Biology

Academic Year: 2014-2015 Marks: 70
Date: March 2015

Question 1: Select and write the most appropriate answer from the given alternative for each sub-question: **[7]**

Question 1.1: A cross used to verify the unknown genotype of F1 hybrid is a _____. **[1]**

Test
Back
Dihybrid
Monohybrid

Solution: Test Cross
The crossing of an F_1 progeny with a double (homozygous) recessive parental progeny is done in order to determine whether the progeny is homozygous or heterozygous for a character under consideration. This is called as test cross. It was first introduced by Gregor Mendel. Those that are heterozygous will have one dominant and one recessive allele individuals and those that are homozygous dominant will have two dominant alleles, and those that are homozygous recessive will have two recessive alleles.

Question 1.2: Appearance of new combinations in F2 generation in a dihybrid cross proves the law of_____. **[1]**

a. dominance
b. segregation
c. independent assortment
d. purity of gametes

Solution: (c) Independent assortment
According to the law of **independent assortment**, the distribution of alleles of different traits is independent of their original combinations in the parents.

Question 1.3: A fine powder of recycled modified plastic is known as_____. **[1]**

a. polyblend
b. polythene
c. polyester
d. polymer

Solution: (a) polyblend

Ahmed Khan from Bengaluru developed **polyblend**. It is mixed with bitumen and is used to lay roads and increases road life.

Question 1.4: The partially decomposed organic matter is formed by a process called [1]

a. fragmentation
b. humification
c. mineralisation
d. leaching

Solution: (b) humification
Humus is formed by the process of humification which is partially decomposed organic matter.

Question 1.5: Transfer of genetic material into a bacterial cell through a viral vector is known as [1]

transformation
transduction
transfection
translation

Solution: transduction

- The process of transfer of DNA from one bacterium to another with the help of vector, that is, the virus is called transduction. Transduction does not require physical contact between the cells for donating the DNA.
- In the transduction process, bacteriophage DNA gets incorporated into the bacterial genome and replicates with the bacterial genome.

Question 1.6: If the number of chromosomes in an endosperm cell is 27, what will be the chromosome number in the definitive nucleus? [1]

a. 9
b. 18
c. 27
d. 36

Solution: (b) 18
Endosperm is triploid (3n) = 27. Hence, n = 9. Definitive nucleus, i.e. the secondary nucleus is diploid, i.e. 2n. Therefore, the number of chromosomes is **18**.

Question 1.7: Lever mechanism of pollination is observed in [1]

a. Salvia
b. Jasmine

c. Bougainvillea
d. Butea

Solution: (a) Salvia
In **Salvia**, when an insect visits a flower, it pushes the lower sterile anther lobe due to which the upper fertile anther lobe bends down. The anther lobe comes in contact with the rear of the insect's body where the pollen grains get attached. When the same insect visits another flower with a mature gynoecium, the pollen grains are picked up by the receptive stigma. This process of pollination is called the lever mechanism.

Question 2.1: Answer each question in 'one' sentence only `[6]`

Question 2.1.1: A pea plant pure for yellow seed colour is crossed with a pea plant pure for green seed colour. In F1 generation all pea plants were with yellow seeds. Which law of Mendel is applicable? `[1]`

Solution: A pea plant pure for yellow seed colour is crossed with a pea plant pure for green seed colour. In the F1 generation, all pea plants were with yellow seeds. Here, Mendel's law of dominance is applicable.

Question 2.1.2: Name the enzyme responsible for delay in ripening of tomato fruit. `[1]`

Solution: The Enzyme responsible for delay in ripening of tomato fruit is polygalacturanase

Question 2.1.3: Which are the bacteria responsible for converting organic acids into methane? `[1]`

Solution: Methanogenic bacteria are responsible for converting organic acids into methane.

Question 2.1.4: Name the high-yielding semi-dwarf varieties of wheat selected and introduced in India in 1963. `[1]`

Solution: Sonalika and Kalyansona were the high-yielding semi-dwarf varieties of wheat selected and introduced in India in 1963.

Question 2.1.5: 'Formation of primary endosperm nucleus is called triple fusion'. Give reason `[1]`

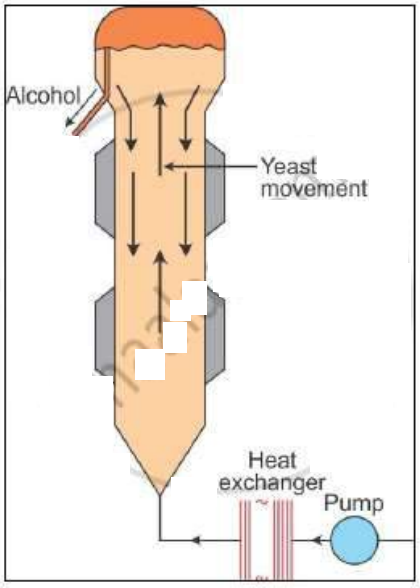
Solution: In angiosperms, one of the two male gametes fuses with the diploid secondary nucleus to form a triploid primary endosperm nucleus. This process is called triple fusion.

Question 2.1.6: Mention any 'two' ecological services for the benefit of mankind `[1]`

Solution: Ecological services for the benefit of mankind are CO_2 fixation and release of oxygen.

Question 2.2: Sketch and label 'tubular tower fermenter'. **[2]**

Solution: Tubular tower fermenter:



Question 2.3: (C) Attempt any TWO of the following **[4]**

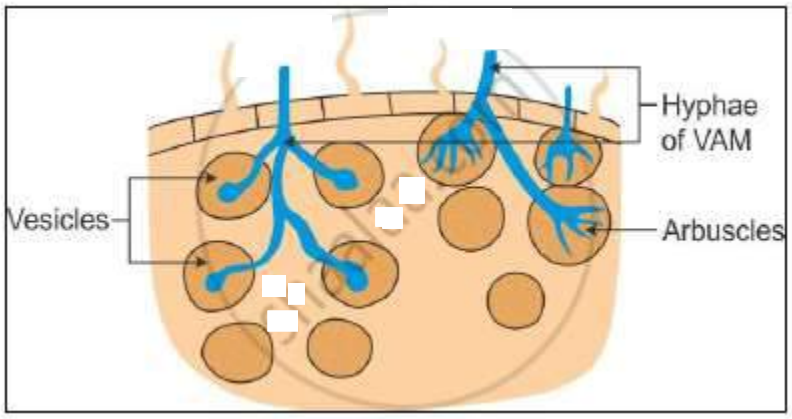
Question 2.3.1: Global warming is caused by greenhouse effect'. Justify. **[2]**

Solution: Global warming is caused by the greenhouse effect:-

- The heating of the Earth's atmosphere due to trapped infrared rays reflected from the Earth's surface by atmospheric gases is called the greenhouse effect.
- An increase in the amount of carbon dioxide present in the atmosphere retains heat energy of the Sun and increases the Earth's temperature. This results in global warming.

Question 2.3.2: With the help of a neat and labelled diagram explain VAM (vesicular arbuscular mycorrhizae). **[2]**

Solution: VAM (vesicular arbuscular mycorrhizae):



(1) VAM is vesicular arbuscular mycorrhizae.

(2) In this, the hyphae live in the intercellular spaces of root cortex and send projections into the root cortical cells.

(3) These branches (inside the cell) may be swollen to form vesicles or become a finely branched mass, called arbuscules.

(4) VAM (vesicular arbuscular mycorrhizae) is the symbiotic association between a fungus (Phycomycetes) and the root of the angiosperm plant. The fungus helps the plants to obtain the plant nutrients from the soil. In return, plant root serves as the habitat for them. They form a network of filaments and colonises in the root system.

Question 2.3.3: Distinguish between light and dark reactions. **[2]**

Solution: Difference between light and dark reactions:-

	Light Reaction		**Dark Reaction**
1	It requires the presence of light.	1	It occurs independently of the presence of light.
2	It occurs in the grana of chloroplast.	2	It occurs in the stroma of chloroplast.
3	It involves absorption of light energy by photosynthetic pigments and its conversion into chemical energy.	3	It involves the reduction of carbon dioxide into glucose.
4	$NADPH_2$ and ATP are produced.	4	$NADPH_2$ and ATP produced during the light reaction are used.
5	Oxygen is liberated.	5	Oxygen is not liberated.

Question 2.3.4: Mendel selected the garden pea plants for his experiments. Explain **[2]**

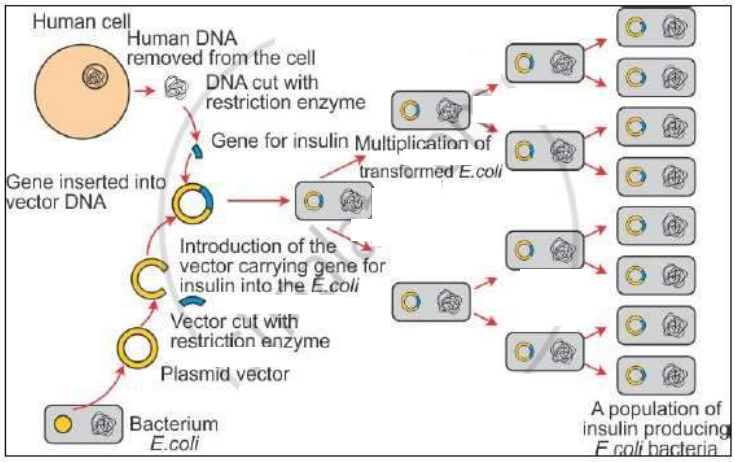
Solution: Mendel selected the garden pea Pisum sativum for his experiments on inheritance for the following reasons:-

- Garden pea is an annual plant with a short lifespan of 3 to 4 months.
- It is self-pollinating.
- It is available in many varieties with contrasting characters.
- The flowers are large enough for easy emasculation which is required for artificial crossing and to produce fertile offspring.

Question 3.1A: Attempt any TWO of the following: [6]

Question 3.1.1: With the help of a neat and labelled diagram describe the steps in recombinant DNA technology. [3]

Solution: Steps in recombinant DNA technology:-



The following steps are involved in recombinant DNA technology:-

- Isolation of genomic DNA from the donor.
- Fragmentation of the isolated DNA fragment by using restriction enzymes.
- Screening of the fragments for the desired gene.
- Insertion of the fragments with the desired gene into a cloning vector so as to develop a recombinant or chimeric DNA.
- Introduction of the recombinant vector into a competent host cell.
- Culturing of the cells containing recombinant vectors to obtain multiple copies of the desired fragment of DNA.
- Use of these copies to transform suitable host cells so as to express the desired gene.

Question 3.1.2: What is 'tissue culture'? [3]

Solution: Tissue culture:-
The culturing or growing of isolated protoplasts or cells, tissues or organs on a nutrient medium under controlled aseptic conditions to produce a complete plant or plant parts is called tissue culture.

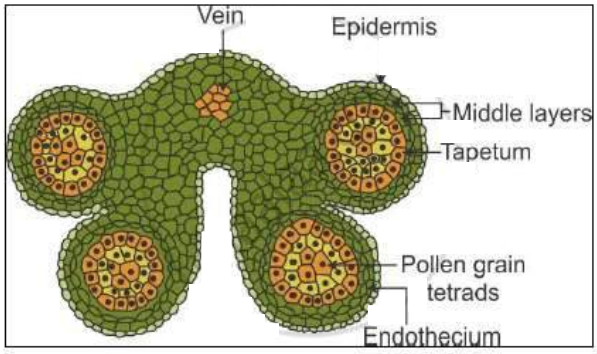
Question 3.1.3: Define vegetative propagation. [3]

Solution 1: Vegetative propagation:-
Reproduction which occurs through the parts of vegetative organs such as the roots, stem, leaf or bud of a plant is called vegetative propagation.

Solution 2: Vegetative propagation is a mode of asexual reproduction in which new plants are obtained from the vegetative parts of plants. It does not involve the production of seeds or spores for the propagation of new plants. Vegetative parts of plants such as runners, rhizomes, suckers, tubers, etc. can be used as propagules for raising new plants.

Question 3.2: Sketch and label T.S of angiospermic anther. [3]

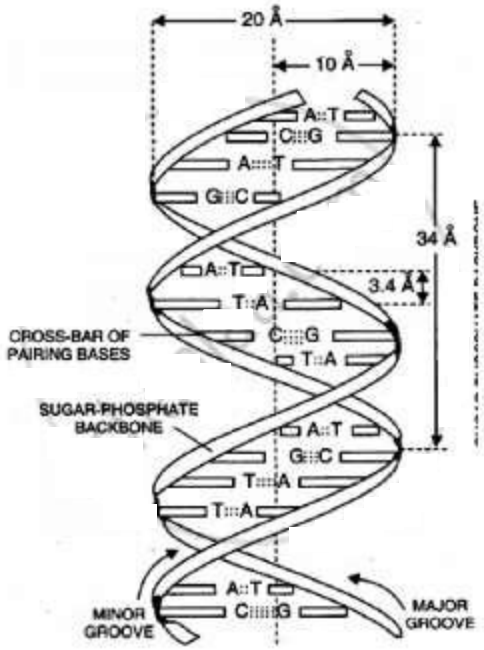
Solution: T. S. of angiospermic anther:-



Question 4: Attempt any one of the following : [7]

Question 4.1: With the help of a neat and labelled diagram describe Watson and Crick's model of DNA. [7]

Solution:



(i) In 1953 James Watson and Francis Crick proposed DNA structure based on X-ray crystallographic studies.

(ii) DNA molecule consist of two long stands coiled around a common imaginary central axis to form a double helix. It look like a twisted ladder.

(iii) Each strand consist of number of nucleiotides. Each nucleotide is made up of deoxyribose sugar, phosphate group and nitrogen base.

(iv) The combination of sugar and nitrogen base is called nucleoside. Together with phosphate called nucleotide.

(v) The successive nucleotide of the same strand are linked by 3'— 5' phosphodiester linkage i.e. phosphate attached to 5th carbon of sugar of nucleotide is joined to 3rd carbon of another.

(vi) The two stands are equidistant and parallel all along their length. Each transverse step is made up of nitrogen bases which are purines and pyrimidines.

(vii) **Double helix :** The strands of DNA molecule are spirally twisted (coiled) around each other. The side arms of ladder are called banister or railing and the steps are called rungs.

(viii) The base pairs forms rungs or steps and a back bone of strand forms railing. Backbone of strand is formed by sugar phosphate chain.

(ix) **Base pairing :** The nitrogen bases present on one strand, pair with the nitrogen

bases of opposite strand.

(x) Purine base A always pairs with pyrimidine base T by two hydrogen bonds and purine base.

(xi) G always pair with the pyrimidine base C with 3 hydrogen bonds.

(xii) This pairing is termed as complementary base pairing.,

Purine : Pyrimidines
Adenine = Thymine (A T or T = A)
Guanine = Cystosine (G =.C or C = G)
Purines (adenine and Guanine) has double ring and Pyrimidines (Cystosine and thymine) has single ring.

Question 4.2: With the help of schematic representation explain Krebs cycle. **[7]**

Solution:

Krebs cycle:-
The cyclic process through which acetyl Co-A is completely oxidised and CO_2 is released in a step-wise manner is called Krebs cycle.

Steps in Krebs cycle:-

1. Condensation:

Acetyl coenzyme -A reacts with oxalo-acetate which is a 4-C compound present in matrix of mitochondrion and a 6-C compound called citric acid or citrate is formed Thus citrate is the first stable compound of Krebs cycle. One water molecules is used in this reaction. The enzyme citrate synthetase catalyses the reaction.

$$\underset{(4\text{-}C)}{OAA} + \underset{(2\text{-}C)}{\text{Acetyl Co}-A} + H_2O \xrightarrow{\text{Citrate synthetase}} \underset{(6\text{-}C)}{\text{Citrate}} + Co - A$$

2. Isomerisation:

In the next step 6-C citrate is first converted into 6-C, Cis aconitate (removel of H_2O) and then into 6-C isocitrate (addition of H_2O)

$$\underset{(6\text{-}C)}{\text{Citrate}} \longrightarrow \underset{(6\text{-}C)}{\text{Cis} - \text{aconitate}} + H_2O$$

$$\underset{(6\text{-}C)}{\text{Cis} - \text{aconitate}} + H_2O \longrightarrow \underset{(6\text{-}C)}{\text{Iso citrate}}$$

3.Oxidation :

Next reaction involves oxidation of Isocitrate (by removal of hydrogen) to form 6-C oxalo succinate. $NADH_2$ is formed in this reaction.

$$\underset{(6\text{-}C)}{\text{Iso} - \text{citrate}} + NAD \longrightarrow \underset{(6\text{-}C)}{\text{Oxalo} - \text{succinate}} + NADH_2$$

4. Decyroboxylation :-

Decarboxylation of 6-C oxalo succinate. Results in the formation of 5-C a-Ketoglutarate with the liberation of CO_2 .

$$\underset{(6\text{-}C)}{\text{Oxalo}-\text{succinate}} \longrightarrow \alpha - \text{ketoglutarate} + CO_2$$

5. Oxidative Decyroboxylation :-

α - kelogutarate acid (5 - C) then undergoes oxidation (by removal of hydrogen) Decyroboxylation to form 4 C succinyl Co - A : It takes place in the presence of Co - A and NAD. $NADH_2$ is formed and CO_2 is released.

$$\underset{(5C)}{\alpha\text{-ketoglutarate}} + NAD + Co - A \longrightarrow \underset{(4\text{-}C)}{\text{SuccinylCo} - A} + NADH_2 + CO_2$$

6. Hydration and phosphorylation:

4-C succinyl-CoA is hydrolysed to succinate (4-C) in the next step. One H_2O is used and Co-A is regenerated.

The reaction is exergonic. Energy released is used for the formation of GTP (Guanosine triphosphate) from GDP and H_3PO_4 . Subsequently GTP is converted to ATP in presence of ADP.

$$\underset{(4\text{-}C)}{\text{Succinyl Co} - A} + H_2O \xrightarrow{GDP \longrightarrow GTP} \underset{(4\text{-}C)}{\text{Succinate}} + Co - A$$

7. Oxidation (Dehydrogenation-III):

In this step, succinate (4-C) is oxidized by dehydrogenation to form fumarate (4-C). The hydrogen removed in this reaction reduces the coenzyme FAD (Flavin Adenine Dinucleotide) to $FADH_2$ .The reaction is catalyzed by the enzyme succinate dehydrogenase.

$$\underset{(4\text{-}C)}{\text{Succinate}} + FAD \longrightarrow \underset{(4\text{-}C)}{\text{Fumarate}} + FADH_2$$

8. Hydration:

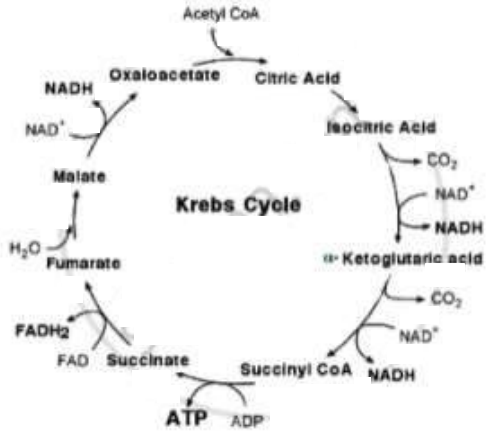
Fumarate (4-C) accepts a water molecule to produce malate (4-C). This occurs in presence of the enzyme fumarase.

$$\underset{(4-C)}{\text{Fumarate}} + H_2O \longrightarrow \underset{(4-C)}{\text{Malate}}$$

9. Oxidation (Dehydrogenation-IV):

Malate (4 - C) is oxidized by removal of hydrogen and oxalo-acetate (4 - C) gets regenerated. The hydrogen removed in this reaction is taken up by the coenzyme NAD to form $NADH_2$. The reaction is catalyzed by the enzyme malate dehydrogenase.

$$\underset{(4-C)}{\text{Malate}} + NAD \longrightarrow \underset{(4-C)}{\text{Oxalo-acetate}} + NADH_2$$



Question 5: Select and write the most appropriate answer from the given alternatives for each sub-question : **[7]**

Question 5.1: In gene therapy, DNA ase is used to treat_____ . **[1]**

a. cystic fibrosis
b. haemophilia
c. pituitary dwarfism
d. insulin dependent diabetes

Solution:

(a) Cystic fibrosis
Pulmozyme (DNase) is an enzyme used to treat **cystic fibrosis** and is inhaled via a nebuliser.

Question 5.2: If only one 'X' chromosome is found in a female person, which of the following symptoms she will show? **[1]**

a. epicanthal skin fold
b. webbing of neck
c. small testis and absence of spermatogenesis
d. presence of simian crease on the palm

Solution: (b) Webbing of neck
A missing X chromosome leads to Turner's syndrome. The symptoms in females are a receding lower jaw and a short webbed neck.

Question 5.3: In which of the following haploid cells a whole genome in human being is present? **[1]**

a. sperm
b. somatic cell
c. mature RBC
d. primary spermatocyte

Solution: (a) Sperm
The haploid human genome can be found in the egg and sperm cells. This genome has about three billion DNA base pairs.

Question 5.4: Which of the following is NOT an example of connecting link? **[1]**

a. Archaeopteryx
b. fchthyostegia
c. Seymouria
d. Biston betularia

Solution: (d) Biston betularia
It is a temporary species which helps in studying industrial melanism.

Question 5.5: In_____ , superior males of one breed are mated with superior females of another breed. **[1]**

a. out crossing
b. cross breeding
c. out breeding
d. inbreeding

Solution: cross breeding

Question 5.6: Normal activities of the heart are regulated by **[1]**

a. brain
b. spinal cord
c. modified cardiac muscles
d. hormones

Solution: (c) Modified cardiac muscles
Normal activities of the heart are auto-regulated by specialised muscles.

Question 5.7: During ..... types of interaction, both organisms are benefited **[1]**

a. mutualism
b. competition
c. commensalism

d. parasitism

Solution: (a) Mutualism
It is a type of interaction in which both organisms are benefited.

Question 6.1A: Answer the following in one-sentence each: **[6]**

Question 6.1.1: What is gene pool? **[1]**

Solution: A gene pool is the set or collection of all the genes in a population of any particular species.

Question 6.1.2: Give any 'two' names of X-linked diseases **[1]**

Solution: Colour blindness and haemophilia are examples of X-linked diseases.

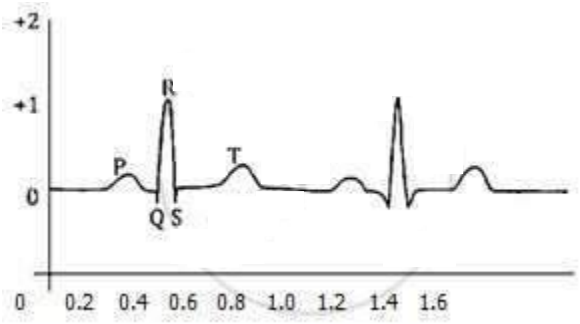
Question 6.1.3: What does abbreviation HGP stand for? **[1]**

Solution: HGP stands for 'Human Genome Project'.

Question 6.1.4: Give 'two' varieties of silk which are considered as inferior quality **[1]**

Solution: Tussar silk and Eri silk are two varieties of silk which are considered of inferior quality.

Question 6.1.5: In the electrocardiogram shown below, which wave represents ventricular diastole? **[1]**



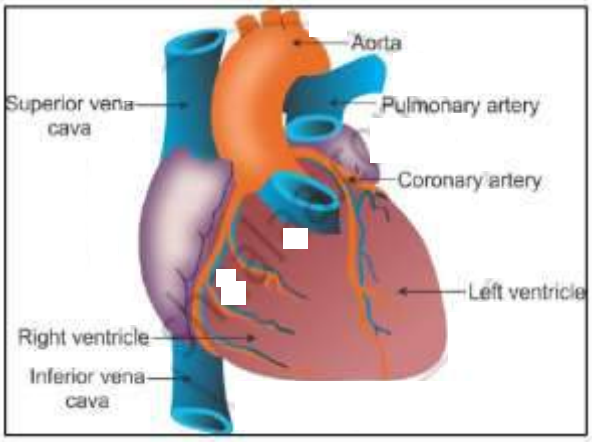
Solution: The 'T-wave' in an electrocardiogram represents the ventricular diastole.

Question 6.1.6: Which method of conservation of biodiversity includes 'hotspot' method? **[1]**

Solution: The in situ method of biodiversity conservation includes the hot-spot method of conservation.

Question 6.2: Sketch and label ventral view of human heart. **[2]**

Solution: Ventral view of the human heart:-



Question 6.3: Attempt any TWO of the following: [4]

Question 6.3.1: Distinguish between ape and man. [2]

Solution:

	Ape		Man
1	Apes possess a prognathous face, slanting forehead and snout protruded with a flat nose.	1	Humans possess an orthognathous face, high forehead, dome shaped skull and elevated nose.
2	They have a cranial capacity of 400–600 c.c.	2	They have a cranial capacity of approximately 1450 c.c.
3	The chin is absent.	3	A prominently developed chin.
4	Locomotion is quadrupedal.	4	Locomotion is bipedal.

Question 6.3.2: Give any 'two' names of X-linked diseases [2]

Solution: Colour blindness and haemophilia are examples of X-linked diseases.

Question 6.3.3: Explain the various types of cancer [2]

Solution: Cancer is divided into various types depending on the type of cells which are altered. There are five major categories of cancer based on the cell type:-

1. Carcinoma:- Cancer in the cells which cover the internal and external organs of the body.
2. Sarcoma:- Cancer of the supportive tissues such as bone, cartilage, connective tissue and muscles.
3. Lymphoma:- Cancer which begins in the lymph nodes and tissues which constitute the immune system.

4. Leukaemia:- Cancer which begins in the bone marrow and accumulates in the blood stream.
5. Adenoma:- Cancer which arises in the tissues of the thyroid, pituitary and adrenal glands.

Question 6.3.4: Give the significance of fertilisation **[2]**

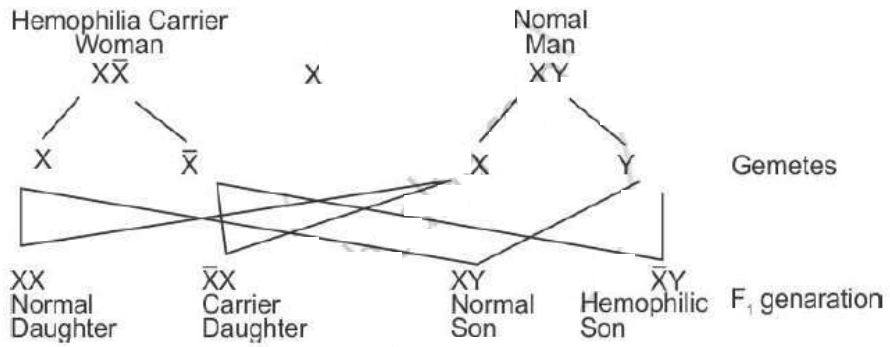
Solution: Significance of fertilisation:-

- Fertilisation maintains the diploid number of chromosomes in the newly formed zygote.
- It combines characters from two parents bringing about variation in the offspring.
- It determines the sex of the offspring.
- Fertilisation introduces centrioles in the cell which are missing in the ovum.

Question 7.1: Attempt any TWO of the following **[6]**

Question 7.1.1: What will be the phenotype of progeny, if a carrier haemophilic female marries a normal male? **[3]**

Solution:



Question 7.1.2: Explain with tile help of a chart, explain the compatibility of human blood groups. **[3]**

Solution: Compatibility of human blood groups

Blood type	Donate blood to	Receive blood from
A+	A+, AB+	A+ A− O+ O−
O+	O+ A+ B+ AB+	O+ O−
B+	B+ AB+	B+ B− O+ O−
AB+	AB+	Everybody
A−	A+ A− AB+ AB−	A− O−
O−	Everyone	O−
B−	B+ B− AB+ AB−	B− O−
AB−	AB+ AB−	AB− A− B− O−

Question 7.1.3: Justify the conservation of endangered species of plants and animals is necessary [3]

Solution:

1. The conservation of endangered species is necessary to maintain the number of individuals of a species and study its life in the natural habitat. There are two types of methods of conservation of endangered species—ex situ conservation and in situ conservation.

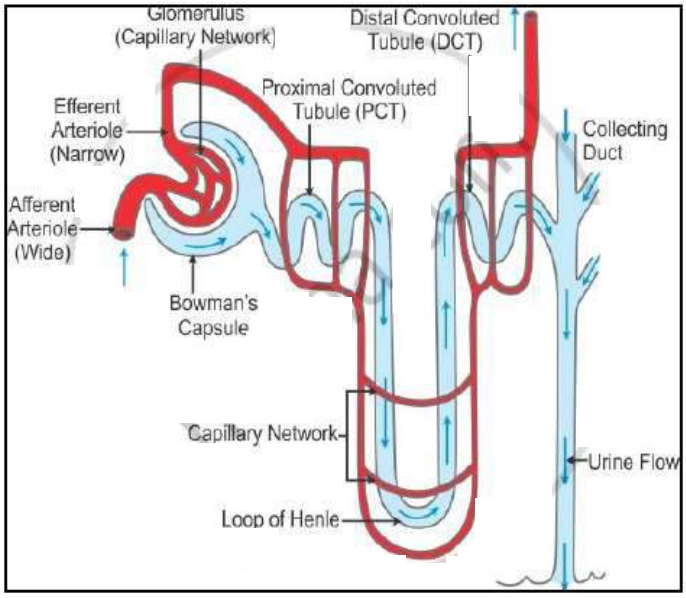
2. In situ conservation includes hot spots which protect, preserve and restore endangered species in their own habitats in protected areas which include grazing, cultivation etc. In situ conservation includes national parks, wildlife sanctuaries and biosphere reserves.

3. Ex situ conservation is the conservation of endangered species outside their natural habitats such as botanical gardens and zoological parks.

4. We can also give importance to the most vulnerable species, and the habitats of the species can be safe-guarded by preventing human disturbances.

Question 7.2: Sketch and label 'structure of nephron'. [3]

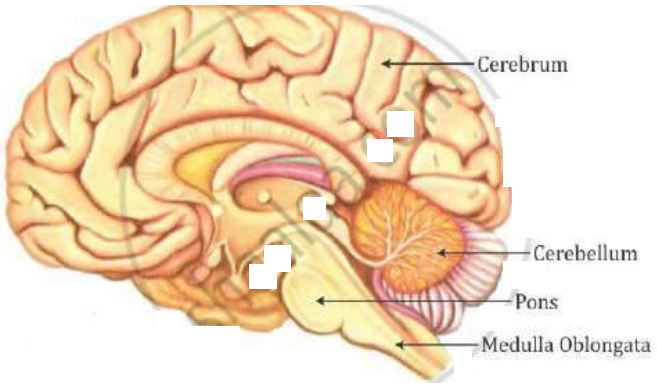
Solution: Structure of nephron:-



Question 8 | Attempt any one of the following : [7]

Question 8.1: With the help of a labelled diagram of lateral view of cerebrum, describe the structure. [7]

Solution: Lateral view of the cerebrum:-

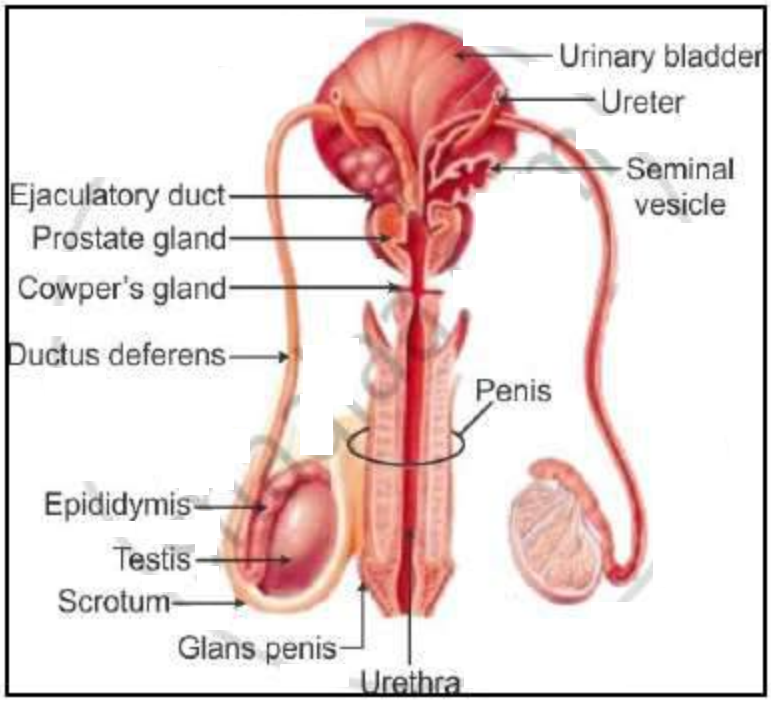


Structure of the cerebrum:-

- It is the largest portion of the brain.
- It is divided into two cerebral hemispheres connected to each other by the corpus callosum.
- Each cerebral hemisphere is divided into four lobes—frontal lobe, parietal lobe, occipital lobe and temporal lobe.
- The walls have an outer cortex and inner medulla.
- The cortex contains cell bodies of the neuron and is greyish in colour; hence, it is called grey matter.
- The grey matter has many folds (i.e. gyri) and grooves (i.e. sulci). They increase the surface area to accommodate more nerve cells.
- A higher number of convolutions lead to greater intelligence.
- The medulla consists of axons of nerve fibres and is called white matter.

Question 8.2: With the help of a neat, labelled diagram describe the human male reproductive system. **[7]**

Solution: Human male reproductive system:-



The human male reproductive system comprises of the following.

1. testes
2. epididymis
3. vas deferens
4. Seminal vesicles
5. prostate gland
6. Cowper's glands
7. penis

1. Testes

Testes produce male gametes and sperm.

To maintain the temperature 2-3°C lower than the body temperature, the scrotum is located outside the body cavity.

2. epididymis

The epididymis stores sperms temporarily.

3. vas deferens

Each epididymis continues further as a sperm duct or vas deferens.

4. Seminal vesicles

The seminal vesicles produce a secretion which is responsible for the transport of sperm.

5. Prostate gland

It is a bilobed structure which surrounds the urethra.

It pours an alkaline secretion into the semen.

6. Cowper’s glands

These are two small ovoid glands.

They open into the urethra.

Its secretion serves as a lubricant.

7. Penis

The urethra passes through the penis.

It carries either urine or semen at a given time.