CBSE 2013
Biology

Time: 3 hrs **Total Marks: 70**

General Instructions:

1. *There are total **26** questions and five sections in the question paper. All questions are compulsory.*
2. *Section A contains questions number **1 to 5**; very short answer type questions of **1** mark each.*
3. *Section B contains questions number **6 to 10**, short-answer type **I** questions of **2** marks each.*
4. *Section C contains questions number **11 to 22**, short answer type **II** questions of **3** marks each.*
5. *Section D contains question number **23**, value based question of **4** marks.*
6. *Section E contains questions number **24 to 26**, long-answer type questions of **5** marks each.*
7. *There is no overall choice in the question paper; however, an internal choice is provided in one question of **2** marks, one question of **3** marks and all the three questions of 5 marks. In these questions, an examinee is to attempt any of the two given alternatives.*

SECTION-A

1. An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give any one reason.

Solution

Tapetum is the innermost layer of microsporangium. It provide nourishment to the developing pollen grains. Hence, an anther with malfunctioning tapetum would fail to produce viable male gametophytes.

2. Why sharing of injection needles between two individuals is not recommend?

Solution

It is because the viruses responsible for diseases such as AIDS and hepatitis B are transferred from one person to another by sharing of infected needles.

3. Name the enzyme and state its property that is responsible for continuous and discontinuous replication of the two strands of a DNA molecule.

Solution

DNA polymerase III. It can polymerize nucleotides only in $5' \rightarrow 3'$ direction on $3' \rightarrow 5'$ strand because it adds them at the $3'$ end.

4. Identify the examples of convergent evolution from the following:

(i) Flippers of penguins and dolphins

(ii) Eyes of octopus and mammals

(iii) Vertebrate brains

Solution

(a) Flippers of penguins and dolphins
(b) Eye of octopus and mammals

5. Write the importance of MOET.

Solution

The technique is used to increase the successful rate of production of hybrids in short duration of time.

6. Why is the enzyme cellulose needed for isolating genetic material from plant cells and not from the animal cells?

Solution

It is because plant cells are surrounded by cellulosic cell walls and this has to be degraded by the action of enzyme cellulase in order to isolate the DNA.

7. Name the type of biodiversity represented by the following:

(a) 50,000 different strains of rice in India

(b) Estuaries and alpine meadows in India.

Solution

(a) Genetic diversity; (b) Ecosystem diversity

8. Write the equation that helps in deriving the net primary productivity of an ecosystem.

Solution

Net Primary Productivity = Gross Primary Productivity – Rate of Respiration

SECTION – B

9. Geitonogamous flowering plants are genetically autogamous but functionally cross-pollinated. Justify.

Solution

Geitonogamy is a type of pollination which involves the transfer of pollen grains from the anther of the flower of one plant to the stigma of another flower of the same plant. Genetically, it is self-pollination as both the flowers belong to the same plant. Functionally, it is cross-pollination as it involves two flowers and requires a pollinating agent.

10. When and where do chorionic villi appear in humans? State their function.

Solution

Chorionic villi are finger-like projections that consist of chorion which projects into the endometrial wall of the uterus. They arise from the trophoblast layer that develops in the zygote after it has undergone implantation.

Functions of chorionic villi:

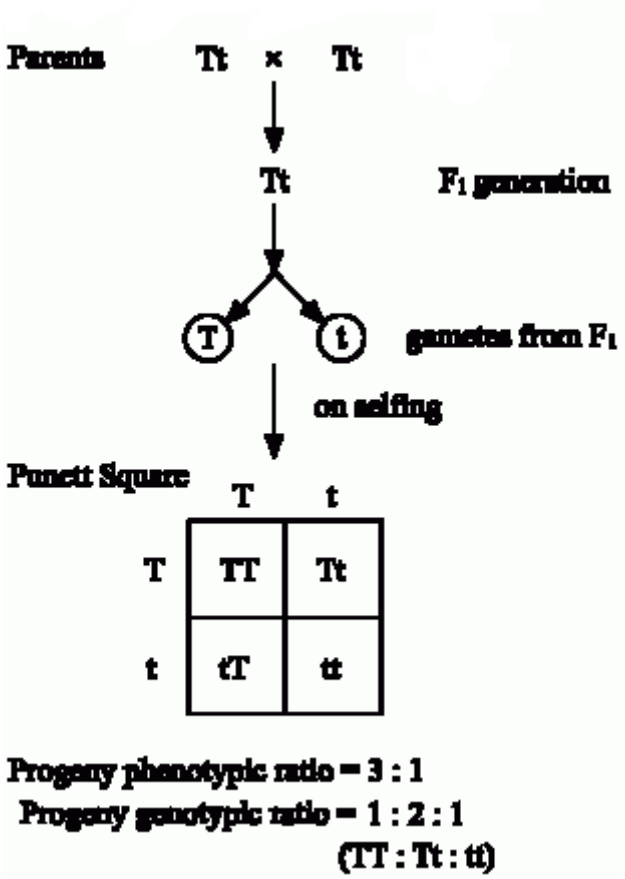
(a) The chorionic villi and uterine tissue become disintegrated and jointly form a umbilical cord (navel) to connect the developing embryo with the placenta.

(b) Blood vessels in the chorionic villi connect to the embryonic heart by way of the umbilical arteries and umbilical vein through the umbilical cord, thus providing blood flow and nourishment to the embryo.

11. In a cross between two tall pea plants some of the offsprings produced were dwarf. Show with the help of Punett square how this is possible.

Solution

This can occur when both parents are heterozygous (*Tt*). The cross is demonstrated below by a Punnett Square shown in Fig.



12. A student on a school trip started sneezing and wheezing soon after reaching the hill station for no explained reasons. But, on return to the plains, the symptoms disappeared. What is such a response called? How does the body produce it?

Solution

Such a response is called allergy. Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.

13. Name two commonly used bioreactors. State the importance of using a bioreactor.

Solution

The two commonly used bioreactors are simple stirred tank bioreactor and sparged stirred tank bioreactor.

The importance of using bioreactors is as follows:

(a) It provides large volume for cultures. Thus, products are obtained in high quantity.

(b) It provides optimal conditions such as temperature and pH for growth of desired product.

14. Write the function of adenosine deaminase enzyme. State the cause of ADA deficiency in hum

Mention a possible permanent cure for a ADA deficiency patient.

Solution

The enzyme adenosine deaminase (ADA) is very important for the proper functioning of our immune system. The cause of ADA deficiency in humans is deletion of the gene which codes for ADA. ADA deficiency can be permanently cured by gene therapy. In this, a functional ADA gene is inserted in the cells at early embryonic age.

15. (i) PCR (ii) ELISA

Expand the following and mention one application of each:

(i) PCR (ii) ELISA

Solution

Early detection of diseases using molecular diagnostics includes techniques such as polymerase chain reaction (PCR) and enzyme linked immunosorbent assay (ELISA).

PCR is usually used to detect HIV in suspected AIDS patient. PCR is a good technique to find many other genetic disorders. ELISA is a confirmatory test for AIDS.

OR

(b) Mention the differences in the mode of action of exonuclease and endonuclease.

(b) How does restriction endonuclease function?

Solution

(a) Exonuclease removes the nucleotides from the ends of the DNA chain while endonuclease cuts the DNA at the specific positions within the DNA strand.

(b) Each restriction endonuclease finds its specific palindromic sequences in the DNA and cuts the DNA at these specific sites. It does so by binding to the DNA at these sites and cutting both the strands at specific points in their sugar-phosphate backbones.

16. Name any two sources of e-Wastes and write two different ways for their disposal.

Solution

Irreparable computers and mobiles are two sources of e-wastes. Two different ways for their disposal are:

(a) Burning in landfills.

(b) Incineration.

17. Why the pyramid of energy is always upright? Explain.

Solution

It is because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

18. Explain why very small animals are rarely found in polar region.

Solution

Small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism. This is the main reason why very small animals are rarely found in polar regions.

SECTION – C

19. Draw a diagram of the microscopic structure of human sperm. Label the following parts in it and write their functions.

(a) Acrosome

(b) Nucleus

(c) Middle piece

Solution

(a) Acrosome is filled with enzymes such as hyaluronidase and proteases that help the sperm to penetrate a secondary oocyte to bring about fertilization.

(b) Nucleus contains 22 highly condensed chromosomes and one sex chromosome (X or Y) to stores the genetic information.

(c) The middle piece contains several mitochondria which provide energy (ATP) for locomotion of sperm to the site of fertilization and for sperm metabolism.

20. Write the help of any two suitable examples explain the effect of anthropogenic actions on organic evolution. 3

Solution

Anthropogenic actions have increased the rate of organic evolution. For example,

(a) The excess use of herbicides and pesticides in the agricultural field to kill pests and insects has resulted in natural selection of resistant variety of pests and insects over a short time. The change favored resistant pests and insects, which led to their evolution. For example, herbicide glyphosate is no longer effective on weed *Amaranthus palmeri* that interferes with cultivation of cotton, some rats have developed resistance to rat poison, etc.

(b) The excess use of antibiotics has caused natural selection of drug resistant microbes. When bacteria are subjected to antibiotics, those which are sensitive to them die, while some which develop mutations become resistant. These resistant varieties then undergo natural selection. For example, DDT can no longer be used to control malaria. DDT was a widely used insecticide. After a few years of extensive use, DDT lost its effectiveness on insects. This is because resistance to DDT is a genetic trait, and presence of DDT in the environment changed it into a favored trait. Hence, only those insects resistant to DDT survived, leading to populations largely resistant to DDT.

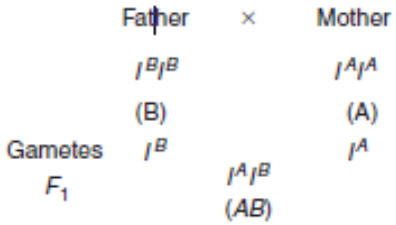
21. (a) Why is human ABO blood group gene considered a good example of multiple alleles? 3

(b) Work out a cross up to F_1 generation only, between a mother with blood group A (Homozygous) and the father with blood group B (Homozygous). Explain the pattern of inheritance exhibited.

Solution

(a) The A, B and O blood groups are controlled by three different alleles of gene *I*, thus ABO group shows multiple alleleism. The three alleles are I^A, I^B and *i*. The slight difference in these alleles lies in the composition of sugar obtained from them. The sugar produced by alleles I^A and I^B are slightly different, while no sugar is produced by allele *i*. For diploid organisms like human beings, each person can possess two of the three gene alleles. It has been found that I^A and I^B are completely dominant over *i* because *i* does not produce any sugar. Thus, in genotype I^Ai, only I^A expresses and in genotype I^B *i*, only I^B expresses.

(b) A cross between a mother with blood group A (homozygous) and the father with blood group B (homozygous) is shown below. As can be seen from the figure, in F_1, the alleles IA and IB express both equally express themselves, thus these are codominant alleles, and therefore the pattern of inheritance is codominance.

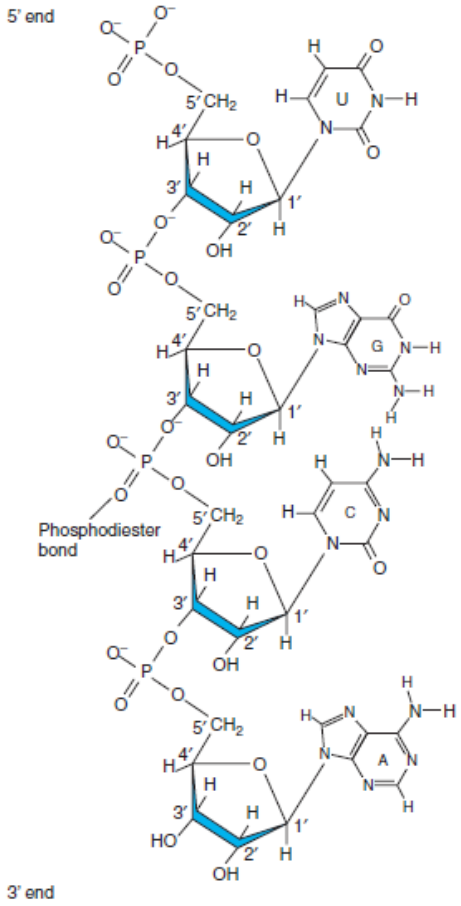


22. Describe the structure of a RNA polynucleotide chain having four different types of nucleotides. 3

Solution

A RNA nucleotide has three main components: a nitrogenous base, a ribose sugar and a phosphate group. The ribose sugar and the phosphates form the backbone of a polynucleotide chain with nitrogenous bases linked to sugar moiety and projecting from the backbone. Two types of nitrogenous bases are present, i.e., purines (adenine and guanine) and pyrimidines (cytosine and uracil). A nitrogenous base is linked to the ribose sugar through N-glycosidic linkages to form a nucleoside. A phosphate group is linked to 5'-OH of a nucleoside through phosphodiester linkage to from a

corresponding nucleotide. Every nucleotide residue has an additional –OH group present at 2'-position in the ribose. Many nucleotides are linked through 3'-5' phosphodiester linkages to each other to form the polynucleotide chain. The end of the chain which has a free phosphate moiety at 5'-end of ribose sugar is referred to as 5'-end and the other end of the chain having a free 3'-OH group at the ribose sugar is referred to as 3'-end of the polynucleotide chain.
The structure of a RNA polynucleotide chain having four different types of nucleotides is shown in Fig.



23. Differentiate between inbreeding and outbreeding in cattle. State one advantage and one disadvantage for each one of the them. 3

Solution

Inbreeding	Outbreeding
Mating of closely related individuals within the same breed for 4-6 generations.	Breeding of unrelated animals of the same or different breed not having common ancestor.
It cannot be divided into further types.	It includes out-crossing, cross-breeding and interspecific hybridization.

Inbreeding:

Advantage: Pure breed of progeny is obtained.

Disadvantage: It leads in reduction in the fertility and productivity of an organism.

Outbreeding:

Advantage: Progeny has desirable features of both the parents.

Disadvantage: The hybrid animal thus produced is not always fertile.

24. (a) Why are the fruit juices bought from market clearer as compared to those made at home?

(b) Name the bioactive molecules produced by *Trichoderma polysporum* and *Monascus purpureus*.

Solution

This is because the bottled juices are clarified by the use of pectinases and proteases.

25. (a) Why are transgenic animals so called?

(b) Explain the role of transgenic animals in (i) Vaccine safety and (ii) Biological products with the help of an example each.

Solution

(a) Transgenic animals are called so as these animals possess the deliberate modification in their genome. The changes in the genome of the organisms are brought by recombinant DNA technology.

(b)

(i) *Role of transgenic animals in vaccine safety*: Transgenic mice are being developed for use in testing the safety of vaccines before they are used on human beings. Transgenic mice are being used to test the safety of the polio vaccine.

(ii) *Role of transgenic animals in production of biological products*: The first transgenic cow, Rosie produced human protein-enriched milk, which contained alpha-lactalbumin and was nutritionally more suitable for human babies than natural cow-milk

26. How have human activities caused desertification? Explain.

Solution

The following activities contribute to desertification.

(a) Deforestation: Humans cut down trees to serve their own purposes like construction of roads and houses which is the main cause of desertification.

(b) Improper farming practices: If same crop is sown continuously, the soil becomes deficient of nutrients resulting in the loss of fertility of soil.

(c) Excessive ploughing of field

(d) Soil erosion: Soil erosion by different human activities like deforestation due to construction of houses and industrialization.

(e) Mining activities and leaching of minerals further destroys soil quality and renders it totally infertile.

he reduction in plant cover that accompanies desertification leads to accelerated soil erosion by wind and water. As vegetation cover and soil layer are reduced, rain drop impact and run-off increases. A reduction in plant cover also results in a reduction in the quantity of humus and plant nutrients in the soil, and plant production drops further. As protective plant, cover disappears, floods become more frequent and more severe.

OR

How does algal bloom destroy the quality of a fresh water body? Explain.

Solution

An algal bloom is the phenomenon of excessive growth of planktonic forms in a nutrient rich water body. As the planktonic species multiply on the surface they form a layer that eventually covers the entire surface of the water body. They block sunlight, which does not reach submerged aquatic plants

that may have a role in supplying necessary nutrients to other aquatic life forms and keeping water clean.

Excretory substances released by planktons build up in concentration and pollute the water. Some algal species even release substances that are toxic for other life forms in the water body. Also, due to high respiratory needs of such a huge concentration of biomass on the surface, the biological oxygen demand (BOD) of the water body increases, causing many of the life forms to die. Their carcasses further contribute to the deterioration of the quality of the water content.

Algal blooms may totally cover the surface of a fresh water body, release toxins in water and cause deficiency of oxygen in the water. Thus, in bloom-infested water body the growth of other algae may be inhibited due to toxins, and aquatic animals (e.g., fish) may die due to toxicity or lack of oxygen.

27. Explain mutualism with the help of any two examples. How is it different from commensalism.

Solution

Mutualism is a relationship in which two species live together in close association, both benefiting from the relationship.

(a) Lichens provides an example of *mutualism*. The lichens are composed of a matrix formed by fungus within which algae are embedded. The fungus provides fixation, water, minerals and shelter to the alga. The alga is protected within the hyphal structure. It produces sugars by photosynthesis, which the fungus consumes.

(b) The mycorrhizal associations of fungi with roots of higher plants is mutually beneficial. The plant obtains essential nutrients from the soil with the help of the fungus while the fungus obtains carbohydrates from the plants.

Commensalism is an association between two species in which one (commensal) is benefitted and the other (host) is unaffected

SECTION D

28. (a) Draw a diagrammatic sectional view of a mature anatropous ovule and label me following parts in it :

(i) that develops into seed coat.

(ii) that develops into an embryo after fertilization.

(iii) that develops into an endosperm in an albuminous seed.

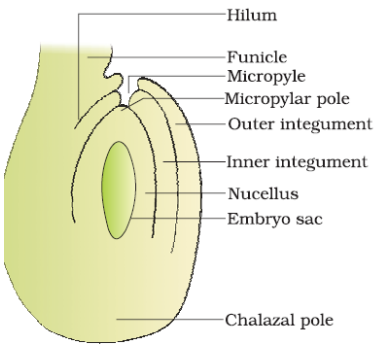
(iv) through which the pollen tube gains entry into the embryo sac

(v) that attaches the ovule to the placenta.

(b) Describe the characteristic features of wind pollinated flowers.

Solution

(a)



(i) Part that develop into seed coat – Integument

(ii) Part that develop into an embryo after fertilization – Embryo sac

(iii) Part that develops into an endosperm in an albuminous seed – Nucellus

(iv) Part through which the pollen tube gains entry into the embryo sac – Micropyle
(v) Part that attaches the ovule to the placenta - Funicle

(b) Characteristics of wind pollinated flowers:
(i) Flowers are inconspicuous, small, not very colorful and often green, not scented and without nectar.
(ii) Pollen grains are produced in abundance which are small, dry, light and non-sticky and can be easily carried by wind.
(iii) Anthers are well-exposed and swing freely in air.
(iv) Stigma is prominent, feathery and well-accessible for trapping the pollen grains readily.
(v) Flowers have a single ovule in each ovary.
(vi) If unisexual flowers are there, then the number of male flowers is higher than female flowers.
(vii) Flowers are produced above the foliage, with numerous flowers packed into inflorescence.

OR

(a) Draw a diagrammatic sectional view of the female reproductive system of human and label the parts

(i) where the secondary oocytes develop

(ii) which helps in collection of ovum after ovulation

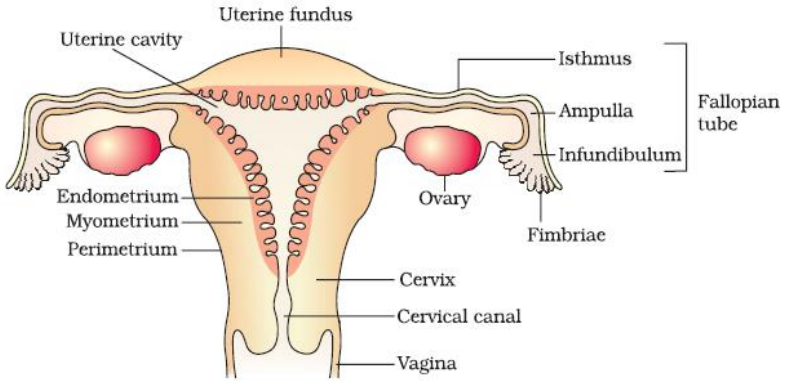
(iii) where fertilization occurs

(iv) where implantation of embryo occurs.

(b) Explain the role of pituitary and the ovarian hormones in menstrual cycle in human females.

Solution

(a) The labelled diagram of female reproductive system is given in Fig.



(i) The secondary oocytes develop in ovary.
(ii) Fimbriae help in collection of ovum after ovulation.
(iii) Fertilization occurs in fallopian tubes (infundibulum).
(iv) Implantation of fertilized ovum occurs in the wall of uterus.

(b) Gonadotropin-releasing hormone (GnRH) secreted by the hypothalamus controls the menstrual cycle. It stimulates the release of FSH and LH from the anterior pituitary. FSH initiates follicular growth, while LH stimulates further development of the ovarian follicles. In addition, both FSH and LH stimulate the ovarian follicles to secrete estrogens. LH stimulates the theca cells of a developing follicle to produce androgens. Under the influence of FSH, the androgens are taken up by the granulosa cells of the follicle and then converted into estrogens.

At midcycle, LH triggers ovulation and then promotes formation of the corpus luteum. Stimulated by LH, the corpus luteum produces and secretes estrogens, progesterone, relaxin and inhibin.

After ovulation, the mature follicle collapses, and the basement membrane between the granulosa cells and theca interna breaks down. Once a blood clot forms from minor bleeding of the ruptured follicle, theca interna cells mix with the granulosa cells as they all become transformed into corpus luteum cells under the influence of LH. Stimulated by LH, the corpus luteum secretes progesterone, estrogen, relaxin and inhibin. Progesterone helps in maintaining endometrium which is essential for implantation of the fertilized ovum. The luteal cells also absorb the blood clot.

(i) If fertilization does not occur, the levels of progesterone and estrogens decline due to degeneration of the corpus luteum. Withdrawal of progesterone and estrogens causes menstruation. Endometrium disintegrates leading to menstruation and known as bleeding phase or menstrual phase.
(ii) If fertilization occurs, then secondary oocyte begins to divide, and the corpus luteum is rescued from degeneration by human chorionic gonadotropin (hCG) produced by the chorion of the embryo beginning about 8 days after fertilization. Like LH, hCG stimulates the secretory activity of the corpus luteum. Because of the secretory activity of the endometrial glands, which begin to secrete glycogen, this period is called the **secretory phase** of the menstrual cycle. These preparatory changes peak about 1 week after ovulation, at the time a fertilized ovum might arrive in the uterus. There is no menstruation during pregnancy.

29. Describe the asexual and sexual phases of life cycle of *Plasmodium* that causes malaria in humSolution

Solution

Asexual phase of life cycle of *Plasmodium* occurs in humSolution It takes place as:

When the infected mosquito bites a healthy human, the infective stage of *Plasmodium* is injected into the human blood. The infective stage is called sporozoite. Sporozoites reach the liver through blood. The parasite (sporozoites) reproduces asexually in liver cells, bursting the cell and releasing into the blood. Parasites enter the red blood cells and reproduce asexually there bursting the red blood cells and cycles of fever and other symptoms. Released parasites infect new red blood cells. Sexual stages (gametocytes) develop in red blood cells.

Asexual phase of life cycle of *Plasmodium* occurs in female *Anopheles* mosquito. It takes place as:

Female mosquito takes up gametocytes with blood meal. Fertilisation and development take place in the mosquito's stomach. The zygote elongates and becomes motile called ookinete. The ookinete moves and bores through the wall of the stomach of female *Anopheles* mosquito. The ookinete changes to oocyst on the surface of the stomach. Inside the oocyst, sporozoites are formed which are released in the body cavity of the mosquito. Mature sporozoites move to different organs of the body cavity but many of them penetrate salivary glands of the mosquito. When the female *Anopheles* mosquito bites a healthy person, the sporozoites are injected into the blood along with saliva.

OR

(a) What is plant breeding ? List the two steps the classical plant breeding involves.

(b) How has the mutation breeding helped in improving crop varieties ? Give one example where this technique has helped.

(c) How has the breeding programme helped in improving the public nutritional health?.State two examples in support of your answer.

Solution

Plant breeding techniques are employed to develop plants that have inherent ability to prevent the action of disease causing organisms. Before the plant breeding processes are selected and carried out on plants, it is important to understand the nature pest and organisms infesting them and the diseases caused. The techniques of plant breeding used to develop disease resistant plants include:

(a) *Conventional breeding*: This method mainly involves hybridization of a plant with disease resistance to a plant with high yield so that the resulting progeny might carry the desirable traits. The important steps in this

30. A child suffering from Thalassemia is born to a normal couple. But the mother is being blamed by the family for delivering a sick baby.

(a) What is Thalassemia ?

(b) How would you counsel the family not to blame the mother for delivering a child suffering from this disease ? Explain.

(c) List the values your counselling can propagate in the families.

Solution

(a) Thalassemia is an autosomal recessive form of anaemia which occurs due to mutation or deletion of the genes controlling the synthesis of globin chains of hemoglobin.. This incomplete synthesis of haemoglobin makes the RBCs are small (microcytic), pale (hypochromic) and short-lived.

(b) Since it is an autosomal recessive disease, the mutant allele is carried on one of the autosomes, so the carrier can be any one of the two parents. So, just blaming the mother for the child's abnormality is unjustified.

(c) The values counseling can propagate in the families are:

(i) Ensure healthy diet for the child, and encourage it to lead a happy and normal life.

(ii) Accept the child with all his/her positives and negatives

(iii) Accept that only one parent is not responsible for the sick child, and realize that the defect is caused by a random change in the genes of the child.

(vi) Render support to the child emotionally during fear, anxiety, and depression or stress.