CHAPTER-WISE PREVIOUS YEARS' QUESTIONS

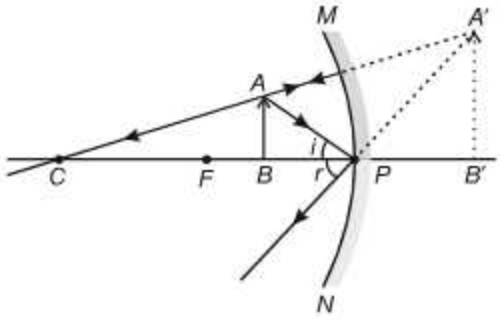
SCIENCE

HINTS & SOLUTIONS

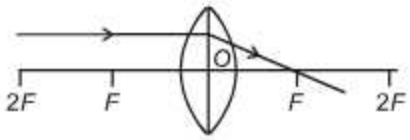
Class X (CBSE)

PHYSICS

1 : Light : Reflection and Refraction

1. 

[1]

2. 

[1]

3. Light has different speeds in different media and it takes such a path of propagation for which time taken is minimum. **[1]**

4. A ray of light passing through the centre of curvature of a concave mirror falls on the mirror along the normal to the reflecting surface. Hence, it gets reflected along the same path following the laws of reflection. **[1]**

5. The nature of the image formed by a concave mirror if the magnification produced by the mirror is +3 is virtual, erect and magnified. **[1]**

6. Answer (c) **[1]**

   Lateral displacement is the sideways shift of the emergent ray from the direction of the incident ray.

7. Answer (d) **[1]**

   A screen, a mirror, holders for them and scale are needed to find the focal length of a concave mirror.

8. Answer (a) **[1]**

   The lens should be moved towards the screen because the distant tree can be considered an object at infinity whose image will be formed at the focus, while earlier the image of nearer grill was formed at a distance farther than the focal length.

9. Answer (a) **[1]**

   The proper sequence to determine the focal length of a convex lens is :

   III - Select a suitable distant object.

   I - Hold the lens between the object and the screen.

   II - Adjust the position of the lens to form a sharp image.

   IV - Measure the distance between the lens and the screen.

10. Answer (d) **[1]**

    The IV observation is the correct one. The ratio of sin$i$ and sin$r$ given by the fourth choice gives 1.5.

    We know that

    $$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{1.5}{1} = 1.5$$

11. Answer (d) **[1]**

    $\angle i$ and $\angle e$ are not marked correctly. Each angle is supposed to be marked from the normal.

12. Answer (c) **[1]**

    The screen is moved away from the mirror so as to focus the object for a fixed position of the mirror and the object.

13. Answer (d) **[1]**

    The distance between mirror and the screen will give the focal length of the mirror as the mirror focuses the light on the screen.

14. Answer (d) **[1]**

    The parallel rays from the distant object fall on the convex lens and converge at its second principal focus (*i.e.*, where the screen is placed). Then the distance between the screen and the convex lens gives the approximate focal length of the lens *i.e.*, 40 cm.

15. Answer (c) **[1]**

The light ray passing through the optical centre of the lens does not deviate. The light ray parallel to the principal axis passes through the second focus of the lens. The light ray passing through the first focus becomes parallel to the principal axis after passing through the lens.

16. Answer (b) **[1]**

Ray (2) is parallel to the principal axis and passes through the second focus of the lens.

Ray (3) passes through the optical centre and does not deviate.

Ray (4) passes through the first focus of the lens and goes parallel to the principal axis.

17. Answer (a) **[1]**

The best set up is given in figure I. The incoming light should not fall perpendicularly as the light will emerge straight and refraction cannot be traced. The light rays should not be very close or far from the normal as the emergent rays are difficult to trace.

18. Answer (d) **[1]**

As the light gets refracted twice at different angles the emergent ray bends at an angle to the direction of incident ray.

19. Answer (a) **[1]**

Since the image is focussed, the spherical mirror is a concave mirror.

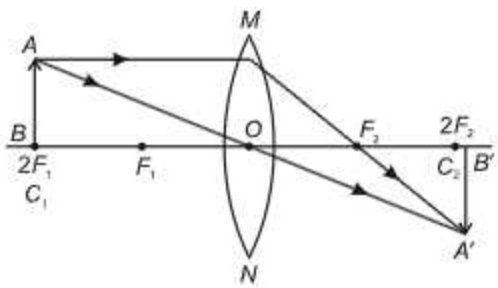
For second mirror the distance is increased to focus the image on the screen. Hence, focal length is more than that of first mirror.

20. Answer (c) **[1]**

Focal length f = 10 cm

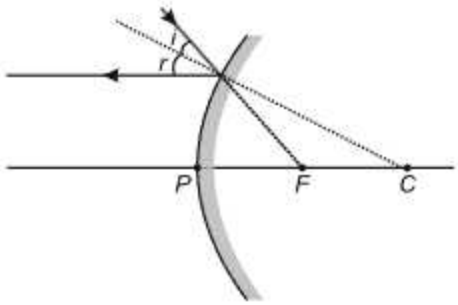
The object is placed at $2F$(2 × 10 = 20 cm).

Hence the image is also formed at $2F$.



Position of object	Position of image	Size of image	Nature of image
At $2F_1$	At $2F_2$	Same size	Real and inverted

21. A light ray is incident on a convex mirror parallel to the principal axis. The ray diagram is shown below



In the above diagram, 'i' is the angle of incidence and 'r' is the angle of reflection. **[1]**

22. Answer (d) **[1]**

In refraction through a rectangular slab, the angle of incidence is equal to the angle of emergence. Also, the angle of refraction should be smaller than the angle of incidence.

23. Answer (b) **[1]**

The focal length of a concave mirror is the distance between its pole and principal focus. That is, the distance of the image formed (screen) from the concave mirror will be equal to the focal length of the concave mirror.

24. Given that object distance, u = –12 cm

Image distance, v = 24 cm

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

$$\Rightarrow \frac{1}{f}=\frac{1}{24}-\frac{1}{-12}$$

$$\Rightarrow \frac{1}{f}=\frac{1}{24}+\frac{1}{12}$$

$$\Rightarrow \frac{1}{f}=\frac{1+2}{24}$$

$$\Rightarrow \frac{-1}{f}=\frac{3}{24}$$

$\Rightarrow f$ = 8 cm

$\therefore$ The focal length of the lens is 8 cm.

Now if the object is moved away from the lens, the screen has to be moved towards the lens. This is because when we move the object away from the lens, the object distance is increased. Hence, by the lens formula, the image distance decreases.

Magnification is given as

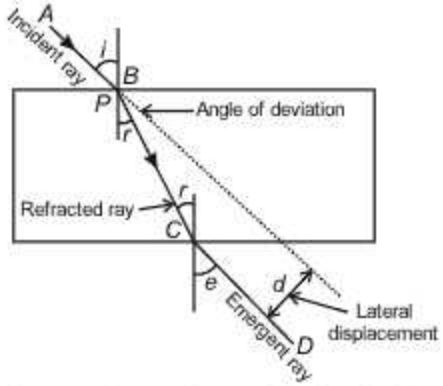
$$m = \frac{v}{u}$$

Because the image distance (v) decreases, the value of magnification also decreases. **[1]**

25. Answer (b) **[1]**

Images obtained on the screen are always diminished and inverted in nature.

26. Answer (a) **[1]**



On entering a glass slab, the incident light gets refracted. According to Snell's law, we get

$$\mu = \frac{\sin i}{\sin r}$$

For glass $\mu > 1$

$\therefore$ $\sin r < \sin i$

or $r < i$

In refraction of light through a glass slab, the emergent ray is parallel to the incident ray. Thus, $\angle i = \angle e$.

27. Given,

$u = -15$ cm (It is to the left of the lens)

$f = -30$ cm (It is a concave lens)

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

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{(-30)} + \frac{1}{(-15)}$$

$$\therefore \quad \frac{1}{v} = -\frac{3}{30} = -\frac{1}{10}$$

$\therefore$ $v = -10$ cm

The negative sign of the image distance shows that the image is formed on the left side of the concave mirror. Thus, the image formed by a mirror is virtual, erect and on the same side as the object. **[1]**

28. Answer (d) **[1]**

29. Answer (d) **[1]**

30. Answer (a) **[1]**

A concave mirror is used in a solar cooker to converge sunrays at focus to produce more heat.

31. Answer (c) **[1]**

In order to get image on a screen, the image must be real. So, the object AB should be placed between F_1 and $2F_1$ to get real and magnified image.

32. Answer (b) **[1]**

The optical device is a concave lens, as it diverges the parallel rays after refraction.

33. Answer (b) **[1]**

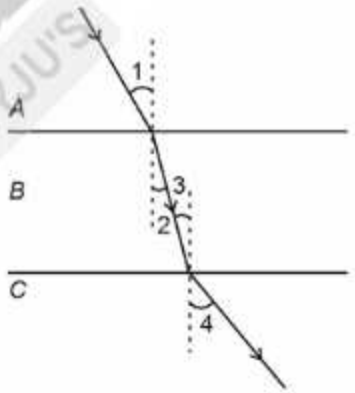
In going from medium A to B, the change in optical density is lesser in comparison to that in going from B to C.

So, bending will be least from A to B.

34. Answer (b) **[1]**

When the object is placed between P and F, the image formed is virtual, erect and magnified. So, the magnification will be positive and more than 1.

35. Answer (c) **[1]**



$\because$ $\angle 2$ and $\angle 3$ are alternate interior angles

Therefore, $\angle 2 = \angle 3$

36. Answer (c) **[1]**

$f = +20$ cm

$$\because \quad P = \frac{1}{f}$$

$$\Rightarrow \quad P = \frac{100}{20} = +5 \text{ D}$$

37. Answer (d) **[1]**

$R = -30$ cm

$$f = \frac{R}{2} = -15 \text{ cm}$$

38. Answer (d) **[1]**

$-3 = \frac{v}{u}$

$\Rightarrow v = -3u$

Now, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\Rightarrow \frac{1}{-3u} - \frac{1}{u} = \frac{1}{30}$

$u = -40$ cm

39. Answer (b) **[1]**

When object is placed at centre of curvature 'C', then the size of image is equal to the size of object.

40. Answer (d) **[1]**

$\because \theta_3 < \theta_2 < \theta_1$

$\Rightarrow n_3 > n_2 > n_1$

$\Rightarrow n_3 > n_1$

41. Answer (d) **[1]**

$V_A = \frac{3\times10^8}{1.5} = 2\times10^8$ m/s

$V_B = \frac{3\times10^8}{1.33} = 2.25\times10^8$ m/s

42. Answer (c) **[1]**

$f = 10$ cm

$u = -30$ cm

$h = 4$ cm

Now, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\Rightarrow \frac{1}{v} = \frac{1}{10} + \frac{1}{30}$

$\Rightarrow v = \frac{15}{2}$ cm

Again

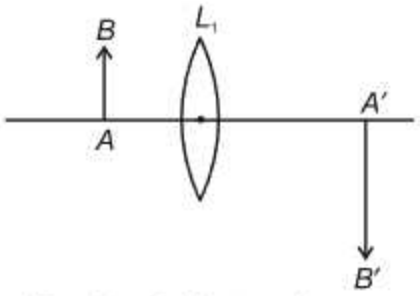
$m = \frac{-v}{u} = \frac{h'}{h}$

$\Rightarrow h' = \frac{-15}{2\times(-30)}\times 4 = 1$ cm

43. Answer (b) **[1]**

In compound microscope both objective and eye piece lenses are convex in nature.

44. Answer (d) **[1]**



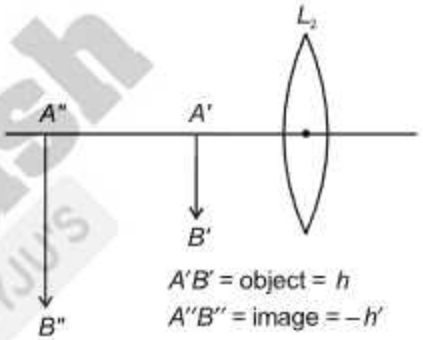
AB = size of object = $+h$
$A'B'$ = size of image = $-h'$

$m = \frac{A'B'}{AB} = \frac{-h'}{h}$ $(h' > h)$

$\Rightarrow |m| > 1$

So, the magnification will be negative and more than 1.

45. Answer (b) **[1]**



$A'B'$ = object = h
$A''B''$ = image = $-h'$

$m = \frac{A''B''}{A'B'} = \frac{-h'}{-h} = \frac{h'}{h}$ $(h' > h)$

$\Rightarrow |m| > 1$

So, the magnification will be positive and more than 1.

46. Answer (b) **[1]**

$f = \frac{1}{P} = \frac{100}{5} = 20$ cm

$v = -80$ cm

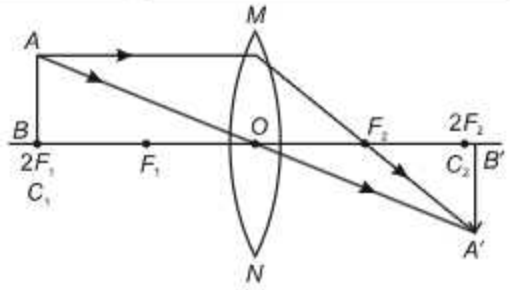
Now,

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

$\Rightarrow \frac{1}{u} = \frac{-1}{80} - \frac{1}{20}$

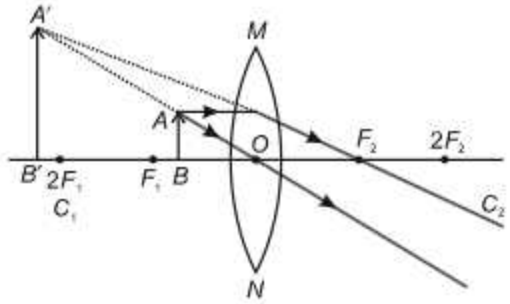
$\Rightarrow u = -16$ cm

47. (a)



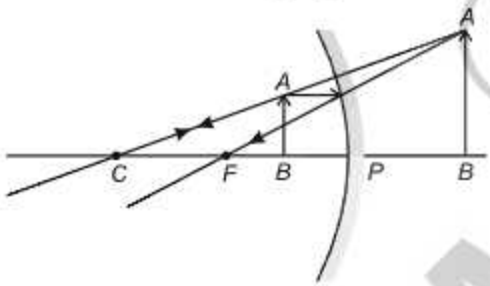
[1]

(b)



[1]

48. At least two rays are required for locating the image formed by a concave mirror for an object. Formation of virtual image by concave mirror : **[1]**



[1]

49. Four characteristics of images formed by a plane mirror are :

(i) The image formed by a plane mirror is always virtual.

(ii) The image formed by a plane mirror is always erect.

(iii) Size of the image is same as the size of the object and the image is laterally inverted.

(iv) The image formed by a plane mirror is at the same distance behind the mirror as object is in front of it. **[4 × ½]**

50. When an object is placed between the focus and the pole of a concave mirror, the image formed is

(i) Virtual

(ii) Enlarged

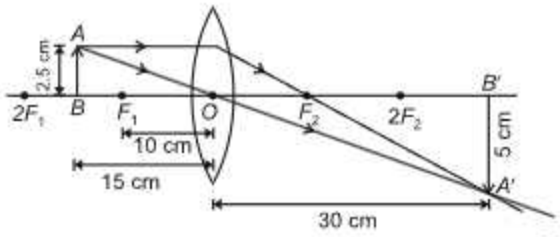
(iii) Behind the mirror

(iv) Erect **[4 × ½]**

51. For magnified and erect image the object is placed between pole *P* and focus *F*. **[1]**

For magnified and inverted image the object is placed either at focus or anywhere between *F* and *C*. **[1]**

52. Ray diagram :



[2]

53. Given : $n_g = \frac{3}{2}$ and $n_w = \frac{4}{3}$

Refractive index of glass,

$$n_g = \frac{\text{Speed of light in air}}{\text{Speed of light in glass}}$$ **[½]**

$$\frac{3}{2} = \frac{\text{Speed of light in air}}{2 \times 10^8}$$

$\therefore$ Speed of light in air

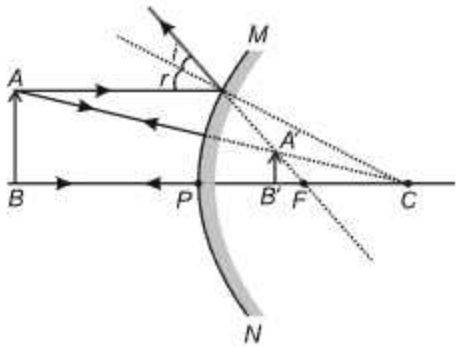
$$= \frac{3}{2} \times 2 \times 10^8 = 3 \times 10^8 \text{ m/s}$$ **[½]**

$\therefore$ Thus, the speed of light in air is 3×10^8 m/s.

Speed of light in water $= \frac{3 \times 10^8}{4/3}$

$= 2.25 \times 10^8$ m/s **[1]**

54. To get erect and diminished image mirror used is convex mirror. **[1]**



[1]

55. (i) The lens should be held in vertical position with its face parallel to screen.

(ii) A clear and sharpest image of the distant object should be obtained by suitably adjusting the position of lens.

(iii) At least three observation should be taken.

(iv) Measure the distance between the convex lens and the screen carefully. **[4 × ½]**

56. Focal length, f = +18 cm

Image distance, v = +24 cm

Object distance, u = ?

Magnification, m = ?

According to lens formula :

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$ **[1]**

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

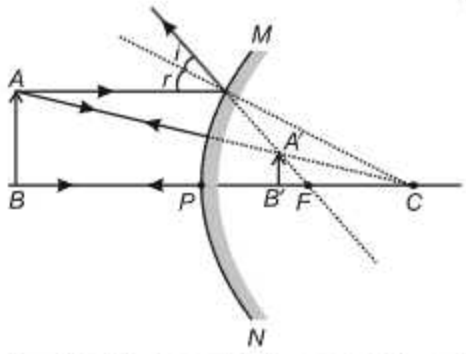
$$\frac{1}{u}=\frac{1}{24}-\frac{1}{18}$$

$$\frac{1}{u}=\frac{3-4}{72}$$

u = 72 cm **[1]**

$$m=\frac{v}{u}=\frac{24}{-72}=-0.33$$ **[1]**

57. **[1]**



An object is placed between infinity and the pole of a convex mirror, the image formed is :

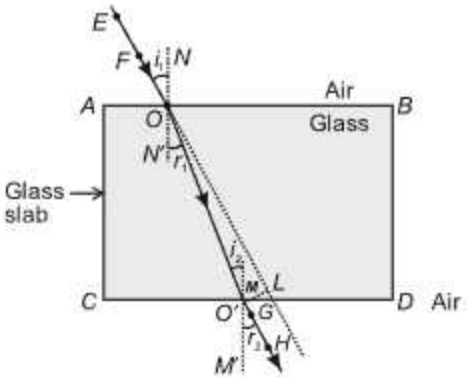
(i) Behind the mirror at focus (F)

(ii) Virtual and erect

(iii) Highly diminished. **[2]**

58. The principle of reversibility of light states that light will follow exactly the same path if its direction of travel is reversed. **[1]**

When light falls obliquely on a rectangular glass slab, the incident ray is parallel to the emergent ray; as shown in the figure. Angle of incidence is equal to the angle of emergence. **[1]**



[1]

59. (i) Convex mirror is used as rear view mirror because : (1) It has a large field of view. (2) It produces erect image of the objects behind the vehicle. **[1½]**

(ii) Concave mirror is used as shaving mirror, because : (1) It produces enlarged image when object is placed close to it. (2) It produces an erect image. **[1½]**

60. Given that :

Object distance, u = –36 cm

Image distance, v = 72 cm

As the image is obtained on a screen it is a real image and hence the spherical lens will be a convex lens. **[1]**

Focal length f = ?

According to lens formula,

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

Substituting the values, we get

$$\frac{1}{72}-\frac{1}{-36}=\frac{1}{f}$$

$$\frac{1}{f}=\frac{1}{72}+\frac{1}{36}$$

$$f=\frac{72}{36}$$

f = 24 cm **[1]**

Therefore the focal length of the lens = 24 cm

It is given that :

Object height, h_1 = 2.5 cm

Image height, h_2 = ?

We know that magnification, $m = \frac{v}{u} = \frac{h_2}{h_1}$

$\Rightarrow \quad h_2 = h_1 \times \frac{v}{u}$

$h_2 = 2.5 \times \frac{72}{-36}$

h_2 = –5 cm

The image of the flame formed will be inverted and have a height of 5 cm. **[1]**

61. (a) Concave mirror **[½]**

(b) Linear magnification of a concave mirror is given by :

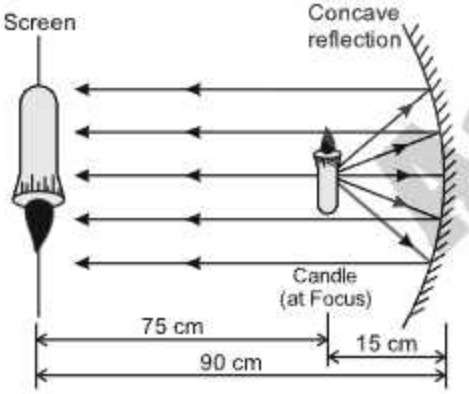
$m = \frac{-v}{u}$

$= \frac{-(-90)}{(-15)}$

$= -6$ **[1]**

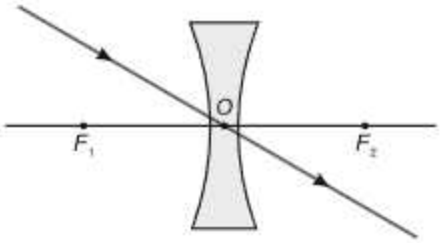
(c) The distance between the object and image = 90 – 15 = 75 cm. **[½]**

(d) Ray diagram



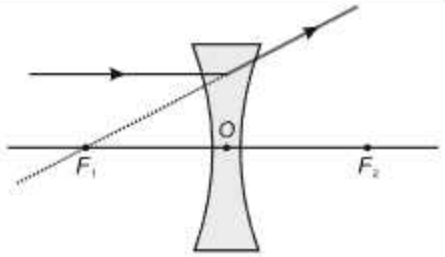
[1]

62. (i) A ray of light passing through the optical centre of the concave lens will emerge without any deviation.



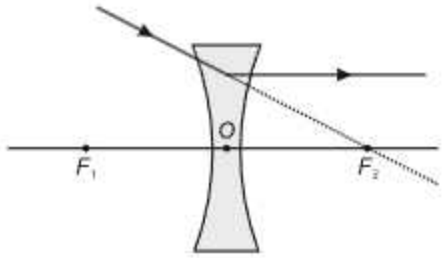
[1]

(ii) A ray of light parallel to the principal axis, after refraction from a concave lens, appears to diverge from the principal focus on the same side of the lens.



[1]

(iii) A ray of light directed towards the principal focus of a concave lens, becomes parallel to its principal axis after refraction through the lens.



[1]

63. Given : Height of the object, h = 5 cm

Focal length of the concave lens, f = –10 cm

Object distance, u = –20 cm

Using the lens formula, we get

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

$\Rightarrow \quad \frac{1}{-10} = \frac{1}{v} - \frac{1}{-20}$

$\Rightarrow \quad -\frac{1}{10} = \frac{1}{v} - \frac{1}{-20}$

$\Rightarrow \quad -\frac{1}{10} - \frac{1}{20} = \frac{1}{v}$

$\Rightarrow \quad \frac{-2-1}{20} = \frac{1}{v}$

$\Rightarrow \quad \frac{-3}{20} = \frac{1}{v}$

$\Rightarrow \quad v$ = 6.67 cm **[1]**

Hence, the image is formed 6.67 cm in front of the lens on the same side as the object.

Because v is negative, we can say that the image is virtual. **[1]**

From the magnification formula for the lens, we get

$m = \frac{h'}{h} = \frac{v}{u}$

$h' = \frac{vh}{u}$

$\Rightarrow \quad h' = \dfrac{-6.67(5)}{-20}$

$\Rightarrow \quad h' = 1.67$

Hence, the size of the image is $h' = 1.67$ cm.

Because the height of the image is positive and smaller than the height of the object, the image is erect and diminished. So, we can conclude that the image is virtual, erect and diminished.

[1]

64. Given: Magnification, $m = -2$

Distance of the image, $v = -30$ cm

Magnification, $m = -\dfrac{v}{u}$

$\therefore \quad u = -\dfrac{v}{m} = -\dfrac{(-30)}{(-2)}$

$\therefore \quad u = -15$ cm **[1]**

Substituting these values in the mirror formula

$\dfrac{1}{f} = \dfrac{1}{v} + \dfrac{1}{u}$

$= \dfrac{1}{(-30)} + \dfrac{1}{(-15)}$

$\dfrac{1}{f} = -\dfrac{1}{10}$

$\therefore \quad f = -10$ cm **[1]**

When the object is moved 10 cm towards the mirror the new position of the object is

$u' = -(15 - 10) = -5$ cm

Substituting the new value in the mirror formula

$\dfrac{1}{f} = \dfrac{1}{v} + \dfrac{1}{u'}$

$\dfrac{1}{v'} = \dfrac{1}{f} - \dfrac{1}{u'} = \dfrac{1}{10} - \dfrac{1}{(-5)}$

$\dfrac{1}{v'} = \dfrac{1}{10}$

$\therefore \quad v' = 10$ cm

Thus, the image is located 10 cm behind the mirror.

And magnification, $m' = \dfrac{v'}{u'} = -\dfrac{10}{(-5)}$

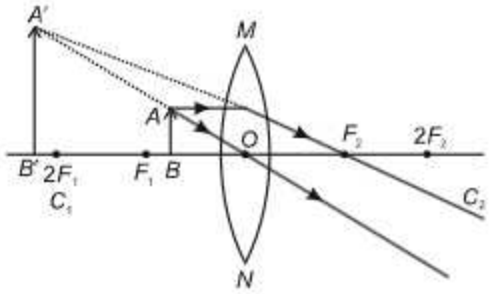
$m' = 2$

Since magnification is positive the image is erect and virtual.

Thus, the image is erect, virtual and magnified in nature. **[1]**

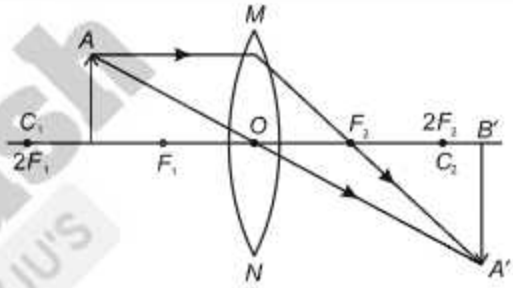
65. Convex lens can form a magnified erect image as well as a magnified inverted image of an object placed in front of it. **[1]**

Position of object	Position of image	Size of image	Nature of image
Between focus F_1 and optical centre O	On the same side of the lens as the object	Magnified	Virtual and erect



[1]

Position of object	Position of image	Size of image	Nature of image
Between F_1 and F_2	Beyond $2F_2$	Magnified	Real and inverted



[1]

66. **Laws of Refraction of light :**

Refraction of light follows the following two laws :

First Law : The incident ray, the normal to the transparent surface at the point of incidence and the refracted ray, all lie in one and the same plane. **[1]**

Second Law : The ratio of sine of the incidence angle ($\angle i$) to the sine of the refracted angle of the medium is called refractive index. It is denoted by n.

i.e., $\dfrac{\sin i}{\sin r} = n$

Refractive index of second medium with respect to the first medium is denoted by ${}_2n_1$.

Thus, eq.(i) can be written as ${}_2n_1 = \dfrac{\sin i}{\sin r}$

This law is called Snell's law as it was stated by Prof. Willebrord Snell (Dutch mathematician and astronomer). **[1]**

Absolute Refractive index :

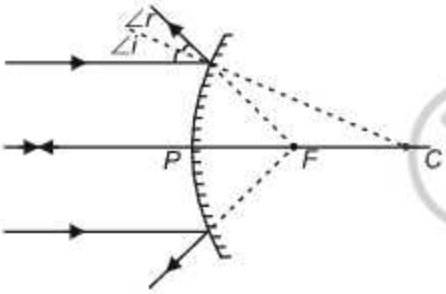
Absolute refractive index of a medium is defined as the ratio of the speed of light in vacuum or air to the speed of light in the medium. It is denoted by n.

Then, $n = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}} = \frac{c}{v}$

It has no unit. **[1]**

67. (A) (i) **Principal Focus (F) :** If rays close and parallel to the principal axis are incident on a diverging mirror, then after reflection they seem to come from a point on the principal axis. This point is called as the principal focus. **[1]**

(ii) **Focal Length :** It is the distance from the pole (P) of the mirror to the principal focus (F) of the mirror. **[1]**



[1]

OR

(B) h_o = 10 cm, u = – 25 cm and f = 15 cm

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

$v = \frac{uf}{u+f}$

$= \frac{(-25)(15)}{-25+15} = 37.5 \text{ cm}$ **[1]**

Also,

$\frac{h_i}{h_o} = \frac{v}{u}$

$\Rightarrow \frac{h_i}{10} = \frac{37.5}{-25}$

$\Rightarrow h_i = -15 \text{ cm}$ **[1]**

68. P = +4 D

$\Rightarrow f = \frac{1}{4} \text{ m} = 25 \text{ cm}$ **[1]**

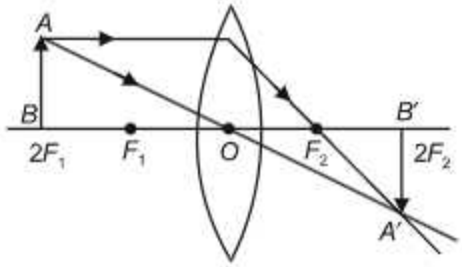
Here, u = – 50 cm

Therefore, v = 50 cm

Since object is placed at centre of curvature of the lens. So, image formed will be of same size as that of the object.

$m = \frac{v}{u} = \frac{50}{-50} = -1$

Image formed is real and inverted **[1]**



[1]

69. (i) $v_{\text{diamond}} = \frac{c}{\mu_{\text{diamond}}}$

$= \frac{3 \times 10^8}{2.42}$

$= 1.24 \times 10^8 \text{ m/s}$ **[1]**

(ii) $\angle r_{CS_2} < \angle r_g < \angle r_w$

A medium having greater absolute refractive index has less angle of refraction. **[1]**

(iii) (A) (a) Glass, because it has less speed of light. **[1]**

(b) There will be no bending in its path, because angle of incidence is zero degree. **[1]**

OR

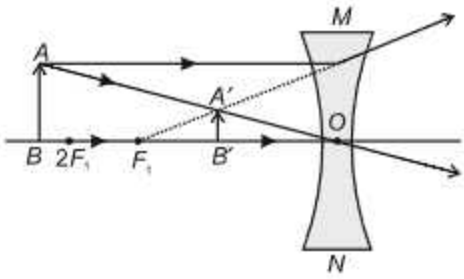
(iii) (B) Here,

$\mu_w = \frac{4}{3}$ and $\mu_g = \frac{3}{2}$

(a) $c = v_g \times \mu_g = 2 \times 10^8 \times \frac{3}{2} = 3 \times 10^8 \text{ m/s}$ **[1]**

(b) $v_w = \frac{c}{\mu_w} = \frac{3 \times 10^8}{\left(\frac{4}{3}\right)} = 2.25 \times 10^8 \text{ m/s}$ **[1]**

70. (a) Ray diagram showing the formation of image of an object placed between infinity and optical centre of a concave lens:



[2]

(b) A concave lens always forms a virtual, erect image on the same side of the object.

Focal length of concave lens, $f = -15$ cm

Image distance, $v = -10$ cm

(i) Let 'u' be the object distance; then using lens formula :

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

or, $$\frac{1}{u}=\frac{1}{v}-\frac{1}{f}$$

Substituting the values,

$$\frac{1}{u}=\left(\frac{-1}{10}\right)-\left(\frac{-1}{15}\right)=\left(\frac{-1}{30}\right)$$

Or, $u = -30$ cm $= -0.3$ m

Thus, object distance is 30 cm **[1]**

(ii) Magnification, $m=\frac{v}{u}=\frac{-10}{-30}=\frac{1}{3}=0.33$ **[1]**

(iii) The positive sign shows that the image is erect and virtual. The image is one-third the size of the object. **[1]**

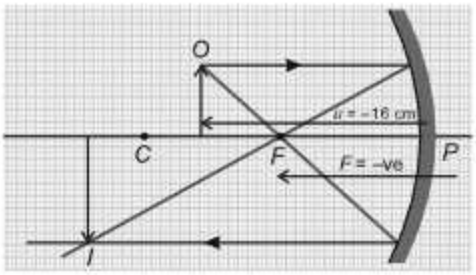
71. Sign conventions of spherical mirror :

(i) Object is always placed to the left of mirror.

(ii) All distances are measured from the pole of the mirror.

(iii) Distances measured in the direction of the incident ray are positive and the distances measured in the direction opposite to that of the incident ray are negative.

(iv) Distances measured along the y-axis (upwards) above the principal axis are positive and that measured along the y-axis (downwards) below the principal axis are negative. **[4 × ½]**



[1]

Given that :

Object distance, $u = -16$ cm

Magnification, $m = 3$

We know that magnification for a spherical Mirror, $m=-\frac{v}{u}=\frac{h_2}{h_1}$

i.e., $$-\frac{v}{u}=3$$

$\Rightarrow v = -3u$

Using mirror formula:

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

$$\frac{1}{f}=\frac{1}{-16}+\frac{1}{-3\times-16}$$

$$\frac{1}{f}=\frac{48}{-4}$$

$u = -12$ cm **[1]**

Negative sign of focal length implies that the focal length is being measured against the direction of incident light and it is a concave mirror. **[1]**

72. (a) (i) **Optical centre:** The central point of the lens is known as optical centre. It is represented as O. The optical centre of a lens has a property that a ray of light passing through it does not suffer any deviation and goes straight.

(ii) **Centre of Curvature:** The centre of sphere of part of which a lens is formed is called the centre of curvature of the lens. Since concave and convex lenses are formed by the combination of two parts of spheres, therefore they have two centres of curvature. One centre of curvature is usually denoted by C_1 and second is denoted by C_2.

(iii) **Principal Axis:** The principal axis of a lens is a line passing through the optical centre of the lens and perpendicular to both the faces of the lens.

(iv) **Aperture:** The diameter of sphere of part of which a lens is formed is called the aperture.

(v) **Principal Focus:** The convex lens converge the rays incident on it after refraction, to a point on the principal axis. This point is known as principal focus of the convex lens.

The rays incident on concave lens appear to diverge from a point on the principal axis. This point is known as the principal focus of concave lens.

(vi) **Focal Length:** The focal length of a lens is the distance between optical centre and principal focus of the lens.

[6 × ½]

(b) Given,

Image distance : v = +48 cm (It is on the other side of the lens)

Focal length : f = +12 cm (It is a converging lens or convex lens)

Object distance : u = ? (To be calculated)

Now, putting these values in the lens formula:

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$ **[½]**

$$\Rightarrow \frac{1}{12}=\frac{1}{48}-\frac{1}{u}$$

$$\Rightarrow \frac{1}{u}=\frac{1}{48}-\frac{1}{12}$$

$$\Rightarrow \frac{1}{u}=\frac{1-3}{48}$$

$$\Rightarrow \frac{1}{u}=\frac{-1}{24}$$

$\Rightarrow u$ = –24 cm **[½]**

Therefore, the object should be placed at a distance of 24 cm from the convex lens. The minus sign with the object distance shows that the object is on its left side. **[1]**

73. The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter p. The power p of a lens of focal length f is given as

$$p=\frac{1}{f}$$

The SI unit of power is dioptre (D). **[1]**

Given:

Focal length of lens A, FA = +10 cm = +0.1 m **[½]**

Focal length of lens B, FB = –10 cm = –0.1 m **[½]**

To calculate the power of lens A :

The power of lens A,

$$p=\frac{1}{f_A}$$

$$\Rightarrow p=\frac{1}{+0.1}$$

$\Rightarrow p$ = +10 D **[½]**

The positive sign indicates that it is a converging or convex lens.

To calculate the power of lens B :

The power of lens B,

$$p=\frac{1}{f_B}$$

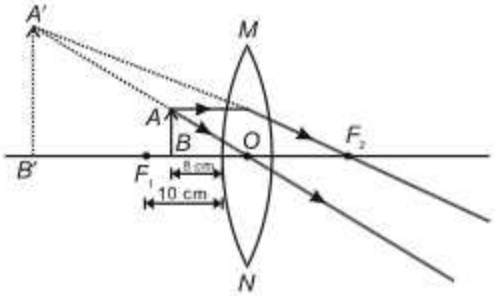
$$\Rightarrow p=\frac{1}{-0.1}$$

$\Rightarrow p$ = –10 D **[½]**

The negative sign indicates that it is a diverging or concave lens.

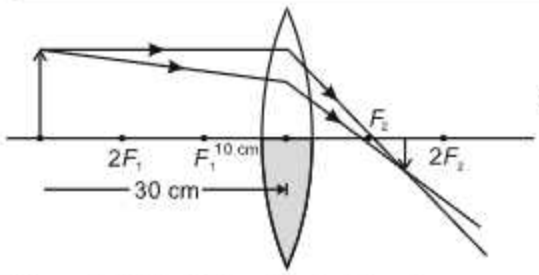
In a convex lens, when the object is placed between the pole and focus, the image formed is always virtual and magnified. **[1]**

On the other hand, a concave lens produces virtual, erect but diminished image. Here the object is placed 8 cm from the lens which is at a distance less than the focal length, *i.e.* less than 10 cm. Thus, the 8 cm position of the object placed in front of the convex lens will produce a virtual and magnified image. The diagram for the same is as shown below :



[1]

74. A convex lens can produce the complete image of the object even though half of the lens is covered. This is because light coming from the object can be refracted from the other half of the lens. However, the intensity of light will be reduced. **[1]**



[1]

Given: Height of the object = h = 4 cm

Focal length of the convex lens = f = 20 cm

Object distance = u = –15 cm

Using the lens formula, we get

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

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

$$\Rightarrow \quad \frac{1}{20}=\frac{1}{v}+\frac{1}{15}$$

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

$$\Rightarrow \quad \frac{-1}{60}=\frac{1}{v}$$

$\Rightarrow$ v = –16 [1]

Hence, the image is formed 60 cm in front of the lens on the same side as the object.

Because v is negative, we can say that the image is virtual. From the magnification formula for the lens, we get

$$m=\frac{h'}{h}=\frac{v}{u}$$

$$h'=\frac{vh}{u}$$

$$\Rightarrow \quad h'=\frac{-60(4)}{-15}$$

$\Rightarrow$ h' = 16 cm [1]

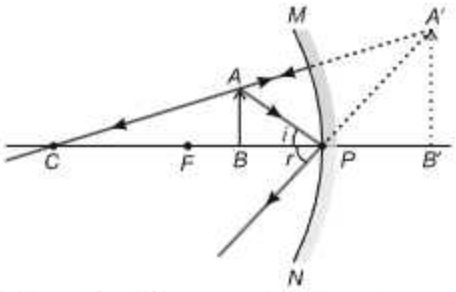
Hence, the size of the image is h' = 16 cm.

Because the height of the image is positive and greater than the height of the object, the image is erect and magnified. So, we can conclude that the image is virtual, erect and magnified. [1]

75. (i) To obtain an erect image, the object should be placed within the focus, *i.e.*, between the pole and the focus. Here, the focal length of the mirror is 12 cm.

Hence, the object should be placed at a distance less than 12 cm. [1]

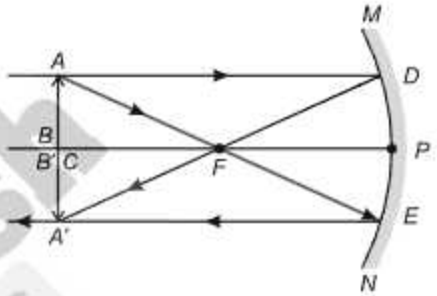
(ii) The image will be larger than the object (enlarged). [1]



[1]

(iii) Since f = 12 cm $\rightarrow$ Centre of curvature = $2f$ = 24 cm

For an object placed at a distance 24 cm, *i.e.*, at the centre of curvature of a concave mirror, the image formed will be real, inverted and of the same size as that of the object. [1]



[1]

76. (a) The focal length of a diverging lens is half the value of its radius of curvature. Conventionally, the sign of the focal length of the diverging lens is taken as negative. [1]

(b) Given :

f = –20 cm (It is a diverging lens.)

v = –15 cm (Image is formed on the same side of the lens.)

Using the lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$ [1]

$$\Rightarrow \quad \frac{1}{u}=\frac{1}{v}+\frac{1}{f}$$

$$=\frac{1}{(-15)}+\frac{1}{(-30)}=-\frac{1}{30}$$

$\therefore$ u = –30 cm [1]

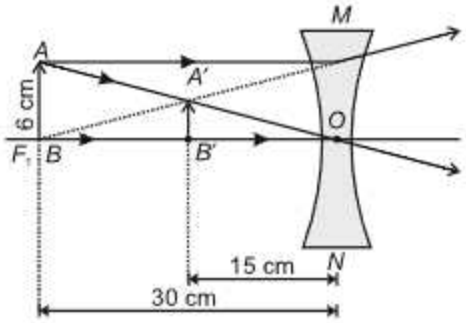
Given: Height of the object, h = 6 cm

Height of the image, h' = ?

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

$\therefore\ h' = h\dfrac{v}{u} = 6 \times \dfrac{(-15)}{(-30)}$

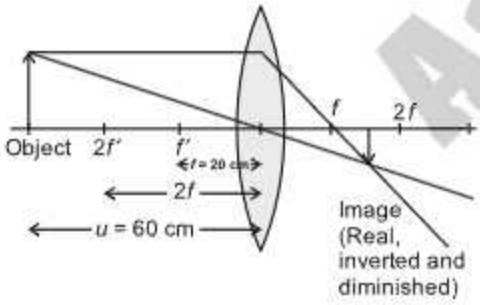
$\therefore\ h' = 3$ cm **[1]**

(c) 

[1]

77. (a) When the object distance and the image distance are the same, it means that the object is placed at $2f$ or the image is formed at $2f$. From the table, it is clear that $2f = 40$ cm. Therefore, the focal length of the convex lens is 20 cm. **[1]**

(b) Serial number 6 is incorrect. Given that the object is placed at 15 cm which is between the focal length and the lens. Thus, the image should be formed on the same side as the object. The data given in the observation serial number 6 does not satisfy the condition. **[2]**

(c) 

[1]

Magnification, $m = \dfrac{v}{u}$

Let us consider the third observation where

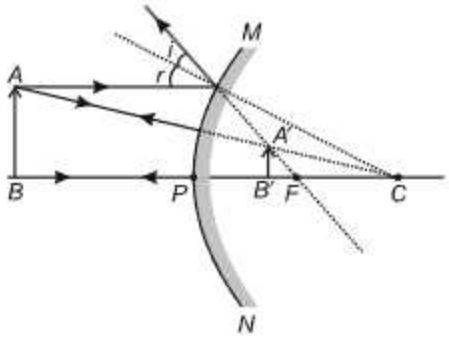
$u = -40$ cm and $v = 40$ cm

$\therefore\ m = \dfrac{v}{u} = \dfrac{40}{-40}$

$\therefore\ m = -1$ **[1]**

78. (a) A convex mirror always forms a diminished, erect and virtual image of the object placed in front of it. **[1]**

Position of object	Position of image	Size of image	Nature of image
Between infinity and the pole of the mirror	Between P and F behind the mirror	Diminished	Virtual and erect



[1]

Use of a convex mirror :

(i) Convex mirrors are commonly used as rear view mirrors in vehicles.

(ii) They are preferred because they always give an erect image, although diminished. Also, they have a wider field of view as they are curved outwards. Thus, convex mirrors enable the driver to view a much larger area than would be possible with a plane mirror. **[2 × ½]**

(b) The radius of curvature of a spherical mirror is the radius of the sphere of which the reflecting surface of the spherical mirror is a part and represented by R. **[1]**

Radius of curvature $R = 24$ cm

Radius of curvature = 2 × focal length

i.e., $R = 2f$

$24 = 2 \times f$

$f = \dfrac{24}{2} = 12$

$f = 12$ cm **[1]**

79. Given

$f = -30$ cm

$u = -60$ cm

$\therefore\ \dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{u}$ **[1]**

$\Rightarrow\ \dfrac{1}{-30} = \dfrac{1}{v} - \dfrac{1}{-60}$

$\Rightarrow\ \dfrac{1}{v} = -\dfrac{1}{30} - \dfrac{1}{60}$

$\Rightarrow \frac{1}{v} = -\frac{3}{60}$

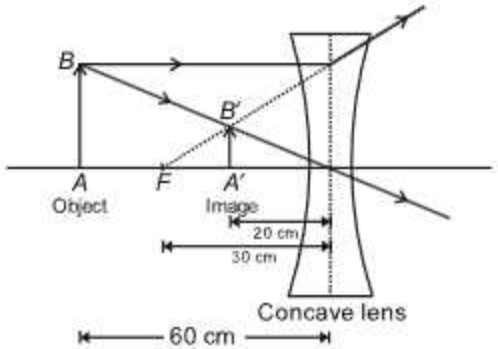
$\Rightarrow v = -20$ cm [1]

Nature : Virtual

Position : 20 cm from the lens, same side as the object

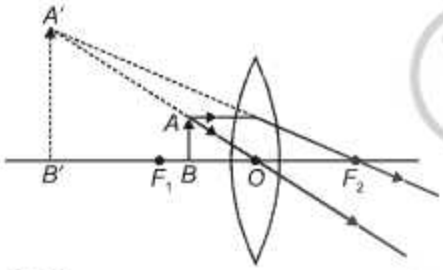
Size : Diminished

Erect/Inverted : Erect [1]



[2]

80. (i) Between optical centre and principal focus of a convex lens

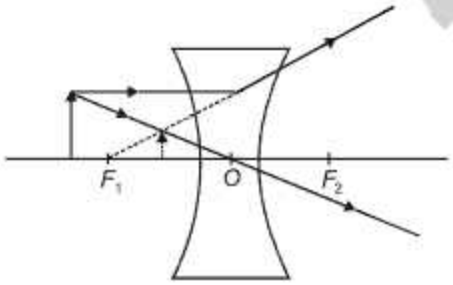


[1]

$m > 1$ [½]

Sign of magnification - positive [½]

(ii) Anywhere in front of a concave lens.

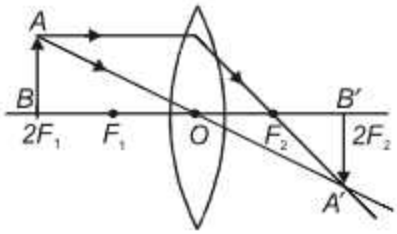


[1]

$0 \leq m < 1$ [½]

Sign of magnification - positive [½]

(iii) At 2F of a convex lens.



[1]

81. (i) Given,

$h = 4$ cm

$u = -25$ cm

$f = -15$ cm

We have,

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

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$ [1]

$\frac{1}{v} = \frac{1}{(-15)} - \frac{1}{(-25)}$

$\frac{1}{v} = \frac{1}{25} - \frac{1}{15}$

$\Rightarrow \frac{1}{v} = -\frac{2}{75}$

$\therefore v = -\frac{75}{2} = -37.5$ cm [1]

(ii) Magnification (m) $= -\frac{v}{u} = \frac{-\left(-\frac{75}{2}\right)}{-25}$

$\Rightarrow m = -\frac{3}{2}$ [1]

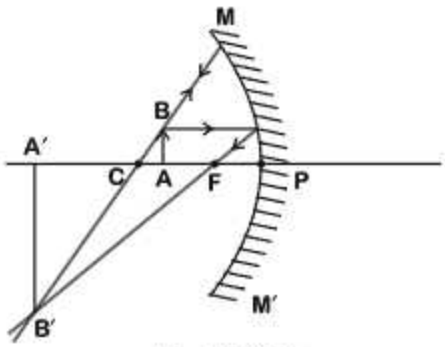
Now, $m = \frac{h'}{h}$

$h' = m \times h$

$h' = -\frac{3}{2} \times 4$

$h' = -6$ cm [1]

(iii) [1]



AB → Object
A′B′ → Image

2 : Human Eye and Colourful World

1. Sky looks blue on a clear day because blue colour of light is scattered most by the particles present in the atmosphere. **[1]**

2. Answer (d) **[1]**

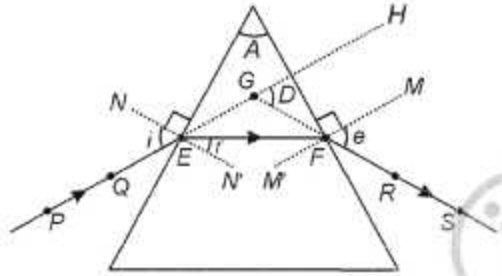
3. Answer (b) **[1]**

4. Answer (d) **[1]**

   The angle between the normal and the incident ray is the angle of incidence.

   The angle between the normal and the emergent ray is the angle of emergence.

   The correctly marked angles are shown in the diagram below :



5. Answer (a) **[1]**

   The angle between the incident ray and the normal is known as the angle of incidence, and the angle between the emergent ray and the normal is known as the angle of emergence. The emergent ray is bent at an angle with the direction of the incident ray. This angle is called the angle of deviation.

6. Answer (b) **[1]**

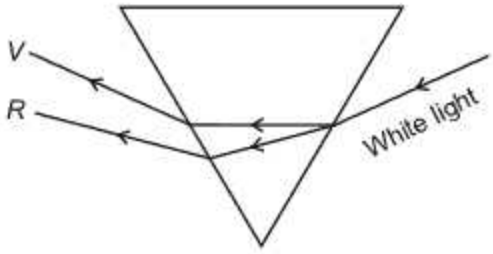
   Because the emergent ray is parallel to the incident ray, the angle of incidence is equal to the angle of emergence. The refracted ray travels from a rarer medium to a denser medium (considering the first refraction); it bends towards the normal. Thus, the angle of incidence is greater than the angle of refraction.

   If we consider the second refraction, then light travels from a denser medium to a rarer medium, due to which it bends away from the normal after refraction. So, in this case, the angle of refraction is again less than the angle of emergence.

7. Answer (c) **[1]**

   Scattering of light takes place due to diffused reflection of light by the minute particles present in the atmosphere.

8. Answer (c) **[1]**



   Clearly, Y represents red colour which is used to paint the danger signals.

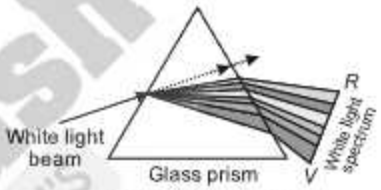
9. (a) Red color will be seen at *Y* and violet colour will be seen at *X*. **[1]**

   (b) Different colors of white light travel at different speeds through the glass prism.

   Hence, they bend through different angles with respect to the incident beam of light.

   [1]

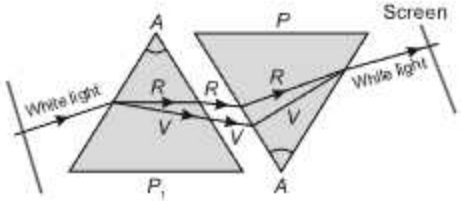
10. **[1]**



Dispersion of white light by the glass prism

   Different colours of white light bend through different angles with respect to the incident ray, as they pass through a prism. Thus the rays of each colour emerge along different paths and become distinct. It is the band of distinct colours that we see in a spectrum. **[1]**

11. When a second identical prism is placed in an inverted position with respect to the first prism, recombination of the spectrum occurs and it forms white light again. **[1]**



[1]

12. The ability of an eye to see objects from infinity (far point) upto 25 cm (near point) is called power of accommodation. **[1]**

   When we look at objects closer to eye, the ciliary muscles contract. This increases the curvature of eye lens. **[1]**

13. (A) (i) Myopia [½]

(ii) (a) Due to increase in the curvature of the eye lens.

(b) Due to decrease in the focal length of the eye lens.

(c) Due to elongation of the eyeball.

(Any two) [1]

(iii) Concave (diverging) lens. [½]

OR

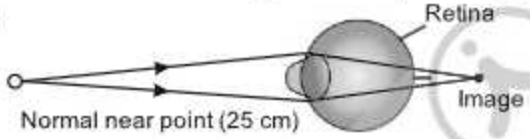
(B) The sky appears dark to the astronauts in space, as the space does not have atmosphere, so the scattering of light does not take place at such heights in the space. **[2]**

14. Hypermetropia is an eye defect in which distant vision is clear while near vision is blurred. **[1]**

Causes of Hypermetropia :

- Shortening of the eyeball, that is, the eyeball becomes smaller. [½]
- Increase in focal length of the eye lens. [½]

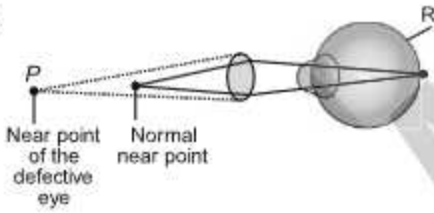
(i)



Hypermetropic Eye

[½]

(ii)



[½]

15. Focal length, f = +18 cm

Image distance, v = +24 cm

Object distance, u = ?

Magnification, m = ? [½]

According to lens formula :

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$ [½]

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

$$\frac{1}{u}=\frac{1}{24}-\frac{1}{18}$$ [½]

$$\frac{1}{u}=\frac{3-4}{72}$$

u = –72 cm [½]

$$m=\frac{v}{u}=\frac{24}{-72}=-0.33$$ **[1]**

16. (a) The process by which the ciliary muscles change the focal length of an eye lens to focus distant or near objects clearly on the retina is called the accommodation of the eye. The ability of the eye to do this is called the power of accommodation of the eye. **[1½]**

(b) To correct this defect of vision, the person must use a concave lens. [½]

Focal length of the corrective lens used

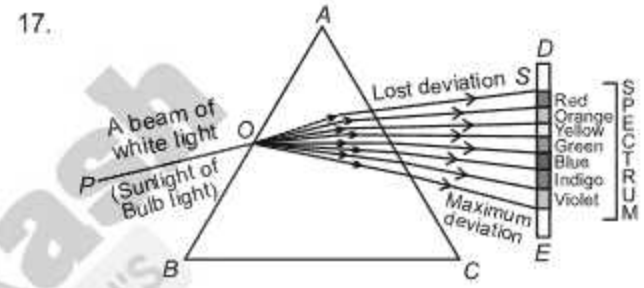
= –(Distance of far point of the myopic eye)

= –1.2 m

Power of the lens

$$=\frac{1}{\text{focal length}}=\frac{1}{-12}=-0.83\text{D}$$ **[1]**

17.



(i) Dispersion of light

Cause : The dispersion of white light occurs because colors of white light travel at different speeds through glass prism. Different colours undergo different deviations on passing through prism. **[1]**

(ii) Rainbow is the example of dispersion of light observed in nature.

It is caused due to dispersion of sunlight by water droplets in the atmosphere. It always forms in the direction opposite to the sun. **[1]**

(iii) White light is a mixture of seven colours. The sequence of colours given by the prism is Violet, Indigo, Blue, Green, Yellow, Orange and Red. VIBGYOR is the acronym for this sequence. The red light bends the least and violet light bends the most. **[1]**

18. The curvature of the eye lens can be adjusted by the ciliary muscles. This changes the focal length of the lens. The defect which arises because of the gradual weakening of the ciliary muscles is known as presbyopia. A bifocal lens can be used to correct presbyopia. Answers to the context questions :

(a) Akshay is not able to see from a far distance, so he is suffering from myopia or nearsightedness. A concave lens should be used to correct this defect. **[1]**

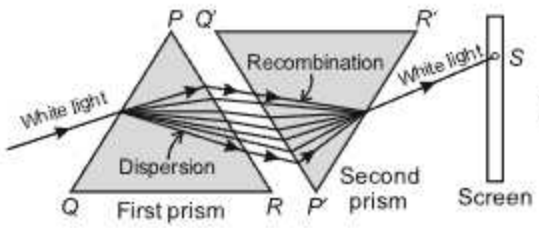
(b) The teacher displayed presence of mind and pro-activeness, and she is of a considerate nature. Salman displayed the virtue of friendship and is caring in nature. **[1]**

(c) Akshay should thank the teacher and Salman in front of the entire class. **[1]**

19. The seven colours of a spectrum can be recombined to give back white light as

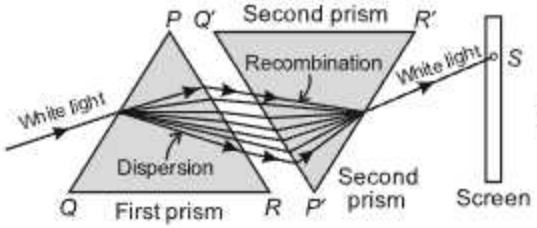
(a) Two identical glass prisms are placed such that their refracting surfaces are in opposite direction (placed inverted). When a beam of light is allowed to fall on the surface of one prism, a patch of ordinary white light is obtained on a screen placed behind the second prism. **[1]**

(b) The first prism disperses the white light into seven coloured rays. The second prism receives all the seven coloured rays from the first prism and recombines them into original white light. This is because the refraction produced by the second prism is equal and opposite to that produced by the first prism. Hence, the light coming out of the second prism will be white. **[1]**



[1]

20. The phenomenon of splitting of white light into its constituent seven colours on passing through a glass prism is called dispersion of light. **[1]**

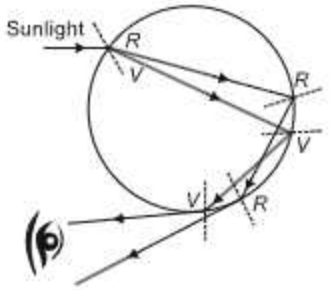


[1]

It is essential to place the two identical prisms in an inverted position with respect to each other because the refraction produced by the second prism is equal and opposite to that produced by the first prism. **[1]**

21. When a bright light focused on our eyes, then light first passes through the cornea and enters into the pupil, where size of pupil contracts which is controlled by iris. Hence less light enters the eye through the pupil. Then light passes through the eye lens and image is formed on the retina. The nature of image formed will be real and inverted. **[3]**

22. Rainbow is a natural optical phenomenon caused by the dispersion of sunlight by tiny water droplet in the Earth's atmosphere. **[1½]**



[1½]

Contribution of a single water droplet suspended in air in the formation of a rainbow

23. The phenomenon of scattering of light by the colloidal particles gives rise to tyndall effect. **[1]**

(i) Tyndall effect can be observed when sunlight passes through a canopy of a dense forest. **[½]**

(ii) Tyndall effect can be observed when a fine beam of light enters a smoke filled room through a small hole. **[½]**

(iii) Blue colour of eye is due to scattering of light by translucent layer over the iris. **[½]**

(iv) Milk is a colloidal solution of globules of fat and protein. When a beam of light is directed at a glass of milk, the light is scattered. [½]

24. A rectangular glass slab is a refracting medium with three parallel refracting surfaces while a glass prism is a refracting medium with two or more non-parallel refracting surfaces. **[1]**

When a monochromatic light passes through a glass slab, then it displaces parallel to itself and when it passes through a glass prism it gets deviate. **[1]**

When a white light passes through a glass slab, then it displaces parallel to itself only and when white light passes through a glass prism get dispersed and deviated. **[1]**

25. (a) (i) Due to scattering of light **[1]**

(ii) At the near point of eye, curvature of eye lens is maximum and focal length is minimum. If object is placed nearer than it, eye lens cannot adjust its curvature. **[1]**

(b) Presbyopia - The defect of vision in which the eye is unable to see nearby as well as far off objects clearly. **[1]**

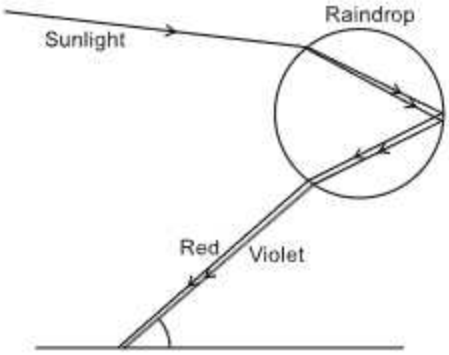
Causes:

Weakening of ciliary muscles. [½]

Diminishing flexibility of the eye lens. [½]

26. (a) Dispersion - The splitting of white light into its constituent colours. [½]

Rainbow formation (figure)

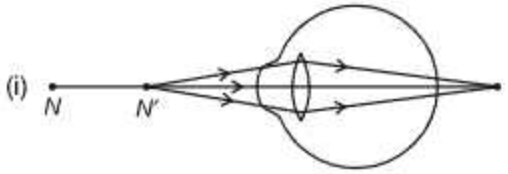


[½]

Water droplets in air refract and disperse the incident sunlight. Then, reflect it internally and finally refract it again when it comes out of the droplet. Due to the dispersion of light and internal reflection, different colours of sunlight reach the observer's eye and are visible in the form of a rainbow. **[1]**

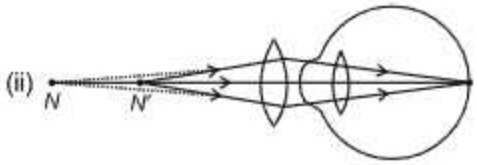
(b) Hypermetropia - The defect of vision due to which a person clearly sees distant objects but cannot clearly see nearby objects. **[1]**

(i)



[1]

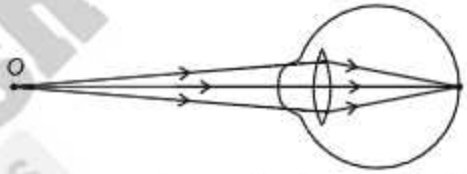
(ii)



[1]

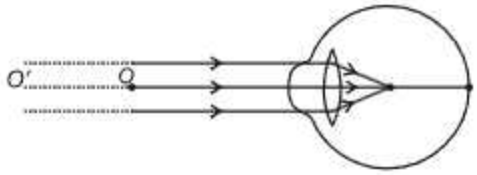
27. (a) This defect may arise due to excessive curvature of the eye lens or elongation of the eyeball.

(i) A person with this defect has the far point nearer than infinity. Such a person may see clearly up to a distance of a few meters.



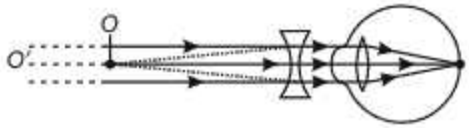
[1]

In a myopic eye, the image of a distant object is formed in front of the retina and not at the retina itself.



[1]

(ii) This defect can be corrected by using a concave lens of suitable power. A concave lens of suitable power will bring the image back onto the retina and thus the defect is corrected.



[1]

(b) Given: Focal length $f = -5$ m

(it is a concave lens)

Power, $P = \frac{1}{f(\text{in m})} = \frac{1}{-5} = -0.2\text{D}$ **[1]**

The negative sign indicates that it is a diverging lens or concave lens. **[1]**

28. His eye suffering from Myopia. [½]

Causes of Myopia : The two possible causes of this defect are :

Increase in the length of the eye ball, as if distance of retina from the eye lens has increased. [1]

Decrease in focal length of the eye lens when the eye is fully relaxed. This is as if the ciliary muscles holding the eye lens do not relax fully and have some tension. [1]

This defect can be corrected by using a concave lens of suitable focal length. [½]

29. (i) **Cornea :** Its function is to act as a window to the world, *i.e.*, to allow the light to enter the eye ball. [½]

(ii) **Iris :** Its function is to control the amount of light entering in the eye. [½]

(iii) **Crystalline lens :** Its function is to focus the images of the objects at different distances, clearly on the retina. [½]

(iv) **Ciliary muscles :** Its function is to alter the focal length of the crystalline lens, so that the image of the objects at various distances if clearly focussed on the retina. [½]

3 : Electricity

1. 40 W lamps [1]

2. To detect the presence of electric current in a circuit. [1]

3. Answer (d) [1]

4. Answer (d) [1]

5. Answer (b) [1]

Same current flows through resistors connected in series.

6. Answer (b) [1]

$$H = \frac{V^2}{R}t$$

$$\Rightarrow \quad H \propto \frac{1}{R}$$

7. Resistivity of an alloy is higher than its constituent metal and alloys do not oxidize as easily as constituent metal at high temperature. That is why the coils of electric toasters are made of an alloy rather than a pure metal. [2]

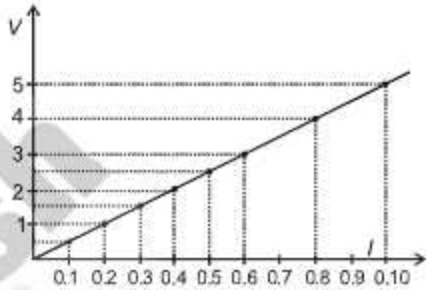
8. $R = \frac{\rho l}{A}$ [½]

If the length is increased to twice the original length, keeping the area of cross-section same, then resistance will become double of its original value. [1]

So new resistance = 2 × 20 = 40 ohm. [½]

9. Resistance (R) = slope of line

$$= \frac{1-0.5}{0.2-0.1} = \frac{0.5}{0.1} = 5\,\Omega$$ [1]



[1]

10. Straight line signify that the potential difference applied across the resistor is directly proportional to the current flowing through it.

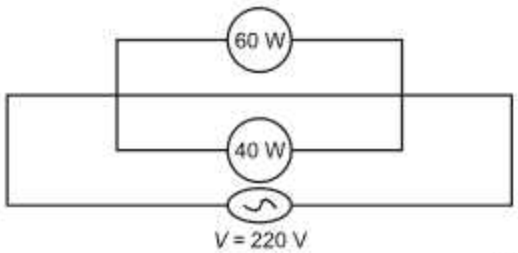
To determine the resistance from the graph, read the current value, in amperes corresponding to a given voltmeter reading and take the ratio $\left(\frac{V}{I}\right)$.

Thus the resistance of conductor is determined in ohms. [2]

11. If the pointer is above the zero mark, the zero error is negative. The number of division it is above the zero mark are to be subtracted from reading. [1]

If the pointer is below zero mark, the zero error is positive. The number of division it is below the zero mark are to be added to reading. [1]

12. (a)



[1]

(b) $I = \frac{P}{V}$

$I_1 = \frac{60\ W}{220\ W} = \frac{3}{11}\ A$

$I_2 = \frac{40\ W}{220\ W} = \frac{2}{11}\ A$

$I = I_1 + I_2 = \frac{3}{11} + \frac{2}{11} = \frac{5}{11}\ A = 0.45\ A$ **[1]**

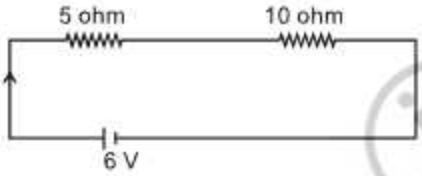
(c) $E = P \times t$ = (40 W + 60 W) × 1 h

= 100 Wh or 0.1 kWh. **[1]**

13. (a) (i) To obtain the minimum current, the resistances should be connected in series. **[½]**

(ii) To obtain the maximum current, the resistances should be connected in parallel. **[½]**

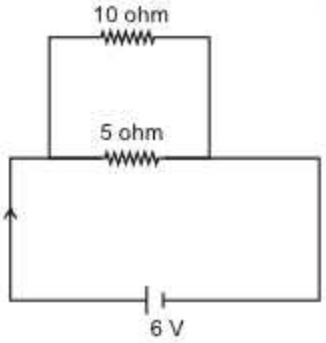
(b) (i) Resistances in series:



Total resistance in the circuit R = 5 + 10 = 15 ohm

Current in the circuit $I = \frac{6}{15} = 0.4\ A$ **[1]**

(ii) Resistances in parallel:



Total resistance in the circuit

$R = \frac{(5 \times 10)}{(5 + 10)} = \frac{50}{15} = \frac{10}{3}$ ohm

Current in the circuit $I = \frac{6 \times 3}{10} = 1.8\ A$ **[1]**

14. (a) Joule's law of heating $H = I^2Rt$

When electric current flows through resistance element, the flowing charges suffer resistance, the work done to overcome resistance is converted to heat energy. **[1]**

(b) P_1 = 100 W, V_1 = 220 V

P_2 = 60 W, V_2 = 220 V

$P = VI$

$I_1 = \frac{P_1}{V_1} = \frac{100}{220} = \frac{10}{22} = 0.45\ A$ **[1]**

$I_1 = \frac{P_2}{V_2} = \frac{60}{220} = \frac{3}{11} = 0.27\ A$ **[1]**

15. (a) Resistance of conductor depends on following factor :

(i) Resistance of conductor is directly proportional to length (l) of the conductor.

$R \propto l$

(ii) Resistance of conductor is inversely proportional to area of cross-section of conductor.

$R \propto \frac{1}{A}$

(iii) Resistance also depends on a material of conductor (ρ)

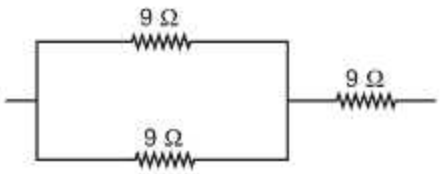
$\therefore \quad R \propto \rho \frac{l}{A}$

(iv) Resistance and resistivity also depends on temperature. **[1]**

(b) Metals have more free electrons than glass to carry currents. That's why glass is bad conductor and metals are good conductors. **[1]**

(c) Alloys are used rather than pure metals in electrical heating devices, since they have low electrical conductivity and also low melting point. **[1]**

16. (i) $\frac{9 \times 9}{9 + 9} = \frac{9 \times 9}{2(9)} = 4.5\ \Omega + 9\ \Omega = 13.5\ \Omega$ **[1½]**

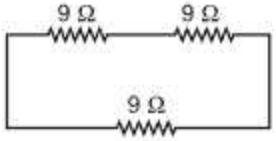


Two 9 Ω resistors are connected in parallel and one in series.

(ii) 2 resistors connected in series

$= (9 + 9)\ \Omega = 18\ \Omega$

18 Ω and 9 Ω are connected in series.

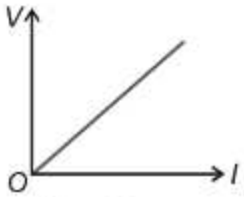


$\frac{18\times9}{18+9} = 6\Omega$ **[1½]**

17. (a) If the physical conditions remains unchanged (such as temperature), the potential difference across the two ends of a conductor is directly proportional to the electric current flowing through it.

$V \propto I$ **[1]**

V-I graph for a conductor



[1]

(b) $\therefore\ V = IR$

$R = \frac{1.4}{0.35} = 4\ \Omega$ **[1]**

18. (a) $H = I^2RT$ **[1]**

(b) $\therefore\ H = VIT = VQ \quad [\because\ Q = IT]$ **[1]**

$H = 40 \times 96000$

$H = 3840000$ J **[1]**

19. (a) Ohm's law states that "If the physical conditions remain unchanged, the potential difference across the two ends of a conductor is directly proportional to the current flowing through it".

Mathematically, $V \propto I$

$V = RI$ **[1]**

where, R is the constant of proportionality and is called the resistance of the conductor.

(b) If 1 volt of potential difference is applied across the ends of a conductor and 1 A of current flows through it, then the resistance of the conductor is said to be 1 ohm. **[1]**

(c) $R = \frac{V}{I} = \frac{2}{0.5} = 4\ \Omega$ **[1]**

20. (a) Resistance of a uniform cylindrical conductor depends on **[4×½=2]**

(i) Length of the conductor

(ii) Area of cross-section of the conductor

(iii) Nature of material of the conductor

(iv) Temperature of the conductor

(b) $r = 0.01$ cm $= 10^{-4}$ m, $R = 10\ \Omega$, $\rho = 50 \times 10^{-8}\ \Omega$m

$\because\ R = \rho\frac{l}{A}$ **[½]**

$\Rightarrow\ l = \frac{RA}{\rho} = \frac{10\times\pi\left(10^{-4}\right)^2}{50\times10^{-8}}$

$\Rightarrow\ l = \frac{3.14}{5} = 0.628$ m

$\Rightarrow\ l = 62.8$ cm **[½]**

21. (a) Electric power of an electrical device is defined as its rate of consumption of electrical energy.

i.e., $P = \frac{E}{t}$ **[1]**

The SI unit of electrical power is watt (W). **[½]**

(b) $P = 2$ kW, $t = 2$ h

(i) $E = P \times t = 2 \times 2 = 4$ kWh **[1]**

(ii) $E = 2000\ \text{W} \times 2 \times 3600\ \text{s}$

$= 1.44 \times 107$ J **[½]**

22. Let us take a resistor of resistance R. Let the current flowing through this resistor is equal to I and the potential difference across it is equal to V. Suppose in time t, Q amount of charge flows through the resistor.

Work done in moving this charge,

$W = VQ$ ...(i)

According to the definition of electric current,

$I = \frac{Q}{t}$

$Q = I \times t$ **[1]**

Putting this in equation (i),

$W = V \times I \times t$

This work done is dissipated as heat.

Hence, heat produced, $H = W = VIt$

$H = VIt$ ...(ii) **[1]**

According to Ohm's law, $V = IR$.

Putting this in equation (ii),

$H = IR \times It$

$H = I^2Rt$ **[1]**

This relation is known as Joule's law of heating

Numerical :

Power, P = 12 W

Potential difference, V = 12 volt

Time duration, t = 1 min = 60 s

$$P = \frac{H}{t}$$ **[1]**

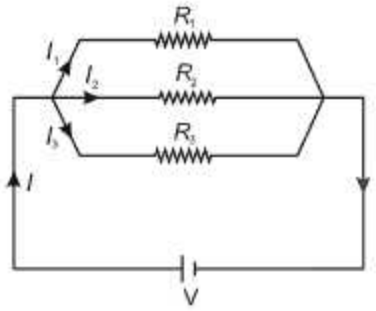
$H = P \times t$

= 12 W × 60 s

= 720 J **[1]**

The heat generated by the instrument is 720 J.

23.



The given figure shows a circuit consisting of three resistors R_1, R_2 and R_3 connected in parallel. The total current in the circuit (I) gets divided among the three resistors as I_1, I_2 and I_3.

Thus, $I = I_1 + I_2 + I_3$ ...(i) **[1]**

Applying Ohm's law for each resistor,

$$\left.\begin{aligned} I_1 &= \frac{V}{R_1} \\ I_2 &= \frac{V}{R_2} \\ I_3 &= \frac{V}{R_3} \end{aligned}\right\} \quad ...(ii)$$ **[1]**

Let the equivalent resistance of the circuit be R_{eq}.

Applying Ohm's law for the equivalent circuit,

$$I = \frac{V}{R_{eq}} \quad ...(iii)$$

Using eqns. (i), (ii) and (iii),

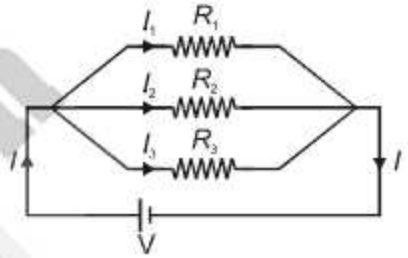
$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$ **[1]**

This is the expression for the equivalent resistance of a parallel combination of three resistances. An ammeter has to be connected in series with the combination of all these resistors so that the current passing through the ammeter is equal to the total current through the circuit. **[1]**

The voltmeter has to be connected in parallel to that resistor across which the potential difference has to be measured. **[1]**

24. (a) Consider three resistors R_1, R_2, R_3 connected in parallel with a battery as shown in the figure



The potential difference across each of the resistor is same as the applied voltage, but the value of current across each resistor is different.

Let I_1, I_2, I_3 be the current flowing through R_1, R_2 and R_3 respectively.

$\therefore\ I = I_1 + I_2 + I_3$ ...(i) **[1]**

Let the effective resistance of this parallel combination be R_P, then using, Ohm's law

$$I = \frac{V}{R_P} \quad ...(ii)$$

As V is same for all resistor, therefore

$$I_1 = \frac{V}{R_1},\ I_2 = \frac{V}{R_2},\ I_3 = \frac{V}{R_3} \quad ...(iii)$$ **[1]**

Hence, from equations (i), (ii) and (iii), we get

$$\frac{V}{R_P} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

$$\boxed{\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$ **[1]**

i.e., the reciprocal of effective resistance in parallel combination is equal to the sum of reciprocals of all the individual resistances.

(b) $\therefore \quad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ [½]

$$\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12}$$ [½]

$R_{eq} = 6\ \Omega$

$\therefore \quad I = \frac{V}{R_{eq}}$ [½]

$I = \frac{6}{6} = 1\ A$ [½]

25. (a) Here conductor and lamp are in series

$\therefore \quad R_{eq} = R_1 + R_2$

$R_{eq} = 4 + 20 = 24\ \Omega$ [1]

(b) $\therefore \quad I = \frac{V}{R_{eq}}$

$I = \frac{6}{24} = 0.25\ A$ [1]

(c) (i) Potential difference across the electric lamp

$\therefore \quad V_L = IR_L$

$V_L = 0.25 \times 20$

$V_L = 5\ V$ [1]

(ii) Potential difference across the conductor

$V_C = IR_C$

$V_C = 0.25 \times 4$

$V_C = 1\ V$ [1]

(d) Power of the lamp

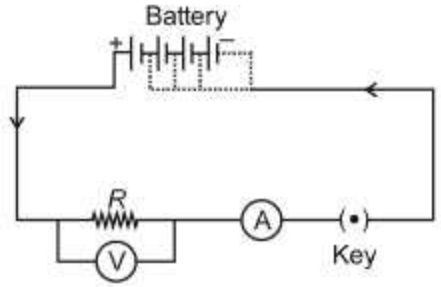
$\therefore \quad P = \frac{V_L^2}{R_L}$

$P = \frac{(5)^2}{20} = \frac{25}{20}$

$P = 1.25\ W$ [1]

26. (i) If the physical conditions remain unchanged (such as temperature), the potential difference across the two ends of a conductor is directly proportional to the electric current flowing through it.If the physical conditions remain unchanged (such as temperature), the potential difference across the two ends of a conductor is directly proportional to the electric current flowing through it.

$V \propto I$ [1]



[1]

(ii) An ammeter is a current measuring device, which is always connected in series in a circuit. Hence, its resistance adds to the total resistance of the circuit. If the resistance of the ammeter would be high, the total resistance would be high. This would decrease the amount of current flowing through the circuit. Hence in order to avoid the change of current flowing in a circuit, the resistance of an ammeter should be low. [1]

(iii) By Ohm's law

$V = IR$

$I = \left(\frac{1}{R}\right)V$

Hence, slope of the *I-V* graph is $\frac{1}{R}$

Slope of B > slope of A [1]

$\frac{1}{R_B} > \frac{1}{R_A}$

$\therefore \quad R_B < R_A$

$\because$ Combination of two resistors in series is greater than combination of two resistors in parallel.

Hence, $A \rightarrow$ Series combination

$B \rightarrow$ Parallel combination [1]

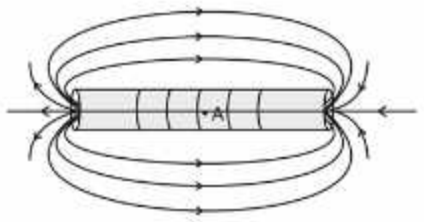
4 : Magnetic Effects of Electric Current

1. A series arrangement is not used for connecting domestic electrical appliances in a circuit because :
   (i) Same current flows through each device, but different devices need current of different values to operate.
   (ii) If one device in a series circuit is defective, current is cut off.
   (iii) Total resistance of the circuit increases, so current flowing is reduced.
   (iv) Selective operation of devices is not possible. **[4 × ¼]**
2. Using Fleming's left hand rule we can easily find out that the nature of the charge on the particle is positive. **[1]**
3. To detect the presence of electric current in a circuit. **[1]**
4. Answer (c) **[1]**
5. Answer (d) **[1]**
   Using Fleming's left hand rule.
6. Answer (b) **[1]**
7. Magnetic field - The region around a magnet in which force of the magnet can be experienced. **[1]**
   A compass needle is a small bar magnet so it experiences the force of the other bar magnet when brought near it and deflects. **[1]**
8. In figure '*a*'
   (a) P - North pole
   Q - South pole **[½]**
   In figure 'b'
   R - North pole
   S - South pole **[½]**
   (b) On the basis of diagrams we conclude that outside the magnet, magnetic field lines emerge from north pole and merge at south pole. **[1]**

   OR

   (i) The force experienced by a current-carrying straight conductor is maximum when the conductor is placed perpendicular to the direction of magnetic field. **[1]**
   (ii) The force experienced by a current-carrying straight conductor is minimum when the conductor is placed along the direction of magnetic field whether parallel or antiparallel. **[1]**
9. (a) Short circuiting - When neutral and live wire come in direct contact. **[1]**
   Overloading - When too many appliances are connected to a single socket drawing much more current or power than permissible. **[1]**
   (b) Resistivity of an alloy is higher than its constituent metal and alloys do not oxidize as easily as constituent metal at high temperature. That is why the coils of electric toasters are made of an alloy rather than a pure metal. **[1]**
10. (A) (i) Alternating current (A.C.) can be transmitted over long distance with a very low loss of energy in comparison to Direct current (D.C.). **[1]**
    (ii) The type of current used in household supply is alternating current which continuously vary in direction and magnitude whereas the current given by the battery of dry cells is direct current which is of constant magnitude and direction. **[1]**
    (iii) A fuse is a safety device having a short length of a thin wire made of tin-lead alloy which has a lower melting point. This wire melts and breaks the circuit if the current exceeds the safe value. This saves costly electric appliances and buildings from damage. **[1]**

    OR

    (B) 

    [1]

    Field strength is maximum at point *A* as it lies inside the solenoid where field lines are most dense. Field strength is minimum at point *B* as it lies outside the solenoid. **[2]**

11. (a) Because a current carrying conductor placed in a magnetic field experiences force. [1]

(b) **Fleming's left hand rule:**

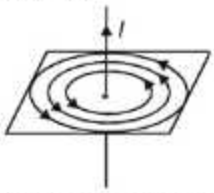
If the forefinger, the second finger and the thumb of the left hand are stretched at right angles to each other, with the forefinger pointing in the direction of the field and the second finger in the direction of the current then the thumb indicates the direction of the force. [1]

(c) (i) Downwards [1]

(ii) Electric motor and electric generator [1]

OR

The magnetic field lines around a straight current carrying conductor are concentric circles on planes perpendicular to the direction of current.



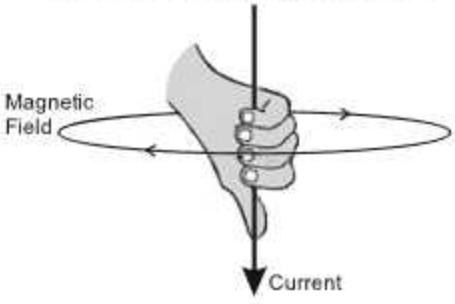
[2]

12. (a) Magnetic field is a region near a magnetised body where magnetic forces can be detected. [1]

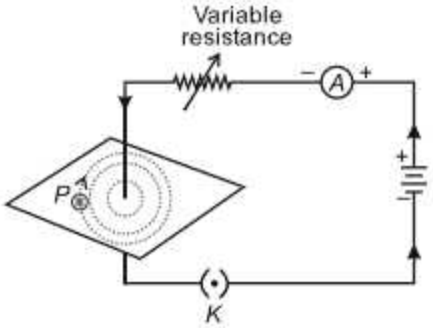
The direction of the magnetic field line at a place is determined by the direction in which a north pole of the compass needle moves inside it. [1]

(b) Direction of the magnetic field produced around a current carrying conductor is determined by the right hand thumb rule.

According to this rule, if we hold a current-carrying straight conductor in right hand such that the thumb points towards the direction of current, then fingers will wrap around the conductor in the direction of the field lines of the magnetic field. This is also shown in the figure given below : [2]

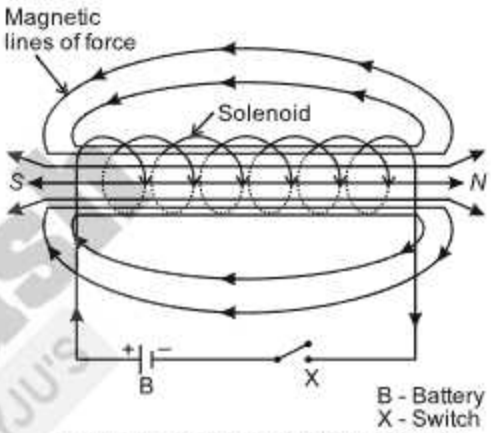


Pattern of field lines due to a current flowing through a straight conductor:



[1]

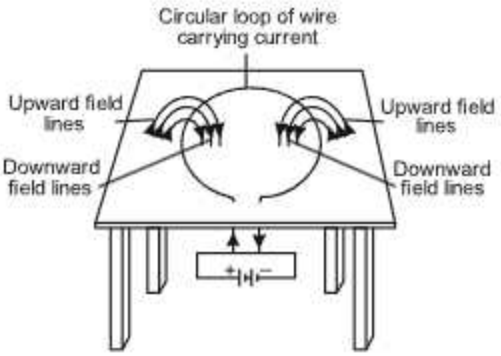
13. (a) A solenoid is a long coil (shaped like a cylinder) containing a large number of close turns of insulated copper wire. [1]



[2]

Field lines of the magnetic field through and around a current carrying solenoid

(b) Direction of magnetic field inside and outside the loop is given as follows:

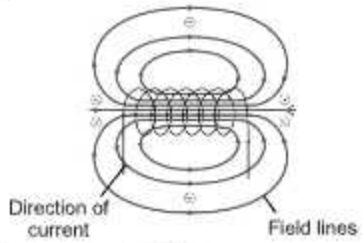


[2]

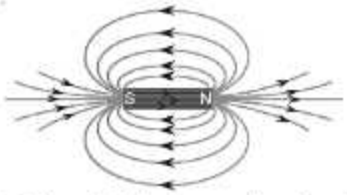
14. Hold the forefinger the centre finger and the thumb of your left hand at right angles to one another. If the forefinger points in the direction of magnetic field, and centre finger points in the direction of current, the thumb gives direction of motion conductor. [1]

15. A solenoid is a long cylindrical coil containing a large number of closely spaced turns of insulated copper wire. **[1]**

(i) **[1]**



(ii) **[1]**



Distinguish between the two fields are

(a) The strength of magnetic field due to solenoid can be changed while the magnetic field strength due to bar magnet cannot be changed. **[1]**

(b) Solenoid produces magnetic field so long as current flows in its coils while bar magnet produces a permanent magnetic field. **[1]**

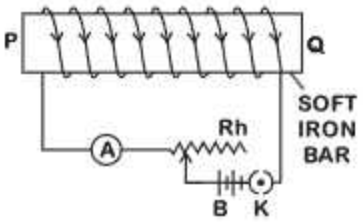
16. (a) An electromagnet is a temporary magnet made from a piece of soft iron when current flows in the coil wound around it. **[1]**

Uses of electromagnet :

(i) For removing pieces of iron from wounds **[½]**

(ii) For lifting and transporting the large masses of iron scrap, grinders, plates etc. **[½]**

(b) **[1]**



(c) If a core of soft iron is placed inside a solenoid, the magnetic field strength inside the solenoid is greatly increased. **[1]**

(d) (i) By increasing the number of turns of winding **[½]**

(ii) By increasing the current **[½]**

❑ ❑ ❑

CHEMISTRY

1 : Chemical Reactions and Equations

1. $3Fe(s) + 4H_2O(l) \longrightarrow Fe_3O_4(s) + 4H_2(g)$ **[1]**

2. Respiration is the process in which during digestion, the food is broken down to form glucose. Glucose then combines with oxygen in the cells of our body to provide energy. Since energy is released during respiration, so it is considered an exothermic process. **[1]**

3. $2Pb(NO_3)_2(s) \xrightarrow{\text{Heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$ **[1]**

4. Hydrochloric acid (HCl) may be used as the reducing agent to obtain manganese from manganese dioxide. **[1]**

5. When iron nails are dipped in copper sulphate solution for about 30 minutes, iron nails become brownish in colour and the colour of copper sulphate solution changes from blue to light green.

$$\underset{\text{Iron (Grey)}}{Fe(s)} + \underset{\text{Copper sulphate (Blue)}}{CuSO_4(aq)} \longrightarrow \underset{\text{Iron sulphate (Light green)}}{FeSO_4(aq)} + \underset{\text{Copper (Brown)}}{Cu(s)}$$ **[1]**

6. Answer (d)

$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$ **[1]**

7. Answer (c)

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow \underset{\text{White}}{BaSO_4(s)} + 2NaCl(aq)$$ **[1]**

8. Answer (b)

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$$ **[1]**

9. Answer (c)

The given reaction represents respiration which is an exothermic reaction. **[1]**

10. Answer (c)

$$\underset{\text{Oxidation}}{MnO_2 + 4HCl \longrightarrow \underset{\text{Reduction}}{MnCl_2} + 2H_2O + Cl_2}$$ **[1]**

In the given reaction :

MnO_2 is oxidising agent and HCl is reducing agent

11. Answer (c)

In a chemical reaction, the composition of reactants changes to give new product(s). **[1]**

12. Answer (d)

	Reaction	Type of reaction
(a)	$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$	Electrolytic decomposition
(b)	$2AgBr(s) \rightarrow 2Ag(s) + Br_2(g)$	Photolytic decomposition
(c)	$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$	Photolytic decomposition
(d)	$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	Thermal decomposition

[1]

13. Answer (d)

Burning of natural gas is an exothermic process.

$$\underset{\text{Methane}}{CH_4(g)} + \underset{\text{Oxygen}}{2O_2(g)} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2(g)} + \underset{\text{Water}}{2H_2O(g)}$$ **[1]**

14. Answer (b) **[1]**

$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

15. Answer (b) **[1]**

$$\underset{\text{'X'}}{2Mg(s)} + O_2(g) \rightarrow \underset{\text{'Y'}}{2MgO(s)}$$

The type of reaction involved is combination reaction.

16. Answer (a) **[1]**

$$\underset{\text{Quicklime}}{CaO(s)} + \underset{\text{Water}}{H_2O(l)} \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2(aq)} + \text{Heat}$$

17. $$\underset{\text{(Lead nitrate)}}{2Pb(NO_3)_2(s)} \xrightarrow{\text{Heat}} \underset{\text{(Lead oxide)}}{2PbO(s)} + \underset{\text{(Nitrogen dioxide)}}{4NO_2(g)} + \underset{\text{(Oxygen)}}{O_2(g)}$$ **[1]**

Activity:

On heating 2 g of lead nitrate powder in a boiling tube, emission of brown fumes of nitrogen dioxide (NO_2) is observed. **[1]**

18. (i) Ferrous sulphate crystals are light green in colour. On heating, the green colour of the crystals changes to white because of loss of water of crystallisation on heating. **[1]**

(ii) On strongly heating ferrous sulphate crystals, ferric oxide, sulphur dioxide and sulphur trioxide are formed.

$$2FeSO_4(s) \xrightarrow{Heat} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$ **[½]**

This is a decomposition reaction. **[½]**

19. When an aqueous solution of sodium sulphate reacts with an aqueous solution of barium chloride, barium sulphate precipitates out along with the formation of solution of sodium chloride. **[1]**

If the reactants are in solid state, then reaction will not take place between sodium sulphate and barium chloride. **[½]**

$$\underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + \underset{\text{Barium chloride}}{BaCl_2(aq)} \longrightarrow \underset{\text{Barium sulphate}}{BaSO_4(s)} + \underset{\text{Sodium chloride}}{2NaCl(aq)}$$ **[½]**

20. (i) A is manganese dioxide (MnO_2) and B is aluminium powder (Al). **[1]**

Chemical equation :

$$\underset{A}{3MnO_2(s)} + \underset{B}{4Al(s)} \xrightarrow{Heat} \underset{D}{2Al_2O_3(s)} + \underset{C}{3Mn(l)} + Heat$$

[½]

Thermal status of the reaction : The reaction is highly exothermic reaction and a lot of heat is evolved. **[½]**

(ii) The above chemical reaction can be classified as

(a) Displacement reaction

(b) Exothermic reaction

(c) Redox reaction **[Any two] [½ × 2 = 1]**

21. (a) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ **[1]**

(b) $2AgCl(s) \xrightarrow{Sunlight} 2Ag(s) + Cl_2(g)$ **[1]**

(c) $2H_2O(l) \xrightarrow[decomposition]{Electrolytic} 2H_2(g) + O_2(g)$ **[1]**

22. **Observation** : White silver chloride turns grey in sunlight due to the decomposition of silver chloride into silver and chlorine. **[1]**

Chemical reaction :

$$\underset{\text{Silver chloride}}{2AgCl(s)} \xrightarrow{Sunlight} \underset{\text{Silver}}{2Ag(s)} + \underset{\text{Chlorine}}{Cl_2(g)}$$ **[1]**

Type of chemical reaction – Decomposition reaction. **[1]**

23. (i) $\underset{\text{Zinc}}{Zn(s)} + \underset{\text{Silver nitrate}}{2AgNO_3(aq)} \longrightarrow$

$$\underset{\text{Zinc nitrate}}{Zn(NO_3)_2(aq)} + \underset{\text{Silver}}{2Ag(s)}$$ **[1]**

Type of reaction – Displacement reaction **[½]**

(ii) $\underset{\text{Potassium iodide}}{2KI(aq)} + \underset{\text{Lead nitrate}}{Pb(NO_3)_2(aq)} \longrightarrow$

$$\underset{\substack{\text{Lead iodide}\\(\text{Yellow ppt.})}}{PbI_2(s)} + \underset{\substack{\text{Potassium}\\\text{Nitrate}}}{2KNO_3(aq)}$$ **[1]**

Type of reaction – Double displacement reaction **[½]**

24. (i) Some drops of an acid are added to water while electrolysing water in order to enhance the conductivity of solution. **[½]**

The gas liberated at cathode is hydrogen and the gas liberated at anode is oxygen. **[½+½]**

The volume of gas collected at cathode is double in volume of gas collected at anode. **[½]**

(ii) When silver chloride is exposed to sunlight its colour changes from white to grey. **[½]**

The type of reaction involved is photochemical decomposition reaction. **[½]**

2 : Acids, Bases and Salts

1. The flow of acid rain water into a river make the survival of aquatic life in the river difficult by lowering the pH of river water. **[1]**
2. When fresh milk changes to curd, its pH value decreases because of the formation of lactic acid. **[1]**
3. Answer (d)

   It smells like vinegar and turns blue litmus red **[1]**
4. Answer (d)

   A clear colourless solution **[1]**
5. Answer (d)

   I, II and IV **[1]**
6. Answer (a)

   The acetic acid dissolves readily in water. **[1]**

7. Answer (c) **[1]**

The chemical formula of Plaster of Paris is

$CaSO_4 \cdot \frac{1}{2}H_2O$

8. **Answer (*)** **[1]**

*In this question, it should be baking powder instead of baking soda as sodium hydrogen carbonate itself is known as baking soda.

∴ Had it been baking powder then the answer will be **option (c)**

9. **Answer (a)** **[1]**

$Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$

$K_2O(s) + H_2O(l) \longrightarrow 2KOH(aq)$

10. Answer (d) **[1]**

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

H_2 gas burns with a pop sound.

11. Answer (c) **[1]**

12. Answer (d) **[1]**

Bases turn pink when a drop of phenolphthalein is added to it

13. Answer (d) **[1]**

Salt	Parent Acid	Parent Base	Nature of Salt
Sodium Chloride	HCl	NaOH	Neutral
Sodium Carbonate	H_2CO_3	NaOH	Basic
Sodium Sulphate	H_2SO_4	NaOH	Neutral
Sodium Acetate	CH_3COOH	NaOH	Basic

14. Answer (c) **[1]**

Lesser the pH value, more will be the hydrogen ion concentration.

So, the correct decreasing order of H^+ ion concentration will be : 2 > 1 > 4 >3

15. Answer (d) **[1]**

$\underset{\text{'P'}}{K_2CO_3(s)} + 2HCl(aq) \longrightarrow 2KCl(aq) + H_2O(l) + \underset{\text{'Q'}}{CO_2(g)}$

- CO_2 turns calcium hydroxide milky.

16. Answer (d) **[1]**

	Compound	Formula
(i)	Bleaching powder	$CaOCl_2$
(ii)	Plaster of Paris	$CaSO_4 \cdot \frac{1}{2}H_2O$
(iii)	Washing soda	$Na_2CO_3 \cdot 10H_2O$
(iv)	Baking soda	$NaHCO_3$

17. Answer (a) **[1]**

Sodium hydrogen carbonate is used as an ingredient in antacids because it is a mild non-corrosive basic salt.

18. Answer (c) **[1]**

The process of dissolving an acid in water is highly exothermic in nature.

On addition of acid to water, concentration of H^+ ions increases, so pH decreases.

19. Answer (c) **[1]**

$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

Carbon dioxide gas is evolved which turns lime water milky.

20. Answer (d) **[1]**

Oxalic acid is present in tomato.

21. Answer (b) **[1]**

Bases which are soluble in water are called alkalis. Sodium hydroxide is a base which is soluble in water while ferric hydroxide is also a base but it is not soluble in water.

22. Answer (c) **[1]**

Sodium carbonate decahydrate ($Na_2CO_3.10H_2O$) is used for removing permanent hardness of water.

23. Washing soda : $Na_2CO_3.10H_2O$ **[½]**

Baking soda is heated to obtain washing soda

$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$ **[½]**

$Na_2CO_3 + 10H_2O \longrightarrow \underset{\text{(Washing soda)}}{Na_2CO_3.10H_2O}$ **[½]**

Uses: **[½]**

(a) It is used for removing permanent hardness of water.

(b) It is used in manufacturing of sodium compounds such as borax.

(c) It is used in the manufacture of glass, soap and paper. [Write any one use]

24. The compound is Plaster of Paris *i.e* calcium sulphate hemihydrate ($CaSO_4.½H_2O$)

$$\underset{\text{Calcium sulphate dihydrate (Gypsum)}}{CaSO_4 \cdot 2H_2O} \xrightarrow[373\,K]{\Delta} \underset{\text{Calcium sulphate hemihydrate (Plaster of Paris)}}{CaSO_4 \cdot \frac{1}{2}H_2O} + \underset{\text{Water}}{\frac{3}{2}H_2O}$$ **[1]**

Use in hospital :

It is used as plaster for supporting fractured bones in the right position. **[1]**

25. The colour change will be observed in test tube A only. **[1]**

The colour of blue litmus solution becomes red as acid turns blue litmus red. **[1]**

26. When 2 mL of dilute HCl is added to 1 g of sodium carbonate, CO_2 is evolved with brisk effervescence along with the formation of water and sodium chloride salt. **[1]**

$$\underset{\text{Sodium carbonate}}{Na_2CO_3(s)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow 2\underset{\text{Sodium chloride}}{NaCl(aq)} + \underset{\text{Water}}{H_2O(l)} + \underset{\text{Carbon dioxide}}{CO_2(g)}$$ **[1]**

27. (A) (i) The compound formed is copper (II) chloride and its colour is blue-green **[½+½]**

(ii) $CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$ **[1]**

OR

(B) X = Sodium chloride (NaCl) **[½]**

Y = Hydrogen (H_2) **[½]**

Z = Chlorine (Cl_2) **[½]**

B = Bleaching powder ($CaOCl_2$) **[½]**

28. The equation of chemical reaction involved is

$$2NaOH(aq) + Zn(s) \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2(s)} + H_2(g)$$ **[1]**

Test to detect the gas :

Hydrogen gas is evolved whose presence can be confirmed by bringing a burning candle near the mouth of the test tube. Hydrogen gas burns with pop sound. **[1]**

When the same metal reacts with dilute solution of a strong acid, hydrogen gas is evolved.

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$ **[1]**

29. The salt is baking soda ($NaHCO_3$.) **[1]**

Baking soda is prepared by reacting cold and concentrated solution of sodium chloride with ammonia and carbon dioxide.

$$\underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Ammonia}}{NH_3} \longrightarrow \underset{\text{Ammonium chloride}}{NH_4Cl} + \underset{\text{Sodium hydrogen carbonate}}{NaHCO_3}$$ **[1]**

Uses :

(a) Sodium hydrogencarbonate is also used as an antacid to remove acidity. **[½]**

(b) It is also used in soda-acid fire extinguishers. **[½]**

30. The acid and the base from which sodium chloride is obtained are HCl and NaOH respectively. **[½ + ½]**

It is a neutral salt as pH of its aqueous solution is 7. **[½]**

Sodium chloride is also found in nature in solid form (large crystals). These large crystals are often brown due to impurities. This is called as rock salt. **[1]**

Beds of rock salt were formed when seas of bygone ages dried up. **[½]**

31.

Products of Chlor-alkali process	Use	
Hydrogen (H_2)	It is used as a fuel.	[½ + ½]
Chlorine (Cl_2)	It is used as a fuel.	[½ + ½]
Sodium hydroxide (NaOH)	It is used for making soaps and detergents	[½ + ½]

32. Washing soda is prepared by recrystallisation of sodium carbonate. **[1]**

$$\underset{\text{Sodium carbonate}}{Na_2CO_3} + 10H_2O \longrightarrow \underset{\text{Washing soda}}{Na_2CO_3 \cdot 10H_2O}$$ **[1]**

It is a basic salt. **[½]**

It can be used for removing permanent hardness of water. **[½]**

33. (i) For diluting a strong concentrated acid, acid should always be added slowly to water with constant stirring. **[1]**

(ii) When sulphuric acid is added to sodium hydroxide, sodium sulphate is formed. **[½]**
pH of sodium sulphate solution is 7. **[½]**

(iii) Dry HCl gas does not change the colour of dry blue litmus paper because separation of H^+ ion from HCl molecules cannot occur in the absence of water. **[1]**

3 : Metals and Non-metals

1. Answer (a)

   Aluminium is more reactive than zinc as it can displace zinc from its solution. **[1]**

2. Answer (b)

   The blue coloured copper sulphate solution changes to light green iron sulphate solution due to the displacement of copper by iron from copper sulphate solution. **[1]**

3. Answer (d)

   Copper sulphate solution is blue coloured and iron sulphate solution is pale green. **[1]**

4. Answer (d)

   $$\underset{(X)}{Fe(s) + CuSO_4(aq)} \longrightarrow \underset{\text{Greenish}}{FeSO_4(aq)} + Cu(s)$$

   $$\underset{(Y)}{Zn(s) + FeSO_4(aq)} \longrightarrow \underset{\text{Colourless}}{ZnSO_4(aq)} + Fe(s)$$ **[1]**

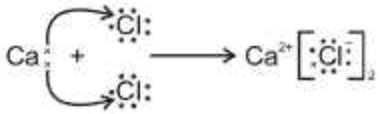
5. Answer (b)

   $3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$ **[1]**

6. Answer (b) **[1]**

7. Answer (c) **[1]**

   Assuming that there is minus sign above chlorine in option (c)

8. Answer (b) **[1]**

   A more reactive metal displaces a less reactive metal from its salt solution.

9. Answer (b) **[1]**

   As R reacts violently with cold water so it can be Na or K, hence needs to be stored in kerosene oil.

10. Answer (d) **[1]**

    Metal Q reacts with hot water and it starts floating, so it can be Mg.

11. Answer (a) **[1]**

    P reacts with steam and formula of its oxide is P_2O_3, so P can be Al, as Al_2O_3 is amphoteric in nature.

12. Answer (c) **[1]**

    R is the most reactive metal as it reacts with cold water violently. After that Q is most reactive as it reacts with hot water, then P which reacts with steam. S is the least reactive metal as it does not react with water at all.

13. (a) Those metal oxides which show both basic as well as acidic behavior are called amphoteric oxides. **[1]**

    ZnO, Al_2O_3 **[1]**

    (b) Non-metals cannot lose electrons to H^+ to form H_2 gas because non-metals are electron-acceptors. So, they do not react with dilute acids. **[1]**

14. Corrosion of iron to a brown flaky substance in the presence of moist air is called rusting. **[½]**

    Activity to find out the conditions under which iron rusts:

    (i) Take three test tubes and place some clean iron nails in each of them.

    (ii) Label these test tubes as A, B and C.

    (iii) Pour some water in test tube A and cork it.

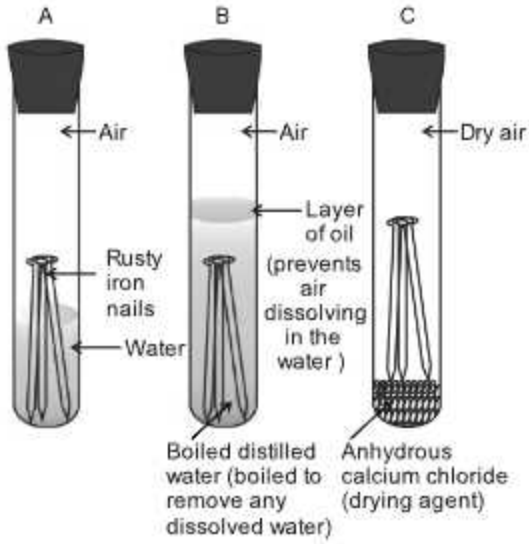
    (iv) Pour boiled distilled water in test tube B, add about 1 mL of oil and cork it. The oil will float on water and prevent air from dissolving in water.

    (v) Put some anhydrous calcium chloride in test tube C and cork it.

    Anhydrous calcium chloride will absorb the moisture, if any, from the air.

    (vi) Leave the three test tubes for a few days. **[1]**

    Observation : After a few days the iron nails in test tube A rusts. In test tubes B and C, no rusting occurs.

    [1]

    Conclusion : Both air and moisture are necessary for rusting of iron. **[½]**

15. Atomic number of X = 20

Electronic configuration = 2, 8, 8, 2 **[1]**

Atomic number of Y = 17

Electronic configuration = 2, 8, 7 **[1]**

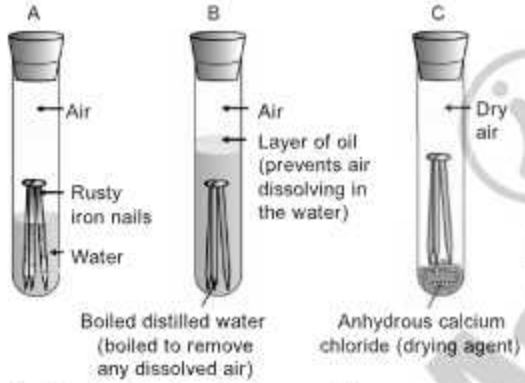
Molecular formula of the compound formed $= XY_2$.

Electron-dot structure of the compound: **[1]**

An ionic bond is formed between the two elements.

16. The slow eating up of iron articles by the action of air, moisture or a chemical on its surface results into the formation of brown flaky substance on it, called rust. This phenomena is called rusting. **[1]**

In order to investigate rusting we take three test tubes and place clean iron nails in each of them as shown below.



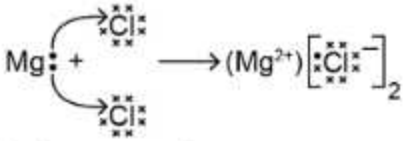
[½]

(i) In test tube A, the nails are exposed to both air and water, therefore they get rusted. **[½]**

(ii) In test tube B, the nails are exposed only to water and there is no air dissolved in it. Therefore they do not rust. **[½]**

(iii) In test tube C, the nails are exposed to dry air therefore they do not rust. **[½]**

17. (i) Electron transfer in the formation of $MgCl_2$



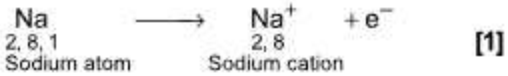
[1]

(ii) Ionic compounds :

(a) Are generally soluble in water and insoluble in organic solvents such as kerosene, petrol etc. **[½]**

(b) Conduct electricity in molten or aqueous state. **[½]**

(iii) (A) Sodium atom has one electron in its outermost shell. After losing one electron from the valence shell, it attains the stable noble gas configuration of neon as shown below: **[1]**



[1]

OR

(iii) (B) (a) Ionic compounds do not conduct electricity in the solid state because movement of ions in the solid is not possible due to their rigid structure. **[1]**

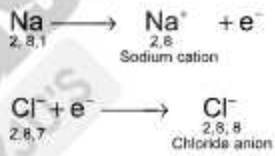
(b) When electricity is passed through an aqueous solution of NaCl, hydrogen gas is released at cathode. **[1]**

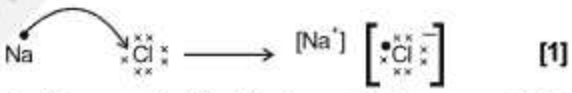
18. Name and symbols of the two most reactive metals belonging to group I of the periodic table:

S. No.	Name of metal	Symbol of metal
1.	Sodium	Na
2.	Potassium	K

[1]

Formation of sodium chloride :





[1]

Sodium and chloride ions, being oppositely charged are held by strong electrostatic forces of attraction to exist as NaCl.

Bond formed between sodium and chloride ion is ionic bond.

The class of compounds formed by the transfer of electrons from a metal to a non-metal are known as ionic compounds or electrovalent compounds. **[1]**

Physical properties of ionic or electrovalent compounds:

(i) Ionic compounds are generally solids and are somewhat hard. **[½]**

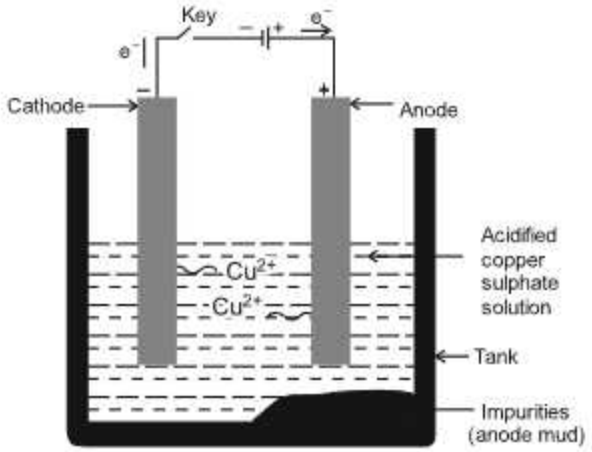
(ii) Ionic compounds have high melting and boiling points. **[½]**

(iii) Ionic compounds are generally soluble in water and insoluble in organic solvents such as kerosene, petrol, etc. **[½]**

(iv) Ionic compounds conduct electricity in aqueous solution and in molten state. They do not conduct electricity in solid state. **[½]**

19. The process of obtaining pure metal from its impure form is called refining of metals. The most widely used method for refining impure metals is electrolytic refining. **[1]**

Electrolytic refining of copper:



[2]

In electrolytic refining of copper, electrolyte is a solution of acidified copper sulphate. The anode is made up of impure copper whereas cathode is made up of a strip of pure copper metal. **[1]**

On passing current through the electrolyte, pure copper metal from the anode dissolves into the electrolyte *i.e.*, acidified copper sulphate and an equivalent amount of pure metal from the electrolyte is deposited on the cathode. **[1]**

The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

20. (i) Lets us consider the extraction of Zn metal from its carbonate ore.

Steps involved are

(a) The ore $ZnCO_3$ is first concentrated by gravity separation method. **[½]**

(b) The ore is calcinated (heated in the absence of air) to convert in to zinc oxide.

$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2 \uparrow$$ **[½]**

(c) The zinc oxide is reduced by coke to zinc. **[½]**

$$ZnO + C \rightarrow Zn + CO$$

(d) The impure Zn thus obtained can be purified by electrolysis. **[½]**

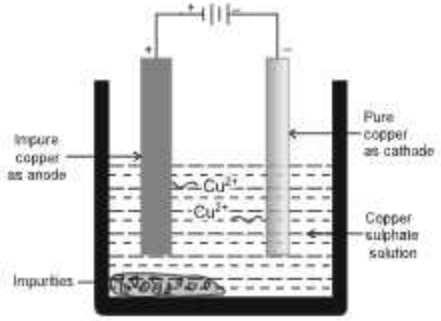
(ii) (a) Copper from its sulphide ore can be extracted simply by heating in air.

The steps involved are

1. $2Cu_2S + 3O_2(g) \xrightarrow{\Delta} 2Cu_2O + 2SO_2$ **[½]**

2. $2Cu_2O + 2Cu_2S \xrightarrow{\Delta} 6Cu(s) + SO_2(g)$ **[½]**

(b) **[2]**



Experimental set up for the electrolytic refining of copper

21. (i)

	Metal	Non-metal	
(a)	Metal oxides are generally basic in nature.	Non-metallic oxides are generally acidic in nature.	**[1]**
(b)	Metals generally react with water to produce hydrogen gas.	Non-metals generally do not react with water or steam.	**[1]**
(c)	Metals are electropositive elements.	Non-metals are electronegative elements.	**[1]**

(ii) (a) Due to the presence of free electrons, most of the metals conduct electricity well. **[1]**

(b) When iron (III) oxide (Fe_2O_3) reacts with heated aluminium, the amount of heat evolved is so large that the metal produced is in molten state and thus used to join cracked machine parts. **[1]**

22. (a) Thermit process is a technique which is used to reduce metal oxide using more reactive metal powder. **[1]**

The reaction of iron (III) oxide with aluminium is a thermit reaction which is used to join railway tracks or cracked machine parts. **[1]**

$Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(l) + Al_2O_3(s) + Heat$ **[1]**

(b) Aluminium metal belongs to category of metals of high reactivity in the reactivity series. It is more reactive than zinc and less reactive than magnesium. **[1]**

(c) Fe_2O_3 is getting reduced and Al is getting oxidised in this process. **[½+½]**

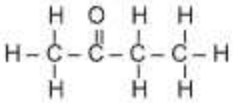
4 : Carbon and its Compounds

1. Two characteristic features of carbon which give rise to a large number of carbon compounds are :

   (a) **Catenation :** Carbon has the unique ability to form bonds with other atoms of carbon giving rise to a large number of molecules *i.e.*, carbon has a tendency to catenate.

   (b) **Tetravalency :** Since carbon has a valency of four, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent element. **[1]**

2. Structure of butanone, $CH_3COC_2H_5$



[1]

3. Answer (c)

   Sodium bicarbonate reacts with acetic acid to release carbon dioxide gas which does not support combustion and hence extinguisher the splinter. **[1]**

4. Answer (b)

   Acetic acid reacts with solid sodium hydrogen carbonate vigorously and effervescence is produced due to evolution of CO_2 gas. **[1]**

5. Answer (a)

   Vapours of acetic acid smell pungent like vinegar. **[1]**

6. Answer (c)

   Na_2CO_3 reacts with acetic acid to evolve carbon dioxide gas. **[1]**

7. Answer (b)

   Hard water contains Ca^{2+} and Mg^{2+} ions. Thus the salts which can be added to water to make it hard are calcium sulphate, calcium chloride and magnesium chloride *i.e.*, salts 1, 3 and 6. **[1]**

8. Answer (d)

   The correct observation are (IV), (I) and (II) **[1]**

9. Answer (b)

   Ethanoic acid is readily soluble in water. **[1]**

10. Answer (c)

    Sodium hydroxide is present in the form of white flakes or pellets. **[1]**

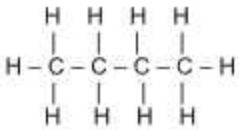
11. Answer (c)

    The reaction is endothermic and the reaction mixture is basic in nature.

    Saponification is defined as the hydrolysis of an ester under basic conditions leading to the formation of sodium salt of fatty acids. It is an endothermic reaction *i.e.*, it absorbs surrounding heat. **[1]**

12. Answer (a) **[1]**

13. There are thirteen covalent bonds ; ten C-H and three C-C bonds, present in a molecule of butane.



[1]

14. Answer (d)

    The purpose of adding common salt is to favour the precipitation of the soap. During saponification, the soap formed remains in a suspended form in the mixture. It is precipitated as a solid from the suspension by the addition of common salt to it. This process is known as salting out of soap. **[1]**

15. Answer (a)

    In test tubes P and Q, lather (foam) is formed by the reaction of soap solution with sodium sulphate and potassium sulphate respectively. They are dissolved in water to give a neutral solution. Sulphates, chlorides and bicarbonates of calcium and magnesium make the water hard. Thus, lather is not formed in the test tubes R and S. **[1]**

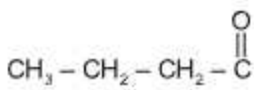
16. Carbon dioxide gas gets liberated. When a pinch of sodium hydrogen carbonate is added to acetic acid in a test tube, a brisk effervescence is produced because of the liberation of carbon dioxide gas. When this gas is passed through the lime water, it turns lime water milky.

    This test confirms that the gas liberated is CO_2. The chemical reaction can be represented as

$$CH_3COOH\ (aq) + NaHCO_3(s) \rightarrow CH_3COONa\ (aq) + H_2O(l) + CO_2(g)$$

    [1]

17. 1-Butanal



[1]

18. The molecular formula of the 2nd and 3rd members of a homologous series where the first member is ethyne (C_2H_2) is formed by adding $-CH_2$ group.

2^{nd} member of alkyne series is Propyne (C_3H_4)
$CH_3 - C \equiv CH$

3^{rd} member of alkyne series is Butyne (C_4H_6)
$CH_3 - CH_2 - C \equiv CH$ **[1]**

19. Answer (d)

Hard water can be prepared by dissolving sulphates, chlorides or bicarbonate salts of calcium or magnesium. **[1]**

20. The functional group present in propanone is ketone. **[1]**

21. Answer (c)

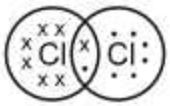
The difference between the molecular masses of the two consecutive members of a homologous series is 14 u. **[1]**

22. Answer (c) **[1]**

Atomic number of chlorine = 17

Electronic configuration = 2, 8, 7

Electron dot structure of chlorine molecule:



23. Due to the presence of double and triple bonds in alkenes and alkynes respectively, the addition of hydrogen is possible in them.

The general formula of alkenes is C_nH_{2n} and that of alkynes is C_nH_{2n-2}. Conditions for addition reactions are

- Presence of an unsaturated compound, i.e. an unsaturated hydrocarbon.
- Presence of a species to be added to an unsaturated compound.
- Presence of a catalyst such as finely divided palladium or nickel.

$$\underset{\text{Ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{Ni} \underset{\text{Ethane}}{CH_3 - CH_3}$$ **[2]**

24. Two main observations about the reaction are :

(a) Brisk effervescence of carbon dioxide which turns lime water milky.

(b) It is a neutralisation reaction and heat is released.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$ **[2]**

25. The chemicals required to prepare soap in the lab are : vegetable oil, common salt and 20% sodium hydroxide solution.

On dipping red litmus paper in the reaction mixture, it turns blue. Hence, the reaction mixture of the saponification reaction is basic in nature. **[2]**

26. Compound 'X' on heating with excess conc. sulphuric acid at 443 gives unsaturated compound.

$$\underset{\substack{\text{'X'}\\\text{(Alcohol)}}}{CH_3 - CH_2 - OH} + H_2SO_4(\text{conc.}) \xrightarrow{443\ K} \underset{\substack{\text{'Y'}\\\text{(Alkene)}}}{CH_2 = CH_2} + H_2O$$

$$\underset{\text{(Alcohol)}}{CH_3 - CH_2 - OH} + Na \longrightarrow CH_3 - CH_2 - ONa + \underset{\text{'Z'}}{H_2}$$

Concentrated H_2SO_4 acts as a dehydrating agent

$X \rightarrow C_2H_5OH$

$Y \rightarrow C_2H_2$

$Z \rightarrow H_2$ **[2]**

27. In test tube A the length of the foam (lather) will be longest.

Reason : Soap produces good lather (or foam) with soft water (distilled water) only.

Both test tubes B and C contain hard water and soap forms scum in hard water. **[2]**

28. Carbon does not prefer to gain or lose electrons because:

On gaining four electrons it will form C^{4-} ion, which is highly unstable due to the large amount of energy required to overcome inter-electronic forces of repulsion. **[1]**

On losing four electrons it will form C^{4+} ion, which is highly unstable due to the large amount of energy required to remove four electrons from the carbon atoms. **[1]**

Therefore, in order to overcome these problems, carbon prefers to share its valence electrons with other atoms of carbon or with atoms of other elements.

29. (i) Electronic configuration of 'X' =

K	L	M
2	8	1

[½]

Valency of 'X' = 1 **[½]**

(ii) Formula of oxide of 'X' = X_2O **[½]**

Nature of oxide of 'X' = Basic **[½]**

30. (i) Covalent compounds do not provide charged particles in aqueous solutions and hence they do not conduct electricity. **[1]**

(ii) Propanone/acetone **[1]**

(iii) CO_2 gas is obtained when ethanoic acid reacts with sodium carbonate. Presence of the gas can be tested by passing the gas through lime water. Carbon dioxide gas turns lime water milky. **[1]**

31. (i) Carbon forms a large number of compounds due to its unique ability to catenate and its tetravalency. **[1]**

(ii) If fuel in the gas burner does not burn completely, then incomplete combustion occurs resulting in production of a sooty flame and hence the vessels get blackened from the bottom. So, the air holes of a gas burner have to be adjusted, for sufficient supply of air for complete combustion. **[1]**

(iii) Use of synthetic detergents causes pollution because they are non-biodegradable in nature. **[1]**

32. The functional groups of organic compounds that can be hydrogenated are alkenes and alkynes.

$$\underset{\text{Ethene}}{H_2C = CH_2} \xrightarrow[\text{Nickel Catalyst}]{H_2} \underset{\text{Ethane}}{CH_3 - CH_3}$$

Unsaturated hydrocarbons undergo addition reactions with hydrogen in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons. During this reaction, unsaturated compounds like vegetable oils which are in liquid state are converted to animal fats in solid state. Vegetable oil is an example of natural source of organic compound that are hydrogenated. **[3]**

33. (i) $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{at 443K}]{\text{Conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$ **[1]**

(ii) $\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{\text{Acid}} CH_3COOCH_2CH_3 + H_2O$ **[1]**

(iii) $CH_3COOCH_2CH_3 + NaOH \longrightarrow CH_3COONa + CH_3CH_2OH$ **[1]**

34. (i) $CH_4 + O_2 \longrightarrow CO_2 + H_2O$ + Heat and light **[1]**

(ii) $C_2H_5OH \xrightarrow[H_2SO_4]{\text{Hot Conc.}} CH_2 = CH_2 + H_2O$ **[1]**

(iii) $NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$ **[1]**

35. Alkaline potassium permanganate ($KMnO_4$) or acidified potassium dichromate ($K_2Cr_2O_7$) can be used as oxidising agents for conversion of ethanol to ethanoic acid.

(i) Litmus test: Ethanoic acid turns blue litmus solution red whereas ethanol being neutral in nature has no effect on litmus solution. **[1]**

(ii) Reaction with sodium carbonate: Ethanoic acid reacts with sodium carbonate to form sodium ethanoate and carbon dioxide gas and water.

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$

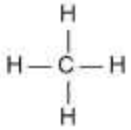
[1]

Ethanol does not react with sodium carbonate.

$CH_3CH_2OH + Na_2CO_3 \longrightarrow$ No reaction **[1]**

36. (i) **Alkanes:** Hydrocarbons in which the carbon atoms are joined by single covalent bonds are called alkanes. They have general formula C_nH_{2n+2}, where n is the number of carbon atoms. Suffix, –ane is used while naming alkanes.

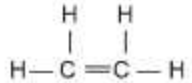
Methane



[1]

Alkenes: Hydrocarbons in which the carbon atoms are joined by a double bond are called Alkenes. They have general formula C_nH_{2n}, where n is the number of carbon atoms. Suffix, -ene is used while naming alkenes.

Ethene



[1]

(ii) Alkanes generally burn with clean flame because in them, the percentage of carbon is comparatively low as compared to other unsaturated hydrocarbons. Hence they get oxidised completely by the oxygen present in air. **[1]**

37. Ethanoic acid reacts with ethanol in the presence of concentrated sulphuric acid as a catalyst to produce the ester, ethyl ethanoate. The reaction is slow and reversible.

$$CH_3CH_2OH \xrightarrow{\text{alk. } KMnO_4} CH_3COOH$$

$$\underset{\text{Ethanoic acid}}{CH_3-COOH} + \underset{\text{Ethyl alcohol}}{CH_3-CH_2-OH} \xrightleftharpoons{H_2SO_4}$$

$$\underset{\text{Ethyl ethanoate 'X'}}{CH-\overset{\overset{O}{\|}}{C}-O-CH_2CH_3} + \underset{\text{Water}}{H_2O}$$

(i) CH_3–COOH :- Ethanoic acid **[1]**

(ii) CH_3 –CH_2 –OH: - Ethyl alcohol or Ethanol **[1]**

(iii) Compound

$$X = CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2CH_3 : \text{Ethyl ethanoate}$$

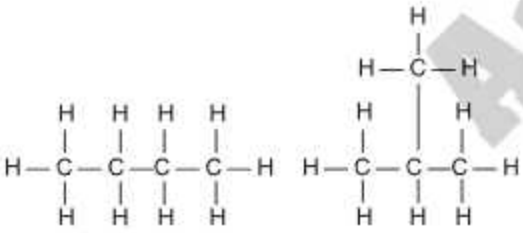
[1]

38. **Structural isomerism :** Molecules which have same molecular formula but different structures are called structural isomers. **[1]**

Propane is represented as CH_3–CH_2–CH_3. In alkanes, isomerism arises when a particular compound can be represented in the form of both straight chain and branched chain. **[1]**

The structural formula of propane shows that it does not have sufficient number of carbon atoms to exist in the form of branched isomer. Hence, they it does not exhibit structural isomerism.

Isomers of Butane: There are two isomers. n-Butane and iso-Butane



n-Butane **iso-Butane** **[1]**

39. By performing the following tests carboxylic acids can be distinguished from an alcohol.

(a) Test with $NaHCO_3$ solution in water.

When a carboxylic acid reacts with baking soda, carbon dioxide is liberated with a brisk effervescence.

No brisk effervescence is observed when a solution of baking soda is added to alcohol. **[1½]**

(b) Test with blue litmus solution.

Carboxylic acid turns blue litmus red. There is no change in colour when a blue litmus solution is added to alcohol. **[1½]**

40. Three different chemical reactions showing the conversion of ethanoic acid to sodium ethanoate:

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$ **[1]**

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$ **[1]**

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$ **[1]**

41.

Esterification	Saponification
1. The reaction of carboxylic acid with alcohol in the presence of a little conc. sulphuric acid to form esters, is called esterification.	1. The reaction of an ester with a base such as NaOH, to be converted back to alcohol and sodium salt of carboxylic acid is called saponification reaction. **[1]**
2. Example: Ethanoic acid reacts with ethanol in the presence of a little conc. sulphuric acid to form esters. $C_2H_5OH + CH_3COOH \underset{\text{Conc. } H_2SO_4}{\rightleftharpoons} CH_3COOC_2H_5 + H_2O$	2. Example: Ethyl ethanoate on reaction with sodium hydroxide gives ethanol and sodium ethanoate. **[1]** $CH_3COOC_2H_5 + NaOH \downarrow C_2H_5OH + CH_3COONa$

(i) Use of esters:

Esters are used in synthetic flavours, perfumes, cosmetics etc. **[½]**

(ii) Use of saponification reaction:

It is used in the preparation of soaps on a commercial basis. **[½]**

42. Structural formula of ethanol:

$$CH_3-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-OH$$ **[1]**

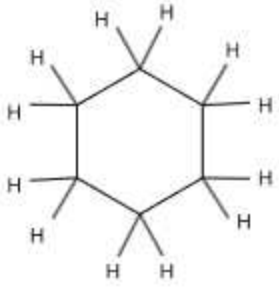
When ethanol is heated with conc. sulphuric acid at 443 K (443 K – 273 = 170 °C) it gives ethene.

$$CH_3CH_2OH \xrightarrow[170^\circ C]{\text{Conc.}H_2SO_4} CH_2 = CH_2 + H_2O$$ **[1]**

The role of conc. H_2SO_4 in the above reaction is that it is used as a dehydrating agent and causes dehydration of ethanol. **[1]**

43. (i) In carbon compounds the electrons are shared, between atoms and no charged particles are formed. Therefore, they are generally poor conductors of electricity. **[1]**

(ii)



Name - Cyclohexane
Single bond - 18

[2]

44. (i) 5% solution of $KMnO_4$ is prepared by dissolving 5 g of $KMnO_4$ crystals in 95 g of water. **[1]**

(ii) Alkaline $KMnO_4$ acts as an oxidising agent. The colour of $KMnO_4$ will not disappear when added in excess. **[1]**

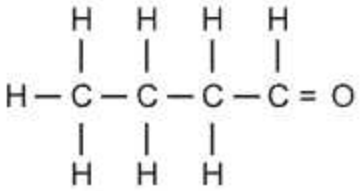
(iii) $CH_3CH_2OH \xrightarrow[\text{Heat}]{\text{Alkaline } KMnO_4} CH_3COOH$ **[1]**

45. (a) The functional group present in these compounds ((i) and (ii)) is aldehyde (– CHO). **[1]**

(b) The general formula for the compounds having aldehyde functional group is $C_nH_{2n}O$. **[1]**

(c) These compounds are the members of the homologous series of aldehydes. **[½]**

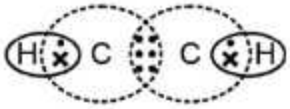
Structure of butanal having aldehyde functional group is-



[½]

(Butanal)

46. (a) Electron dot structure of ethyne : **[1]**



Ethyne molecule

(b) Differences between ionic and covalent compounds :

	Covalent compounds		Ionic compounds	
(1)	Ionic compounds are formed by complete transfer of electrons	(1)	Covalent compounds are formed by mutual sharing of electrons	**[1]**
(2)	Ionic compounds have high melting and boiling points	(2)	Covalent compounds have comparatively low melting and boiling points	**[1]**
(3)	Ionic compounds conduct electricity in aqueous solution or in molten state	(3)	Covalent compounds are generally non-conductors of electricity	

[Any two]

47. (i) Two properties of carbon which lead to a very large number of carbon compounds are :

(a) **Tetravalency:** Carbon has valency 4. Hence, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent element. **[1]**

(b) **Catenation:** Carbon has the unique ability to form bonds with other atoms of carbon to form long chains, hence giving rise to large molecules. **[1]**

(ii) A soap molecule has two parts –one hydrophobic part and the other hydrophilic part. When soap is added to water, the hydrophobic part arranges itself towards the dirt and the hydrophilic end arranges itself towards the water. Therefore is micelle is formed.

Micelle formation does not take place when soap is added to ethanol because the hydrophobic part of soap molecules is soluble in ethanol. **[3]**

48. Compounds with same molecular formula but different structures are called isomers. This phenomenon is called isomerism. **[1]**

Four characteristics of isomers:

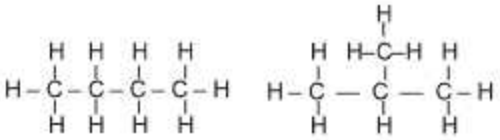
(a) Isomers have different physical properties.

(b) Isomers may have same or different chemical properties.

(c) All isomers have the same number of atoms.

(d) Isomers have different structural arrangements. **[2]**

Isomers of butane, C_4H_{10}.



n-Butane 2-Methylpropane **[2]**

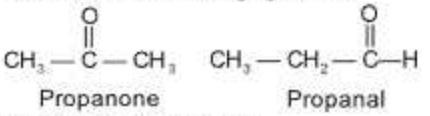
49.

	Ethanol	Ethanoic acid
Physical properties	1. It exists only in liquid form. 2. It belongs to the family of alcohols. 3. It has a specific smell but not like vinegar.	It can exist both in liquid as well as solid form. It belongs to the family of carboxylic acids. It smells like vinegar.
Chemical properties	1. Reaction with sodium bicarbonate: No salt formation occurs and carbon dioxide gas is also not evolved. 2. It does not give litmus test i.e., no change in the colour of litmus solution..	Reaction with sodium bicar-bonate: It will react with sodium bicarbonate to form a salt and carbon dioxide gas will be released. It turns blue litmus red.

[5]

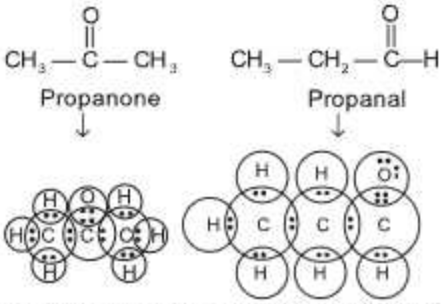
50. (i) Isomers are those compounds which have same molecular formula but different structural formula. **[1]**

(ii) Two possible isomers of the compound with molecular formula C_3H_6O are :



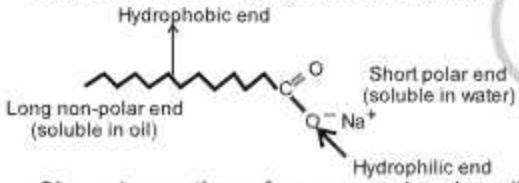
[2]

(iii) Electron dot structure



[2]

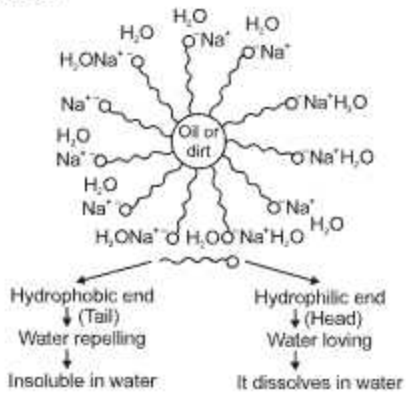
51. Difference between soap and detergent: The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. Detergents are generally sodium salts of sulphonic acids or ammonium salts with chloride or bromide ions etc. Both have long hydrocarbon chain. **[1]**



Cleansing action of soap can be described as follows:

The long hydrocarbon part of soaps is water repelling (hydrophobic) and is called tail. The ionic part (COO^-, in soap) is water attracting (hydrophilic) and is called head. When soap is dissolved in water, molecules combine to form micelles. The tails are towards the centre and heads are outside in contact with water molecules. Hydrocarbon tails dissolve the grease or dirt and detach them from fabric. Thus, an emulsion of oil (dirt or grease) and fat in water is formed and clothes are cleaned. **[2]**

Micelles



"A micelle is a spherical cluster of hundreds of molecules of soap in their solution in water".

Soap in the form of a micelle is able to clean the cloth, since the oily dirt will be collected in the centre of the micelle.

Soaps do not form lather in hard water because hard water contains calcium and magnesium salts. Soap molecules react with calcium and magnesium salts to form an insoluble precipitate called scum. Two problems arise because of the use of detergents instead of soap : **[1]**

(a) Soaps are biodegradable, while detergents are non-biodegradable; hence, detergents accumulate in the environment and cause environmental problems. **[½]**

(b) Certain phosphate additives are added to detergents. These phosphate additives act as nutrients for algae which form a thick green scum over the river water and upset the animal life in the river. **[½]**

52. $P \xrightarrow[H_2SO_4]{\text{Excess}} Q \xrightarrow[\text{catalyst}]{H_2/Ni} R \xrightarrow{O_2} 2CO_2 + 3H_2O$

$P \xrightarrow[H_2SO_4]{\text{Excess}} Q$

$CH_3CH_2OH \xrightarrow{\text{Excess } H_2SO_4} \underset{'Q'}{CH_2 = CH_2}$
('P')

$Q \xrightarrow{H_2/Ni \text{ catalyst}} R$

$\underset{'Q'}{CH_2 = CH_2} \xrightarrow{H_2/Ni \text{ catalyst}} \underset{'R'}{CH_3 - CH_3}$

$R \xrightarrow{O_2} 2CO_2 + 3H_2O$

$\underset{'R'}{CH_3 - CH_3} \xrightarrow{O_2} 2CO_2 + 3H_2O$

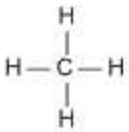
$\underset{\text{Ethanol}}{\underset{P}{CH_3CH_2OH}} \xrightarrow{\text{Excess } H_2SO_4} \underset{\text{Ethene}}{\underset{Q}{CH_2 = CH_2}} \xrightarrow[\text{catalyst}]{H_2/Ni}$

$\underset{\text{Ethane}}{\underset{R}{CH_3 - CH_3}} \xrightarrow{O_2} 2CO_2 + 3H_2O$

[5]

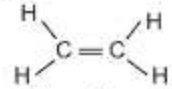
53. Certain compounds contain only carbon and hydrogen. So, such organic compounds are called hydrocarbons. **[1]**

General formula for the homologous series of alkanes = C_nH_{2n+2}



[1]

First member of the alkane family is methane.
General formula for the homologous series of alkenes = C_nH_{2n}



First member of the alkene family is ethene.
General formula for the homologous series of alkynes = C_nH_{2n-2}
First member of the alkyne family is ethyne.

$$H-C\equiv C-H$$ **[1]**

Catalytic hydrogenation is the reaction used to convert unsaturated compounds to saturated compounds.

$$CH_2=CH_2+H_2 \xrightarrow[300^\circ C]{\text{Nickel}} C_2H_6$$ **[2]**

54. Chemical formula of the compound = C_2H_5OH **[½]**
Name of the compound = Ethanol **[½]**
Uses of ethanol :
(a) It is used as a solvent in tincture of iodine. **[1]**
(b) It is used as a solvent in cough syrups.

(i) $\underset{\text{Ethanol}}{2C_2H_5OH} + \underset{\text{Sodium}}{2Na} \longrightarrow \underset{\substack{\text{Sodium}\\\text{ethoxide}}}{2C_2H_5ONa} + \underset{\text{Hydrogen}}{H_2}$

[1½]

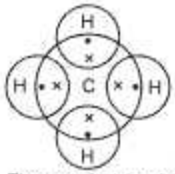
Name of the products formed = Sodium ethoxide and hydrogen

(ii) $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\,K]{\text{Hot conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + \underset{\text{Water}}{H_2O}$

[1½]

Name of the products formed = Ethene and water.

55. Methane is a compound of carbon with chemical formula CH_4. **[1]**



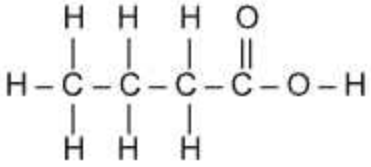
Electron dot structure of methane

[1]

Covalent bonds are formed in this compound.
(i) In covalently bonded molecules, the electrons are shared between atoms and no charged particles are formed. Therefore, such compounds are generally poor conductors of electricity. **[1]**
(ii) Covalently bonded molecules are seen to have strong bonds within the molecule, but have weak inter-molecular forces. This gives rise to low melting and boiling points of these compounds. **[1]**

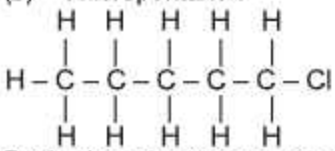
When methane burns in oxygen, CO_2, H_2O and a large amount of heat and light is released. **[1]**

56. (A) (i) (a) Butanoic acid :



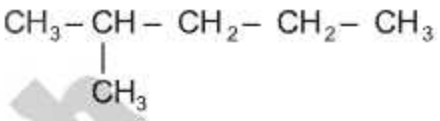
[1]

(b) Chloropentane :



[1]

(ii) Both the structures are structural isomers of each other (hexane) as both have same molecular formula but different structures. **[1]**



(Or any other) **[1]**

(iii)

Saturated carbon compounds	Unsaturated carbon compounds
General formula: C_nH_{2n+2} (alkanes) (n = Number of C atoms)	General formula: C_nH_{2n} (alkenes) or C_nH_{2n-2} (alkynes) (n = Number of C atoms)

[1]

OR

(B) (i) Ethanol reacts with sodium leading to evolution of H_2 gas and formation of sodium ethoxide. **[1]**

$$\underset{\text{(Ethanol)}}{2CH_3CH_2OH} + \underset{\text{(Sodium)}}{2Na} \longrightarrow \underset{\substack{\text{(Sodium}\\\text{ethoxide)}}}{2CH_3CH_2O^-Na^+} + \underset{\text{(Hydrogen)}}{H_2\uparrow}$$ **[1]**

(ii) Melting point of pure ethanoic acid is 290 K and hence it often freezes during winters forming white crystals resembling glaciers. This gave rise to its name glacial acetic acid. **[1]**
(iii) Heating ethanol at 443 K with concentrated sulphuric acid gives ethene on dehydration. **[½]**
Concentrated H_2SO_4 acts as a dehydrating agent. **[½]**
(iv) $CH_3COOC_2H_5 + NaOH \longrightarrow C_2H_5OH + CH_3COONa$ **[1]**

❑ ❑ ❑

1 : Life Processes

1. CO_2 is obtained from the environment and N_2 is obtained from the soil and environment. **[1]**

2. Xylem tissue conducts water and minerals from the soil to different parts of the plant. If the xylem tissue is removed, then the transport of water and mineral will not take place and the plant will die. **[1]**

3. The green dot-like structures are chloroplasts. This green colour is due to the presence of chlorophyll. **[1]**

4. Answer (d) **[1]**

   The labelled parts 'A' and 'B' depicted in the given figure are pulmonary artery and pulmonary vein respectively. Left ventricle has thick muscular wall as it has to pump blood to aorta.

5. Answer (a) **[1]**

   Water is produced only during aerobic respiration.

6. Answer (c) **[1]**

   In single celled organisms, simple diffusion is sufficient to meet the requirement of exchange of gases and the entire surface of these organisms is in contact with the environment for taking in food.

7. Answer (b) **[1]**

   Urea is a waste product produced in animals.

8. Answer (a) **[1]**

   The labelled part 'A' depicted in the diagram is diaphragm. During inhalation, the diaphragm flattens and as a result the chest cavity becomes larger.

9. Answer (c) **[1]**

   In the depicted figure, the stomata are in closed condition. The guard cells shrink when water flows out from them, causing the stomatal pore to close. In this condition, there will be no gaseous exchange.

10. Answer (b) **[1]**

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

11. Answer (a) **[1]**

    Both assertion (A) and reason (R) are true statements and reason (R) is the correct explanation of assertion (A).

12. Answer (c) **[1]**

    Both the potted plants are kept in sunlight for two hours before starch test.

13. Answer (b) **[1]**

    Both gills and alveoli have thin and moist surface for easy gaseous exchange.

14. Answer (c) **[1]**

    When the person exhales into the test-tube containing lime water, then lime water turns milky because the percentage of carbon dioxide is more in the exhaled air than in inhaled air.

15. Answer (b) **[1]**

    The length of small intestine in a herbivore (deer) is more as compared to the length of small intestine in a carnivore (tiger) because the type of food consumed by them is different. Herbivores eating grass need longer small intestine to allow the cellulose to be digested whereas carnivores eating meat need shorter small intestine as meat is easier to digest.

16. Answer (b) **[1]**

    Phloem tissue consists of four elements i.e., phloem parenchyma, sieve tubes, companion cells and phloem fibres. Out of which, companion cells and sieve tubes help in transportation of food in plants.

17. Answer (c) **[1]**

    Semi-permeable membrane allows substances that body needs to get rid of to pass through it. During dialysis, the waste products pass through them in the dialyzing solution.

18. Answer (c) **[1]**

    In artificial kidney, there is no reabsorption of essential nutrients from the blood.

19. Answer (a) **[1]**

    The used dialyzing solution is rich in urea and excess salts.

20. Answer (c) **[1]**

In nephron, tubules serve the function of reabsorption of certain substances like glucose, ions, water, etc.

21. Answer (b) **[1]**

The given process is transpiration which creates a suction force which pulls water inside the plant.

22. Answer (b) **[1]**

Opening and closing of stomata is due to movement of water in and out of the guard cells.

23. Answer (c) **[1]**

Villi increase the surface area for absorption of food and the absorbed food is sent to each and every cell of the body.

24. (a) Blood vessels: Transport of blood.

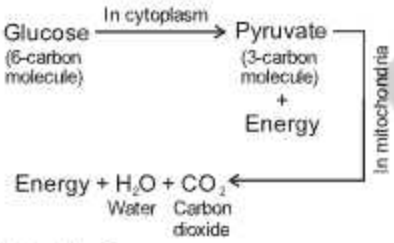
(b) Blood platelets: Clotting of blood.

(c) Lymph: Carries digested fats.

(d) Heart: Helps to circulate blood in the whole body by acting as a pump. **[4×½]**

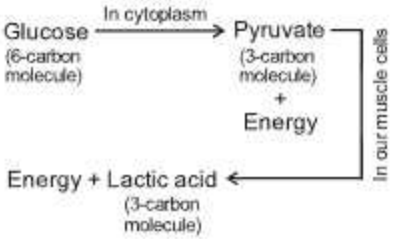
25. Following are the two different ways in which glucose is oxidized to provide energy in human body:

(i) In presence of oxygen:



[1]

(ii) In lack of oxygen:



[1]

26. The substance taken in the small test tube kept in the conical flask is KOH (potassium hydroxide) solution. **[1]**

The CO_2 produced by germinating seeds is absorbed by KOH solution due to which the air from the bent tube moves into the conical flask, which eventually pulls the water up in the bent glass tube. **[1]**

27. (i) Renal Artery : It carries oxygenated blood containing waste from aorta to the kidneys for filtration. **[½]**

(ii) Urethra : It starts from the neck of the urinary bladder and opens outside the body, urine is released through the urethra. **[½]**

(iii) Glomerulus : Blood is filtered out from the blood capillaries (glomerulus) into Bowman's capsule. **[½]**

(iv) Tubular part of nephron : When blood filtrate passes through the tubular part of nephron useful products like glucose, amino acids, Na^+, Cl^-, K^+, ions and a large amount of water are selectively reabsorbed by the tubular part of nephron. **[½]**

28. The plant kept in dark could not survive longer than the plant kept in sunlight because it could not perform photosynthesis as it is a process by which green plants convert light energy into chemical energy and use this energy to survive. The process of photosynthesis releases oxygen which can be utilized by the plant for respiration. So, in the absence of sunlight the plant will not survive. **[2]**

29. (i) Respiratory pigment haemoglobin takes up O_2 from the air in the lungs and carries it to tissues. **[1]**

(ii) CO_2 is being transported from various tissues into the alveoli by blood and is released during exhalation. **[1]**

Within the lungs, the trachea divides into smaller and smaller tubes which finally terminate in balloon like structures called alveoli. These alveoli increase the surface area for the exchange of gases. **[1]**

30. The three types of blood vessels are:

(a) Artery

(b) Vein

(c) Capillary **[3×½]**

Features:

(a) Arteries are the vessels which carry blood away from the heart to various organs of the body. Since the blood emerges from the heart under high pressure, the arteries have thick, elastic walls. **[½]**

(b) Veins collect the blood from different organs and bring it back to the heart. They do not need thick walls because the blood is no longer under pressure, instead they have valves that ensure that the blood flows only in one direction. [½]

(c) Capillaries are the smallest vessels which have walls and are one-cell thick. Exchange of material between the blood and surrounding cells takes place across this thin wall. [½]

31. (A) (i) *Paramecium* has a definite shape. It ingests the food by a definite cell mouth lying at the bottom of the buccal cavity. The food is moved to this spot by the movement of cilia which cover the entire surface of the cell. Ingested food is digested in food vacuole and the undigested food is egested from the anal spot. [1]

(ii) **Role of each of the following in our digestive system :-**

(a) **Hydrochloric acid:** It kills most of the harmful bacteria that enter along with the food and makes the medium acidic. Acidic medium facilitates activation of proenzyme pepsinogen and action of enzyme pepsin. [½]

(b) **Trypsin:** It is an enzyme secreted by the pancreas. It helps in the digestion of proteins. [½]

(c) **Muscular walls of stomach:** The muscles of the stomach wall contract periodically and thereby help in the churning and mixing of food with the digestive enzymes and hydrochloric acid. It helps in chemical digestion. [½]

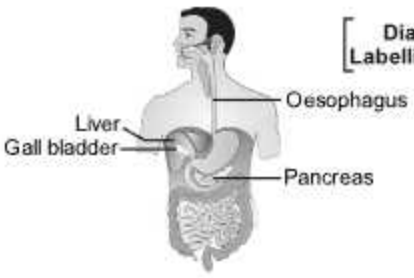
(d) **Salivary amylase:** It acts on starch which is a complex molecule to form maltose sugar. [½]

OR

(B) (i) **Double circulation:** A mechanism in which blood circulates twice through the heart in one complete cycle is known as double circulation. One is pulmonary circulation and the other is systemic circulation. [1]

(ii) Separation of the right side and left side of heart allows a highly efficient supply of oxygen to the body as it prevents mixing of oxygenated and deoxygenated blood. It is useful for birds and mammals, that have high energy needs, which constantly use energy to maintain their body temperature. [2]

32. (a)

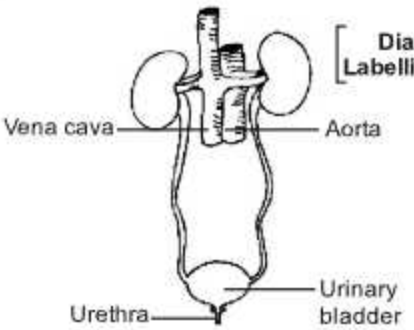


(b) Bile does not contain any enzyme, but it plays an important role in digestion because:

(i) The bile salts emulsify fat by acting on large fat globules to break them into smaller globules. This increases the efficiency of pancreatic enzymes. [1]

(ii) The food entering the small intestine is acidic. It is made alkaline by the action of bile juice so as to facilitate the action of pancreatic enzymes. [1]

33. (a)



(b) The two vital functions of kidney are:

(i) It filters out the nitrogenous wastes from the blood and forms urine. [1]

(ii) It also regulates the water balance and levels of mineral ions in the body. [1]

34. (i) Mouth : In mouth, large food pieces are crushed with the help of our teeth and mixed with saliva secreted by the salivary glands, using the tongue. Salivary amylase, the enzyme present in saliva, breaks down starch to give sugar. [1]

(ii) Stomach : The muscular walls of the stomach help in mixing the food thoroughly with the digestive juices secreted by the gastric glands present in the wall of the stomach. These glands release hydrochloric acid, a protein digesting enzyme called pepsin, and mucus, which protects the inner lining of the stomach. The hydrochloric acid creates an acidic medium which facilitates the action of the enzyme pepsin. **[1]**

(iii) Small intestine : The small intestine is the site of the complete digestion of carbohydrates, proteins and fats. It receives the secretions of the liver and pancreas for this purpose.

Bile juice from liver makes the acidic food coming from stomach alkaline for facilitating the action of pancreatic enzymes. Bile also emulsifies fats so as to increase the efficiency of enzyme action. **[1]**

The pancreas secretes pancreatic juice which contains enzymes like trypsin for digesting proteins and lipase for breaking down emulsified fats. **[1]**

The walls of the small intestine contain glands which secrete intestinal juice. The enzymes present in it finally convert the proteins into amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol. **[1]**

35. (a) The three events that occur during the process of photosynthesis are:

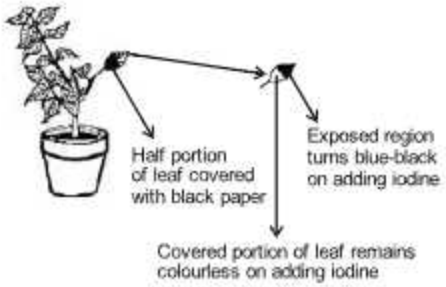
(i) Absorption of light energy by chlorophyll. **[½]**

(ii) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen. **[½]**

(iii) Reduction of carbon dioxide to carbohydrates. **[½]**

Stomata help in exchange of gases (carbon dioxide and oxygen) for the purpose of photosynthesis. **[½]**

(b) **[1]**



Experimental set-up to show that light is essential for photosynthesis:

(i) Keep a potted plant in a dark room for three days so that all the starch gets used up.

(ii) Now cover one half of a leaf of this plant with black paper or metal foil on both sides.

(iii) Then keep the plant in sunlight for about six hours.

(iv) Pluck the leaf which was half covered and remove the paper or foil.

(v) Mark the covered area.

(vi) Dip this leaf in boiling water for a few minutes.

(vii) Then immerse it in a beaker containing alcohol.

(viii) Carefully place this beaker in a water-bath and heat till the alcohol begins to boil.

(ix) The leaf gets decolourised.

(x) Now, dip the leaf in a dilute solution of iodine for a few minutes.

(xi) Take out the leaf and rinse off the iodine solution. Observe the colour of the leaf.

The part containing starch will be turned blue-black by iodine.

You will find that the portion of the leaf exposed to sunlight will turn blue-black whereas the covered half of the leaf remains colourless. This is because the covered part did not receive sunlight and hence could not form carbohydrates.

This proves that light is essential for photosynthesis. **[2]**

36. (a) Two components of blood are

(i) Blood plasma

(ii) Blood cells **[1]**

(b) Movement of oxygenated blood in the body as follows

Pulmonary veins → Left atrium → Left ventricle → Systemic aorta → All part of the blood **[2]**

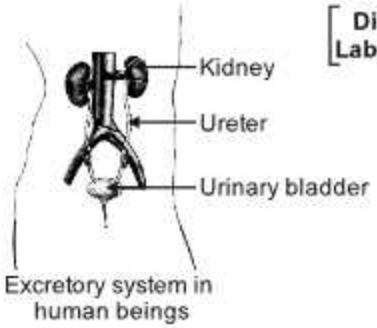
(c) The valves in the heart are to prevent the backflow of blood when the atria or ventricles contract. **[1]**

(d) Arteries are thick walled whereas veins are thin walled. **[1]**

37. (a) The biological process involved in the removal of these harmful metabolic wastes from the body is called excretion. **[1]**

(b) The nephron is the filtration units present in the kidney. **[1]**

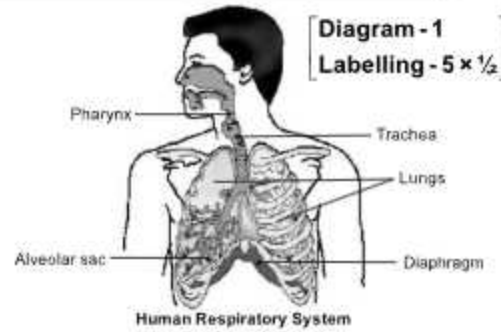
(c) [Diagram : 1½ Labelling: 3×½]



Excretory system in human beings

38. (a) There is a difference between the rate of breathing between aquatic organisms and terrestrial organisms because terrestrial animals can breathe the oxygen in the atmosphere but animals living in water need to use the oxygen dissolved in water. Hence, the amount of dissolved oxygen in water is fairly low compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms. **[1½]**

(b) [Diagram - 1 Labelling - 5 × ½]



Human Respiratory System

OR

(a) The organs that form the excretory system in human beings are :

(i) A pair of kidneys

(ii) A pair of ureters

(iii) A urinary bladder

(iv) A urethra **[4×½]**

(b) Each kidney consists of large numbers of filtration units called nephrons which filter out the waste products from the blood. Urine is formed in the kidneys through filtration of blood. Some substances such as glucose, amino acids, salts and a major amount of water are selectively reabsorbed as the urine flows along the tube of nephron. Urine then enters into ureter and gets stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra. This is how urine is produced in human body. **[3]**

2 : Control and Coordination

1. Nervous and muscular tissues provide control and coordination in multicellular animals. **[1]**

2. The spinal cord is protected by the vertebral column or backbone. **[1]**

3. Answer (a) **[1]**

In plants, the role of cytokinin is to promote cell division.

4. Nastic movements are non-directional and growth independent movements that occur in response to stimuli such as light, temperature, humidity, etc. For example: Touch-me-not plant leaves bend and droop on touching. **[1]**

Curvature movements are the bending or curving movements of a plant in response to any stimuli. For example: the bending of the shoot tip towards light. **[1]**

5. A hormone is a chemical compound synthesized by a group of cells or endocrine glands that affect cells in other parts of the body and is also used for control and coordination in the organisms. **[1]**

Thyroid gland secretes the hormone thyroxin. **[½]**

Thyroxin regulates carbohydrate, protein and fat metabolism in the body so as to provide the correct balance for growth. **[½]**

6. (a) Gustatory receptors – Tongue

Olfactory receptors – Nose **[1]**

(b) Dendrite → Cyton → Axon → End point of Neuron **[1]**

Here, 'a' is cyton and 'b' is axon.

7. (A) (i) Maintaining posture and balance – Cerebellum [½]

(ii) Beating of heart – Medulla oblongata [½]

(iii) Thinking – Cerebrum [½]

(iv) Blood pressure – Medulla oblongata [½]

OR

(B) Auxins are synthesized at shoot and root tips in plants. [½]

The plant organs which show the following types of movement are :

(i) Positive phototropism – Stem / shoot [½]

(ii) Negative geotropism – Stem / shoot [½]

(iii) Positive hydrotropism – Root [½]

8. Following are the hormones & functions secreted by given glands.

(a) **Thyroid gland :** Thyroid gland secretes thyroxine hormone.

Function : Thyroxine regulates carbohydrate, protein and fat metabolism in the body to provide best balance for the growth. [1]

(b) **Pituitary gland :** Pituitary gland secretes growth hormone.

Function : Growth hormone regulates growth and development of the body. [1]

(c) **Pancreas :** Pancreas secretes insulin hormone.

Function : Insulin helps in regulating blood sugar level. [1]

9. Plant hormones are the organic substances produced in small quantities, which regulate growth, development and other physiological functions. [1]

The plant hormones responsible for the following are:

(i) Growth of stem - Auxin / Gibberellins

(ii) Promotion of cell division - Cytokinin

(iii) Inhibition of growth - Abscisic acid

(iv) Elongation of cells - Auxin [4×½ = 2]

10. The following immediate changes take place in the squirrel body which makes it able to either fight or run:

(i) Adrenaline is secreted directly into the blood and carried to different parts of the body.

(ii) Heart beats faster resulting in supply of more oxygen to the muscles.

(iii) The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs.

(iv) Breathing rate increases because of contractions of the diaphragm and the rib muscles. **(Any Three) [3×1]**

OR

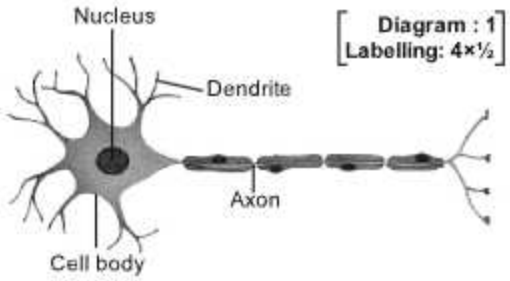
Chemical communication is better than electrical impulses as a means of communication between cells in a multi-cellular organism because:

(i) The electrical impulses do not reach each and every cell rather, these reach only those cells that are connected by nervous tissue. [1]

(ii) After the generation and transmission of an electrical impulse, the cell takes some time to reset its mechanisms for the generation and transmission of a new impulse. [1]

(iii) Chemical communication is a steady and a persistent response. [1]

11. (a)



[Diagram : 1 Labelling: 4×½]

(b) (i) Information is acquired through dendrite.

(ii) From the dendrite to the cell body and then along the axon to its end. [2×1]

12. (a) (i) Phototropism: The movement of a plant or it's part in response to light is called phototropism. [½]

(ii) Geotropism: The movement of a plant or it's part in response to gravity is called geotropism. [½]

Activity to show that light and gravity change the direction that plant part grows in:

(i) Fill a conical flask with water.

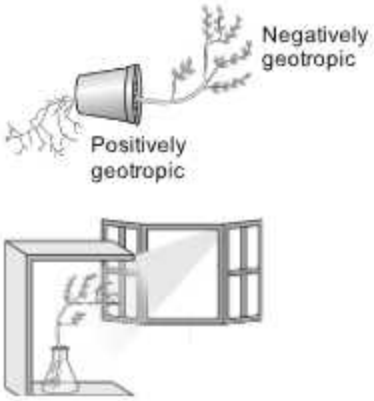
(ii) Cover the neck of the flask with a wire mesh.

(iii) Keep two or three freshly germinated bean seeds on the wire mesh.

(iv) Take a cardboard box which is open from one side.

(v) Keep the flask in the box in such a manner that the open side of the box faces light coming from a window.

(vi) After two or three days, you will notice that the shoots bend towards light and roots away from light.



[3]

(b) (i) Auxin : It promotes growth and cell elongation. [½]

(ii) Abscisic acid: It inhibits growth and causes wilting of leaves. [½]

3 : How do Organisms Reproduce?

1. Imperfect DNA copying in the reproduction process leads to variations or evolution. **[1]**

2. Answer (d)

   The correct observations are:

   a. Single cells of *Amoeba* and Yeast were undergoing binary fission and budding respectively.

   c. Elongated nucleus was dividing to form two daughter nuclei in *Amoeba*. **[1]**

3. Answer (d) **[1]**

4. Answer (d)

   In the figure, the part marked A is Plumule, B is Radicle and C is Cotyledon. **[1]**

5. Answer (d)

   Yeast reproduces asexually by the process of budding.

   Budding is a type of asexual reproduction in which a new organism is formed from a bud of an existing organism. A small bud is formed at a specific position on the parent cell. The nucleus of parent cell splits and a part of it enters inside the newly formed bud. The bud develops into a new cell or daughter organism. The new organism remains attached to the parent organism till it matures. After attaining maturity it separates from the parent body. **[1]**

   OR

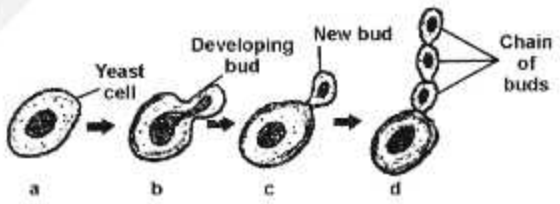
   Answer (c)

   This is the correct sequence of budding in yeast. **[1]**

6. *Hydra* and *Planaria* have the ability of regeneration. **[2×½]**

7. (a) A fine screw is used to focus the slides of budding in yeast under high power of a microscope. [½]

   (b) Sequence showing budding in yeast:



[½]

8. Answer (c)

   An embryo has two large cotyledons and one embryo axis or tigellum. The upper end of the embryo axis is the plumule, and the lower end of the embryo axis which projects beyond the cotyledons is the radicle. The testa is the thick outer seed coat, and the tegmen is the inner transparent seed coat of seeds. **[1]**

9. Two functions of the ovary of the human female reproductive system are

   a. It produces ova, which are female gametes.

   b. It secretes the female hormones, oestrogen and progesterone. **[2 × ½]**

10. Answer (d)

A dicot embryo consists of radicle, plumule and a pair of cotyledons. Testa, tegmen and micropyle are the parts of the seed coat. **[1]**

11. (a) Common signs of sexual maturation in boys and girls are :
    (i) Thick hair growth in the pubic region and armpits.
    (ii) Thin hair appears on legs and arms.
    (iii) The skin frequently becomes oily and there might be occurrence of acne.
    (Any two) [2×½]

    (b) Because of reckless female foeticide, child sex ratio is declining at an alarming rate in some sections of our society. **[1]**

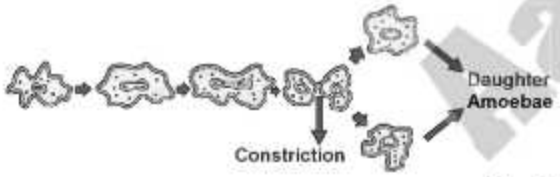
    (c) The hormonal methods like oral pills change the hormonal balance of the body. **[1]**

    (d) Birth and death rate in a given population determine the size of a population. **[1]**

12. Answer (d)

The number of chromosomes in parents and offsprings of a particular species undergoing sexual reproduction remains constant due to halving of chromosomes at the time of gamete formation. **[1]**

13. Binary fission in *Amoeba*:



[4 × ½]

14. Reasons for vegetative propagation:
    i. It is done for plants which have lost the capacity to produce seeds.
    ii. It helps in producing plants which are genetically similar to the parent plant.
    iii. It helps in producing those plants which either produce very few seeds or produce such seeds which are not viable.
    iv. It can be used to produce plants which reach maturity and produce fruits and seeds faster. **[4 × ½]**

15. i. Seminal vesicles - It secrete alkaline secretions which lower the pH of semen and provides nourishment. **[1]**
    ii. Prostate gland - It increases the motility of sperms. **[1]**

16. It is the age at which the reproductive system becomes functional in human beings. **[1]**

The changes observed in girls at the time of puberty are:

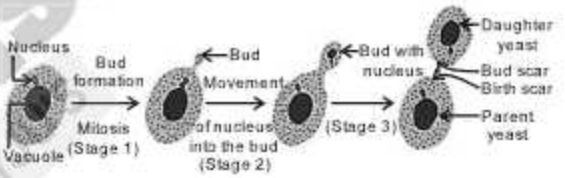
- Breast size begins to increase.
- There is darkening of skin of nipples at the tips of breasts.
- Menstruation begins.
- Deposition of fat in various body parts like thighs and hips.
- High pitched voice. **(Any two) [2×½]**

17. It is a mode of reproduction in which new individuals are produced from a single parent without the involvement of fusion of gametes. **[1]**

The forms of asexual reproduction are - budding, binary fission, regeneration, fragmentation, multiple fission. **(Any two) [2 × ½]**

18. Yeast reproduces asexually by the process of budding. **[½]**

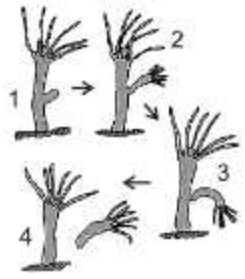
Different stages of budding as observed by the student are depicted below: **[1½]**



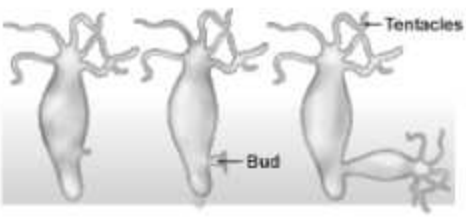
19. (a) They produce male germ cells *i.e.*, sperms. **[1]**

    (b) They secrete the hormone testosterone which controls secondary sexual characters in males. **[1]**

20. Budding in *Hydra*: **[4×½]**



OR



[4×½]

21. (i) Placenta is extremely essential for foetal development because of the following reasons:

(a) The embryo gets nutrition from the mother's blood with the help of placenta. [½]

(b) The developing embryo will also generate waste substances which can be removed by transferring them into the mother's blood through the placenta. [½]

(ii) Uterine lining becomes thick and spongy after fertilisation because it provides nurture and protection to the growing embryo. **[1]**

22. (a) Sporangium and spores are the reproductive parts of bread mould (*Rhizopus*) while hyphae is a non-reproductive part of bread mould. **[1]**

(b) Advantages of vegetative propagation:

(i) Vegetative propagation helps in producing disease free plants.

(ii) All plants produced by vegetative propagation are genetically similar to the parent plants.

(iii) Vegetative propagation is usually a means of propagating plants which do not produce viable seeds.

(iv) Plants raised by vegetative propagation can bear flowers and fruits earlier than those which are produced from seeds.

(Any two) [2×½]

23. The reproductive parts of an angiosperm are as follows:

(a) Male reproductive part is stamen and

(b) Female reproductive part is pistil or carpel [½]

The reproductive parts of an angiosperm are located in the flower. [½]

The male reproductive part or stamen produces pollens. Each stamen consists of a stalk called filament and a flattened top called anther. The anthers produce pollen grains. **[1]**

OR

Puberty is the beginning of development for sexual maturity. It is the age at which production of sex hormones begin and boy and girl become sexually mature. It occurs at the age of 10-12 years in girls and 13-15 years in boys. **[1]**

Changes that are common to both boys and girls in early teenage years are:

(i) Thick hair growth in the pubic region and armpits.

(ii) Thin hair appears on legs and arms, as well as on the face.

(iii) The skin frequently becomes oily and there might be occurrence of acne.

[Any two] [2×½]

24. (a) (i) Implantation is the event during pregnancy in which a fertilized egg or zygote adheres to the walls of the uterus, inside the female body. **[1]**

(ii) Placenta is a disc like vascular structure embedded in the uterine wall. The placenta supplies nutrients like glucose and oxygen to the developing embryo. It also removes waste substances generated by the embryo. **[1]**

(b) The average duration of human pregnancy is nine months. **[1]**

25. DNA - Deoxyribonucleic acid. [½]

DNA is present in the nucleus of the cell. [½]

DNA in the cell nucleus is the information source for making proteins and is thereby, responsible for inheritance of features. A basic event in reproduction process is DNA copying, accompanied by the creation of an additional cellular apparatus after which the DNA copies separate, each with its own cellular apparatus.

The consistency of DNA copying during reproduction is important for the maintenance of body design features. Variations occur in the DNA copying reactions during reproduction, due to which the surviving cells are similar to, but subtly different from each other. This inbuilt tendency for variation during reproduction is the basis for evolution. **[2]**

26. HIV stands for Human Immunodeficiency Virus. [½]

Yes, HIV is an infectious agent which spreads through sexual contact. [½]

Modes by which can HIV spread:

i. Through sexual contact.

ii. From pregnant mothers to the growing foetus.

iii. Through transfusion of infected blood.

iv. By sharing of needles or syringes. **[4×½]**

27. Sexually transmitted diseases (STD's) are diseases which are usually passed through sexual contact with an infected partner.

i. Sexually transmitted diseases caused due to bacterial infection: Gonorrhoea and Syphilis. [½]

ii. Sexually transmitted diseases caused due to viral infection: AIDS and Herpes. [½]

A key strategy in the prevention of STD's involves screening, diagnosis and treatment of patients as well as their sexual partners to interrupt transmission.

Prevention of transmission of STD's:

(a) Having sex with an infected or any unknown person should be avoided.

(b) Sharing of needles, syringes etc. must be prohibited.

(c) Surgical and dental instruments should be sterilised properly before use.

(d) Avoid blood transfusion from an infected person. Blood should be tested before transfusion.

(e) Adequate medical treatment should be provided to the pregnant woman to protect the child from getting infected.

(Any four) [4 × ½]

28. (a) In *Planaria*, any part of the body which gets cut is capable of regeneration or developing into a complete organism. Regeneration is carried out by specialized cells which proliferate and make large numbers of cells. From these mass of cells, different cells undergo changes to become various cell types and tissues. These changes take place in an organised sequence referred to as development. **[1]**

(b) Differences between Regeneration and Reproduction :

Regeneration	Reproduction
1. This process occurs by asexual method only.	1. This process occurs by asexual and sexual method.
2. The organisms are being cut or broken and each of the broken or being cut part grows into a separate new individual.	2. The individuals give rise to young ones of their own kind.

[2 × 1]

29. Asexual reproduction involves single individual which produces new generation whereas sexual reproduction involves two individuals one is male parent and other is female parent to produce new individuals. **[1]**

Sexually reproducing species is likely to have comparatively better chance of survival as it involves two different individuals.

Sexual mode of reproduction incorporates such a process of combining DNA from two different gametes of two different parents *i.e.*, male and female gametes of male and female parents respectively.

Thus, sexual reproduction involves variation in the new individuals which helps in survival of the species. **[2]**

30. The DNA copying which is not perfectly accurate in the reproduction process results in variations in populations for the survival of species. The amount of DNA remains constant because the gametes are special type of cells called reproductive cells which contain only half the amount of DNA as compared to the normal body cells of an organism. **[3]**

31. Four methods of contraception used by humans: Intrauterine devices, oral contraceptive methods, surgical methods and natural methods (coitus interrupts) **[4 × ½]**

Two advantages of adopting such preventive methods :

(i) It helps in preventing unwanted pregnancies.

(ii) It reduces the chance of getting STDs such as AIDS. **[2×½]**

32. (a) Two reasons for the appearance of variations among the progeny formed by sexual reproduction are :

(i) Sexual reproduction results in new combinations of genes which are brought together during the formation of gametes.

(ii) Gene combinations are different in gametes. **[2×½]**

(b) (i) Part 'A' labelled is pollen grain. [½]

(ii) Part 'B' is stigma. The pollen grain reaches the stigma through wind, water or animals. [½]

(iii) Part 'C' is the pollen tube. The pollen tube carries the gametes to the embryo sac for fertilisation. [½]

(iv) Part 'D' is the egg cell. After fertilisation with the male gametes, the egg cell forms the zygote. [½]

33. Reproduction is the ability of living organisms to produce living beings similar to them. **[1]**

Reproduction maintains the number of chromosomes specific to a species in each generation. Multicellular organisms have specialised cells in their gonads, which have only half the number of chromosomes and half the amount of DNA as compared to non-reproductive body cells. So, when these germ cells from two different individuals combine during sexual reproduction to form a new individual, it results in the re-establishment of the number of chromosomes and the DNA content in the new generation. Thus, it provides stability to the population of a species. **[2]**

34. Regeneration is the ability of organisms to generate lost or damaged parts of the body. **[1]**

When a *Hydra* is bisected anywhere in the upper 7th or 8th part of the body column, the upper half will regenerate a foot at its basal end and the lower half will regenerate a head at its apical end; each half generates the organ which it is missing. The regeneration is precise, and the head and foot are always formed specifically at the apical and basal ends, respectively. **[2]**

35. Two types of reproduction:

(i) Sexual reproduction

(ii) Asexual reproduction **[2×½]**

Sexual reproduction is responsible for bringing in more variations in its progeny.

It takes place by the combination of male and female gametes.

Gametes are formed from one cell which involves copying of DNA and the cellular apparatus. DNA copying is not absolutely accurate, and errors result in new variations. With every DNA copied, a new variation is introduced, and this DNA copy may already have several variations accumulated from the previous generations. **[2]**

36. Techniques to prevent pregnancy:

(a) Coitus interruptus **[½]**

(b) Barrier methods like use of condoms, cervical cap and diaphragm. **[½]**

(c) Use of intra-uterine devices such as loop and copper-T **[½]**

Use of intra-uterine devices is not meant for males. **[½]**

The use of these techniques will keep the mother in good health. With a small family size, parents will be able to provide quality resources to the child such as food, clothes and education. This will improve the overall mental and physical well-being of the family. **[1]**

37. Vegetative propagation is a type of reproduction in which several plants are capable of producing naturally through their roots, stems and leaves. **[1]**

Advantages of vegetative propagation:

Plants not capable of producing sexually are produced by this method.

It is a fast and certain method to obtain plants with desired features. **[2×½]**

Disadvantages of vegetative propagation:

There is no possibility for variation.

The new plant grows in the same area as the parent plant which leads to competition for resources. **[2×½]**

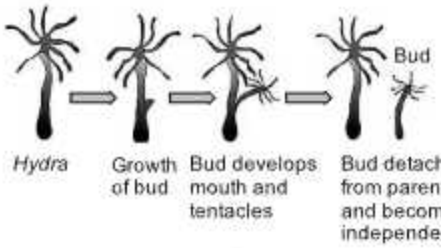
38. (a)

Binary Fission	Multiple Fission
1. It gives rise to two daughter individuals.	1. It forms many (more than two) daughter individuals.
2. It occurs during favourable conditions.	2. It can occur under favourable as well as unfavourable conditions.
3. Nucleus of the parent cell divides only once to form two daughter cells.	3. Nucleus of the parent undergoes repeated division to form a number of daughter nuclei.
4. Cytoplasm divides after nuclear division.	4. Cytoplasm does not divides after every nuclear division.
5. No part of the parent body is left unused.	5. A part of the body, covering a residual cytoplasm, is left behind.

[Any two] [2×1]

(b) When a mature *Spirogyra* filament attains considerable length, its body breaks up into two or more parts called fragments, each of which grows into a new individual. **[1]**

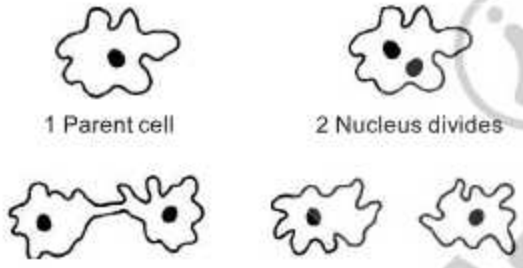
39. In *Hydra*, a bud develops as an outgrowth due to repeated cell divisions at one specific site. These buds develop into tiny individuals and when fully mature, detach from the parent body and become new independent individuals. **[2]**



[3]

OR

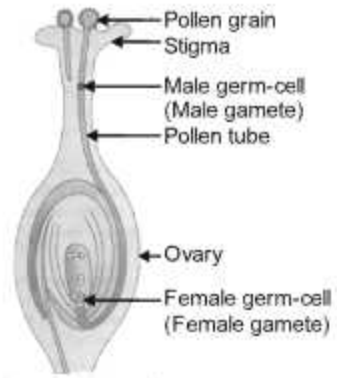
Binary fission is an asexual method of reproduction. *Amoeba* reproduces by this method. During this process, nuclear division takes place first, followed by the appearance of a constriction in the cell membrane, which gradually increases inwards and divides the cytoplasm into two parts. Finally, two daughter organisms are formed. **[3]**



[2]

40. Pollination - Transfer of pollen grains from the anther to the stigma is called pollination. **[1]**

Fertilisation - The process of fusion of male and female gametes to form a zygote which eventually develops into an embryo is called fertilisation. **[1]**



Germination of pollen on stigma

[Diagram : 1 Labelling: 4×½]

OR

(i) Testis: It is the organ which produces sperms and the male sex hormone, testosterone. **[1]**

(ii) Seminal vesicle: It provides nourishment to sperms. **[1]**

(iii) Vas deferens: Vas deferens is a tube transporting spermatozoa from the epididymis to the prostate part of the urethra. **[1]**

(iv) Ureter: It carries urine from the kidneys to the urinary bladder. **[1]**

(v) Prostate gland: It contributes additional fluid to the ejaculate and also help to nourish the sperms. **[1]**

41. (a) **Function of placenta:**

(i) Exchange of nutrients and water between mother and the foetus.

(ii) Excretion of nitrogenous wastes from foetus. Nitrogenous waste crosses the placenta and is removed by mother's kidney. **[2×1]**

(b) Ways of preventing pregnancy:

(i) **Natural methods:** This method involves withdrawal of penis from vagina just before discharge of semen. **[½]**

(ii) **Barrier methods:** In this method, the fertilisation of ovum and sperm is prevented with the help of physical devices such as condoms and diaphragm. **[½]**

(iii) **Oral contraceptives:** In this method, tablets or drugs are taken orally. These contain small doses of hormones which prevent the release of eggs and prevent fertilisation. **[½]**

(iv) **Surgical methods :** In this method, vas deferens in males and fallopian tube in females are blocked in order to prevent fertilisation. **[½]**

Advantages of using such preventive measures are:

- It helps from unwanted pregnancy.
- It protects the user from sexually transmitted diseases. **[2 × ½]**

42. (a) A - Stigma.

Function - The stigma is a sticky surface where the pollen grains land and germinate. **[1]**

B - Pollen tube.

Function - It carries the pollen grains to the egg cell for fertilisation. **[1]**

C - Egg cell.

Function - It fuses with the male gamete and leads to the formation of the zygote. **[1]**

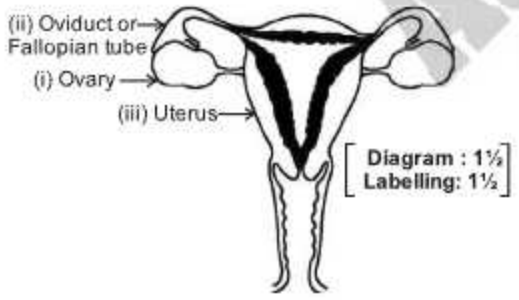
(b) Role of gametes - Gametes carry the entire genetic information of the organism. These gametes upon fusion result in the formation of the zygote, which develops into a new individual. Any deformation in the gametes will lead to deformity in the newly formed offspring. **[1]**

Role of zygote - Zygote is the diploid cell formed by the fusion of male and female gametes during fertilisation in sexual reproduction. Zygote is the first stage in the development process of an organism and it contains all the genetic information of both the parents essential for the growth of the new organism. **[1]**

43. (a) (i) Ovary

(ii) Fallopian tubes

(iii) Uterus



(b) (i) If the uterus receives the zygote, the female becomes pregnant. The embryonic development of the zygote starts immediately. The embryo moves down into the uterus forming a thick and soft lining of blood vessels around itself. This process is called implantation. After implantation, a special tissue develops between the uterine wall and the embryo called placenta, where the exchange of nutrients, oxygen and waste products takes place. **[1]**

(ii) If the egg released by the ovary is not fertilized and the zygote is not formed, then the thick lining of the uterus breaks down and comes out through the vagina in the form of blood and mucous. This is called menstruation. **[1]**

44. (a) A - Pollen grain

B - Pollen tube

C - Ovary

D - Female germ cell **[4 × ½]**

(b) Pollination is the process of transfer of pollen grains from anther to stigma of the flower.

Significance of pollination: Pollination is a significant event because it precedes fertilization. It brings the two types of gametes closer for the process of fertilization. Also, cross pollination introduces variations in the plants due to mixing of different genes which increases adaptability towards environment or surroundings. **[1]**

(c) The male germ cell produced by pollen grain reach to the ovary through a tube that grows from pollen grain and travels through style. The male germ cell fuses with the female germ cell inside ovule to form zygote which is capable of growing into a new plant. **[1]**

After fertilization, ovules develop into the seeds and ovary develops into the fruit. **[1]**

45. (a) Testes produce sperms and secrete a hormone called testosterone. **[1]**

The function of testosterone is to control the development of male sex organs and male features such as a deeper voice, moustache, beard and more body hair as compared to females. **[1]**

(b) i. Fertilisation takes place in the oviduct or fallopian tubes.

ii. Implantation of the fertilised egg occurs in the uterus. **[2 × ½]**

After implantation, a disc-like special tissue called placenta develops between the uterus wall and the embryo. The placenta helps in the exchange of nutrients, oxygen and waste products between the embryo and the mother. Thus, it provides nourishment to the growing embryo. **[2]**

46. The placenta is an organ attached to the lining of the womb during pregnancy. **[1]**

The placenta is composed of both maternal tissue and tissue derived from the embryo. It contains blood spaces on the mother's side and villi on the embryo's side. **[2]**

Functions of the placenta:

1. It provides food and oxygen to the foetus.
2. The foetus gives away waste products and carbon dioxide to the mother's blood for excretion. **[2 × 1]**

47. (a) (i) Ovary : It produces female gametes. One ovum is released by one ovary every month. It also secretes hormones oestrogen and progesterone. **[1]**

(ii) Uterus: It protects and nourishes the developing embryo. **[1]**

(iii) Fallopian tube: It passes down the ovum towards the uterus released by the ovary. **[1]**

Structure of the placenta in human female:

(b) (i) The placenta is a disc which is embedded in the uterine wall.

(ii) It contains villi on the embryo side. The mother's end of the placenta has blood spaces which surround the villi. **[2 × ½]**

Functions of the placenta in human female:

(i) Nutrients and oxygen are received by the foetus from the mother's blood.

(ii) The foetus gives away waste products and carbon dioxide to the mother's blood for excretion. **[2 × ½]**

48. The process of transfer and deposition of pollen grains from the anther to the stigma of the flower is called pollination. **[1]**

There are two different types of pollination :

(i) Self pollination : It is the process of transfer of pollen grains from the anther to the stigma of the same flower. **[1]**

(ii) Cross pollination : It is the process of transfer of the pollen grains from the anther of one flower to the stigma of another flower. **[1]**

Pollination can be achieved by the agents like wind, water and animals. **(Any two) [2 × ½]**

After the pollen lands on a suitable stigma, it has to reach the female germ-cells which are in the ovary. For this, a tube grows out of the pollen grain and travels through the style to reach the ovary and then fertilisation occurs. **[1]**

OR

(a) The given diagram is of female reproductive system. **[½]**

1 - Fallopian tube
2 - Ovary
3 - Uterus
4 - Cervix
5 - Vagina **[5 × ½]**

(b) The birth control methods which deliberately prevent fertilization are referred to as contraception. **[½]**

Advantages of adopting contraceptive measures are :

(i) It prevents unwanted pregnancy.
(ii) It prevents the transmission of STDs.
(iii) It controls the birth rate and determines the size of the population. **[3 × ½]**

49. (i) The two modes of asexual reproduction observed in *Hydra* are budding and regeneration.

Budding- Budding is a method of asexual reproduction in which a new organism develops from a bud of an existing organism. **[1]**

Regeneration- Regeneration is the process of renewal or restoration of any lost part of the body or the formation of the whole body of an organism from a small fragment. **[1]**

(ii) **Vegetative propagation :** Vegetative propagation is a mode of asexual reproduction in which new plants are obtained from the vegetative parts such as roots, stems and leaves of plants. **[1]**

Advantages of vegetative propagation are :

(a) Vegetative propagation is usually a means of propagating plants which do not produce viable seeds or produce very few seeds or have long dormant period of seeds. Examples : banana, pineapple, orange, grape, rose and jasmine.

(b) It helps in producing disease free plants.

(c) All plants produced by vegetative propagation are genetically similar to the parent plants.

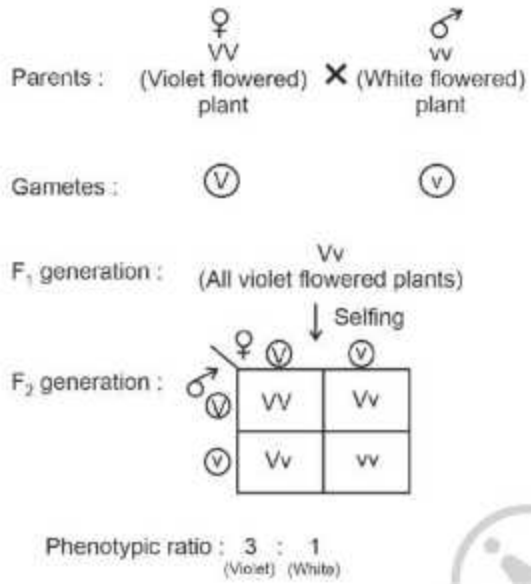
(d) Plants raised by vegetative propagation can bear flowers and fruits earlier than those which are produced from seeds.

(Any two) [2×1]

4 : Heredity and Evolution

1. Variation increases the chances of survival of a species in a constantly changing environment. **[1]**

2. Answer (c) **[1]**



3. Answer (d) **[1]**

Progeny having gene combination bb will have brown eyes.

4. Example of inherited trait - Shape of the eye or hair colour. **[½]**

Example of acquired trait - Building of muscles while exercising. **[½]**

Difference between the inherited and the acquired characters:

Inherited Characters	Acquired Characters
Inherited characters affect the DNA of germ cells and hence can be passed on to the future generations.	Acquired characters do not cause changes in DNA of the germ cells and hence cannot be passed on to future generations.

[1]

5. In Mendelian experiment, breeding of pea plants bearing violet flowers with pea plant bearing white flower leds to production of all violet coloured flowers (F_1 progeny plants). The plants bearing violet coloured of the flower is dominant over write coloured flower in pea plant. **[2]**

6. Different ways in which individuals with a particular trait may increase in population are variation, natural selection and genetic drift.

Variation : Variation is defined as the occurrence of differences among the individuals. No two individuals are exactly alike. Variations arising during the process of reproduction can be inherited and lead to increased survival of the individuals. **[1]**

Natural selection : It results in adaptations in population to fit their environment better. Thus, natural selection directs evolution in the population of a particular species. **[1]**

Genetic drift : The change in the frequency of certain genes in a population over generations is called genetic drift. **[1]**

7. (a) Blue **[1]**

(b) 25% **[1]**

(c) 1 : 2 **[1]**

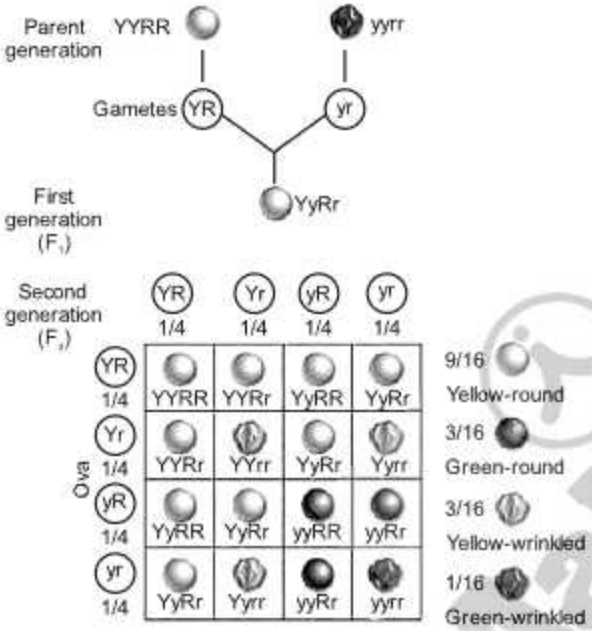
8. Some traits are determined by the combined effect of more than one pair of genes. These are referred to as polygenic or continuous, traits.

An example of this is human stature. The combined size of all of the body parts from head to foot determines the height of an individual. There is an additive effect. The sizes of all of these body parts are, in turn, determined by numerous genes. Human skin, hair, and eye color are also polygenic traits because they are influenced by more than one allele at different loci. The result is the perception of continuous gradation in the expression of these traits. **[3]**

9. Chromosomes are thread-like structures found in the nucleus at the time of cell division. They are made of proteins and DNA. **[1]**

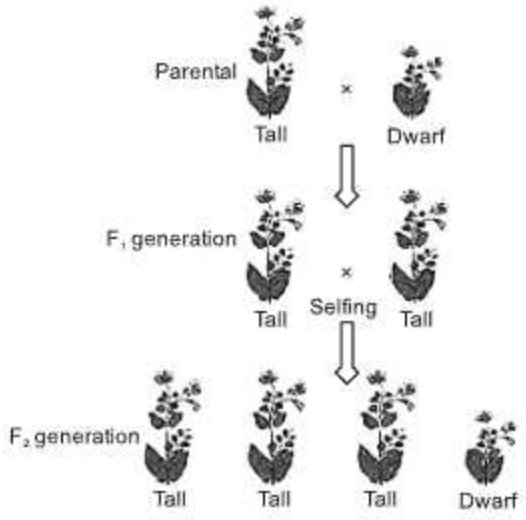
In sexually reproducing organisms, the gametes undergo meiosis, and hence, each gamete contains only half a set of chromosomes. When two gametes fuse, the zygote formed contains the full set of chromosomes. Hence, the formation of gametes by meiosis helps to maintain the number of chromosomes in the progeny. **[2]**

10. Mendel carried out dihybrid crosses by crossing two pea plants differing in contrasting traits of two characters. For example, he crossed a pea plant having yellow colour and round seed characters with another pea plant bearing green colour and wrinkled seed characters. In the F_2 generation, he obtained pea plants with two parental and two recombinant phenotypes as yellow round and green wrinkled (parental) and yellow wrinkled and green round (recombinant). This indicated that traits separated from their original parental combinations and got inherited independently. **[1]**



[2]

11. Mendel explained that it is possible that a trait is inherited but not expressed in an organism with the help of a monohybrid cross.



[1½]

1. He crossed pure-bred tall plants (TT) with pure-bred dwarf plants (tt).
2. The progeny he received in the first filial generation was tall. The dwarfness did not show up in the F_1 generation.
3. He then crossed the tall pea plants of the F_1 generation and found that the dwarf plants were obtained in the second generation. He obtained three tall plants and one dwarf plant. **[3 × ½]**

12. Parents – Tall TT × Short tt → T, t

Gametes –

F_1 Generation – Tt (All tall offsprings) **[1]**

Selfing of F_1 generation: Tt × Tt → T, t and T, t

Gametes –

F_2 generation –

♀ \ ♂	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Short)

[1]

F_2 Phenotypic ratio – Tall : Short **[½]**

3 : 1

F_2 Genotypic ratio – TT : Tt : tt **[½]**

1 : 2 : 1

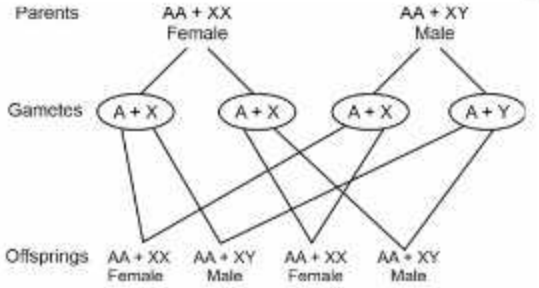
13. Differences between acquired traits and inherited traits : **[3 × 1]**

	Acquired traits	Inherited traits
1.	These traits are gained during the lifetime of an individual.	These traits are controlled by specific genes.
2.	These traits cannot be passed to the progeny.	These traits are passed on from one generation to another.
	Ex. : Pierced earlobes	Ex. : Colour of the eyes

14. (a) The two types of gametes produced by men are :

22A + X and 22A + Y [A denotes autosomes] **[½+½]**

(b) No, a male child does not inherit X chromosome from his father but from his mother. [½]



As it is clear from the above representation, the mother passes X chromosome to male child. [1]

(c) Only one type of gamete is produced by female i.e. 22A + X. [½]

15. (a) The F_1 progeny of tall plants with round seeds (TTRR) and short plants (ttrr) with wrinkled seeds would be tall plants with round seeds (TtRr). [1]

(b) The recessive traits in the above case are short plants and wrinkled seeds. [1]

(c) On selfing F_1 generation,

F_1 generation — TtRr (All tall plants with round seeds) ↓ Self Pollination

Gametes ♂→ / ♀↓	TR	Tr	tR	tr
TR	TTRR	TTRr	TtRR	TtRr
Tr	TTRr	TTrr	TtRr	Ttrr
tR	TtRR	TtRr	ttRR	ttRr
tr	TtRr	Ttrr	ttRr	ttrr

F_2 generation

- Tall and round = $\frac{9}{16}$
- Tall and wrinkled = $\frac{3}{16}$
- Short and round = $\frac{3}{16}$
- Short and wrinkled = $\frac{1}{16}$

Phenotypic ratio = 9 : 3 : 3 : 1 [1]

OR

If 1600 plants were obtained in F_2 progeny, then the number of

(i) Tall with round seeds = $\frac{9}{16} \times 1600$

= 900 [1]

In F_2 progeny, 900 tall plants with round seeds are produced.

(ii) Short with wrinkled seeds = $\frac{1}{16} \times 1600$

= 100 [1]

In F_2 progeny, 100 short plants with wrinkled seeds are produced.

Conclusion:

The above given experiment depicts the dihybrid cross that reveals Mendel's 'Law of independent assortment' which states that-

'The alleles of two different characters/traits segregate or assort independently i.e., the segregation of alleles of a trait in the gametes is independent of the segregation of alleles of the other trait'. [2]

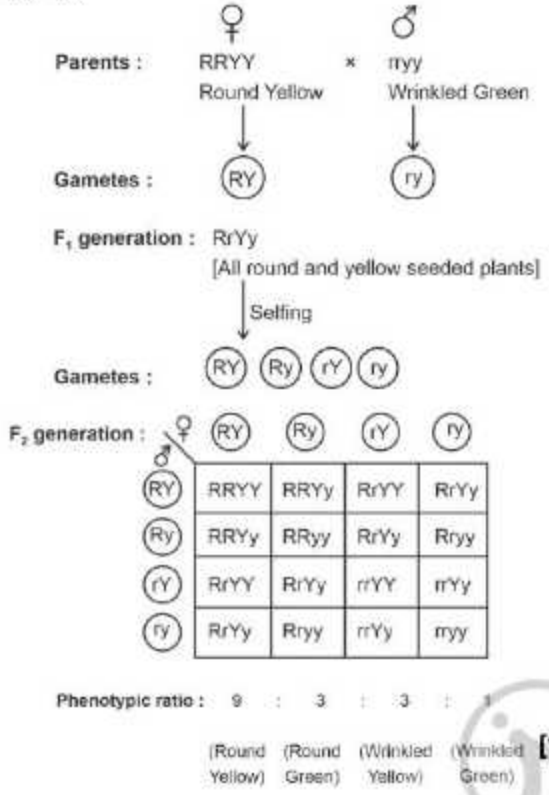
16. (i) In sexual reproduction, the offsprings produced are not identical to parents because two parents are involved and there is fusion of male and female gametes which introduces variations in offsprings and hence, offsprings are not true copy of the parents. [1]

(ii) F_1 generation is the first filial generation obtained by crossing two different parents whereas F_2 generation is the second filial generation obtained by self crossing the F_1 generation. [1]

(iii) (A) Variations make species more adapted to survive and grow in the changing environmental conditions. The variant species helps the species overcome extreme conditions in surroundings. Therefore, they can survive better and reproduce to pass the genes to the offsprings. Variations occur during meiosis which causes gamete formation in the organism. It maintains the population and hence variations occur in genetic material in every generation. [2]

OR

(iii) (B)



[1]

The new combinations obtained were round green and wrinkled yellow seeds.

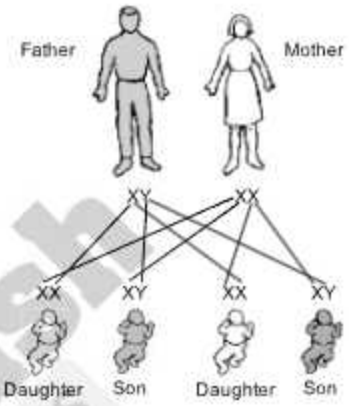
The appearance of new combinations appeared in F_2 generations can be explained by the 'Law of independent assortment'. It states that when two pairs of traits are combined in a hybrid, one pair of character segregates independent of the other pair of character.

In dihybrid cross, four types of gametes were produced and each of these segregate independent of each other, each having frequency of 25% of the total gametes produced. **[1]**

17. In human beings, females have two X chromosomes and males have one X and one Y chromosome. Therefore, the females are represented as XX and males as XY. At the time of mating, large number of sperms are ejaculated from the male reproductive organ (penis), into the female reproductive organ i.e., vagina. They travel towards the fallopian tubes, where only one sperm meets with the egg.

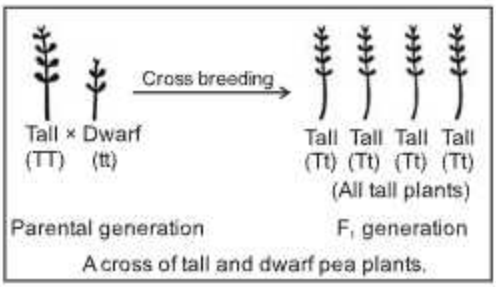
The process of fusion of the sperm and ovum is called fertilisation. The sperm has either X or Y chromosome and egg has only X chromosome. So, if a sperm carrying Y chromosome fuses with the egg, the newly born child will be male and if a sperm carrying X chromosome fuses with the egg, the newly born child will be female. There is an equal chance of fusion of either X or Y chromosome with the egg so we can say that the sex of a new born child is a matter of chance and none of the parent is responsible for it. **[3]**

Sex determination in humans is shown below:



[2]

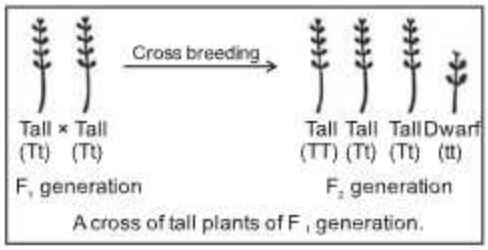
18. (a) Mendel crossed pure bred tall pea plants with pure bred dwarf pea plants and found that only tall pea plants were produced in the first generation and there were no dwarf pea plants. He concluded that the first generation showed the traits of only one of the parent plants-tallness. The trait of the other parent plant- dwarfness- did not show up in the progeny of the first generation.



A cross of tall and dwarf pea plants.

He then crossed the tall pea plants obtained in the first generation (F_1 generation) and found that both tall plants and dwarf plants were obtained in the second generation (F_2 generation) in the ratio of 3 : 1.

Mendel noted that the dwarf trait of the parent pea plant which disappeared in the first generation progeny reappeared in the second generation. In this way, Mendel's experiments with tall and dwarf pea plants showed that the traits may be dominant and recessive.



A cross of tall plants of F_1 generation.

[2½]

(b) When Mendel crossed pure-bred tall pea plants with pure-bred dwarf pea plants, he found that only tall pea plants were produced in the F_1 generation. When he further crossed the tall pea plants of the F_1 generation, he found that the tall plants and dwarf plants were obtained in the ratio 3 : 1 in the F_2 generation.

Mendel noted that all the pea plants produced in the F_2 generation were either tall or dwarf. There were no plants with intermediate height (or medium height) in between the tall and dwarf plants.

In this way, Mendel's experiment showed that the traits (like tallness and dwarfness) are inherited independently. This is because if the traits of tallness and dwarfness had blended (or mixed up), then medium-sized pea plants would have been produced. **[2½]**

19.

Acquired Trait	Inherited Trait
A trait or characteristic which develops in response to the environment and cannot be inherited.	A characteristic feature inherited from the previous generation.
Example: A person learns to swim.	Example: A girl has brown eyes just like her mother.

[2]

Only those traits are inherited which are developed because of changes in genes.

An acquired trait or experience is developed as a response to the environment; it is not inherited. These are not developed due to the changes in genes.

Example : Human beings experiencing weight loss due to starvation. There will be reduction in weight as a response to starvation. This will result in the reduction in the number of body cells or overall body-mass ratio of the individual. It will not have any effect on the genetic constitution of the individual. Because there is no change in the gene of the individual, it is not an acquired trait. **[3]**

20. (a) Genetics is defined as the branch of biology which deals with the study of heredity and variations. **[1]**

(b) Gene is the functional unit of heredity present at a specific point on a chromosome. **[1]**

(c) The following factors are responsible for the rise of a new species :

(i) **Natural selection :** It is a process in which heritable variations enabling better survival are enabled to reproduce and leave greater number of progeny.

(ii) **Genetic drift :** It is the change in gene frequency by chance in a small population due to random sampling.

(iii) **Reproductive isolation :** Over a period of time, a population may become so different from the parent population that they are no longer able to interbreed with one another. It is called reproductive isolation.

(iv) **Geographical isolation :** When a geographical barrier separates two populations of a species, then these are no longer able to reproduce together. **[Any three] [3×1]**

5 : Our Environment

1. Our increasing demand for energy is depleting our natural resources and polluting the environment in one or the other way. **[1]**

2. Milk bags and tin cans are the non-biodegradable substances. **[1]**

3. Exploitation and overconsumption of natural resources will ultimately result in their scarcity. **[1]**

4. Grass → Insect → Frog → Snake,

   Frog is the secondary consumer. **[1]**

5. According to the 10% law of flow of energy, 2 J of energy will be available for man in this food chain. **[1]**

6. (a) As human beings occupy the top level in any food-chain, the maximum concentration of these chemicals/pesticides get accumulated in the human body. **[1]**

   (b) (i) Consume peeled and washed fruits and vegetables.

   (ii) Ban the use of pesticides.

   (iii) Consume the food produced by organic farming. (Any one) **[1]**

   (c) Answer (b)

   Trophic level **[1]**

   (d) Answer (a)

   Consumer **[1]**

7. Answer (b) **[1]**

   The transfer of energy from one trophic level to the next is in the form of chemical energy.

8. Answer (d) **[1]**

   Soil fertility refers to the ability of soil to sustain plant growth.

9. Fossil fuels like coal and petroleum are huge reservoirs of carbon and its compounds. On burning fossil fuels, huge reservoirs of carbon present in fossil fuels get converted to carbon dioxide and go into air. The amount of carbon dioxide increases in the atmosphere which leads to an increased green house effect leading to excessive heating of the Earth which is called global warming. **[2]**

10. Some of the ways to make people realise that the improper disposal of waste is harmful to the environment are:

    (a) Improper disposal of waste will serve as a breeding ground for mosquitoes and will create favourable conditions for the spread of various diseases.

    (b) Improper disposal of waste will release harmful gases in the environment which makes the environment unclean and unhygienic for normal living of organisms.

    (c) The waste will flow to water bodies along with the rain water and become a threat to aquatic organisms. **(Any two) [2]**

11. Consequences of elimination of decomposers:

    (i) If all the decomposers of earth are eliminated then the dead bodies of plants and animals would not be decomposed into simpler non-polluting substances.

    (ii) Elimination of decomposers would cause imbalance of nutrients as they break complex organic material into simpler substances in different nutrient cycles. **[2]**

12. Four activities which can be done as an environmentalist to conserve natural resources are

    (i) Using public transport for commuting instead of using a personal vehicle.

    (ii) Avoid using clothes, accessories or articles made of animal skin.

    (iii) Using energy-efficient electrical appliances to save electricity.

    (iv) Ensuring no leakage of water taps and pipes at home. **[4×½]**

13. Grass (20 kJ) ⟶ Grasshopper (2 kJ) ⟶

    Frog (200 J) ⟶ Snake (20 J) ⟶ Peacock (2 J)

    According to the ten percent law of transfer of energy, if 2J of energy is available to peacock, then the amount of energy present in grass is 20 kJ. **[1]**

When green plants are eaten by herbivores, a great amount of energy is lost as heat to the environment and in various other body processes. On an average, 10% of the food (energy) is turned into the body of herbivores. Similarly, 10% of the total energy available to the herbivores is made available for the next level of consumers. **[1]**

OR

(a) Garbage is refuse of food, vegetables and fruit articles along with other domestic wastes. **[½]**

The two classes in which garbage is classified are :

(i) Biodegradable substances **[½]**

(ii) Non-biodegradable substances **[½]**

(b) Enzymes are bio-catalysts that break down complex substances into simpler ones and they are specific for the substrates on which they act. **[½]**

14. Pesticides are sprayed over crop plants to protect them from pests and diseases. From the soil, these are absorbed by the plants along with water and minerals and from the water bodies these are taken up by aquatic plants and animals.

In this way, they enter the food chain. Since pesticides are non-biodegradable so they get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, so their maximum concentration get accumulated in the human body and causes softening of brain, cerebral haemorrhage, liver damage, hypertension and cancer. **[2]**

15. UV rays in the atmosphere split some molecular oxygen (O_2) into free oxygen (O) atoms.

These atoms combine with molecular oxygen to form O_3.

$$\underset{\text{oxygen molecule}}{O_2} \xrightarrow[\text{(from Sun)}]{\text{UV radiations}} \underset{\text{oxygen atom}}{[O]} + \underset{\text{oxygen atom}}{[O]}$$

$$\underset{\text{oxygen molecule}}{O_2} + \underset{\text{oxygen atom}}{[O]} \longrightarrow \underset{\text{ozone molecule}}{O_3}$$

[1]

Damage to ozone layer will allow UV rays to reach on the surface of earth causing skin cancer, cataract and damage to crops. **[1]**

Release of chlorofluorocarbons in the atmosphere which are used as refrigerants or in fire extinguishers damages the ozone layer. **[1]**

16. (a) All living organisms such as plants, animals and microorganisms interact with one another and also with their physical surroundings such as soil, air and water to maintain a balance in nature. This forms a self sustaining unit called ecosystem. **[1]**

The two components of the ecosystem are Biotic and Abiotic.

Biotic system consists of all the living organisms of particular area like humans, animals etc. and the abiotic components consists of air, minerals, soil, water and sunlight. **[1]**

(b) Ponds do not need to be cleaned but aquarium needs to be cleaned because an aquarium does not contain soil and decomposing bacteria which helps in degrading complex organic substances into simple inorganic substances. But ponds or lakes have this ability of self-purification, and therefore these do not need to be cleaned. **[1]**

17. 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. **[1]**

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. **[1]**

Biomagnification of a toxic substance has the potential to cause harm to organisms, particularly to the tertiary consumers as it gets accumulated in their bodies. **[1]**

18. The flow of energy in the ecosystem is said to be unidirectional because the energy lost as heat from the living organisms of a food chain cannot be reused by plants in photosynthesis. Pesticides are non-biodegradable wastes which pass along the food chain from crops to man or other animals and birds and harm them. **[3]**

19.

Biodegradable wastes	Non-biodegradable wastes
(a) Waste materials which can be broken down to non-poisonous substances in nature in due course of time by the action non-biodegradable wastes	(a) Waste materials which cannot be broken down into non-poisonous or harmless substances in nature are called non-biodegradable wastes
(b) Example: Cattle dung, wool, paper, compost	(b) Example: Plastics, polythene bags, metal articles, glass objects

[2×1]

The changes which people must adopt to dispose non-biodegradable wastes for saving the environment are :

(a) Household waste, chemical waste and hospital waste should be disposed off by dumping them in the low-lying areas of the ground called a landfill.

(b) Broken plastic articles such as buckets, bowls, cups, plates etc. should be sent to plastic processing factories. **[2×½]**

20. (a) It is necessary to conserve our environment because it helps in protecting the ozone layer and helps in maintaining animal and human food chains. **[1]**

(b) Disposal of household waste is carried out in green and blue bins as it is very useful in the separate disposal of biodegradable and non-biodegradable wastes. **[1]**

(c) The two values exhibited are :

(i) Creating environmental awareness among students and society.

(ii) Working hard on prevention of environmental degradation of surroundings. **[2×½]**

21. (a) The two measures to manage the garbage we produce are :

(i) Garbage should be kept in proper place indicated by municipality.

(ii) We can put wet garbage and dry garbage in separate containers so that they can be used for recycling. **[2×½]**

(b) Ways to generate the least garbage are:

(i) We should be careful in kitchen not to cook more food than necessary.

(ii) We can also give green vegetable and food waste to nearby pet animals like cow etc. **[2×½]**

(c) The two values teacher instilled are:

(i) Teacher is environment conscious.

(ii) Teacher wants to make his students responsible citizens. **[2×½]**

22. The problem of waste disposal can be reduced by the following ways:

(a) **Recycling :** Different kind of solid wastes like paper, plastics, etc., can be recycled. For example, waste paper is sent to the paper mills where it is reprocessed to produce new paper.

(b) **Composting :** Biodegradable domestic wastes such as left-over food, fruit and vegetable peels, leaves of potted plants, etc., can be converted into compost by burying them in a pit dug into ground.

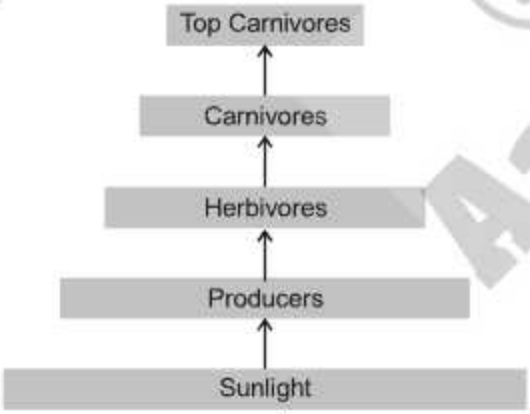
(c) **Biogas and manure :** Organic wastes can also be decomposed anaerobically to yield biogas and manure.

(d) **Burning :** The solid combustible waste is burnt. It however, causes air pollution.

(e) **Sewage treatment plants (STPs) :** The dirty drain water containing urine and faeces, which is carried from our homes by underground pipes (called sewers) is called sewage. Sewage should always be disposed off by treating it in sewage treatment plants (STPs). The treatment results in the production of clean water, which is then discharged into river. **[Any three] [3×1]**

OR

All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. Ecosystem consists of biotic and abiotic components. **[1]**



[2]

Block diagram showing flow of energy in an ecosystem.

23. (a) Natural ecosystems like ponds and lakes need not to be cleaned regularly as they contain decomposers which act as cleansing agents whereas an aquarium is an artificial ecosystem and does not contain any decomposer that will cleanse it so, aquarium needs to be cleaned regularly. **[1]**

(b) The release of ozone depleting substances like chlorofluorocarbons, halogens, carbon tetrachloride in environment causes the depletion of ozone at higher levels of atmosphere. **[1]**

Depletion of ozone layer allows the UV radiation to reach the earth surface. These radiations are highly damaging to the organisms, for example, it can cause skin cancer in human beings. **[1]**

24. **Difference between biodegradable and non-biodegradable wastes :**

Biodegradable Wastes	Non-biodegradable Wastes
These can be broken down into simple, non-poisonous substances by the action of micro-organisms in nature.	These cannot be broken down into simple, non-poisonous substances by the action of micro-organisms in nature.

[1]

Impact of accumulation of biodegradable wastes :

(a) Foul smell comes out as a result of decomposition of biodegradable substances.

(b) These wastes may block the drains, sewage system etc. which then become breeding places of flies and mosquitoes.

[2×½]

Impact of accumulation of non-biodegradable wastes :

(a) Excessive use of fertilisers, pesticides and dumping of industrial wastes affect the soil fertility and subsequently reduce the crop yield.

(b) Some harmful non-biodegradable chemicals like pesticides, DDT and heavy metals enter the bodies of organisms through food chain and get concentrated at each trophic level.

[2×½]

6 : Sustainable Management of Natural Resources

1. Advantages of water stored in the ground are:

   (i) It doesn't evaporate.

   (ii) It spreads out to recharge wells.

   (iii) It provides water for irrigating vegetation cover over a wide area.

   (iv) It is available throughout the year for irrigation and other activities like drinking, bathing, washing and cleaning.

   (v) The recharged ground water of hilly terrains can bring dried up rivers back to life.

   (vi) It prevents floods and water logging.

   (vii) It does not provide breeding grounds for mosquitoes like stagnant water collected in ponds or artificial lakes.

   (viii) It is also relatively protected from contamination by human and animal waste.

   (Any two) [2×1]

2. The following activities can help to reduce the consumption of natural resources:

   (a) Use of materials such as paper should be preferred as they can be reused and recycled.

   (b) Materials like glass and some plastics can be recycled on heating and get easily converted into different products like toys, containers which can be reused again.

   (c) e-wastes such as unused computers, mobiles etc. can be repaired and used again.

   (d) Household wastes such as vegetable wastes etc. can be used as manure for plants. **[4 × ½]**

3. Sustainable management of natural resources is necessary as it yields the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. **[1]**

   Reusing is better than recycling because reuse does not require energy whereas some energy is spent to recycle old objects. **[1]**

4. The term 'biodiversity' refers to the variety of all life forms and habitats found in a defined area. **[1]**

   Two advantages of conserving forests and wild life are:

   (i) They add to the natural beauty of the environment.

   (ii) They provide valuable things which are required for our survival. **[2 × ½]**

5. Four stakeholders which may help in the conservation of forests are:

   (i) The Forest Department of the Government

   (ii) Local People

   (iii) Industrialists who use various forest products for their factories

   (iv) Wildlife and nature enthusiasts **[4×½]**

6. Four activities which can be done as an environmentalist to conserve natural resources are

   (i) Using public transport for commuting instead of using a personal vehicle.

   (ii) Avoid using clothes, accessories or articles made of animal skin.

   (iii) Using energy-efficient electrical appliances to save electricity.

(iv) Ensuring no leakage of water taps and pipes at home. **[4×½]**

7. Coal and petroleum are categorized as natural resources as they have been formed by natural processes like the degeneration of dead plants and animals biomass buried deep in the earth several million years ago. **[1]**

It has taken millions of years for the formation of these fossil fuels, and the present rate of consumption of these fossil fuels far exceeds the rate at which they are formed. If exhausted, these resources will not be available for use in the near future, and hence, they should be used judiciously. **[1]**

8. (a) Two ways by which awareness on how to save water can be created in the neighbourhood are :

(i) By bringing to notice the current situation of drought in rural areas and its dreadful effects on humans and animals.

(ii) Making people realise the importance of water in life and the shortage of water and its consequences in the near future. **[2×½]**

(b) Khadin is one way of recharging groundwater. A khadin consists of a 100-300 m long embankment called bund made of earth. The bund is built across the lower edge of the sloping farmland. Rainwater from the catchment area flows down the slope and collects in front of the bund forming a reservoir. Pathways through the bund allow excess water to flow through and collect in shallow wells dug behind the bund. **[2]**

9. Dams are the massive barriers built across rivers and streams to confine and utilise water for various human purposes such as irrigation and generation of electricity. **[½]**

Various Benefits of Dams :

(a) Hydroelectric power generation.

(b) Transfer of water using canals from areas of excess water (source) to water deficit areas.

(c) Irrigation during dry period.

(d) Flood control and soil protection.

(e) Ensure year-round water supply.

(f) Multipurpose river valley projects also provide inland water navigation.

(Any two) [2×½]

Problems Caused Due to Dams :

(a) The enormous weight of water behind the dam could lead to cracks in dams and may result in floods. This will lead to the submergence of large areas of land that might include fertile fields and human settlements.

(b) Resettlement and rehabilitation problem of displaced people.

(c) Salts left behind by evaporation increase the salinity of the river and make its water unusable when it reaches the downstream cities.

(d) There is no equitable distribution of water. Thus, farmers close to the water source grow water intensive crops like sugarcane and rice while farmers farther downstream do not get any water. The woes of these people who have been promised benefits which never arrived are added to the discontentment among the people who have been displaced by the building of the dam and its canal network. **(Any three) [3×½]**

10. Water harvesting means "capturing water". Capture, collection and storage of rain water and surface run off in a local area for filling either small water bodies or recharging ground water so that water continues to be available in non-rainy season is known as water harvesting. **[1]**

Advantages associated with water harvesting at community level are :

(a) It increases the production and income of the watershed community.

(b) It also mitigates droughts and floods.

(c) It increases the life of the downstream dams and reservoirs. **(Any two)** **[2×½]**

Causes for the failure of sustained availability of ground water are :

(a) Loss of vegetation cover.

(b) Diversion for high water demanding crops.

(c) Pollution from industrial effluents and urban wastes. **(Any two)** **[2×½]**

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