

## SECTION - A

1. Atomic number of X =  $2 + 8 + 2 = 12$

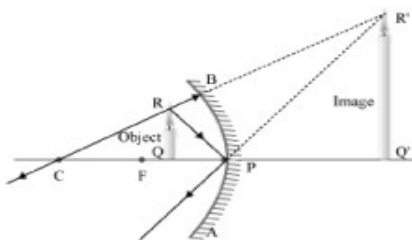
Atomic number of Y =  $2 + 8 + 6 = 16$

2. The transmission of characteristics from one generation to another is known as heredity.

3. Steel cans and paper can be easily recycled, but we generally throw them in dustbins.

4. The first step in sexual reproduction is gamete formation. In this step, the number of chromosomes gets halved. Thus, each gamete receives half the number of chromosomes to that of somatic cells. During fertilisation, the fusion of male and female gametes takes place, which results in the number of chromosomes in the zygote to be equal to that of somatic cells. Thus, the chromosomal number of the sexually producing parents and their offspring is the same.

5.



When the object is located between the focus (F) and the pole (P) of the mirror, the image is formed behind the mirror; this image is virtual, erect and large.

6. Decomposers include microorganisms such as bacteria and fungi that obtain nutrients by breaking down the remains of dead plants and animals.

### Role of Decomposers

They help in the breakdown of organic matter or biomass of dead plants and animals into simple inorganic raw materials such as  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and nutrients.

- They help in the natural replenishment of soil.
- They help in keeping the environment clean.

7. Watershed management is the study of the characteristics of a watershed. It helps to manage water quality, water supply, drainage and rainwater flow. It also ensures sustainable maintenance planning of a watershed.

Benefits of a watershed management system:

Water quality is strictly maintained.

Distribution of water is equal and sustainable.

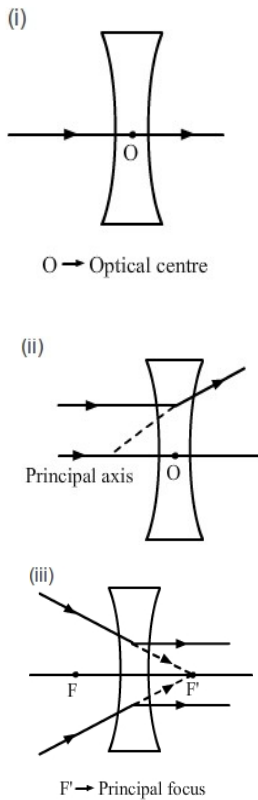
Controlling the flow of rain water can help to protect the land in flood conditions.

8. The producers convert solar energy into chemical energy in the form of organic compounds. The primary consumers (herbivores) derive their nutrition from the producers. According to the energy transfer law, only 10% of energy is transferred from one trophic level to the other. So, the energy that is captured by the producers does not revert back to the Sun and the energy transferred to the herbivores does not come back to the producers. It just keeps on moving to the next trophic level in a unidirectional way. That is why the flow of energy in the food chain is always unidirectional.

A large number of pesticides and chemicals are used to protect our crops from pests and diseases. Some of these chemicals are washed down from the soil, while some enter the water bodies. From the soil, they are absorbed by plants along with water and minerals; and from the water bodies, they

are taken up by aquatic plants and animals. This is how these chemicals enter the foodchain. As these chemicals cannot decompose, they accumulate progressively at each trophic level. This increase in the concentration of harmful chemicals with each step of the food chain is called biomagnification. As human beings occupy the top level in any food chain, these chemicals get accumulated in our bodies.

9.



10. (a) He should use a concave mirror, as it forms a real image on the same side of the mirror.

(b) Object distance,  $u = -12$  cm

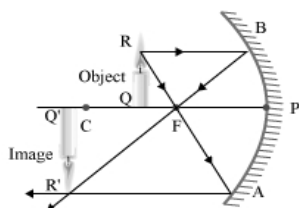
Image distance,  $v = -48$  cm

Magnification,  $m = -\frac{v}{u} = -\frac{(-48)}{(-12)} = -4$

The minus sign in magnification shows that the image formed is real and inverted.

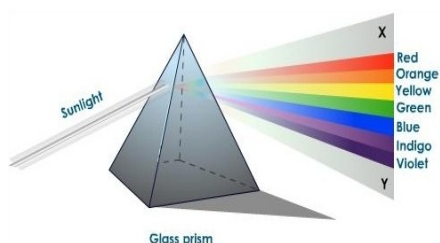
(c) The image is formed at a distance of 36 cm from the object.

(d)



In this case, the image is formed beyond the centre of curvature. This image is real, inverted and enlarged.

11.



(i) The phenomenon of the splitting up of the white light into its constituent colours is called dispersion of light.

Dispersion of light is caused because different constituent colours of light offer different refractive indexes to the material of the prism.

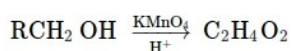
(ii) The formation of rainbow is caused by the dispersion of the white sunlight into its constituent colours.

(iii) Based on the dispersion of white light into its constituent colours, we can conclude that

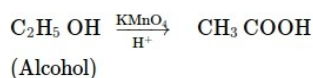
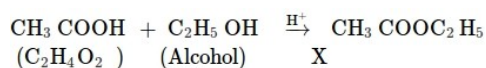
(a) the white light consists of seven colours

(b) the violet light suffers maximum deviation and the red light suffers minimum deviation.

12. Given



Chemical reactions involved:



(i) The carboxylic acid involved in the reaction is acetic acid ( $CH_3COOH$ ).

(ii) The alcohol involved in the reaction is ethanol ( $CH_3CH_2OH$ ).

(iii) X is the ester formed by the condensation of acetic acid, and ethanol is ethyl acetate ( $CH_3COOC_2H_5$ ).

13. Homologous Series

A homologous series is a series of organic compounds that belongs to the same family (i.e., possesses the same functional group) and show similar chemical properties. The members of this series are called homologues; they differ from each other by the number of  $CH_2$  units in the main carbon chain.

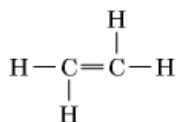
General Formula

Alkenes:  $C_nH_{2n}$

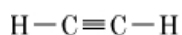
Alkynes:  $C_nH_{2n-2}$

Structures

The first member of alkenes is ethene and its structure is given below.



The first member of alkynes is ethyne and its structure is given below.



14. (i) Element E will form covalent compounds by sharing its four valence electrons.

(ii) Element D is a metal with valency three.

- (iii) Element B is a non-metal with valency three.
- (iv) We know that the size of elements decreases on moving left to right in a period. Therefore, element D is greater than element E.
- (v) The name of the family to which elements C and F belong is the noble gas family (group 18).

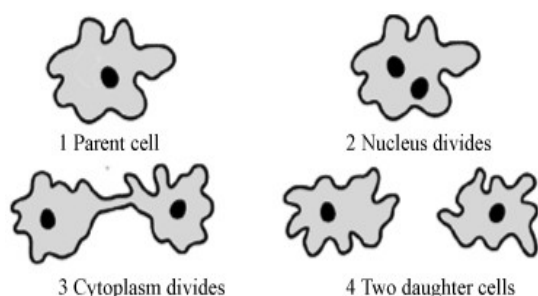
15. Vertical columns of the periodic table are known as groups.

- (i) The number of valence electrons remains constant when we move down the group.
- (ii) The number of occupied shells increases down the group.
- (iii) The size of atoms increases down the group.
- (iv) The metallic character of elements increases down the group.
- (v) The effective nuclear charge decreases down the group.

16. The two modes of asexual reproduction in animals are:

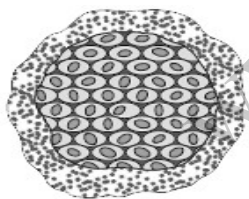
(i) Binary fission

In binary fission, a single cell divides into halves. Some of the organisms that divide by binary fission are bacteria and *Amoeba*.



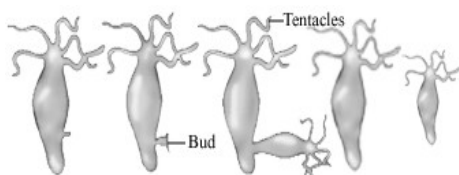
In *Amoeba*, cell division or splitting of cells can take place in any plane. Binary fission can occur in a particular axis. For example, *Leishmania* (a parasitic flagellated protozoan), which causes kala-azar in humans, divides longitudinally.

(ii) Multiple fission: In multiple fission, a single cell divides into many daughter cells simultaneously. Examples: *Plasmodium* and *Amoeba*.



(iii) Budding: It involves formation of a new individual from a protrusion called a bud. It is very common in plants, yeasts and lower level animals, such as *Hydra*.

In *Hydra*, the cells divide rapidly at a specific site and develop as an outgrowth called a bud. The bud, while attached to the parent plant, develops into a small individual. When this individual becomes large enough, it detaches itself from the parent body to exist independently.



Vegetative propagation is a form of asexual reproduction. It is the ability of plants to produce new plants from the vegetative parts, such as leaves, stems and roots, under favourable conditions. This method is the means of reproduction of some seedless plant varieties such as banana, rose and

jasmine. This method is also used in agriculture for the commercial production of some plants such as sugarcane, grapes and roses.

### Advantages of vegetative propagation:

- Only one parent is required for reproduction; this eliminates the need of special mechanisms (pollination).
- Many plants are able to tide over unfavourable conditions because of the presence of vegetative reproductive parts like tubers, corm and bulbs.
- Plants that do not produce seeds are propagated by this method, e.g., sugarcane and potato.
- Vegetative propagation is a cheaper, easier and rapid method of propagation in plants than growing plants from their seeds. For example, lilies grow very slowly and take four to seven years to develop flowers when their seeds are grown, but flowers are produced only after a year or two when grown vegetatively.
- The trait (character) of the parent plant is preserved and the offspring are genetically identical.

17. Following are the four methods of contraception used by humans:

(i) Natural method: It involves avoiding the chances of meeting of the sperm and the ovum. In this method, the sexual act is avoided from day 10th to day 17th of the menstrual cycle because during this period, ovulation is expected; therefore, the chances of fertilisation are very high.

(ii) Barrier method: In this method, fertilisation of the ovum and sperm is prevented with the help of barriers. Barriers are available for both males and females. Condoms, which are made of thin rubber, are used to cover the penis in males and the vagina in females.

(iii) Oral contraceptives: In this method, tablets or drugs are taken orally. These contain small doses of hormones that prevent the release of eggs, thus preventing fertilisation.

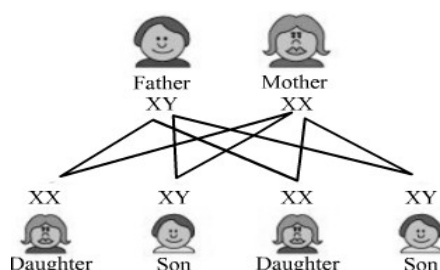
(iv) Implants and surgical methods: Contraceptive devices such as the loop or copper-T are placed in the uterus to prevent pregnancy. Some surgical methods can also be used to block the gamete transfer. In vasectomy, the vas deferens is blocked to prevent the transfer of sperms. Similarly, in tubectomy, the fallopian tubes of the female can be blocked so that the egg does not reach the uterus.

Effects of contraception on the health and prosperity of a family:

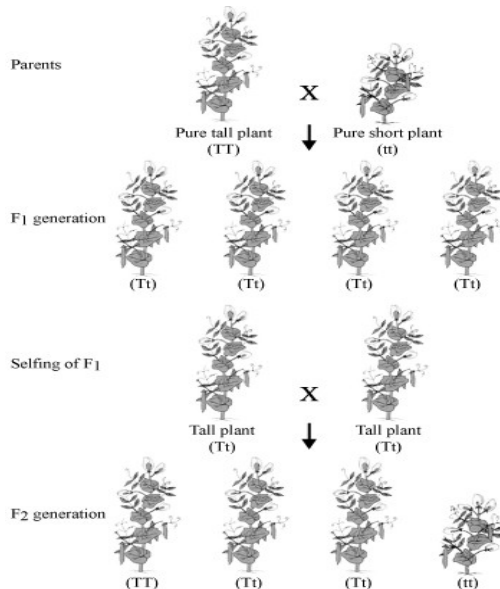
- It helps in preventing unwanted pregnancies.
- It prevents the chances of frequent pregnancies, which otherwise affect the health of females.
- It helps in family planning by controlling the number of children in a family, thus reducing the chances of poverty.
- It also reduces the chances of transmission of sexually transmitted diseases such as AIDS.

In this way, birth control methods play an important role in the health and prosperity of a family.

18. Sex of a child is dependent on the type of the male gamete fusing with the female gamete. Human beings possess 23 pairs of chromosomes. Out of these, 22 pairs are known as autosomes, while the remaining one pair comprises sex chromosomes (XX in females and XY in males). At the time of fertilisation, the egg cell fuses with the sperm cell, resulting in the formation of the zygote. If the egg cell carrying an X chromosome fuses with the sperm carrying an X chromosome, the resulting child would be a girl. If the egg cell carrying an X chromosome fuses with the sperm carrying a Y chromosome, the resulting child would be a boy.



19. Let us take the following example to justify the above statement. Mendel crossed tall pea plants with dwarf pea plants.

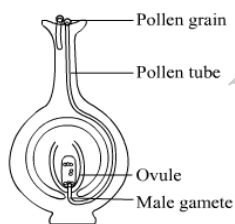


#### Mendel's Observation

F1 generation contained all tall plants. When F1 generation underwent selfing, the trait that was unexpressed in F1 (dwarf) was observed in some F2 progeny. Thus, both traits, tall and dwarf, were expressed in F2 generation in the ratio 3:1.

The above experiment indicates that although both the traits of tallness and shortness were inherited in F1 plants, only the tallness trait was expressed. This shows that traits may not show up in an individual but are passed on to the next generation.

20.



- (a) In the given figure,  
 A represents the pollen grain  
 B represents the pollen tube  
 C represents the ovary  
 D represents the female germ cell

(b) The transfer of pollen grains from the anther to the stigma of a flower is known as pollination. It is of two types:

(i) Self-pollination : It is the transfer of pollen grains from the anther to the stigma of the same flower or another flower on the same plant.

(ii) Cross-pollination : It is the transfer of pollen grains from the anther to the stigma of the flower present on two different plants.

Significance of pollination:

- (i) It is a significant event because it precedes fertilisation.
- (ii) It brings the male and female gametes closer for the process of fertilisation.
- (iii) Cross-pollination introduces variations in plants because of the mixing of different genes.

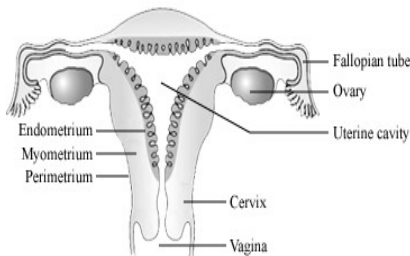
These variations further increase the adaptability of plants towards the environment or surroundings.

(c) Double fertilisation is a characteristic feature of flowering plants. In this process, out of the two sperm nuclei, one sperm nucleus fuses with the egg nucleus to form an embryo (process is called syngamy) and another fuses with the polar nucleus to form an endosperm (process is called triple fusion). Because two kinds of fusion-syngamy and triple fusion-take place, the process is known as double fertilisation.

After fertilisation,

- (i) the ovule develops into a seed
- (ii) the ovary develops into a fruit

21. (a) The human female reproductive system consists of a pair of ovaries, a pair of oviducts, the uterus and the vagina.



- (i) The development of egg occurs in the ovary.
- (ii) Fertilisation takes place in the fallopian tubes.
- (iii) The fertilised egg gets implanted in the uterus.

(b) (i) The uterus prepares itself every month to receive a fertilised egg/zygote. The inner uterus lining (endometrium) becomes thick and is supplied with blood to nourish the embryo.

(ii) If the egg is not fertilised, then the uterus lining is not required. Hence, it breaks down and gets released in the form of blood and mucous through the vagina. This process lasts for 2–8 days. This cycle occurs every month and is known as menstruation.

22. (a) The pupil is the perforation in the iris. It is the pupil (or aperture of the eye) through which light enters our eyes. The relaxation and contraction of the muscular fibres of the iris regulate the opening and closing of the pupil. Hence, it is the pupil that controls the amount of light entering our eyes.

(b) The retina is the “film” of the eye like the film of a camera. The retina is the light-sensing part of the eye. It converts the incident light into electrical signals and sends them to the brain.

(c) Eyes of a dead person can be donated to a person having corneal blindness. It will help him/her see the world. We can also register ourselves to donate our eyes. The organisations that put up eye donation camps preserve our eyes after our death and donate them to the needy.

23. Centre of curvature: It is defined as the centre of the spheres of which the lens is originally a part of. Because the spherical lens consists of two spherical surfaces, the lens has two centres of curvature.

Optical centre: The centre point of a lens is known as its optical centre. It always lies inside the lens. A light beam passing through the optical centre immerges without any deviation.

Principal axis: The line joining the centre of curvature and the optical centre is called the principal axis.

Principal focus: A light ray parallel to the principal axis of the lens meets at a point on the principal

axis. This point is called the principal focus.

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

Image distance,  $v = -15$  cm (Negative sign is taken because of sign convention.)

Using the lens formula, we get:

$$\begin{aligned}\frac{1}{f} &= \frac{1}{v} - \frac{1}{u} \\ \Rightarrow \frac{1}{-20} &= \frac{1}{-15} - \frac{1}{u} \\ \Rightarrow \frac{1}{u} &= \frac{1}{-15} + \frac{1}{20} \\ \Rightarrow \frac{1}{u} &= \frac{-4+3}{60} \\ \Rightarrow u &= -60 \text{ cm}\end{aligned}$$

The distance of the object from the mirror is 60 cm.

$h_i$  is the size of the image formed.

$h_o$  is the size of the object; it is 6cm.

We know that the image formed by the concave lens is virtual and erect.

The magnification is given as:

$$\begin{aligned}m = \frac{v}{u} &= \frac{h_i}{h_o} \\ \Rightarrow \frac{-15}{-60} &= \frac{h_i}{6} \\ \Rightarrow h_i &= 1.5 \text{ cm}\end{aligned}$$

Hence, the size of the image is 1.5 cm.

24. The atomic number of carbon is 6. This means that it has 4 electrons in its outermost shell and it needs 4 more electrons to attain noble gas electronic configuration. It cannot form  $C^{4+}$  cation, as the removal of 4 valence electrons requires a huge amount of energy. The cation formed has 6 protons and 2 electrons. This makes it highly unstable. Carbon cannot form  $C^{4-}$  anion, as its nucleus with 6 protons cannot hold 10 electrons. Thus, carbon achieves noble gas electronic configuration by sharing its 4 electrons with other elements-that is, it forms covalent compounds.

In ionic compounds, ionic bonds are formed; while in carbon compounds, covalent bonds are formed.

Because carbon compounds are covalent in nature, they are bad conductors of electricity; they lack free electrons.

## SECTION – B

25. Light rays from infinity are converged at the focal point of the convex lens. Therefore, the focal length of the convex lens is 20 cm.

Hence, the correct option is C.

26. Real and inverted image is formed by the concave mirror. As mentioned, in the second case, the image distance ( $v$ ) is increasing. Well-illuminated distant object i.e. object is at infinity.

Mirror formula is given by:



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

$$F = \frac{uv}{u+v} = \frac{uv}{u \left\{ 1 + \frac{v}{u} \right\}}$$

$$= \frac{v}{\left\{ 1 + \frac{v}{u} \right\}}$$

If  $u \rightarrow \infty$   $\frac{v}{u} = 0$  which is negligible.

Hence,  $F \propto v$

Therefore  $F_1 < F_2$

Hence, the correct option is A.

27. Rays 2, 3 and 4 are obeying the laws of refraction and can be used to draw the corresponding ray diagram.

Therefore, the correct option is D.

28. focal length of the lens,  $f = 10$  cm

Object distance,  $u = -20$  cm (negative sign is used due to sign convention)

Using the lens formula:

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

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

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

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

$$\Rightarrow \frac{1}{v} = \frac{1}{20}$$

$$\Rightarrow v = 20 \text{ cm}$$

Hence, the image will be formed on the other side of the lens.

Magnification is given as:

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

$$\frac{h_i}{h_o} = \frac{20}{-20} = -1$$

$$\therefore h_i = -h_o$$

Therefore, the image formed by the convex lens will be of same size, real and inverted.

Hence, the correct option is C.

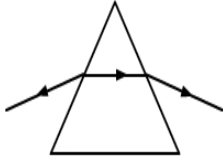
29. The angle made by the incident ray with the normal to the first face of the prism is called incident angle, which is angle Y here.

The angle made by the emergent ray with the normal to the surface when it comes out from the prism after refraction is called emergent angle, which is angle Q here.

The angle between the incident ray and the emergent ray is called angle of deviation, which is angle P here.

Hence, the correct option is D.

30. Student Q has traced the path correctly.



When light is travelling from a rarer medium to a denser medium, it bends towards the normal to the surface, while the light from a denser medium to a rarer medium bends away from the normal to the surface.

Hence, the correct option is B.

31. Angle of incidence, angle of refraction and angle of emergence, all are measured from the normal to the surface. Therefore, only angle of refraction,  $\angle r$  is marked correctly.

Hence, the correct option is C.

32. Observation III will give the best result because

(i) it has the largest angle of incidence, due to which the lateral displacement between the incident ray and the emergent ray will be maximum.

(ii) for light rays passing through a glass slab,  $\angle i = \angle e$   $\angle r < \angle i$

Hence, the correct option is C.

33. In the given figure, I represents the plumule, II represents the cotyledon and III represents the radicle.

The correct option is A.

34. Homologous structures are similar in origin but perform different functions.

Carrot and radish are underground roots. So, they represent the correct homologous structures.

Hence, the correct option is D.

35. The correct statements are III and IV.

III. Wings of birds and wings of insects are analogous organs as they have different structures but perform the same function.

IV. Wings of bird and forelimbs of horse are homologous organs as they have same structure but perform different functions.

Thus, the correct option is C.

36. Budding is a type of asexual reproduction in which a new organism is formed from a bud of an existing organism. In yeast, the cells divide rapidly at a specific site and develop as an outgrowth called a **bud**. These buds, while attached to the parent plant, develop into small individuals. When this individual becomes large enough, it detaches itself from the parent body to exist as an independent individual. In this way, they form a colony.

Hence, the correct option is C.

37. Correct sequence of the above steps to observe the slide under the microscope:

II, I, IV, III.

II- Fix the slide on the stage carefully.

I- Adjust the diaphragm and the mirror of the microscope so that sufficient light may enter to illuminate the slide.

IV- Adjust the microscope to low power and focus.

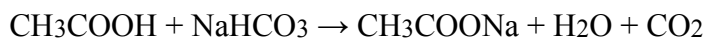
III- Adjust the microscope to high power and focus.

The correct option is B.

38. Water containing calcium and magnesium salts is known as hard water. Among the given salts, calcium sulphate, magnesium chloride and calcium chloride can be dissolved in water to obtain hard water.

Hence, the correct option is A.

39. When sodium hydrogen carbonate is added to a test tube containing ethanoic acid, the following reaction occurs in the test tube:



In this reaction, carbon dioxide gas is evolved immediately. It turns the lime water milky. As carbon dioxide gas is a non-supporter of combustion, it will extinguish the burning splinter.

Hence, the correct option is D.

40. When ethanoic acid and distilled water are mixed with each other, they form a clear solution, as ethanoic acid is completely miscible with water.

Hence, the correct option is B.

41. Solid sodium hydroxide is stored in the form of white pellets/flake.

Hence, the correct option is C.

42. Saponification reaction is a highly exothermic reaction. The reaction mixture of this reaction is basic in nature and hence, this will turn red litmus blue. Thus, it is basic in nature.

Hence, the correct option is D.