Q11 (a) Give the evidence that the birds have evolved from reptiles.

(b) Insects, octopus, planaria and vertebrates possess eyes. Can we group these animals together on the basis of eyes that they possess ? Justify your answer giving reason.

Solution:

(a) Fossils provide evidence of evolution. A fossil bird called *Archaeopteryx*, which lived in the Late Jurassic Period around 148–150 million years ago, had feathered wings like that of birds and a long bony tail, jaws with sharp teeth and various skeletal features like that of reptiles. Thus, *Archaeopteryx* is considered a connecting link between reptiles and birds.

Some dinosaurs had feathers that provide them insulation in cold weather; however, they could not fly using those feathers. Birds seem to have later used feathers to fly. This, of course, means that birds are very closely related to reptiles because dinosaurs were reptiles. Hence, it suggests that birds have evolved from reptiles.

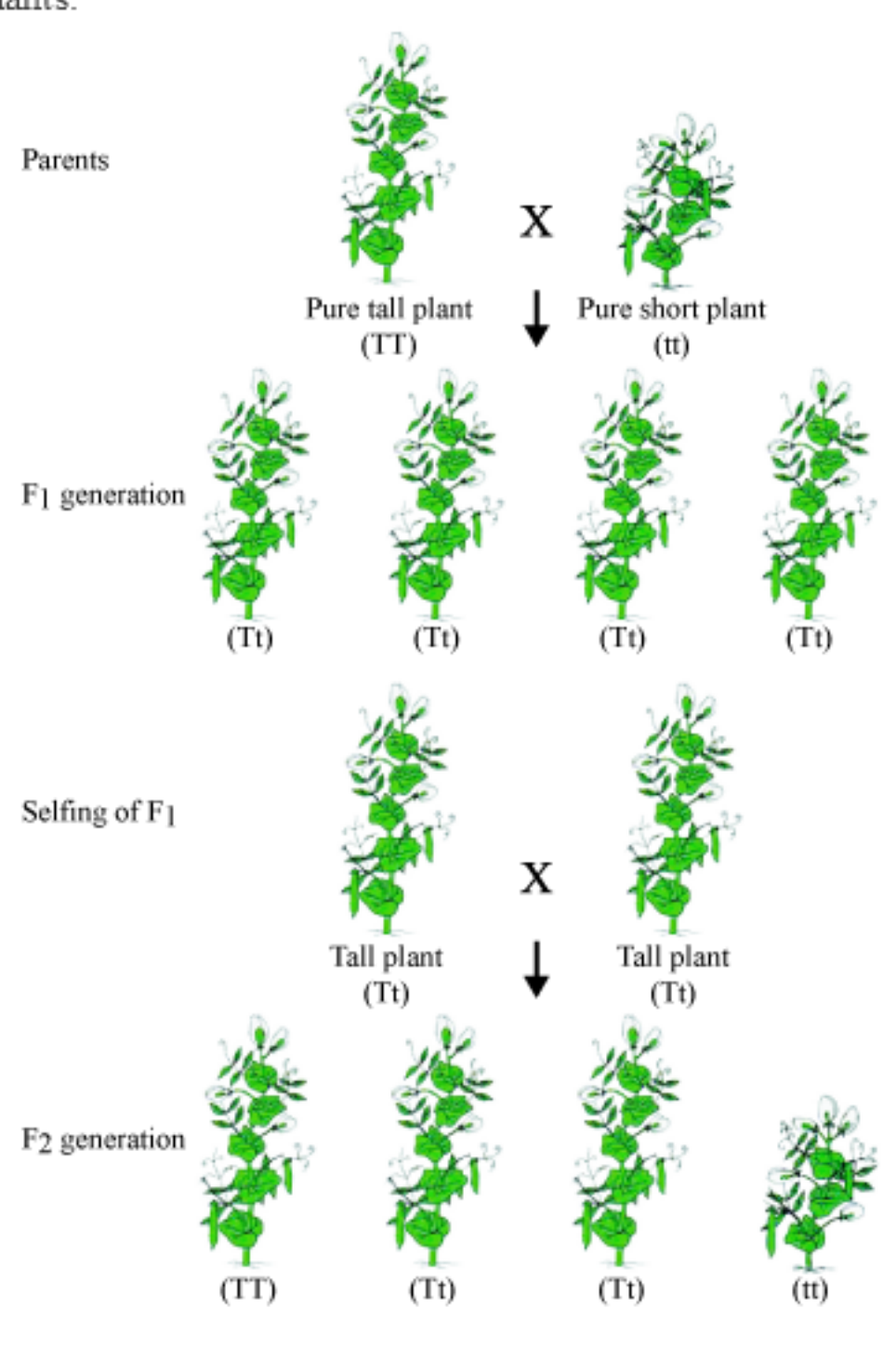
(b) While making groups, we need to decide the characteristics that are responsible for the more fundamental differences among organisms. The characteristics that account for the broadest divisions among living organisms should be independent of any other characteristics in their effects on the forms and structural functions of organisms like cellularity, mode of nutrition and nature of cell.

Insects, octopus and *planaria* are invertebrates; they cannot be grouped together with vertebrates, as they lack an internal skeleton with a backbone. Also, all of them belong to different phyla on the basis of different characteristics they possess. Just on the basis of one characteristic, i.e., presence of eyes, these organisms cannot be grouped together.

Q12 (a) Mendel crossed tall pea plants with dwarf pea plants in his experiment. Write his observations giving reason on the F_1 and F_2 generations.
(b) List any two contrasting characters other than height that Mendel used in his experiments in pea plants.

Solution:

(a) Mendel crossed tall pea plants with dwarf pea plants.



Mendel's Observation
The F_1 generation contained all tall plants. When F_1 generation underwent selfing, the trait that was unexpressed in F_1 (dwarf) was observed in some F_2 progeny. Thus, both traits, tall and dwarf, were expressed in F_2 generation in the ratio 3:1.

Mendel proposed that something was being passed unchanged from generation to generation. He called these things factors (presently called genes). Factors contain and carry hereditary information.

He also observed that traits might not show up in an individual but were passed to the next generation.

(b) The two contrasting traits other than height used by Mendel are:
(i) Pod colour - Green pod colour was dominant over yellow colour
(ii) Seed shape - Round seed shape was dominant over wrinkled seed shape

Q13 State the laws of refraction of light. If the speed of light in vacuum is 3×10^8 ms^{-1}, find the speed of light in a medium of absolute refractive index 1.5.

Solution:

(a) There are two laws of refraction:

First law of refraction:
The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant. This is known as Snell's law. Mathematically, it can be expressed as:

$$\frac{\sin i}{\sin r} = n_{12}$$

Here, n_{12} is the relative refractive index of medium 1 with respect to medium 2.

Second law of refraction:
The incident ray, the refracted ray and the normal to the interface of two media at the point of incidence lie on the same plane.
If a light ray goes from medium 1 to medium 2, then the refractive index of medium 1 with respect to medium 2 is expressed as:

$$n_{12} = \frac{\text{Speed of light in medium 2}}{\text{Speed of light in medium 1}} = \frac{v_2}{v_1}$$

Here, v_1 and v_2 are the speeds of light in medium 1 and medium 2, respectively.

(B)
Given:
Speed of light in vacuum = 3×10^8 ms^{-1}
Refractive index of the medium:

$$n_m = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$
$$\Rightarrow 1.5 = \frac{3 \times 10^8}{v}$$
$$\Rightarrow v = \frac{3 \times 10^8}{1.5} = 2 \times 10^8 \text{ m/s}$$

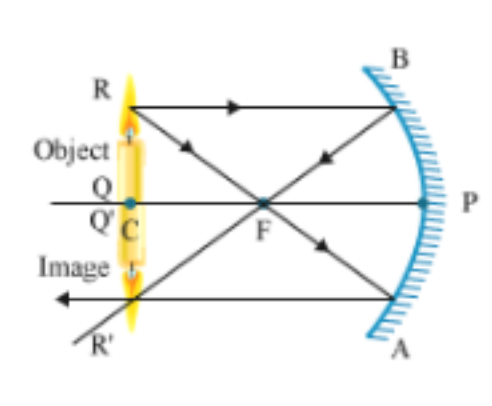
Hence, the speed of light in the medium of refractive index 1.5 is 2×10^8 m/s.

Q14 A spherical mirror produces an image of magnification −1 on a screen placed at a distance of 40 cm from the mirror:
(i) Write the type of mirror.
(ii) What is the nature of the image formed?
(iii) How far is the object located from the mirror?
(iv) Draw the ray diagram to show the image formation in this case.

Solution:

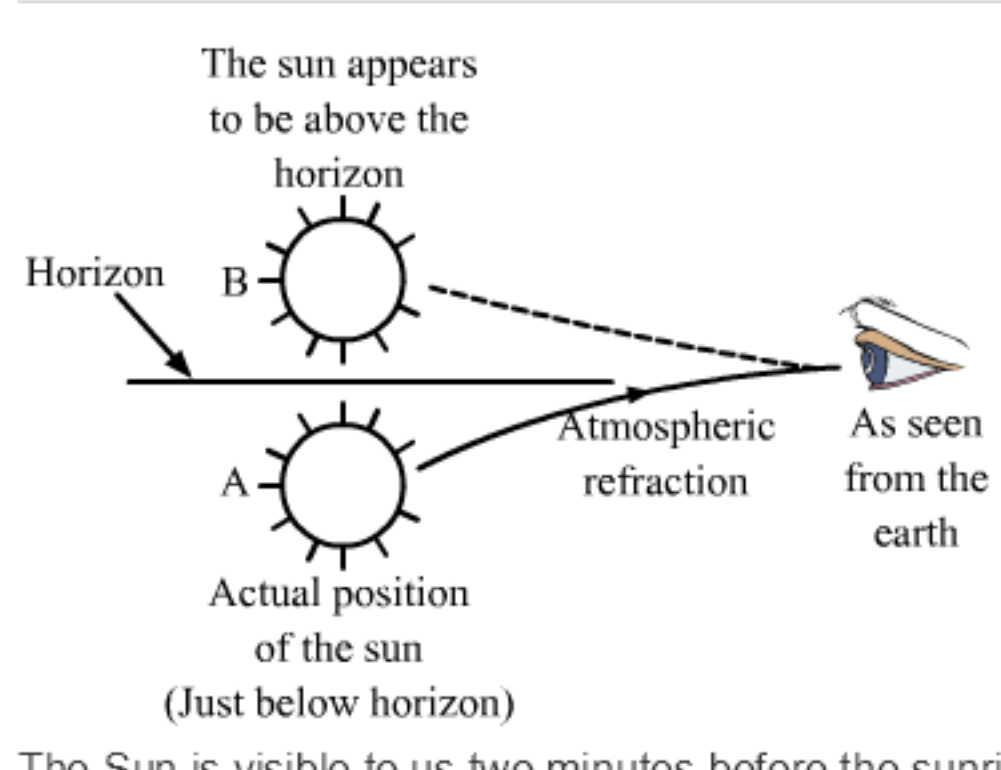
(i) The mirror is concave.
(ii) The image formed is real and inverted and of the same size as that of the object.
(iii) In this case, the object is placed at the centre of curvature of the mirror, so the object distance is equal to the image distance. Here, the screen is placed 40 cm from the mirror.
∴ Image distance = Object distance = 40 cm

(iv)



Q15 Why does the sun seem to rise two minutes before the actual sunrise and set two minutes after the actual sunset ? Explain with the help of labelled diagram.

Solution:



The Sun is visible to us two minutes before the sunrise and two minutes after the sunset because of the bending of the light due to atmospheric refraction. The actual sunrise takes place when the Sun is just above the horizon. But due to atmospheric refraction of light, we see the Sun about two minutes before it is actually above the horizon.
When the Sun is slightly below the horizon, its light moves from less dense air to more dense air and gets refracted towards the normal. Because of this atmospheric refraction, the Sun appears to be above the horizon when it is actually slightly below the horizon. It is also due to atmospheric refraction that we can still see the Sun for about two minutes even after it has set below the horizon.

Q16 Write the name and general formula of a chain of hydrocarbons in which an addition reaction with hydrogen can take place. Stating the essential conditions required for an addition reaction to occur, write the chemical equation giving the name of the reactant and the product of such a reaction.

Solution:

Name and general formula of hydrocarbons undergoing addition reaction with hydrogen:

Name	General Formula
Alkene	C_nH_{2n}
Alkyne	C_nH_{2n-2}

Essential conditions required for the addition reaction to occur:
Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.
Addition of hydrogen should be carried out in the presence of catalyst such as nickel or platinum.
Chemical Equation:

$$\underset{\text{Ethene}}{CH_2 = CH_2} + H_2 \xrightarrow{\text{Ni or Pt}} \underset{\text{Ethane}}{CH_3 - CH_3}$$

$$\underset{\text{Ethyne}}{CH \equiv CH} + 2H_2 \xrightarrow{\text{Ni or Pt}} \underset{\text{Ethane}}{CH_3 - CH_3}$$

Q17 State the meaning of the functional group in an organic compound. Write the formula of the functional group present in alcohols, aldehydes, ketones and carboxylic acids.

Solution:

Definition:
Functional group is an atom or a group of atoms that is bonded to a carbon chain. It defines the chemical property of the organic compound.

Compound	Functional Group
Alcohol	-OH
Aldehyde	-CHO
Ketone	>C=O
Carboxylic acid	-COOH

Q18 (a) Define the following terms :
(i) Valency (ii) Atomic size

(b) How do the valency and the atomic size of the elements vary while going from left to right along a period in the modern periodic table?

Solution:

a. (i) **Valency**: The combining power or the combining capacity of an atom is called its valency. Valency of an atom is simply equal to the number of electrons gained, lost or shared by an atom to achieve the nearest noble gas configuration.

(ii) **Atomic size**: Atomic size or atomic radius is the distance between the centre of the nucleus and the outermost shell of an isolated atom.

b. **Variation in valency**
On moving from left to right in the periodic table, valency increases up to 4 and then decreases.
The electrons present in the last shell determine the valency of a particular element.
If the number of valence electrons is less than or equal to 4, valency = number of valence electrons
If the number of valence electrons is more than 4, valency = 8 - number of valence electrons
Variation in atomic size:
Atomic size decreases along a period. This is because on moving across a period, the number of valence shells remains the same and the electrons increase by one unit. As a result, the nuclear charge increases and thus, the atomic radius decreases.

Q19 Consider two elements 'A' (Atomic number 17) and 'B' (Atomic number 19) :
(i) Write the positions of these elements in the modern periodic table giving justification.
(ii) Write the formula of the compound formed when 'A' combines with 'B.'
(iii) Draw the electron dot structure of the compound and state the nature of the bond formed between the two elements.

Solution:

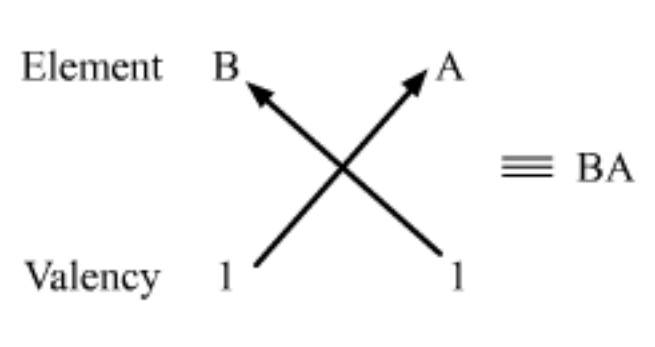
(i) Position of the elements in the periodic table:

Element	Period	Group
A	3	17
B	4	1

(ii)

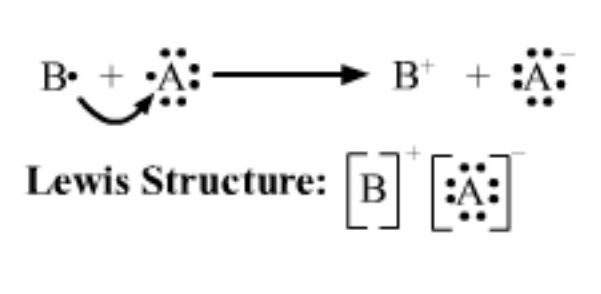
Atomic number of A = 17
Electronic configuration A = 2,8,7
Number of valence electrons of A = 7
Valency of A = 8 - 7 = 1

Atomic number of B = 19
Electronic configuration B = 2,8,8,1
Number of valence electrons of B = 1
Valency of A = 1



So, the formula of the compound formed when elements A and B combine is BA.

(iii)



Q20 State the reason why carbon can neither form C^{4+} cations nor C^{4-} anions but forms covalent compound. Also state the reason to explain why covalent compounds:
(i) are bad conductors of electricity.
(ii) have low melting and boiling points.

Solution:

Atomic number of carbon is six. This means that it has four electrons in its outermost shell and it needs four more electrons to attain noble gas electronic configuration. It does not form C^{4+} cation, as the removal of four valence electrons will require a huge amount of energy. The cation formed will have six protons and two electrons. This makes it highly unstable. Carbon is unable to form C^{4-} anion as its nucleus with six protons will not be able to hold ten electrons. Thus, carbon achieves noble gas electronic configuration by sharing its four electrons with other elements, i.e. it forms covalent compounds.

(i) Covalent compounds are bad conductors of electricity due to lack of free electrons.

(ii) Covalent compounds are formed by covalent bonds and it has been found that the intermolecular forces of attraction in covalent compounds are weak. Thus, their melting and boiling points are quite low.

Q21 (a) Name the respective part of human female reproductive system:

(i) that produces eggs,
(ii) where fusion of eggs and sperm takes place, and
(iii) where zygote gets implanted.

(b) Describe in brief what happens to the zygote after it gets implanted.

Solution:

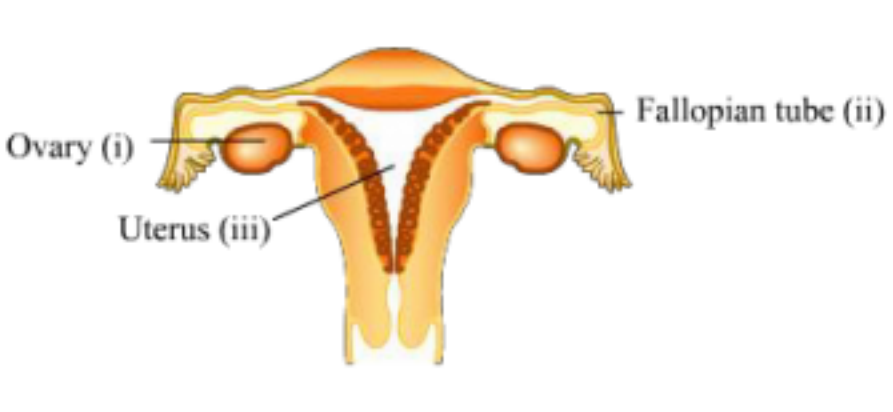
(a)

(i) Ovary

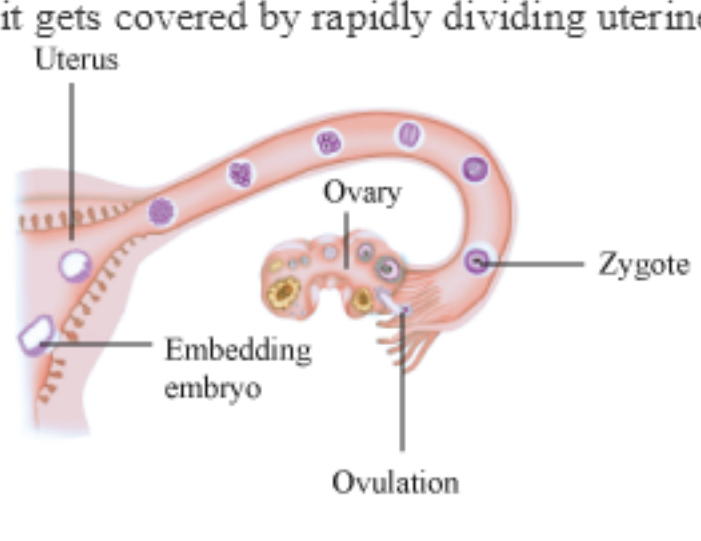
(ii) Fallopian tube

(iii) Uterus

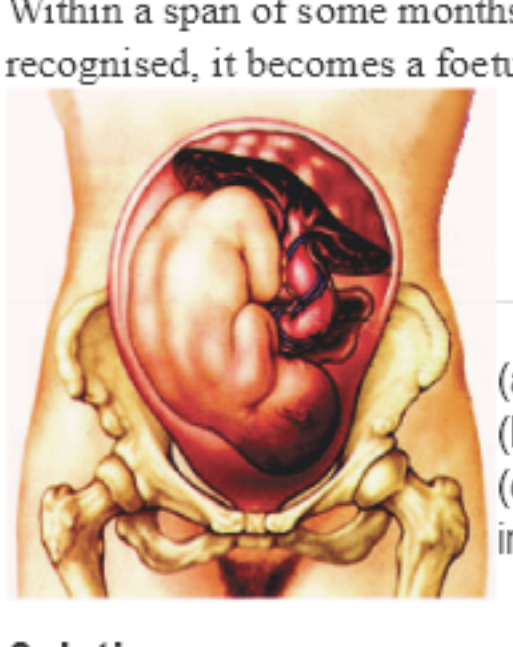
Diagram of the female reproductive system



(b) The zygote formed after fertilisation in the fallopian tube is implanted in the uterus. It divides repeatedly to form a mass of cells known as embryo. This embryo gets attached to the inner layer of the uterine cavity, i.e., endometrium. It thickens every month and is supplied with blood to nourish the embryo. Soon it gets covered by rapidly dividing uterine cells. This leads to pregnancy.



Within a span of some months, the embryo starts developing limbs and begins to resemble a miniature human being. When all body parts of the embryo can be recognised, it becomes a foetus. When this foetus is fully developed, the mother gives birth to the baby.



Q22 (a) Give one example each of a unisexual and a bisexual flower.
(b) Mention the changes a flower undergoes after fertilization.
(c) How does the amount of DNA remain constant though each new generation is a combination of DNA copies of two individuals?

Solution:

(a) Unisexual flowers: Cucumber, pumpkin, water melon, papaya, etc.
Bisexual flowers: Hibiscus, rose, lily, etc.
(Any one example can be written).

(b) Changes in a flower after fertilisation:
The outer layers of the ovule become impervious and hard and function as a seed coat. An ovule with an embryo inside is called a seed.

The ovary enlarges and ripens to become a fruit. Other floral parts such as sepals, petals, stamens, styles and stigma may fall off. However, in some cases, they remain persistent in the fruit.

(c) Deoxyribonucleic acid (DNA) copying is an essential part of reproduction, as it passes genetic information from parents to offspring. The reproducing cells produce a copy of their DNA through some chemical reactions and result in two copies of DNA. The copying of DNA always takes place along with the creation of additional cellular structure. This process is then followed by the division of a cell into two cells. In this way, the amount of DNA remains constant through each new generation.

Q23 (a) List three common refractive defects of vision. Suggest the way of correcting these defects.
(b) About 45 lac people in the developing countries are suffering from corneal blindness. About 30 lac children below the age of 12 years suffering from this defect can be cured by replacing the defective cornea with the cornea of a donated eye. How and why can students of your age involve themselves to create awareness about this fact among people?

Solution:

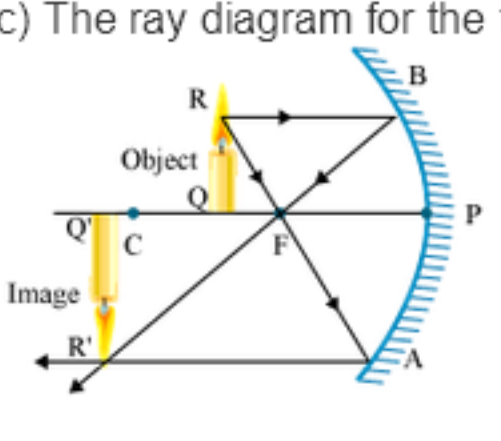
(a) The three common refractive defects of vision are as follows:
Myopia (short-sightedness): It is corrected by using spectacles having concave lenses of appropriate power.
Hypermetropia (far-sightedness): It is corrected by using spectacles having convex lenses of appropriate power.
Presbyopia: This defect is corrected using bifocal lenses of appropriate power in which the upper part consists of a concave lens (to correct myopia) and the lower part consists of a convex lens (to correct hypermetropia).
(b) Eyes of a dead person can be donated to the person having corneal blindness. It will help him/her see the world. We can also register ourselves to eye donation camps who can preserve our eyes after our death and donate them to the needy.

Q24 A student wants to project the image of a candle flame on the walls of the school laboratory by using a mirror.

(a) Which type of mirror should he use and why?
(b) At what distance, in terms of focal length 'f' of the mirror, should he place the candle flame to get the magnified image on the wall?
(c) Draw a ray diagram to show the formation of the image in this case.
(d) Can he use this mirror to project a diminished image of the candle flame on the same wall? State 'how' if your answer is 'yes' and 'why not' if your answer is 'no.'

Solution:

(a) He should use a concave mirror as it forms real images.
(b) He should place the candle flame between the focus and centre of curvature of the mirror to get the magnified image on the wall.
(c) The ray diagram for the formation of the image is shown below:



(d) Yes, he can get a diminished image of the candle flame when the object is located at infinity.