the centre.
 - By applying Right hand Thumb rule, we can find the direction of magnetic field at every section of the wire.



- (c) Magnetic field due to current in a solenoid.
- A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called solenoid.
 - By Right hand Thumb Rule, we can draw the pattern of magnetic field lines around a current carrying 'Solenoid'.

- One end of the solenoid behaves as a magnetic north pole (current direction anticlockwise), while the other end behaves as the South Pole (current direction clockwise).
- The field lines inside the solenoid are in form of parallel straight lines, that implies that magnetic field inside the solenoid is same at all points
i.e. Field is uniform.
- The magnetic field due to a current carrying solenoid is similar to that of a bar magnet.
- The strength of the magnetic field produced depends upon
 - (a) **Number of turns:** by increasing the number of turns, magnetic field strength of a solenoid can be increases and vice versa.
 - (b) **Strength of current:** by increasing the strength of current passing through the solenoid, magnetic field strength of solenoid can be increased and vice versa.
 - (c) **Soft iron core:** by putting a soft iron inside the solenoid

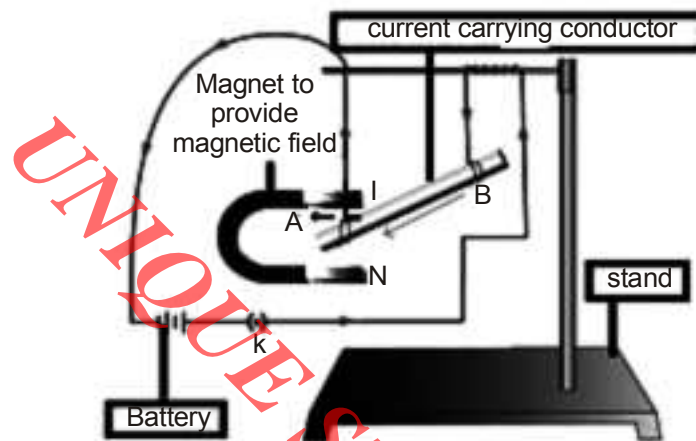


ELECTROMAGNET

- Strong magnetic field inside the solenoid can be used to magnetise a magnetic material for example soft iron, when it is placed inside the coil.
- The magnet so formed is called electromagnet.
- It is a temporary magnet (behaves like a magnet only when current is passed through it).

Force on a Current Carrying Conductor placed in a Magnetic Field

- Andre Marie Ampere suggested that when an electric conductor is placed in a magnetic field, it experiences a force.
- The direction of exerted force depends on
 - (a) direction of current
 - (b) direction of magnetic field lines.



Fleming's left-hand rule

- According to this rule, stretch thumb, forefinger, and middle finger of your left hand such that they are mutually perpendicular to each other.
- If fore finger represents direction of magnetic field & middle finger represent direction of current, then thumb will point in the direction of motion or force acting on the conductor.

APPLICATION OF MAGNETIC EFFECTS OF ELECTRIC CURRENT

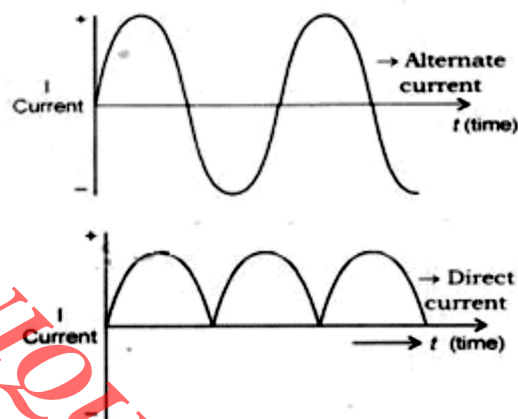
Several devices are based on magnetic effect of current like loudspeakers, electric motor, electric generator, microphones and measuring instruments.

AC AND DC CURRENT

AC – Alternating Current

- Current in which direction is changed periodically is called alternating current.

- In India, most of the power stations generate alternate current. The direction of current changes after every $1/100$ second in India, i.e. the frequency of A.C in India is 50 Hz.
- AC is transmitted upto a long distance without much loss of energy is advantage of AC over DC.



DC – Direct Current

- Current that flows in one direction only is called Direct current.
- Electrochemical cells produce direct current.

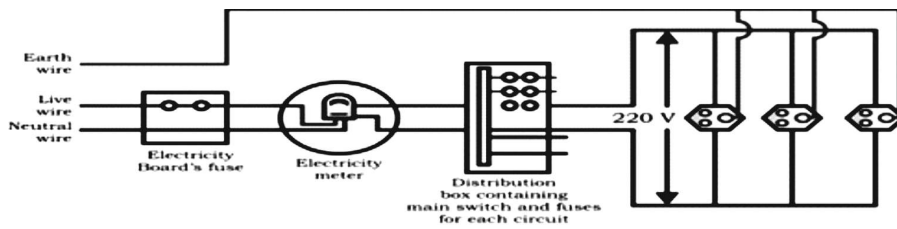
Advantages of AC over DC

- Cost of generator of AC is much less than that of DC.
- AC can be easily converted to DC.
- AC can be controlled by the use of choke which involves less loss of power whereas, D.C can be controlled using resistances which involves high energy loss.
- AC can be transmitted over long distances without much loss of energy.
- AC machines are stout and durable and do not need much maintenance.

Disadvantages of AC

- AC cannot be used for the electrolysis process or showing electromagnetism as it reverses its polarity.
- AC is more dangerous than DC.

DOMESTIC ELECTRIC CIRCUIT



In our homes, we receive supply of electric power through a main supply (also called mains), either supported through overhead electric poles or by underground cables.

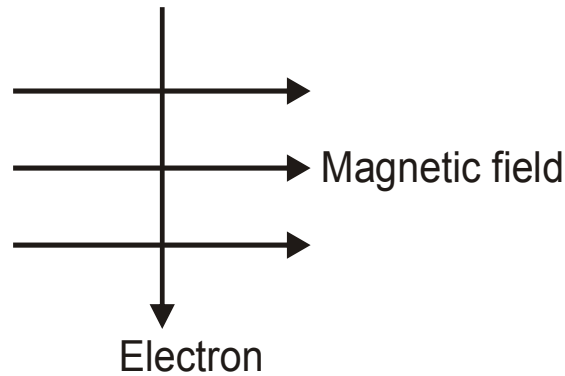
- One of the wires in this supply, usually with red insulation cover, is called live wire (or positive).
- Another wire, with black insulation, is called neutral wire (or negative). In our country, the potential difference between the two is 220 V.
- The earth wire, which has insulation of green colour, is usually connected to a metal plate deep in the earth near the house. This is used as a safety measure, especially for those appliances that have a metallic body, for example, electric press, toaster, table fan, refrigerator, etc.

These wires supply electricity to separate circuits within the house. Often, two separate circuits are used, one of 15 A current rating for appliances with higher power ratings such as geysers, air coolers, etc. The other circuit is of 5 A current rating for bulbs, fans, etc.

MULTIPLE CHOICE QUESTIONS (1 MARK)

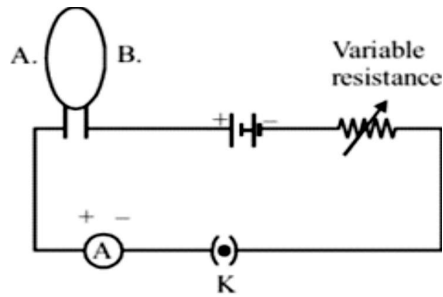
1. The most suitable material for making the core of an electromagnet is:
 - (a) soft iron
 - (b) brass
 - (c) Aluminium
 - (d) Steel
2. A magnet attracts:
 - (a) plastics
 - (b) carbon
 - (c) Aluminium
 - (d) iron and steel

3. Which of the following statements is incorrect regarding magnetic field lines?
 - (a) The direction of magnetic field at a point is taken to be the direction in which the north pole of a magnetic compass needle points.
 - (b) Magnetic field lines are closed curves
 - (c) If magnetic field lines are parallel and equidistant, they represent zero field strength
 - (d) Relative strength of magnetic field is shown by the degree of closeness of the field lines
4. Magnetic effect of current was discovered by
 - (a) Oersted
 - (b) Faraday
 - (c) Bohr
 - (d) Ampere
5. Magnetic lines do not intersect one-another because
 - (a) they are at a distance
 - (b) they are in the same direction
 - (c) they are parallel to another
 - (d) at the point of intersection there will be two direction of the magnetic force which is impossible
6. A small magnet is placed perpendicular to a uniform magnet field. The forces acting on the magnet will result in
 - (a) Rotational motion
 - (b) Translatory motion
 - (c) No motion at all
 - (d) Translational and rotational motion both
7. Inside the magnet, the field lines move
 - (a) from north to south
 - (b) from south to north
 - (c) away from south pole
 - (d) away from north pole
8. An electron beam enters a magnetic field at right angles to it as shown in the Figure.



The direction of force acting on the electron beam will be:

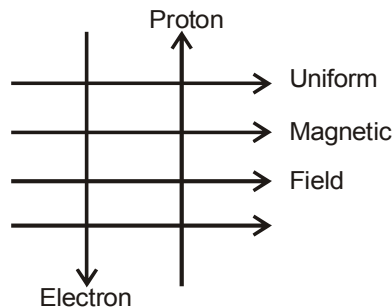
- (a) to the left
 - (b) to the right
 - (c) into the page
 - (d) out of the page
9. A plotting compass is placed near the south pole of a bar magnet. The pointer of plotting compass will:
- (a) point away from the south pole
 - (b) point parallel to the south pole
 - (c) point towards the south pole
 - (d) point at right angles to the south pole
10. The force exerted on a current-carrying wire placed in a magnetic field is zero when the angle between the wire and the direction of magnetic field is:
- (a) 45°
 - (b) 60°
 - (c) 90°
 - (d) 180°
11. A current carrying wire in the neighbourhood produces
- (a) no field
 - (b) electric and magnetic fields
 - (c) electric field only
 - (d) magnetic field only
12. A circular loop placed in a plane perpendicular to the plane of paper carries a current when the key is ON.



The current as seen from points A and B (in the plane of paper and on the axis of the coil) is anti-clockwise and clockwise respectively. The magnetic field lines point from B to A. The N-pole of the resultant magnet is on the face close to

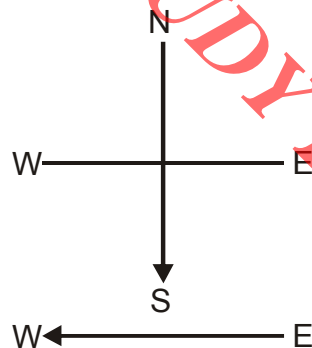
- (a) A
 - (b) B
 - (c) A if the current is small, and B if the current is large
 - (d) B if the current is small and A if the current is large
13. The magnetic lines of force, inside a current carrying solenoid, are
- (a) along the axis and are parallel to each other
 - (b) perpendicular to the axis and equidistance from each other
 - (c) circular and they do not intersect each other
 - (d) circular at the ends but they are parallel to the axis inside the solenoid.
14. Which of the following determines the direction of magnetic field due to a current carrying conductor?
- (a) Faraday's laws of electromagnetic induction
 - (b) Fleming's left-hand rule
 - (c) Lenz's rule
 - (d) Maxwell's cork screw rule
15. The value of magnetic field due to a small element of current carrying conductor at a distance r and lying on the plane perpendicular to the element of conductor is
- (a) zero
 - (b) maximum
 - (c) inversely proportional to the current
 - (d) none of the above

16. A uniform magnetic field exists in the plane of paper pointing from left to right as shown in figure. In the field an electron and a proton move as shown. The electron and the proton experience



- (a) forces both pointing into the plane of paper
(b) forces both pointing out of the plane of paper
(c) forces pointing into the plane of paper and out of the plane of paper, respectively
(d) force pointing opposite and along the direction of the uniform magnetic field respectively.
17. Along the direction of current carrying wire, the value of magnetic field is
(a) zero
(b) infinity
(c) depends on the length of the wire
(d) uncertain
18. When an electron beam is moving in a magnetic field, then the work done is equal to the
(a) charge of electron
(b) magnetic field
(c) product of electronic charge and the magnetic field
(d) zero
19. The direction of magnetic lines of forces close to a straight conductor carrying current will be
(a) along the length of the conductor
(b) radially outward
(c) circular in a plane perpendicular to the conductor
(d) helical

20. A current carrying loop lying in a magnetic field does not behaves like a.
- (a) A magnetic dipole
 - (b) magnetic pole
 - (c) magnetic material
 - (d) non-magnetic material
21. The strength of magnetic field around a current carrying conductor is
- (a) inversely proportional to the current but directly proportional to the square of the distance from wire.
 - (b) directly proportional to the current and inversely proportional to the distance from wire.
 - (c) directly proportional to the distance and inversely proportional to the current
 - (d) directly proportional to the current but inversely proportional the square of the distance from wire.
22. A constant current flows in a horizontal wire in the plane of the paper from east to west as shown in the figure. The direction of magnetic field at a point will be North to South



- (a) directly above the wire
 - (b) directly below the wire
 - (c) at a point located in the plane of the paper, on the north side of the wire
 - (d) at a point located in the plane of the paper, on the south side of the wire.
23. The strength of magnetic field inside a long current carrying straight solenoid is
- (a) more at the ends than at the centre

- (b) minimum in the middle
(c) same at all points
(d) found to increase from one end to the other
24. In India the potential difference between live wire and neutral wire is
(a) 240 V
(b) 250 V
(c) 280 V
(d) 220 V
25. When a bar magnet is broken into two pieces?
(a) we will have a single pole on each piece
(b) each piece will have two like poles
(c) each piece will have two unlike poles
(d) each piece will lose magnetism
26. An alpha particle is moving towards west is deflected towards north by a field. The field is magnetic. What will be the direction of field?
(a) Towards south
(b) towards east
(c) downward
(d) upward
27. The factors on which one magnetic field strength produced by current carrying solenoids depends are
(a) Magnitude of current
(b) Number of turns
(c) Nature of core material
(d) All of the above
28. The force experienced by a current-carrying conductor placed in a magnetic field is the largest when the angle between the conductor and the magnetic field is:
(a) 45°
(b) 60°
(c) 90°
(d) 180°

29. The front face of a circular wire carrying current behaves like a north pole, The direction of current in this face of the circular wire is:
- (a) clockwise
 - (b) downwards
 - (c) anticlockwise
 - (d) upwards
30. The similar magnets of steel are than the magnets of soft iron
- (a) stronger
 - (b) of equal strength
 - (c) weaker
 - (d) none of the above

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

Direction:

In the following Questions, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both A and R are true and R is the correct explanation of A.
- (b) A and R are correct but R is not the correct explanation of the Assertion.
- (c) A is true but R is false.
- (d) A is false but R is true.

1. **Assertion:** A Moving magnet can induce electric current.
Reason: Metallic conductors can conduct electricity due to electrons.
2. **Assertion:** When electric current is passed through a copper wire, magnetic needle kept near to wire shows deflection.
Reason: the electric current through copper wire has produced magnetic field.
3. **Assertion:** Strength of an electromagnet depends on the magnitude of current flowing through them.
Reason: Electromagnets are majorly used for lifting heavy weights.
4. **Assertion:** When the direction of velocity of moving charge is perpendicular to the magnetic field, it experience a maximum force.

Reason: Force on the moving charge does not depend on the direction of magnetic field in which it moves.

5. **Assertion:** On changing the direction of flow of current through a straight conductor, the direction of a magnetic field around the conductor is reversed.

Reason: The direction of magnetic field around a conductor can be given in accordance with left hand thumb rule.

6. **Assertion:** On freely suspending a current-carrying solenoid, it comes to rest in N-S direction just like a bar magnet.

Reason: One end of current carrying straight solenoid behaves as a North pole and the other end as a South pole.

7. **Assertion:** Alternating Current is used in household supply.

Reason: AC electric power can be transmitted over long distances without much loss of energy.

8. **Assertion:** A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the magnitude of an electric current in the wire is increased.

Reason: Strength of a magnetic field at a point near the conductor increases on increasing the current.

9. **Assertion:** Copper is used to make electric wires.

Reason: Copper has very low electrical resistance.

10. **Assertion:** In a conductor, free electrons keep on moving but no magnetic force acts on a conductor in a magnetic field.

Reason: Force on free electrons due to magnetic field always acts perpendicular to its direction of motion.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

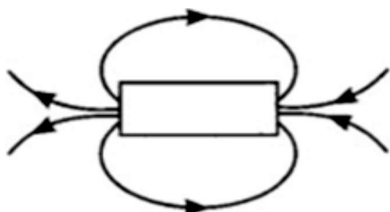


Figure (1)

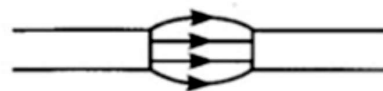
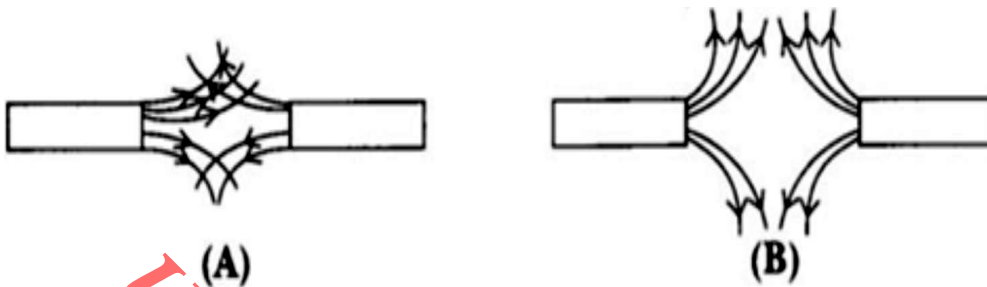


Figure (2)

1. Identify the poles of the magnet in the given figure (1) and (2).
2. When is the force experienced by a current-carrying conductor placed in a magnetic field largest?
3. Magnetic field lines of two magnets are shown in fig. A and fig. B.



Select the figure that represents the correct pattern of field lines. Give reasons for your answer. Also name the poles of the magnets facing each other.

4. What will happen if a current carrying conductor is placed in magnetic field? How can the direction of magnetic field be found out?
5. What does the direction of thumb indicate in the right-hand thumb rule? In what ways this rule is different from Fleming's left-hand rule?
6. Write one application of each of the following:
 - (a) Right-hand thumb rule
 - (b) Fleming's left hand rule
7. To which wire do you connect fuse wire in a house hold circuit? Write name of one source of AC current and one source of DC current.
8. (a) Why do we connect earth wire in a house? Give two reasons.
(b) What is the frequency of AC used in household circuit?
9. The given magnet is divided into three parts A, B, and C. Name the parts where the strength of the magnetic field is:
 - (i) maximum
 - (ii) minimum.How will the density of magnetic field lines differ at these parts?

A	B	C
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10. Draw magnetic field around a bar magnet.

SHORT ANSWERS TYPE QUESTIONS (3 MARKS)

1. State one main difference between A.C and D.C. Why A.C is preferred over D.C for long range transmission of electric power? Name one source each of D.C and A.C.
2. One of the major cause of fire in office building is short circuiting. List three factors which may lead to the short circuit.
3. What is meant by solenoid? How does a current carrying solenoid behave? Give its main use.
4. How is the strength of magnetic field near a straight current-conductor
 - (i) is related to the strength of current in the conductor?
 - (ii) is affected by changing the direction of flow of current in the conductor?
 - (iii) is affected by changing the length of the conductor?
5. The magnetic field associated with a current-carrying straight conductor is in anticlockwise direction. If the conductor was held along the east-west direction, what will be the direction of current through it? Name and state the rule applied to determine the direction of current.
6. Explain the need of earthing?
7. List the properties of magnetic lines of force.
8. (a) Two magnets are lying side by side as shown below. Draw magnetic field lines between poles P and Q.



- (b) What does the degree of closeness of magnetic field lines near the poles signify?

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. Why and when does a current carrying conductor kept in a magnetic field experience force? List the factors on which direction of this force depends?
2. What is meant by the term 'frequency of an alternating current'? What is its value in India? Why is an alternating current considered to be advantageous over direct current for long range transmission of electric energy?
3. Explain any two situations that can cause electrical hazards in domestic circuits.

4. Explain the role of fuse in series with any electrical appliance in an electric circuit. Why should a fuse with defined rating for an electric circuit not be replaced by one with a larger rating?
5. What are magnetic field lines? Justify the following statements
 - (a) Two magnetic field lines never intersect each other.
 - (b) Magnetic field lines are closed curves.

CASE STUDY BASED QUESTIONS (4 MARKS)

- (1) Read the passage carefully and answer the following questions:

When a small compass is placed near a magnet, it will experience a force due to the magnetic field of the magnet. It is evidently observed due to a deflection in the north pole pointer of the compass. The path traced by the north pole pointer under the influence of a magnetic field is called the magnetic field line. The magnetic field lines are produced from the north pole of the magnet and end at the south pole of the magnet. When the compass is moved around the field line, it always sets itself tangential along the curves.

- (i) Draw a bar magnet showing the magnetic field lines and poles.
- (ii) What are the important informations determined by seeing the magnetic field lines?
- (iii) Which of the following is incorrect regarding magnetic field lines?
 - (a) The field Lines are directed N to S inside the magnet.
 - (b) The Crowdedness of the field lines shows the strength of the magnet.
 - (c) The field is tangent to the magnetic field line.
 - (d) Magnetic field lines are closed and continuous curves
- (iv) A strong bar magnet placed vertically above a surface. What will be the direction of magnetic field lines?
 - (a) Only in a horizontal plane around the magnet.
 - (b) Only in a vertical plane around the magnet.
 - (c) Both in horizontal and vertical plane around the magnet.
 - (d) In all the planes around the magnet.

- (2). Read the paragraph carefully and answer the following questions:

Hans Christian Oersted, one of the leading scientists of the 19th century, played a crucial role in understanding electromagnetism. In 1820, he accidentally

discovered that a compass needle got deflected when an electric current passed through a metallic wire placed nearby. Through this observation Oersted showed that electricity and magnetic were related phenomenon. This research later created technologies such as radio, television and fibre optics. The unit of magnetic field was named as Oersted in his honour.

Electromagnetism is the study of electromagnetic force. It is a type of interface that happens between electrically charged particles. The electromagnetic force generally exhibits electromagnetic fields like magnetic fields, electric fields and light, and is one of the four essential interactions commonly known as forces in nature, The other 3 important interactions are the strong interaction, gravitation and the weak.

- (i) Oersted experiment is used to explain which effect of current?
- (ii) Which instrument helps to detect the presence of magnetic field at a point?
- (iii) In the diagram below, the direction of magnetic field is:



- (iv) On reversing the direction of the current in a wire, the magnetic field produced by it:
 - (a) Gets reversed in direction
 - (b) Increase in strength
 - (c) Decreases in strength
 - (d) Remains unchanged in strength and direction
- (3) Read the paragraph and answer the following questions

A magnet must exert an equal and opposite force on a current carrying conductor. We know that current is due to the charge in motion. Thus, it is evident that a charge moving in a magnetic field experiences a force, If the direction of motion is perpendicular to the direction of the magnetic field, the magnitude of force experienced depends upon the charge, velocity, and strength of the magnetic field. Fleming's left-hand rule gives the direction of the magnetic force.

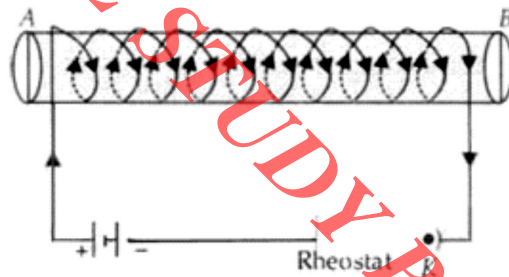
- (i) If a charged particle is moving along a magnetic field line, What will be the magnetic force on the particle?
- (ii) An electron is travelling horizontally towards the east. A magnetic field in the vertically downward direction will exert a force in:
- (a) East
 - (b) West
 - (c) North
 - (d) South
- (iii) Magnetic field exerts no force on:
- (a) a stationary electric charge.
 - (b) a magnet.
 - (c) an electric charge moving perpendicular to its direction.
 - (d) an unmagnetized iron bar.
- (iv) In Fleming's left-hand rule, what does thumb's direction shows?
- (4) Read the following and answer the following questions:

An insulated copper wire wound on a cylindrical cardboard tube such that its length is greater than its diameter is called a solenoid. When an electric current is passed through the solenoid, it produces a magnetic field around it. The magnetic field produced by a current-carrying solenoid is similar to the magnetic field produced by a bar magnet. The field lines inside the solenoid are in the form of parallel straight lines. The strong magnetic field produced inside a current-carrying solenoid can be used to magnetise a piece of magnetic material like soft iron, when placed inside the solenoid.

The strength of magnetic field produced by a current carrying solenoid is directly proportional to the number of turns and strength of current in the solenoid.

- (i) The strength of magnetic field inside a long current-carrying straight solenoid is
- (a) more at the ends than at the centre
 - (b) minimum in the middle
 - (c) same at all points
 - (d) found to increase from one end to the other.
- (ii) The north-south polarities of an electromagnet can be found using which rule?

- (iii) For a current in a long straight solenoid N- and S-poles are created at the two ends. Among the following statements, the incorrect statement is
- (a) The field lines inside the solenoid are in the form of straight lines which indicates that the magnetic field is the same at all points inside the solenoid.
 - (b) The strong magnetic field produced inside the solenoid can be used to magnetise a piece of magnetic material like soft iron, when placed inside the coil.
 - (c) The pattern of the magnetic field associated with the solenoid is different from the pattern of the magnetic field around a bar magnet.
 - (d) The N- and S-poles exchange position when the direction of current through the solenoid is reversed.
- (iv) A soft iron bar is enclosed by a coil of insulated copper wire as shown in figure. When the plug of the key is closed, the face B of the iron bar marked as



ANSWER KEY

MULTIPLE CHOICE QUESTIONS (1 MARK)

1. (a) soft iron
2. (d) iron and steel
3. (c) If magnetic field lines are parallel and equidistant, they represent zero field strength
4. (a) Oersted
5. (d) at the point of intersection there will be two direction of the magnetic force which is impossible
6. (a) Rotational motion

7. (b) from south to north
8. (c) into the page
9. (c) point towards the south pole 10. (d) 1800
11. (d) magnetic field only
12. (a) A
13. (a) along the axis and are parallel to each other
14. (d) Maxwell's cork screw rule
15. (b) maximum
16. (a) forces both pointing into the plane of paper
17. (a) zero
18. (d) zero
19. (c) circular in a plane perpendicular to the conductor
20. (d) non-magnetic material
21. (b) directly proportional to the current and inversely proportional to the distance from wire.
22. (b) directly below the wire
23. (c) same at all points 24. (d) 220 V
25. (c) each piece will have two unlike poles
26. (c) downward
27. (d) All of the above 28. (c) 90
29. (c) anticlockwise
30. (c) weaker

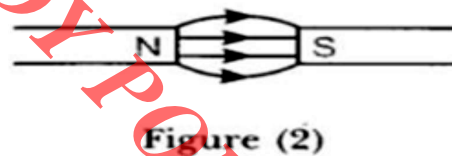
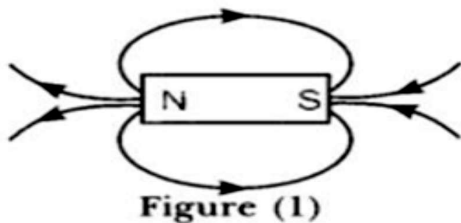
ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

1. (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
2. (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.

3. (b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
4. (c) Assertion is true but the Reason is false.
5. (c) A is true but R is false.
6. (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
7. (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
8. (d) The statement of the Assertion is false but the Reason is true.
9. (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
10. (c) Assertion is true but the Reason is false.

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

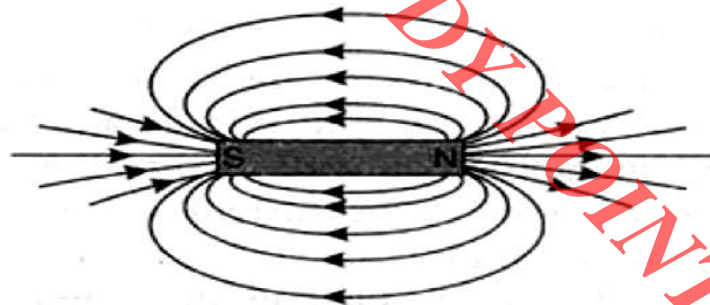
1. Field lines emerge from north pole (N) and merge at the south pole (S) as shown in both the figures



2. When the length of current-carrying conductor and direction of magnetic field are perpendicular to each other, the maximum force is experienced by the current-carrying conductor.
3. Figure B represents the correct pattern of field lines. In figure A, field lines cross each other which is not possible because if they cross each other, at the point of intersection, there would be two directions of field lines.
4. A current-carrying conductor when placed in a magnetic field experiences a force.

If the direction of the field and that of the current are mutually perpendicular to each other, then the force acting on the conductor will be perpendicular to both as given by Fleming's left-hand rule.

5. The thumb indicates the direction of current in the straight conductor held by curled fingers, whereas Fleming's left-hand rule gives the direction of force experienced by current carrying conductor placed in an external magnetic field.
6. (a) Right-hand thumb rule is used to find the direction of magnetic field in a coil of wire and the electric current in a straight conductor.
(b) Fleming's left hand rule is used to find the direction of force exerted on a current carrying conductor placed in a magnetic field as in electric motor.
7. Fuse wire is connected to the Live wire. House hold supply is AC current and Electric cell provides DC current.
8. a) Earth wire are used to prevent electric shock to us
b) Alternating Current(AC) used in house hold supply is 220V.
9. (i) Maximum strength – at A and C
(ii) Minimum strength – at B
At A and C, magnetic field lines are crowded while at B, they are spread out.
10. Magnetic field lines are as follows:



SHORT ANSWER TYPE QUESTIONS (3 MARKS)

1. Difference between A.C. and D.C. The alternating current (A.C.) reverses its direction periodically whereas the direct current (D.C.) always flows in one direction.

A.C. is preferred over D.C. because it can be transmitted over long distance without much loss of energy.

D.C. source: Battery
A.C. source: A.C. generator

2. It occurs as a consequence of failure of electrical insulation's due to which live wire comes in direct contact with neutral or earth wire. presence of external conducting material such as water which is introduced accidentally into the circuit. electrical appliances are forced to operate when its moving parts are jammed. connection of current carrying parts of electrical equipment's comes in contact to one another due to human or natural cause and use of less rating wires. When this happens, there is an excessive electric current which can damage the circuit and may also cause electrical fires.

3. **Solenoid:** A coil of many circular turns of insulated copper wire wound on a cylindrical insulating body (i.e., cardboard etc.) such that its length is greater than its diameter is called solenoid.

When current is flowing through the solenoid, the magnetic field line pattern resembles exactly with those of a bar magnet with the fixed polarity, i.e.

North and South pole at its ends and it acquires the directive and attractive properties similar to bar magnet. Hence, the current carrying solenoid behave as a bar magnet.

Use of current carrying solenoid: It is used to form a temporary magnet called electromagnet as well as permanent magnet.

4. (i) The strength of magnetic field around a straight current conductor increases on increasing the strength of current in the conductor or vice versa.
- (ii) The direction of magnetic field around a straight current carrying conductor gets reversed if the direction of current through that conductor is reversed.
- (iii) The length of the conductor is directly proportional to the magnetic field.
5. Direction of current – east to west as determined by Right-hand thumb rule.

Rule: If we hold a current-carrying conductor by right hand in such a way that the stretched thumb is along the direction of current, then the curly fingers around the conductor represents the direction of field lines of magnetic field.

6. Need of earthing:

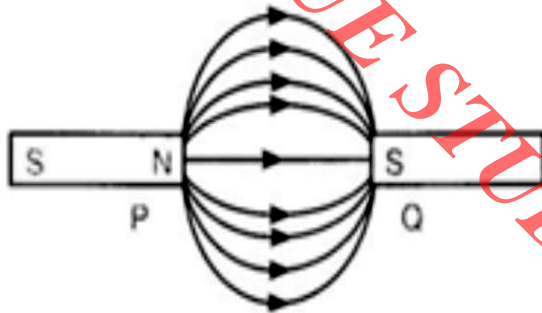
In our house we receive 220V of an AC electric power whose frequency is 50Hz. In domestic electric circuit, the wire with red insulation is the live wire and the wire with black insulation is the neutral wire. The potential difference between the live wire and neutral wire is 220V.

And the wire with green insulation is the earth wire which is directly connected to the metal which deep inside the earth.

When there is large current or leakage of current then it will go directly through earth wire and to the ground where metal is deeped. So, earthing protects us from severe electric shocks. Because of this in domestic electric circuit earthing is necessary.

7. The properties of magnetic lines of force are as follows.
- (a) Magnetic field lines emerge from the north pole.
 - (b) They merge at the south pole.
 - (c) The direction of field lines inside the magnet is from the south pole to the north pole.
 - (d) Magnetic lines do not intersect with each other.

8. (a)



- (b) The degree of closeness of magnetic field lines near the poles signify that the field is stronger there, i.e. the pole of another magnet when placed in the magnetic field experiences a greater force where the field lines are crowded.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. The drifting of free electrons of a conductor in a definite direction causes the current to flow through it. When such conductor is placed in a uniform magnetic field, each drifted electron of a conductor experience a magnetic force. This force is collectively experience by a conductor as a whole. Hence a current carrying conductor kept in a magnetic field experience a force. The direction of magnetic force depends on
- (i) direction of current through the conductor, and
 - (ii) direction of magnetic field.

2. Frequency of Alternating current is equal to the number of cycles completed in one second. In India, frequency of AC is 50 Hz i.e. 50 cycles per second.

An alternating current is considered to be advantageous over direct current for long range transmission of electric energy because it can be transmitted over long distances to distant places without much loss of electric power as compared to direct current.

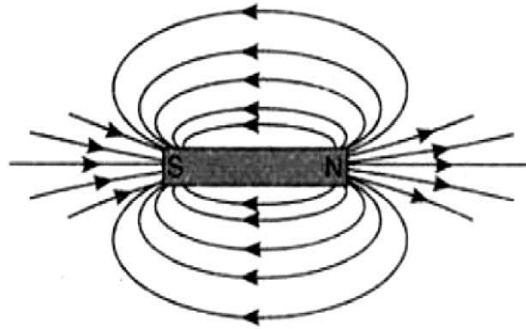
3. (i) Connecting too many electrical devices to a single socket or in the extension cord for any length of time draws high current from the mains that will exceed the current rating of connecting wires. The wires cannot withstand such a high current and melt and may cause fire.
- (ii) Most electrical hazards in domestic circuits are caused by the faulty electrical outlets, old and out-dated appliances. The chances of short circuit i.e., contact of live wire and neutral wires with each other due to damage in their insulation or some fault in the appliances are very high. It may result spark at the contact point which may even cause fire,

4. Fuse is a safety device connected in series with live wire or with any electrical appliance in an electric circuit. It stops the flow of unduly high electric current in the circuit by getting melted due to rise in temperature as per Joule's law of heating.

High rating fuse wire has the larger capacity. So, it will not stop the flow of any relatively high current. Therefore, electrical devices cannot be protected from the possible damage.

5. Magnetic field lines: It is defined as the path along which the unit North pole (imaginary) tends to move in a magnetic field if free to do so.
- (a) The magnetic lines of force do not intersect (or cross) one another. If they do so then at the point of intersection, two tangents can be drawn at that point which indicates that there will be two different directions of the same magnetic field, i.e. the compass needle points in two different directions which is not possible.
- (b) Magnetic field lines are closed continuous curves. They diverge from the north pole of a bar magnet and converge its south pole. Inside the magnet they move from south pole to north pole.

CASE STUDY BASED QUESTIONS (4 MARKS)



- (1) (i)
(ii) (d) both the direction and the relative strength of the magnetic field.
(iii) (a) The field Lines are directed N to S inside the magnet.
(iv) (d) In all the planes around the magnet.
- (2) (i) (b) Magnetic field
(ii) (c) Compass needle
(iii) (a) Clockwise
(iv) (a) Gets reversed in direction
- (3) (i) (d) zero
(ii) (d) South
(iii) (a) a stationary electric charge.
(iv) (c) motion
- (4) (i) (c): Magnetic field inside infinite solenoid is uniform. Hence it is same at all points.
(ii) (c) Clock face rule
(iii) (c) The pattern of the magnetic field associated with solenoid, is same as the pattern of the magnetic field around a bar magnet.
(a) N-pole

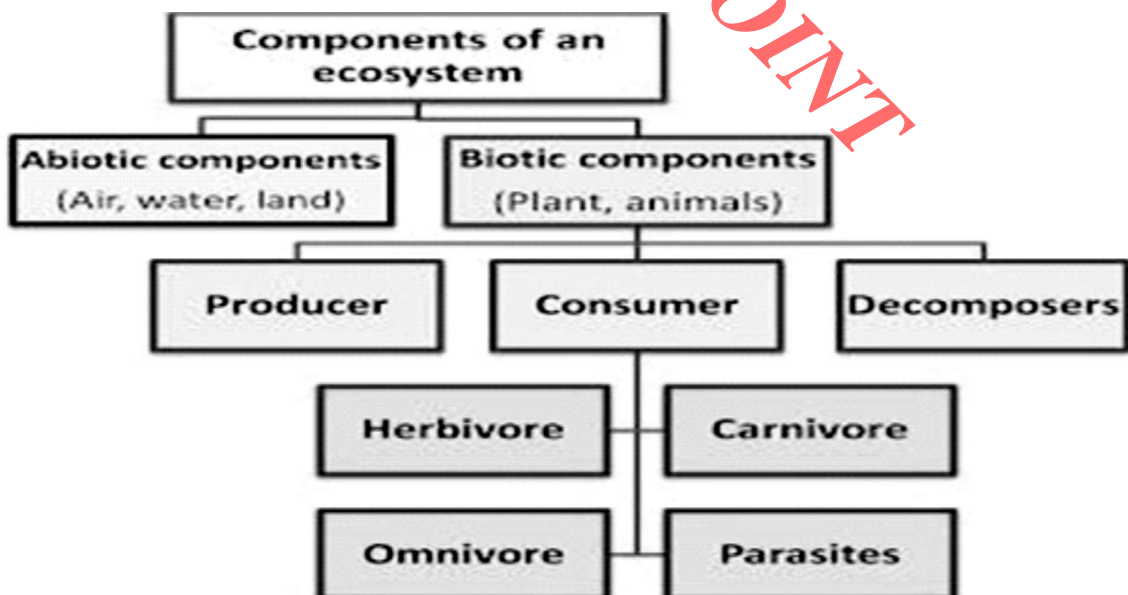
CHAPTER – 15 OUR ENVIRONMENT

ECOSYSTEM

- Everything that surrounds us is environment. It includes both living (biotic) and non-living (abiotic) components.
- Interaction between these biotic and abiotic components form an ecosystem.
- In an ecosystem living components depend on each other for their food which give rise to food chain and food web in nature.
- Human activities lead to environmental problems such as depletion of ozone layer and production of huge amount of garbage.
- All the interacting organism in an area together with the non-living constituents of the environment form an ecosystem. For ex forest, pond etc.

TYPES OF ECOSYSTEM

- It is of two types:
 - a) **Natural ecosystem:** The ecosystem which exist in nature on its own. For e.g. forest, lake, ocean etc.
 - b) **Artificial ecosystem:** Man-made ecosystem are called artificial ecosystem. For e.g. crop field, aquarium, garden.



- a) **ABIOTIC COMPONENT:** All the non-living components such as water, land, light, temperature etc. form the abiotic components.
- b) **BIOTIC COMPONENT:** All the living components such as plants, animals, bacteria, fungi etc. form biotic components.

Biotic components are further divided into

Producers: All green plants and blue-green algae can produce their own food using abiotic components (photosynthesis), hence called producers.

Consumers: It includes all animals which depend on producers directly or indirectly for their food.

Consumers are further divided into:

1. **Herbivores:** Plant-eaters ex goat, deer.
2. **Carnivores:** Flesh eaters ex tiger, crocodile.
3. **Omnivores:** Eat both plants and animals e.g. human
4. **Parasites:** Live on the body of host and take food from it e.g. lice, cuscutta.

Decomposers: include organisms which decompose the dead plants and animals

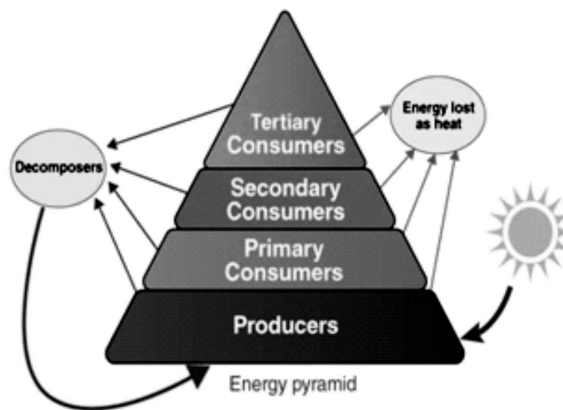
e.g. bacteria, fungi. These help in the replenishment of natural resources.

FOOD CHAIN

- Food chain is a series of organisms in which one organism eats other organism as food, e.g.
Grass → deer → lion
- In a food chain various steps where transfer of energy takes place is called a trophic level.
- Flow of energy in a food chain is unidirectional.
- Green plants capture 1% of sunlight and convert it into food energy.

10 PERCENT LAW

- Only 10 % of energy is transferred to the next trophic level. The remaining 90% energy is used in life processes (digestion, growth, reproduction) by present trophic level.
- Due to this gradual decrease in energy, food chain contains 3-4 levels.

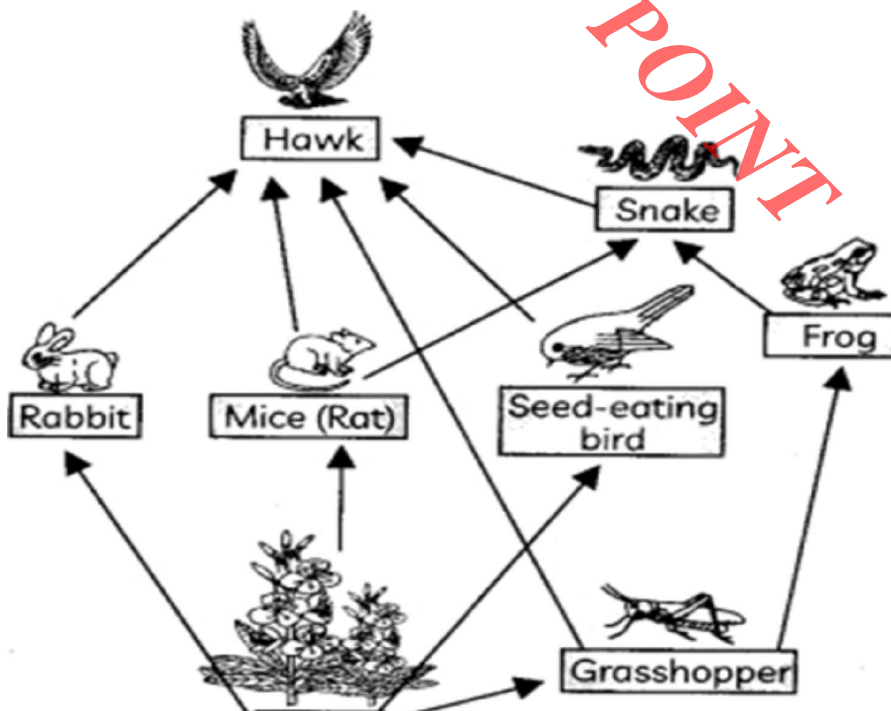


BIOLOGICAL MAGNIFICATION

- The concentration of harmful chemicals increases with every next trophic level in a food chain. This is known as biological magnification.
- Maximum concentration of such chemicals get accumulated in human bodies as humans occupy top level in any food chain. The chemicals increase in concentration at each step.

FOOD WEB

- In nature large number of food chains are inter-connected forming a food web.



ENVIRONMENTAL PROBLEMS

- Changes in the environment affect us and our activities change the environment around us. Humans activities lead to pollution, deforestation etc.

OZONE LAYER

- Ozone layer is a protective blanket around the earth which absorbs most of the harmful UV (Ultraviolet) radiations of the sunlight thus protecting living beings from many health hazards such as skin cancer, cataract, destruction of plants etc.
- (O₃) Ozone layer is present at higher level of atmosphere. It is a deadly poison at ground level.

FORMATION OF OZONE MOLECULE

- (i) The high energy UV radiations break down the O₂ MOLECULES into oxygen (O) atoms.



- (ii) These oxygen atoms then combine with oxygen (O₂) molecule to form the ozone molecule.



DEPLETION OF OZONE LAYER

- The decrease in the thickness of ozone layer over Antarctica was first observed in 1985 and was termed as ozone hole.
- This decrease was linked to excessive use of synthetic chemicals like chlorofluorocarbons (CFCs) which are used in refrigerators, ACs, fire-extinguishers, aerosols, sprays etc.
- United Nations Environment Programme (UNEP) succeeded in forging an agreement to stop CFC production at 1986 levels (KYOTO PROTOCOL) by all countries.

GARBAGE DISPOSAL

- Improvements in lifestyle have resulted in accumulation of large amounts of waste materials. Garbage contains following type of materials:
 - (a) **Biodegradable:** Substances which can be decomposed by the action of micro-organisms are called biodegradable wastes. E.g. fruit and vegetable peels, cotton, juice, dung, paper, etc.

- (b) **Non- Biodegradable wastes:** Substances which cannot be decomposed by the action of micro-organisms are called non-biodegradable wastes. E.g. plastic, polythene, metal, pesticides etc.

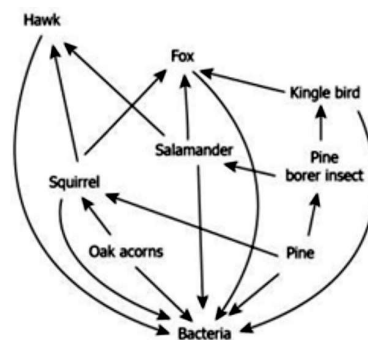
Micro-organisms release enzymes which decompose the material but these enzymes are specific in their action that's why enzymes cannot decompose all the materials.

SOME METHODS OF WASTE DISPOSAL

- **Biogas plant:** Biodegradable waste can be used in biogas plant to produce biogas and manure.
- **Sewage treatment plant:** The drain water can be cleaned in sewage treatment plant before adding it to rivers.
- **Land fillings :** The wastes are buried in low lying areas and are compacted by rolling with bulldozers .
- **Composting :** Organic wastes are filled in a compost pit and covered with a layer of soil , after about three months garbage changes to manure .
- **Recycling :** Non-biodegradable wastes are recycled to make new items .
- **Reuse:** It is a conventional technique to use an item again .eg , newspaper for making envelopes .

MULTIPLE CHOICE QUESTIONS (1 MARK)

1. Which statement shows interaction of an abiotic component with a biotic component in an ecosystem?
- (a) A grasshopper feeding on a leaf.
 - (b) Rainwater running down into the lake.
 - (c) An earthworm making a burrow in the soil.
 - (d) A mouse fighting with another mouse for food.



2. The image shows a food web.
- Fox feeds on hawk obtain energy.
 - Hawk feeds on oak acorn to obtain energy.
 - Squirrel feeds on pine borer to obtain energy.
 - Salamander feeds on pine borer to obtain energy.
3. Ozone forms by combination of free oxygen atoms and oxygen molecules. How do free oxygen atoms form at higher levels of atmosphere?
- by splitting of molecular oxygen into free oxygen atoms in the presence of low energy UV radiations
 - by splitting of a molecular oxygen into free oxygen atoms in presence of high energy UV radiations
 - by the combination of two molecular oxygen in the presence of high energy UV radiations
 - by the combination of two free oxygen atoms in the presence of lower energy UV radiations.
4. The table lists some waste products.
- grass cutting
 - polythene bags
 - plastic toys
 - used tea bags
 - paper straw
 - old clothes
- Which group of waste materials can be classified as non-biodegradable?
- plant waste, used tea bags
 - polyethene bags, plastic toys
 - used tea bags, paper straw
 - old clothes, broken footwear
5. The manufacturing of Chlorofluorocarbons free refrigerators is mandatory throughout the world. How this help prevents ozone depletion?
- This will help convert oxygen molecules into ozone.
 - This will help convert the CFCs into ozone molecules.
 - This will reduce the production of CFC from oxygen molecules.
 - This will reduce the release of CFCs that reacts with ozone molecules.

6. Which of the following are environment friendly practices ?
- (a) Carrying cloth-bags to put purchases in while shopping
 - (b) Switching off unnecessary lights and fans
 - (c) Walking to school instead of getting your mother to drop on her scooter
 - (d) All of the above
7. Food web is constituted by:
- (a) relationship between the organism and the environment.
 - (b) relationship between plants and animals.
 - (c) various interlinked food chains in an Ecosystem.
 - (d) relationship between animals and environment.
8. Choose the incorrect statement from the following:
- (a) Ozone is a molecule formed by three atoms of oxygen.
 - (b) Ozone shields the surface of the Earth from ultraviolet radiations.
 - (c) Ozone is deadly poisonous.
 - (d) Ozone gets decomposed by UV radiations.
9. The percentage of solar radiation absorbed by all the green plants for the process of photosynthesis is about
- (a) 1%
 - (b) 5%
 - (c) 8%
 - (d) 10%
10. Which of the following is the best way for disposal of vegetable and fruit peels?
- (a) Landfill
 - (b) Recycling
 - (c) Composting
 - (d) Burning
11. In a food chain, the third trophic level is always occupied by
- (a) Carnivores
 - (b) Herbivores
 - (c) Decomposers
 - (d) Producers

12. the given food chain, suppose the amount of energy at fourth trophic level is 5 kJ, what will be the energy available at the producer level?
Grass → Grasshopper → Frog → Snake → Hawk
- (a) 5 kJ
 - (b) 50 kJ
 - (c) 500 kJ
 - (d) 5000kJ
13. What will happen if deer is missing in the food chain given below?
Grass → Deer → Tiger
- (a) The population of tiger increases (b)The population of grass decreases
 - (c) Tiger will start eating grass
 - (d) The population of tiger decreases and the population of grass increases.
14. The percentage of solar radiation absorbed by all the green plants for the process of photosynthesis is about:
- (a) 1%
 - (b) 5%
 - (c) 8%
 - (d) 10%
15. In the following groups of materials, which group(s) contains only non-biodegradable items?
- i. Wood, paper, leather
 - ii. Polythene, detergent, PVC
 - iii. Plastic, detergent, grass
 - iv. Plastic, Bakelite, DDT
- (a) (iii)
 - (b) (iv)
 - (c) (i) and (iii)
 - (d) (ii) and (iv)
16. In an ecosystem, the 10% of energy available for transfer from one trophic level to the next is in the form of
- (a) Heat energy
 - (b) Light energy

- (c) Chemical energy
(d) Mechanical energy
17. Excessive exposure of humans to UV-rays results in
- (i) Damage to immune system
 - (ii) Damage to lungs
 - (iii) Skin cancer
 - (iv) Peptic ulcers
- (a) (i) and (ii)
(b) (ii) and (iv)
(c) (i) and (iii)
(d) (iii) and (iv)
18. Which group of organisms are not constituents of a food chain?
- i. Grass, lion, rabbit, wolf
 - ii. Plankton, man, fish, grasshopper
 - iii. Wolf, grass, snake, tiger
 - iv. Frog, snake, eagle, grass, grasshopper
- (a) i and iii
(b) iii and iv
(c) ii and iii
(d) i and iv
19. Disposable plastic plates should not be used because
- (a) They are made of materials with light weight.
 - (b) They are made of toxic materials.
 - (c) They are made of biodegradable materials.
 - (d) They are made of non-biodegradable materials.
20. The decomposers in an ecosystem
- (a) Convert inorganic material, to simpler forms
 - (b) Convert organic material to inorganic forms
 - (c) Convert inorganic materials into organic compounds
 - (d) Do not breakdown organic compounds.

21. Organisms of a higher trophic level which feed on several types of organisms belonging to a lower trophic level constitute the
- Food web
 - Ecological pyramid
 - Ecosystem
 - Food chain
22. Flow of energy in an ecosystem is always
- Unidirectional
 - bidirectional
 - Multi directional
 - No specific direction
23. If a grasshopper is eaten by a frog, then the energy transfer will be from
- Producer to decomposer
 - Producer to primary consumer
 - Primary consumer to secondary consumer
 - Secondary consumer to primary consumer
24. Which among the following is a correct full form for DDT?
- Dichloro diphenyl trichloroethane
 - Dichloro diphenyl tetrachloroethane
 - Dichloro decaphenyl trichloroethane
 - Dichloro diethyl trichloroethane
25. Global warming is a phenomenon related to
- Evaporation
 - Ecological balance
 - Greenhouse effect
 - Desertification
26. How much energy is lost in the environment?
- 20 %
 - 90 %
 - 100 %
 - 50 %

27. What is the molecular formula of Ozone?
- (a) O
 - (b) O₂
 - (c) O₃
 - (d) O₄
30. The network of animals which is dependent on each other is known as .
- (a) food chain
 - (b) food line
 - (c) food web
 - (d) none of these

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

- (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)** : Ozone layer is getting depleted at upper atmosphere and it is a serious cause of concern.

Reason (R) : CFC reacts with ozone and breaks it.

2. **Assertion (A)** : Certain pesticides and other chemicals used to protect our crops from diseases and pests are non-bio degradable.

Reason (R) : They do not get accumulated at various trophic levels

3. **Assertion (A)** : An ecosystem consists of 3 to 4 trophic levels.

Reason (R) : Removal of Primary consumers will not affect the ecosystem adversely.

4. **Assertion (A)** : Polythene bags and plastic containers are non-biodegradable substances.

Reason (R) : They can be broken down by microorganisms in natural simple harmless substances.

5. **Assertion (A)** : Ozone is formed in upper atmosphere by O₂ in presence of UV radiations.

Reason (R) : Ozone depletion will lead to UV rays reaching earth which may cause skin cancer.

6. **Assertion(A) :** Food web consists of only producers.

Reason (R) : Specific enzymes are required for breakdown of substances in environment.

7. **Assertion (A) :** The function of consumers is to convert organic compound into inorganic compound.

Reason (R) : Green plants are called the producers.

8. **Assertion (A) :** The various components of an ecosystem are interdependent.

Reason (R) : food chain and web are formed due to linkage in organisms.

9. **Assertion (A) :** Aquarium needs regular cleaning.

Reason (R) : There are no microbes to clean water in aquarium, therefore, it needs to be regularly cleaned.

10. **Assertion (A) :** The concentration of harmful chemicals is least in human beings.

Reason (R) : Man is at the apex of the food chain.

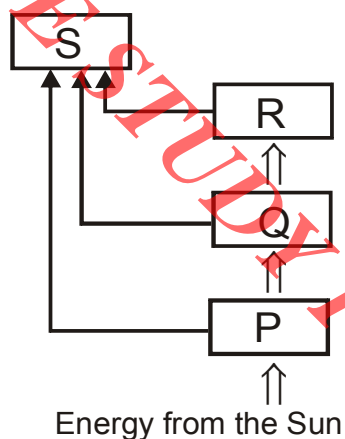
SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. What are the advantages of cloth bags over plastic bags during shopping?
2. (a) 1000J of energy is available at the first trophic level. What is the energy available at third trophic level?
(b) Write one effect on our health due to Ozone layer?
3. How can we help in reducing the problem of waste disposal? Suggest any two methods?
4. Define an ecosystem? Draw a block diagram to show the flow of energy in an ecosystem?
5. Natural water bodies are not regularly cleaned whereas an aquarium needs regular cleaning. Why?
6. How is ozone formed in the upper atmosphere? Write one harmful effect of ozone depletion?

7. Our food grains such as wheat and rice, the vegetables and fruits and even meat are found to contain varying amounts of pesticide residues.” State the reason to explain how and why it happens?
8. Give reason - The existence of decomposers is essential in a biosphere.
9. “Reuse is better than recycling of materials”. Give reason to justify this statement.
10. The first trophic level in a food chain is always a green plant. Why?

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. Why is Government of India imposing a ban on the use of polythene bags? Suggest two alternatives to these bags and explain how this ban is likely to improve the environment.
2. The figure shown below represent the energy flow in our biosphere. Refer to the diagram and answer the questions on the basis of the diagram given



- (i) Name the boxes represented by P, Q, and R.
 - (ii) What is S and why is it linked with all three boxes?
 - (iii) If a harmful chemical enters the food chain comprising snakes, peacock, mice and plants, which of these organisms is likely to have the maximum concentration of this chemical in its body?
3. (i) Explain the phenomenon of “biological magnification.” How does it affect organisms belonging to different trophic levels particularly the tertiary consumers?
 - (ii) Suggest three ways to maintain a balance between environment and development to survive?

4. The activities of man had adverse effects on all forms of living organisms in the biosphere. Unlimited exploitation of nature by man disturbed the delicate ecological balance between the living and non-living components of the biosphere. The unfavorable conditions created by man himself threatened the survival not only of himself but also of the entire living organisms on the mother earth. One of your classmates is an active member of 'Eco club' of your school which is creating environmental awareness amongst the school students, spreading the same in the society and also working hard for preventing environmental degradation of the surroundings.
- Why is it necessary to conserve our environment?
 - State the importance of green and blue dust-bins in the safe disposal of the household waste.
 - List two values exhibited by your classmate who is an active member of Eco-club of your school?
5. (i) Why is Government of India imposing a ban on the use of polythene bags? Suggest two alternatives to these bags and explain how this ban is likely to improve the environment.
- (ii) What is a food chain? Why is the flow of energy in an ecosystem unidirectional? Explain briefly.

CASE STUDY BASED QUESTIONS (4 MARKS)

1. Human body is made up of five important components, of which water is the main component. Food as well as potable water are essential for every human being. The food is obtained from plants through agriculture. Pesticides are being used extensively for a high yield in the fields. These pesticides are absorbed by the plants from the soil along with water and minerals and from the water bodies these pesticides are taken up by the aquatic animals and plants. As these chemicals are not biodegradable, they get accumulated progressively at each trophic level. The maximum concentration of these chemicals gets accumulated in our bodies and greatly affects the health of our mind and body.
- Why is the maximum concentration of pesticides found in human beings?
 - Give one method which could be applied to reduce our intake of pesticides through food to some extent.
 - Various steps in a food chain represent:
 - Food web
 - Ecosystem
 - Trophic level
 - Biomagnification

- (iv) With regard to various food chains operating in an ecosystem, man is a:
- Consumer
 - Producer
 - Producer and consumer
 - Producer and decomposer
2. Students in a school listened to the news read in the morning assembly that the mountain of garbage in Delhi, suddenly exploded and various vehicles got buried under it. Several people were also injured and there was traffic jam all around. In the brain storming session, the teacher also discussed this issue and asked the students to find out a solution to the problem of garbage. Finally, they arrived at two main points – one is self-management of the garbage we produce and the second is to generate less garbage at individual level.
- Suggest two measures to manage the garbage we produce.
 - As an individual, what can we do to generate the least garbage? Give two points.
 - List two values the teacher instilled in his students in this episode.
3. India today is facing the problem of overuse of resources, contamination of water and soil and lack of methods of processing the waste. The time has come for the world to say goodbye to time has come for the world to say goodbye to “single-use plastics”. Steps must be undertaken to develop environment- friendly substitutes, effective plastic waste collection and methods of its disposal and methods of its disposal. Indore treated 15 lakhs metric tons of waste in just 3 years, through biomining and bioremediation techniques. Bioremediation involves introducing microbes into a landfill to naturally ‘break’ it down and biomining involves using trammel machines to sift through the waste to separate the ‘soil’ and the waste component. The city managed to chip away 15 lakhs metric tons of waste at a cost of around Rs 10 crore. A similar experiment was successfully carried out in Ahmedabad also.
- State two methods of effective plastic waste collection in your school.
 - Name any two uses of “single use plastic” in daily life?
 - If we discontinue the use of plastic, how can an environment- friendly substitute be provided?
 - Do you think microbes will work similarly in landfill sites as they work in the laboratory? Justify your answer.

4. Food chains are very important for the survival of most species. When only one element is removed from the food chain it can result in extinction of a species in some cases. The foundation of the food chain consists of primary producers. Primary producers, or autotrophs, can use either solar energy or chemical energy to create complex organic compounds, whereas species at higher trophic levels cannot and so must consume producers or other life that itself consumes producers. Because the sun's light is necessary for photosynthesis, most life could not exist if the sun disappeared. Even so, it has recently been discovered that there are some forms of life, chemotrophs, that appear to gain all their metabolic energy from chemosynthesis driven by hydrothermal vents, thus showing that some life may not require solar energy to thrive.
- i) If 10,000 J solar energy falls on green plants in a terrestrial ecosystem, what percentage of solar energy will be converted into food energy?
- 10,000 J
 - 100 J
 - 1000 J
 - It will depend on the type of the terrestrial plant.
- ii) Matter and energy are two fundamental inputs of an ecosystem. Movement of
- Energy is bidirectional and matter is repeatedly circulating.
 - Energy is repeatedly circulation and matter is unidirectional.
 - Energy is unidirectional and matter is repeatedly circulating.
 - Energy is multidirectional and matter is bidirectional.
- iii) Mr. X is eating curd/yogurt. For this food intake in a food chain he should be considered as occupying
- | | |
|------------------------|-------------------------|
| a) First trophic level | b) Second trophic level |
| c) Third trophic level | d) Fourth trophic level |
- iv) Which of the following limits the number of trophic levels in a food chain?
- Decrease in energy at higher trophic levels
 - Less availability of food
 - Polluted air
 - Water

ANSWER KEY

MULTIPLE CHOICE QUESTIONS (1 MARK)

1. (c) An earthworm making a burrow in the soil.
2. (d) Salamander feeds on pine borer to obtain energy.
3. (b) by splitting of a molecular oxygen into free oxygen atoms in presence of high energy UV radiations
4. (b) polyethene bags, plastic toys
5. (d) This will reduce the release of CFCs that reacts with ozone molecules.
6. (d) All of the above
7. (c) various interlinked food chains in an Ecosystem.
8. (d) Ozone gets decomposed by UV radiations.
9. (a) 1%
10. (c) Composting
11. (a) Carnivores
12. (d) 5000KJ
13. (d) The population of tiger decreases and the population of grass increases
14. (a) 1%
15. (d) (ii) and (iv)
16. (c) Chemical energy
17. (c) (i) and (iii)
18. (c) ii and iii
19. (d) They are made of non-biodegradable materials.
20. (b) Convert organic material to inorganic forms
21. (c) Bio magnification
22. (b) producers
23. (a) Food web
24. (a) Unidirectional

25. (c) Primary consumer to secondary consumer
26. (b) Dichloro-diphenylte-trachloroethane
27. (c) Greenhouse effect
28. (c) 100%
29. (c) O₃
30. (c) food web

ASSERTION-REASONING TYPE QUESTIONS (1 MARK)

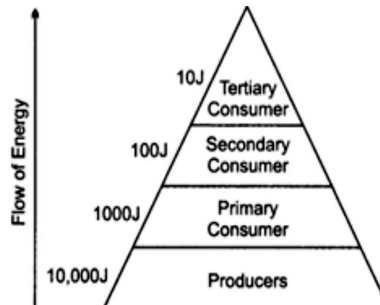
1. (a)
2. (a)
3. (c)
4. (c)
5. (b)
6. (b)
7. (d)
8. (a)
9. (a)
10. (d)

UNIQUE STUDY POINTS

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. Cloth bags are capable of carrying more things. Made of biodegradable material.
Do not pollute our environment. Can be reused
2. a) Third level-10 J
b) Skin cancer, sun burn, eye burning problem.
3. The three methods by which we can reduce the problem of waste disposal are:
 - i. Adopting the 3R approach i.e.-Reduce, Reuse, Recycle.
 - ii. Segregation of waste into biodegradable and non-biodegradable waste.
 - iii. Conversion of waste into useful components like biogas and then using compost as a fertilizer.

4. Ecosystem refers to the interaction of all the biotic and abiotic components present in a particular area. Energy flows across the trophic levels following the 10% law. Only 10% of the energy available to a trophic level is passed on to the next trophic level.



5. Natural water bodies are not regularly cleaned whereas an aquarium needs regular cleaning because an aquarium is an artificial ecosystem that does not contain producers and decomposers. Therefore, the leftover food particles of fishes mix with water and accumulated to form toxic substances.
6. UV rays in the atmosphere split some molecular oxygen (O_2) into free oxygen (O) atoms.

Damage to ozone layer will allow UV rays to reach on the surface of earth causing skin cancer, cataract and damage to crops.

7. Pesticides are poisonous chemical substances which are sprayed over crop plants to protect them from pests and diseases. These pesticides mix up with soil and water and are then absorbed by growing plants along with water and other minerals. Thus, pesticides enter the food chain at the producer level (plant level) and in the process of transfer of food through food chains these harmful chemicals get concentrated at each trophic level. These chemicals are non-biodegradable, so they get accumulated at each trophic level. Pesticides present in wheat grains, fruits vegetables and meat cannot always be removed by washing, etc.
8. Decomposers break down complex organic substances (dead remains and waste products of organisms) into simpler inorganic substances that can be absorbed by the plants. They are essential for the proper functioning of an ecosystem.
- Decomposers play an important role in the cycling of materials in the biosphere.
 - By decomposing dead bodies of plants and animals they help it cleaning the environment.
 - They replenish the soil naturally.

9. The 'reuse' strategy is better than 'recycling' because even the process of recycling uses large amount of energy and money. In the reuse strategy we can preserve energy. For instance, plastic bottles in which we buy various food items like jam and pickle can be used for storing things in the kitchen. Whereas, if we send the discarded plastic bottles for recycling to the industry, we will be using energy sources for the recycling process.
10. The first trophic level in a food chain is always a green plant because green plants have a mechanism for trapping solar energy with the help of their green pigment called chlorophyll and convert it into chemical energy which is stored as carbohydrates in the plant for the use of the next trophic level.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. Plastic bags are non-biodegradable which cannot be broken down into non-poisonous substances in nature. Plastic bags are the main cause of sewer blockages as plastic bags are not decomposed by micro-organisms. Plastic bags if eaten by stray animals (like cows) can block their alimentary canal.
Two alternatives:
We should take our own jute or cloth bags while going for purchasing articles from the market.
Disposable paper cups should be used for serving tea in trains instead of plastic cups.
Shopkeepers can use paper bags instead of plastic bags.
2. (i) P-Producers, Q- Herbivores, R-Carnivores.
(ii) S-represents decomposers. As decomposers can breakdown the dead remains of all living organisms, the box S is linked with all three boxes that represent producers (plants), herbivores and carnivores.
(iii) Peacock
3. i) When non-biodegradable substances such as pesticides, enter the food chain, they get accumulated progressively at each trophic level. This results in a cumulative increase in the concentration of the substance in successively higher trophic levels of the food chain. This phenomenon is known as biological magnification. For example - Pesticides entering our food chain through soil or water are not degradable and hence gets progressively accumulated at each trophic level, with maximum accumulation in human bodies. Biomagnification of a toxic substance

has the potential to cause harm to organisms, particularly to the tertiary consumers. This is because tertiary consumers occupy the top level in a food chain and hence maximum concentration of such chemicals gets accumulated in their bodies.

- ii) Three ways to maintain balance between environment and development:
 - a) Judicious use of natural resources and replenishing of such resources which can be replenished like growing of trees in the forests.
 - b) Protecting the wild animals from hunting and preserving their natural habitats.
 - c) Managing the waste and pollutant materials by decomposing and recycling of such materials.
- 4. i) It is necessary to conserve our environment because
 - (a) It helps in protecting the ozone layer.
 - (b) It helps in maintaining animal and human food chains.
 - (c) It provides us with many useful products such as medicines and wood.
- ii) Disposal of household waste is carried out in green and blue bins, respectively. It will be very useful in the separate disposal of biodegradable and non-biodegradable wastes. This will also ensure the application of 3Rs—reduce, reuse and recycle.
- iii) Two values exhibited are
 - (a) Creating environmental awareness among students and society
 - (b) Working hard on prevention of environmental degradation of surroundings.
- 5. (i) Government of India is imposing a ban on the use of polythene bags because these are non- biodegradable substances which are not acted upon by the microbes. So, they cannot be decomposed and therefore persist in the environment for a long time thereby causing harm to the ecosystem. These bags choke drains which results in water logging, that allows breeding of mosquitoes and hence leads to various diseases like malaria, dengue, etc. Jute bags and cloth bags are the alternatives to the polythene bags.
- ii) The sequential interlinking of organisms involving transfer of food energy from the producers, through a series of organisms with repeated eating and being eaten is called the food chain. A food chain involves a

nutritive interaction between the living organisms of an ecosystem. There is a unidirectional flow of energy from sun to producers and subsequently to series of different types of consumers,

i.e., Solar radiations → Producers → Herbivores → Carnivores.

It cannot pass in reverse direction. There is always a decrease in the flow of energy and content with rise in trophic level. Large quantity of energy is lost at each step in the form of heat and is also used up in various metabolic activities.

CASE STUDY BASED QUESTIONS (4 MARKS)

1.
 - i) The maximum concentration of pesticides found in humans because of Biomagnification. Humans occupy a secondary or tertiary position in the food pyramid when they consume meat. With every increase in trophic level the amount of food consumed increases to meet the reduced energy needs.
 - ii) Preferring organic or locally grown fruits and vegetables also reduces the level of pesticides intakes to some extent.
 - iii) (b) Trophic level
 - iv) (a) Consumer
2.
 - i) less garbage, self-management
 - ii) use cloth or jute bags, avoid use of plastics
 - iii) reduce waste, reuse and recycle
3.
 - i) Two methods of effective plastic waste collection in the school are-
 - a. Curbside Recycling
 - b. Drop-Off Recycling
 - ii) Two uses of “single use plastic” in daily life are-
 - a. Plastic grocery bag
 - b. Plastic drinking bottles
 - iii) If we discontinue the use of plastic, we can use long-lasting environment-friendly substitutes like stainless steel or glass water bottles, reusable shopping bags, eco- friendly cutlery etc.
 - iv) Yes, microbes can work in landfill sites as they work in laboratory. The landfills can be broken down naturally by the process of bioremediation that involves the microbes.
4.
 - i) b) 100J
 - ii) c) Energy is unidirectional and matter is repeatedly circulating.
 - iii) c) Third trophic level
 - iv) a) Decrease in energy at higher trophic levels

SAMPLE QUESTION PAPER 2022-23

SCIENCE

CLASS-X

Time Allowed: 3 hours

Max. Marks: 80

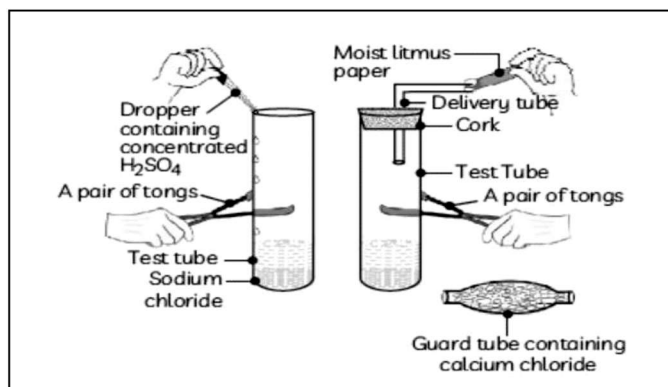
General Instructions:

- i. This question paper consists of 39 questions in 5 sections.
- ii. All questions are compulsory. However, an internal choice is provided in some questions. A student is expected to attempt only one of these questions.
- iii. **Section A** consists of 20 objective type questions carrying 1 mark each.
- iv. **Section B** consists of 6 Very Short questions carrying 02 marks each. Answers to these questions should be in the range of 30 to 50 words.
- v. **Section C** consists of 7 Short Answer type questions carrying 03 marks each. Answers to these questions should be in the range of 50 to 80 words.
- vi. **Section D** consists of 3 Long Answer type questions carrying 05 marks each. Answer to these questions should be in the range of 80 to 120 words.
- vii. **Section E** consists of 3 source-based/case-based units of assessment of 04 marks each with sub-parts.

SECTION - A

Select and write one most appropriate option out of the four options given for each of the questions 1 – 20

1. The change in colour of the moist litmus paper in the given set up is due to

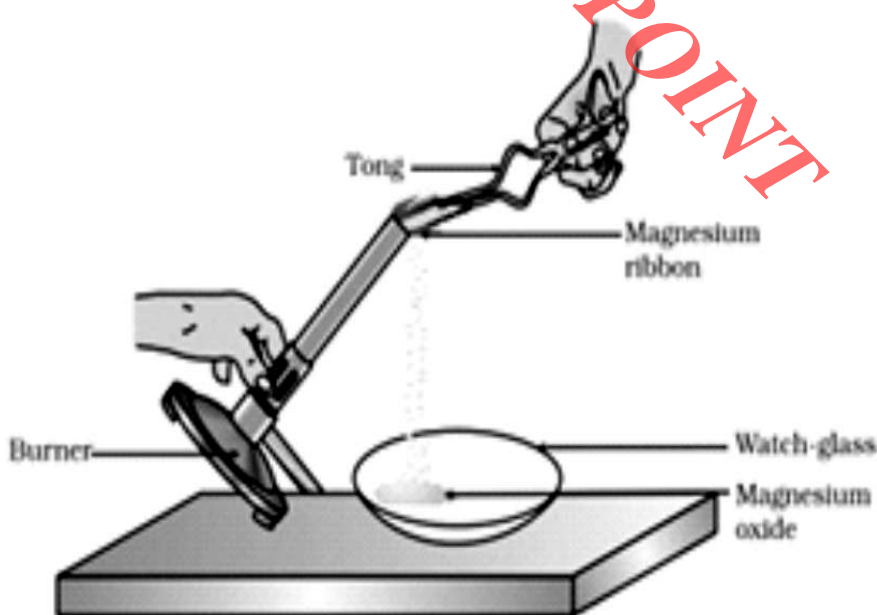


- i. presence of acid 1
- ii. presence of base
- iii. presence of H^+ (aq) in the solution
- iv. presence of Litmus which acts as an indicator
- (a) i and ii
- (b) Only ii
- (c) Only iii
- (d) Only iv.

2 In the redox reaction 1



- (a) MnO_2 is reduced to $MnCl_2$ & HCl is oxidized to H_2O
- (b) MnO_2 is reduced to $MnCl_2$ & HCl is oxidized to Cl_2
- (c) MnO_2 is oxidized to $MnCl_2$ & HCl is reduced to Cl_2
- (d) MnO_2 is oxidized to $MnCl_2$ & HCl is reduced to H_2O
3. Which of the following is the correct observation of the reaction shown in the above set up? 1



- (a) Brown powder of Magnesium oxide is formed.
- (b) Colourless gas which turns lime water milky is evolved.
- (c) Magnesium ribbon burns with brilliant white light.
- (d) Reddish brown gas with a smell of burning Sulphur has evolved.

4. With the reference to four gases CO_2 , CO , Cl_2 and O_2 , which one of the options in the table is correct? 1

Option	Acidic oxide	Used in treatment	Product of of respiration	Product of incomplete water combustion
(a)	CO	Cl_2	O_2	CO
(b)	CO_2	Cl_2	CO_2	CO
(c)	CO_2	O_2	O_2	CO_2
	CO	O_2	CO_2	CO_2

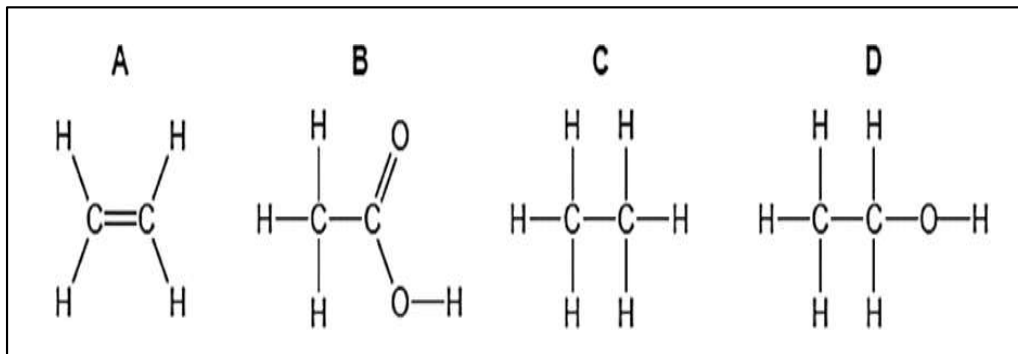
5. On placing a copper coin in a test tube containing green ferrous sulphate solution, it will be observed that the ferrous sulphate solution 1

- (a) turns blue, and a grey substance is deposited on the copper coin.
- (b) turns colourless and a grey substance is deposited on the copper coin.
- (c) turns colourless and a reddish–brown substance is deposited on the copper coin.
- (d) remains green with no change in the copper coin.

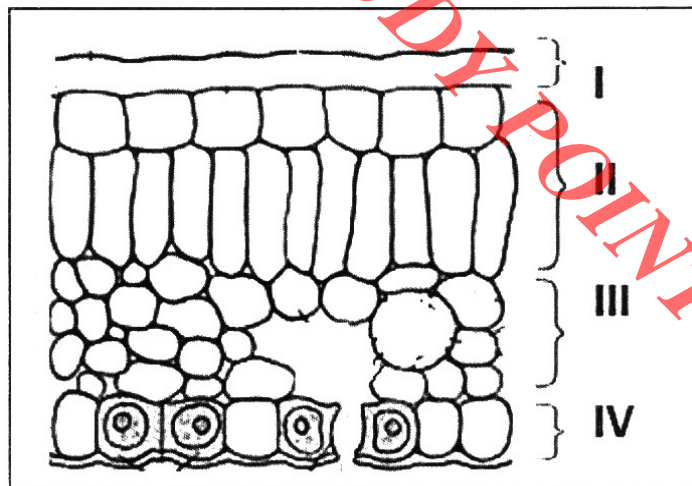
6. Anita added a drop each of diluted acetic acid and diluted hydrochloric acid on pH paper and compared the colors. Which of the following is the correct conclusion? 1

- (a) pH of acetic acid is more than that of hydrochloric acid.
- (b) pH of acetic acid is less than that of hydrochloric acid.
- (c) Acetic acid dissociates completely in aqueous solution.
- (d) Acetic acid is a strong acid

- 7 The formulae of four organic compounds are shown below. Choose the correct option 1

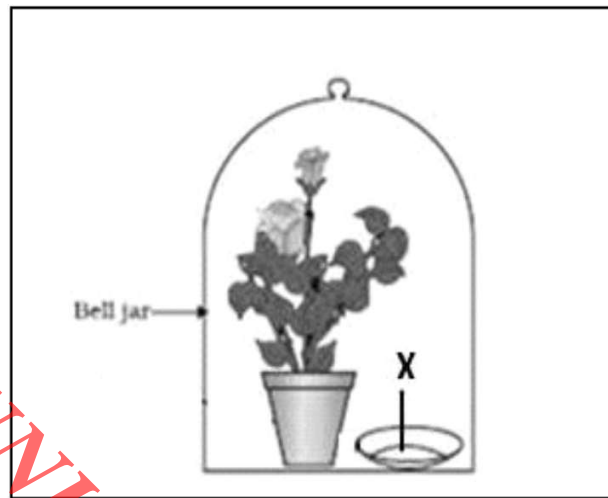


- (a) A and B are unsaturated hydrocarbons
(b) C and D are saturated hydrocarbons
(c) Addition of hydrogen in presence of catalyst changes A to C
(d) Addition of potassium permanganate changes B to D
8. In the given transverse section of the leaf identify the layer of cells where maximum photosynthesis occurs. 1

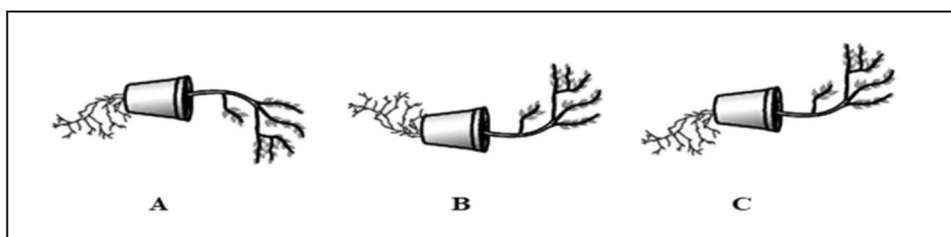


- (a) I, II
(b) II, III
(c) III, IV
(d) I, IV

9. Observe the experimental setup shown below. Name the chemical indicated as 'X' that can absorb the gas which is evolved as a byproduct of respiration. 1

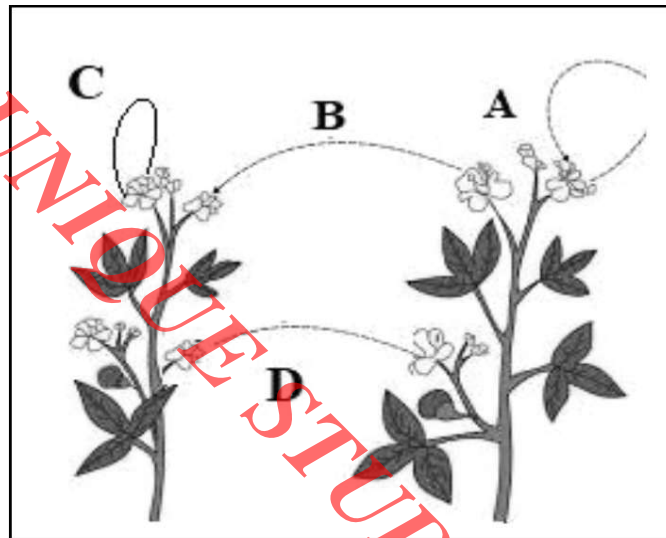


- (a) NaOH
(b) KOH
(c) Ca (OH)₂
(d) K₂CO₃
10. If a tall pea plant is crossed with a pure dwarf pea plant then, what percentage of F1 and F2 generation respectively will be tall? 1
- (a) 25%, 25%
(b) 50%, 50%
(c) 75%, 100%
(d) 100%, 75%
11. Observe the three figures given below. Which of the following depicts tropic movements appropriately? 1



- (a) B and C
- (b) A and C
- (c) B only
- (d) C only

12. The diagram shown below depicts pollination. Choose the options that will show a maximum variation in the offspring. 1



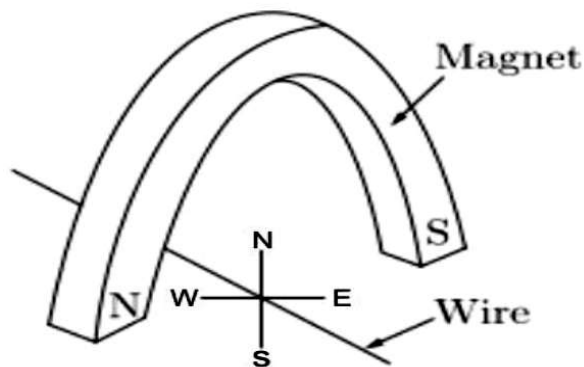
- (a) A, B and C
- (b) B and D
- (c) B, C and D
- (d) A and C

13. A complete circuit is left on for several minutes, causing the connecting copper wire to become hot. As the temperature of the wire increases, the electrical resistance of the wire 1

- (a) decreases.
- (b) remains the same.
- (c) increases.
- (d) increases for some time and then decreases

14. A copper wire is held between the poles of a magnet.

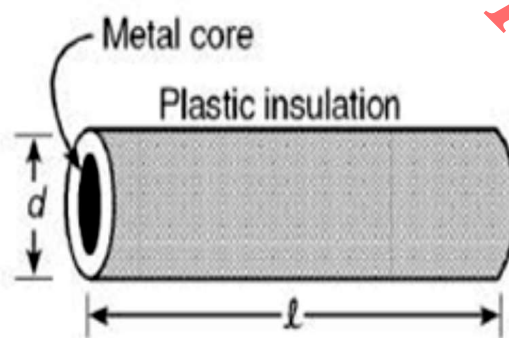
1



The current in the wire can be reversed. The pole of the magnet can also be changed over. In how many of the four directions shown can the force act on the wire?

- (a) 1
(b) 2
(c) 3
(d) 4
15. Plastic insulation surrounds a wire having diameter d and length l as shown above. A decrease in the resistance of the wire would be produced by an increase in the

1



- (a) length l of the wire
(b) diameter d of the wire
(c) temperature of the wire
(d) thickness of the plastic insulation

16. Which of the following pattern correctly describes the magnetic field around a long straight wire carrying current? 1
- (a) straight lines perpendicular to the wire.
 - (b) straight lines parallel to the wire.
 - (c) radial lines originating from the wire.
 - (d) concentric circles centred around the wire.

Q. no 17 to 20 are Assertion - Reasoning based questions. These 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 and R is not the correct explanation of A
 - (c) A is true but R is false
 - (d) A is False but R is true
17. Assertion: Silver bromide decomposition is used in black and white photography. Reason: Light provides energy for this exothermic reaction. 1
18. Assertion: Height in pea plants is controlled by efficiency of enzymes and is thus genetically controlled. Reason: Cellular DNA is the information source for making proteins in the cell. 1
19. Assertion: Amphibians can tolerate mixing of oxygenated and deoxygenated blood. Reason: Amphibians are animals with two chambered heart 1
20. Assertion: On freely suspending a current – carrying solenoid, it comes to rest in Geographical N-S direction. Reason : One end of current carrying straight solenoid behaves as a North pole and the other end as a South pole, just like a bar magnet. 1

SECTION – B

Q. NO. 21 TO 26 ARE VERY SHORT ANSWER QUESTIONS.

21. A clear solution of slaked lime is made by dissolving Ca(OH)_2 in an excess of water. This solution is left exposed to air. The solution slowly goes milky as a faint white precipitate forms. Explain why a faint white precipitate forms, support your response with the help of a chemical equation. 2

OR

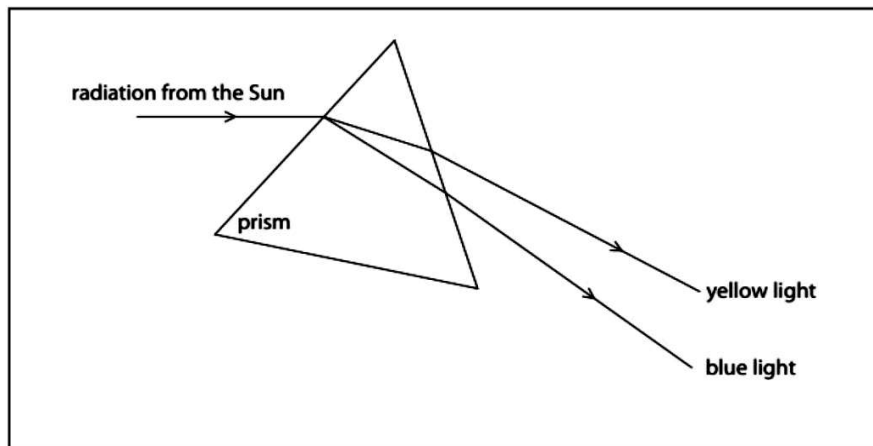
Keerti added dilute Hydrochloric acid to four metals and recorded her observations as shown in the table given below:

Metal	Gas Evolved
Copper	Yes
Iron	Yes
Magnesium	No
Zinc	Yes

Select the correct observation(s) and give chemical equation(s) of the reaction involved.

- 22 How is the mode of action in beating of the heart different from reflex actions? Give four examples. 2
- 23 Patients whose gallbladder are removed are recommended to eat less oily food. Why? 2
- 24 Name the substances other than water, that are reabsorbed during urine formation. What are the two parameters that decide the amount of water that is reabsorbed in the kidney? 2

25.



2

State the phenomena observed in the above diagram. Explain with reference to the diagram, which of the two lights mentioned above will have the higher wavelength?

OR

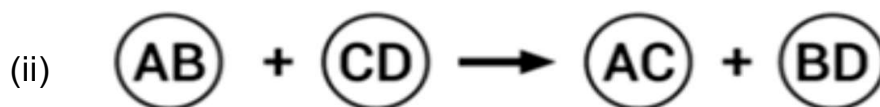
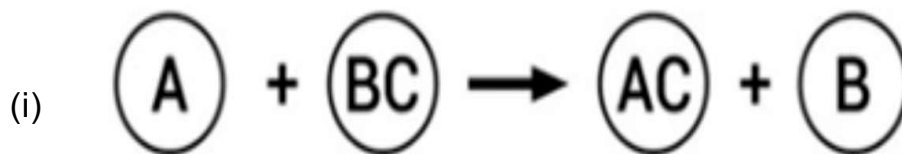
How will you use two identical prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? Draw the diagram.

26. A lot of waste is generated in neighborhood. However, almost all of it is biodegradable. What impact will it have on the environment or human health? 2

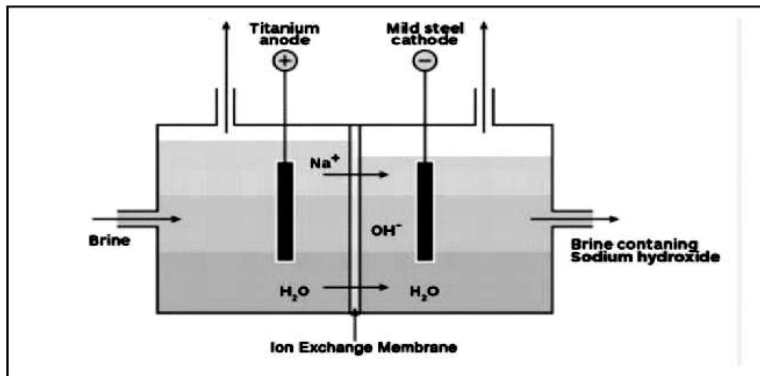
SECTION - C

Q.NO. 27 TO 33 ARE SHORT ANSWER QUESTIONS.

27. Identify the types of reaction mentioned above in (i) and (ii). Give one example for each type in the form of a balanced chemical equation. 3



28.



3

- Identify the gasses evolved at the anode and cathode in the above experimental set up.
- Name the process that occurs. Why is it called so?
- Illustrate the reaction of the process with the help of a chemical equation.

29. The leaves of a plant were covered with aluminium foil, how would it affect the physiology of the plant? 3

OR

How is lymph an important fluid involved in transportation? If lymphatic vessels get blocked, how would it affect the human body? Elaborate.

30 Rohit wants to have an erect image of an object using a converging mirror of focal length 40 cm. 3

- Specify the range of distance where the object can be placed in front of the mirror. Justify.
- Draw a ray diagram to show image formation in this case.
- State one use of the mirror based on the above kind of image formation.

31 (a) A lens of focal length 5 cm is being used by Debashree in the laboratory as a magnifying glass. Her least distance of distinct vision is 25 cm. 3

- What is the magnification obtained by using the glass?
- She keeps a book at a distance 10 cm from her eyes and tries to read. She is unable to read. What is the reason for this?

(b) Ravi kept a book at a distance of 10 cm from the eyes of his friend Hari. Hari is not able to read anything written in the book. Give reasons for this?

32 A student fixes a white sheet of paper on a drawing board. He places a bar magnet in the centre and sprinkles some iron filings uniformly around the bar magnet. Then he taps gently and observes that iron filings arrange themselves in a certain pattern. 3

- (a) Why do iron filings arrange themselves in a particular pattern?
(b) Which physical quantity is indicated by the pattern of field lines around the bar magnet?
(c) State any two properties of magnetic field lines.

OR

A compass needle is placed near a current carrying wire. State your observations for the following cases and give reasons for the same in each case-

- (a) Magnitude of electric current in wire is increased.
(b) The compass needle is displaced away from the wire.

33 Why is damage to the ozone layer a cause for concern? What are its causes and what steps are being taken to limit this damage? 3

SECTION - D

Q.NO. 34 TO 36 ARE LONG ANSWER QUESTIONS.

34 Shristi heated Ethanol with a compound A in presence of a few drops of concentrated sulphuric acid and observed a sweet smelling compound B is formed. When B is treated with sodium hydroxide it gives back Ethanol and a compound C. 5

- (a) Identify A and C
(b) Give one use each of compounds A and B.
(c) Write the chemical reactions involved and name the reactions.

OR

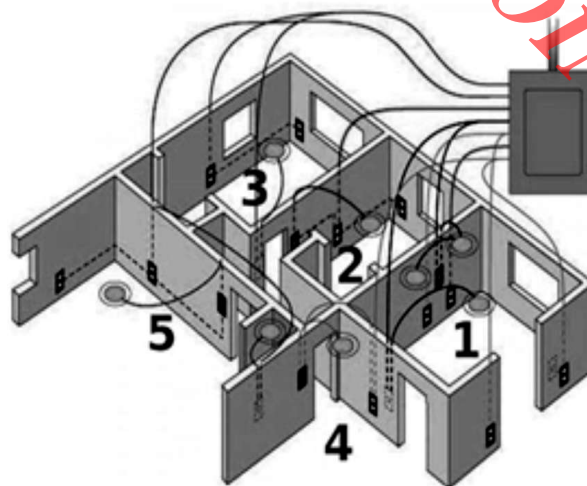
- (a) What is the role of concentrated Sulphuric acid when it is heated with Ethanol at 443 K. Give the reaction involved.
- (b) Reshu by mistake forgot to label the two test tubes containing Ethanol and Ethanoic acid. Suggest an experiment to identify the substances correctly? Illustrate the reactions with the help of chemical equations

- 35 (a) Why is it not possible to reconstruct the whole organism from a fragment in complex multicellular organisms? 5
- (b) Sexual maturation of reproductive tissues and organs are necessary link for reproduction. Elucidate.

OR

- (a) How are variations useful for species if there is drastic alteration in the niches?
- (b) Explain how the uterus and placenta provide necessary conditions for proper growth and development of the embryo after implantation?

36. The diagram above is a schematic diagram of a household circuit. The house shown in the above diagram has 5 usable spaces where electrical connections are made. For this house, the mains have a voltage of 220 V and the net current coming from the mains is 22A. 5



- (a) What is the mode of connection to all the spaces in the house from the mains?

(b) The spaces 5 and 4 have the same resistance and spaces 3 and 2 have respective resistances of 20Ω and 30Ω . Space 1 has a resistance double that of space 5. What is the net resistance for space 5.

(c) What is the current in space 3?

What should be placed between the main connection and the rest of the house's electrical appliances to save them from accidental high electric current?

SECTION - E

Q.no. 37 to 39 are case - based/data -based questions with 2 to 3 short sub - parts. Internal choice is provided in one of these sub-parts.

37. Two students decided to investigate the effect of water and air on iron object under identical experimental conditions. They measured the mass of each object before placing it partially immersed in 10 ml of water. After a few days, the object were removed, dried and their masses were measured. The table shows their results

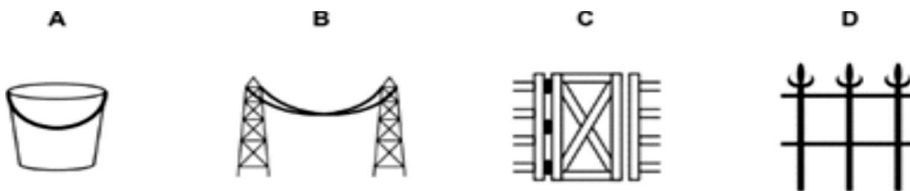
Students	Object	Mass of Object before Rusting in g	Mass of the coated object in g
A	Nail	3.0	3.15
B	Thin plate	6.0	6.33

(a) What might be the reason for the varied observations of the two students?

(b) In another set up the students coated iron nails with zinc metal and noted that, iron nails coated with zinc prevents rusting. They also observed that zinc initially acts as a physical barrier, but an extra advantage of using zinc is that it continues to prevent rusting even if the layer of zinc is damaged. Name this process of rust prevention and give any two other methods to prevent rusting.

OR

(b) In which of the following applications of Iron, rusting will occur most? Support your answer with valid reason.



- A - Iron Bucket electroplated with Zinc
- B - Electricity cables having iron wires covered with aluminium
- C - Iron hinges on a gate
- D - Painted iron fence

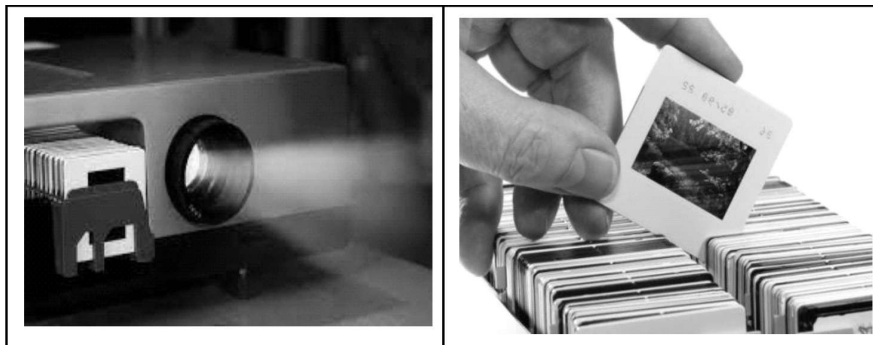
38. Pooja has green eyes while her parents and brother have black eyes. Pooja's husband Ravi has black eyes while his mother has green eyes and father has black eyes. 4

- (a) On the basis of the above given information, is the green eye colour a dominant or recessive trait? Justify your answer.
- (b) What is the possible genetic makeup of Pooja's brother's eye colour?
- (c) What is the probability that the offspring of Pooja and Ravi will have green eyes? Also, show the inheritance of eye colour in the offspring with the help of a suitable cross.

OR

- (d) 50% of the offspring of Pooja's brother are green eyed. With help of cross show how this is possible.

39. The above images are that of a specialized slide projector. Slides are small transparencies mounted in sturdy frames ideally suited to magnification and projection, since they have a very high resolution and a high image quality. There is a tray where the slides are to be put into a particular orientation so that the viewers can see the enlarged erect images of the transparent slides. This means that the slides will have to be inserted upside down in the projector tray. 4



To show her students the images of insects that she investigated in the lab, Mrs. Iyer brought a slide projector. Her slide projector produced a 500 times enlarged and inverted image of a slide on a screen 10 m away.

- (a) Based on the text and data given in the above paragraph, what kind of lens must the slide projector have?
- (b) If v is the symbol used for image distance and u for object distance then with one reason state what will be the sign for $\frac{v}{u}$ in the given case?
- (c) A slide projector has a convex lens with a focal length of 20 cm. The slide is placed upside down 21 cm from the lens. How far away should the screen be placed from the slide projector's lens so that the slide is in focus?

OR

- (c) When a slide is placed 15 cm behind the lens in the projector, an image is formed 3 m in front of the lens. If the focal length of the lens is 14 cm, draw a ray diagram to show image formation. (not to scale)

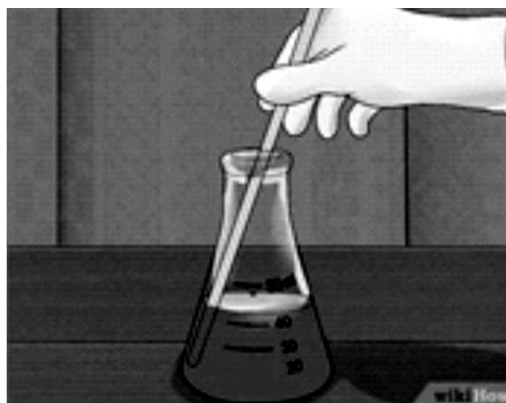
PRACTICE PAPER
CLASS X (2022-23)
SCIENCE (086)

1. This question paper consists of 39 questions in 5 sections.
2. All questions are compulsory. However, an internal choice is provided in some questions. A student is expected to attempt only one of these questions.
3. Section A consists of 20 Objective Type questions carrying 1 mark each.
4. Section B consists of 6 Very Short questions carrying 02 marks each. Answers to these questions should be in the range of 30 to 50 words.
5. Section C consists of 7 Short Answer type questions carrying 03 marks each. Answers to these questions should be in the range of 50 to 80 words.
6. Section D consists of 3 Long Answer type questions carrying 05 marks each. Answer to these questions should be in the range of 80 to 120 words.
7. Section E consists of 3 source-based/case-based units of assessment of 04 marks each with sub-parts.

SECTION-A

Select and write one most appropriate option out of the four options given for each of the questions 1–20.

1. Which of the following is/are correct for diluting acid?



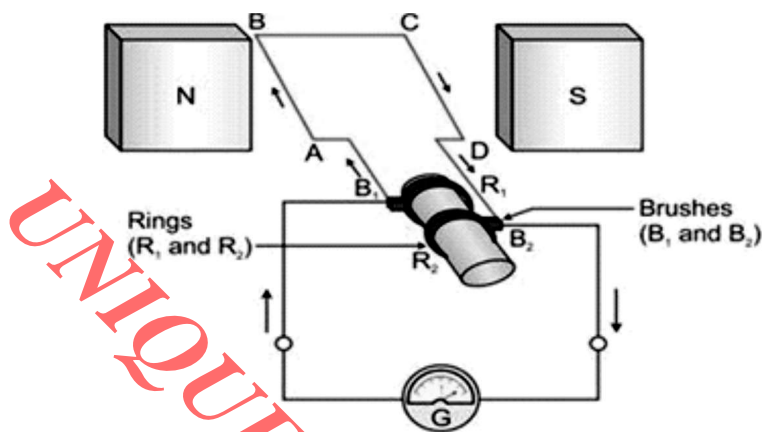
1. Adding acid to water by stirring.
2. Adding water to acid by stirring.
 - (a) Only 1
 - (b) Only 2
 - (c) Both 1 and 2
 - (d) Neither 1 nor 2
2. A solution of substance X is used for white washing . Here X is
 - (a) CaO
 - (b) CO₂
 - (c) NaCl
 - (d) KCl
3. When hydrogen sulphide gas is passed through a blue solution of copper sulphate, a black precipitate of copper sulphide is obtained and the sulphuric acid so formed remains in the solution. The reaction is an example of:
 - (a) a combination reaction.
 - (b) a displacement reaction.
 - (c) a decomposition reaction.
 - (d) a double displacement reaction.
4. Which of the following are exothermic processes?
 - (i) Reaction of water with quicklime
 - (ii) Dilution of an acid
 - (iii) Evaporation of water
 - (iv) Sublimation of camphor (crystals)
 - (a) i and ii
 - (b) ii and iii

- (c) i and iv
(d) iii and iv
5. 2 mL each of concentrated HCl, HNO₃ and a mixture of concentrated HCl and concentrated HNO₃ in the ratio of 3: 1 were taken in test tubes labelled as A, B and C. A small piece of metal was put in each test tube. No change occurred in test tubes A and B but the metal got dissolved in test tube C respectively. The metal could be
- (a) Al
(b) Au
(c) Cu
(d) Pt
6. Which ions are present in a dilute aqueous solution of hydrochloric acid?
- (a) H₃O⁺⁺Cl⁻
(b) H₃O⁺⁺OH⁻
(c) Cl⁻+OH⁻
(d) Unionised HCl
7. Which among the following are unsaturated hydrocarbons
- (i) H₃C-CH₂-CH₂-CH₃
(ii) H₃C-C≡C-CH₃
H₃C-CH-CH₃
(iii) H₃C-C(CH₃)=CH₂
(iv) H₃C-C(CH₃)₂-CH₃
- (a) i and iii
(b) ii and iii
(c) ii and iv
(d) iii and iv

8. Passage of air through the respiratory tract during inspiration is
- (a) Nostril – Nasal cavity – Larynx – Pharynx – Bronchi – Trachea – Bronchioles – Alveoli
 - (b) Nostril – Nasal cavity – Pharynx – Larynx – Trachea – Bronchi – Bronchioles – Alveoli
 - (c) Nostril – Nasal cavity – Larynx – Pharynx – Trachea – Bronchi – Bronchioles – Alveoli
 - (d) Nostril – Nasal cavity – Bronchioles – Bronchi – Larynx – Pharynx – Trachea – Alveoli
9. Name the ultimate source of energy in any food chain
- (a) Wind energy
 - (b) Solar energy
 - (c) Thermal energy
 - (d) Geothermal energy
10. From the list given below, select the character which can be acquired but not inherited
- (a) Colour of eye
 - (b) Colour of skin (c) Size of body
 - (d) Nature of hair
11. Which of the following statements is correct about receptors?
- (a) Gustatory receptors detect taste while olfactory receptors detect smell
 - (b) Both gustatory and olfactory receptors detect smell
 - (c) Auditory receptors detect smell and olfactory receptors detect taste
 - (d) Olfactory receptors detect taste and gustatory receptors smell
12. Which of the following statements are true for flowers?
- (i) Flowers are always bisexual.

- (ii) They are the sexual reproductive organs.
- (iii) They are produced in all groups of plants.
- (iv) After fertilisation, they give rise to fruits.
- (a) (i) and (iv)
- (b) (ii) and (iii)
- (c) (i) and (iii)
- (d) (ii) and (iv)
13. Two resistors having resistance $2\ \Omega$ and $4\ \Omega$ respectively are connected in series. What is the value of equivalent Resistance?
- (a) $4\ \Omega$
- (b) $6\ \Omega$
- (c) $5\ \Omega$
- (d) $3\ \Omega$
14. For a current in a long straight solenoid N- and S-poles are created at the two ends. Among the following statements, the incorrect statement is
- (a) The field lines inside the solenoid are in the form of straight lines which indicates that the magnetic field is the same at all points inside the solenoid
- (b) The strong magnetic field produced inside the solenoid can be used to magnetise a piece of magnetic material like soft iron, when placed inside the coil
- (c) The pattern of the magnetic field associated with the solenoid is different from the pattern of the magnetic field around a bar magnet
- (d) The N- and S-poles exchange position when the direction of current through the solenoid is reversed
15. A cylindrical conductor of length L and uniform area of cross-section A has resistance R . Another conductor of length $2L$ and resistance R of the same material has an area of cross-section:
- (a) $A/2$
- (b) $3A/2$
- (c) $2A$
- (d) $3A$

16. Commercial electric motors do not use :
- (a) An electromagnet to rotate the armature
 - (b) Effectively large no. of turns of conducting wire in the current carrying coil
 - (c) A permanent magnet to create the armature
 - (d) A soft iron core on which the coil is wound



Question no 17 to 20 are assertion-Reasoning based questions

Below given 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.

17. **Assertion (A)** : Decomposition of vegetable matter into compost is an example of exothermic reactions. **Reason (R)** : Exothermic reaction are those reactions in which heat is evolved.

18. **Assertion** : When pea plants (Homozygous) having round yellow seeds are crossed with HOMOZYGOUS plants having wrinkled green seeds, then all pea plants obtained in F₁ generation bear wrinkled green seeds.

Reason: Round and yellow seeds are dominant to wrinkled and green seeds.

19. **Assertion (A)** : In a candle, wax vapours burn in sufficient supply of oxygen, which leads to blue flame.

Reason (R) : When the oxygen supply is sufficient, then fuels burn completely producing a blue flame.

20. **Assertion(A):** On changing the direction of flow of current through a straight conductor, the direction of a magnetic field around the conductor is reversed.

Reason (R) : The direction of magnetic field around a conductor can be given in accordance with left hand thumb rule.

Question no 21 to 26 are very short answer questions

21. A metal A which is used in Thermite process, when heated with oxygen gives an oxide B which is amphoteric in nature. Identify A and B. write down the reaction of oxide B with HCl and NaOH.
22. Why does herbivores have longer small intestine than carnivores?
23. Do the freshwater animals reabsorb water through their excretory system like marine animals? Justify your answer.
24. What is translocation? Why is it essential for plants?
25. What would the sky look if the earth had no atmosphere? Why?

OR

How do we see the colours?

26. What is 10% Law? Explain by an example.

SECTION C

Question no 27 to 33 are short answer questions

27. Lead Nitrate solution is added to a test tube containing Potassium iodide solution.
- (a) Write the name and colour of the compound precipitated.
- (b) Write the balanced Chemical equation for the reaction involved. (c) Name the type of reaction justifying your answer
28. Give the reaction involved during extraction of Zinc from its ore by:
- (a) Roasting of Zinc Ore
- (b) Calcination of Zinc Ore
- (c) Reduction of Zinc Oxide.

29. (a) Why is Vegetative propagation practiced for growing some types of plants?
- (b) Name the different parts of a flower that has germ cells. (c) List any two agents of pollination.

OR

- (a) List three distinguishing features between sexual and asexual types of reproduction.
- (b) Explain why variations are observed in the offspring of sexually reproducing organisms?
30. The image formed by a spherical mirror is real, inverted and is of magnification -2 . If the image is at a distance of 30cm from the mirror, where is the object placed? find the focal length of the mirror. List two characteristics of the image formed if the object is moved 10cm towards the mirror.
- 31 (a) Define Optical centre of a spherical lens.
- (b) A divergent lens has a focal length of 20 cm . At what distance should an object of height 4cm from the optical centre of lens be placed so that its image is formed 10cm away from the lens. Find the size of the image also.
- (c) Draw a ray diagram to show the formation of image in the above situation.
32. (a) What is an electromagnet? List any two uses.
- (b) Draw a labelled diagram to show how an electromagnet is made.
- (c) State the purpose of soft iron core used in making an electromagnet.

OR

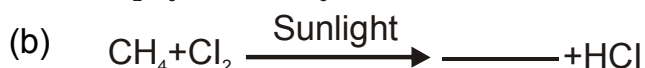
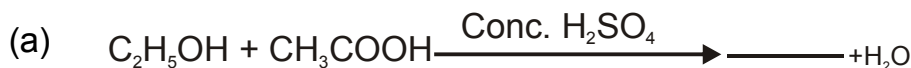
- (a) Draw the magnetic field lines produced due to a current carrying circular loop
- (b) State the law used to find the direction of magnetic field around a straight current carrying conductor
33. (a) What do you mean by food chain?

- (c) Give the characteristics of food chain

SECTION D

Question no 34 to 36 are long answer questions.

34. (I) Complete the following reactions:



- (II) State two properties of carbon which lead to huge number of carbon compounds we see around us.

OR

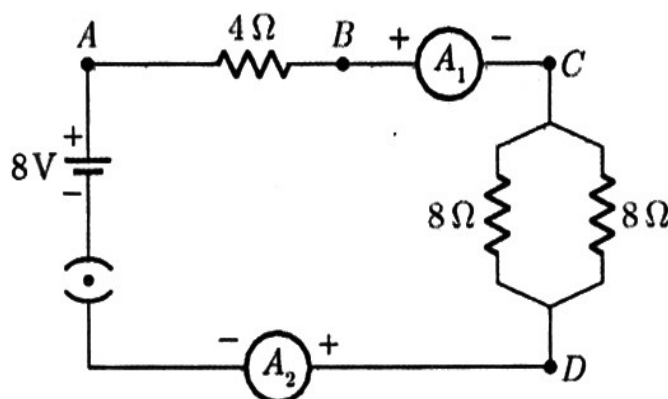
Answer the following questions:

- (a) Describe a chemical test to distinguish between ethanol and ethanoic acid.
- (b) Give reason for the following:
- Ethanol is used in the preparation of tincture of iodine.
 - Ethanoic acid is used in the preservation of pickles.
35. (a) Suggest any two categories of contraceptive methods to control the size of human population which is essential for the prosperity of a country. Also explain about each method briefly.
- (b) Name two bacterial and two viral infections each that can get sexually transmitted.
- (c) List two advantages of using condom during sexual act.

OR

- Describe the role of prostate gland, seminal vesicle and testes in the human male reproductive system.
- How is the surgical removal of unwanted pregnancies misused?
- Explain the role of oral contraceptive pills in preventing conception.

36. Find out the following in the electric circuit given in figure:



- (a) Effective resistance of two $8\ \Omega$ resistors in the combination.
(b) Current flowing through $4\ \Omega$ resistor.
(c) Potential difference across $4\ \Omega$ resistance.
(d) Power dissipated in $4\ \Omega$ resistor.

SECTION-E

37 to 39 are case-based/data-based questions with 2 to 3 short sub-parts. Internal choice is provided in one of these sub-parts.

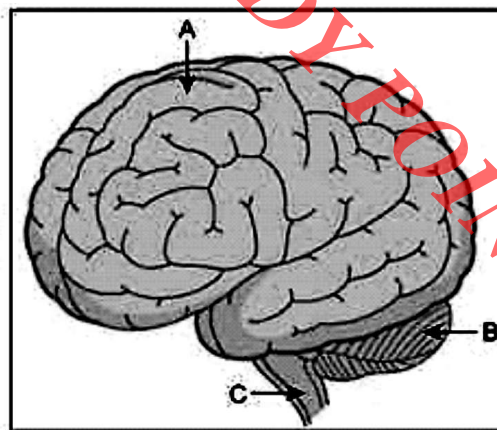
37. The arrangement of metals in a vertical column in the decreasing order of their re-activities is called the reactivity series or activity series of metals. The most reactive metal is at the top position of the reactivity series. The least reactive metal is at the bottom of the reactivity series. Hydrogen, though a non-metal, has been included in the activity series of metals only for comparison. Apart from it, the hydrogen atom also has tendency to lose its valence electron and form cation like the behaviour shown by metals. Thus,



- (i) An element 'X' after reacting with acids liberate hydrogen gas and can displace lead and tin from their salt solution. Write down the Name of X metal.

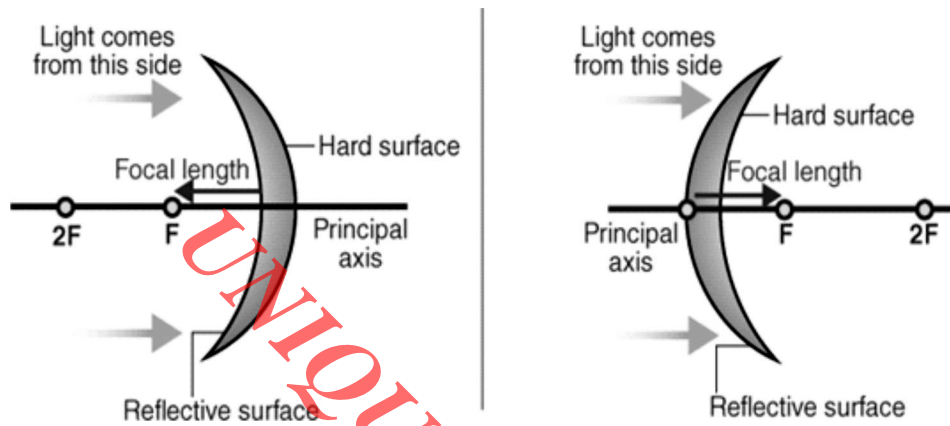
- (ii) Which metal can be displaced by copper from its salt solution?
- (iii) Write down the name of most reactive metal and which metal does not liberate hydrogen gas after reacting with acid ?
- (iv) The human brain is the command centre for the human nervous system. It receives signals from the body's sensory organs and outputs information to the muscles. The human brain has the same basic structure as other mammal brains but is larger in relation to body size than the brains of many other mammals, such as dolphins, whales and elephants.

The human brain weighs about 3 lbs. (1.4 kilograms) and makes up about 2% of a humans body weight. On average, male brains are about 10% larger than female brains, according to North-western Medicine in Illinois. The average male has a brain volume of nearly 78 cubic inches (1,274 cubic centimetres), while the average female brain has a volume of 69 cubic inches (1,131 cubic cm). The cerebrum, which is the main part of the brain located in the front area of the skull, makes up 85% of the brain's weight



- Name the given figure and identify the labelled part A and B
- Which region of brain is responsible for pain and conscious association?
- Give two functions of the part 'A'
- Name the part of the brain which controls posture and balance of the body.

- (v) Is there a relationship between the radius of curvature R , and focal length f , of a spherical mirror? For spherical mirrors of small apertures, the radius of curvature is found to be equal to twice the focal length. We put this as $R = 2f$. This implies that the principal focus of a spherical mirror lies midway between the pole and centre of curvature.



- (i) Write relation between radius of curvature and focal length.
(ii) For which type of mirrors above relation is verified?
(iii) What is the magnification of the images formed by plane mirror and why
(iv) Where does the Principal focus of a spherical mirror lies?

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