# Biology

Academic Year: 2014-2015 Date & Time: 7th October 2015, 4:00 pm Duration: 3h

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

**Question 1.1:** How many meiotic divisions will be needed to produce 44 female gametophytes in angiosperms? **[1]** 

## Solution: 44

The female gametophyte develops from megaspore mother cell by meiotic division during the process of megasporogenesis. The meiosis in the megaspore mother cell produces four haploid megaspores out of which three degenerate and only one matures to form the functional female gametophyte. Thus to produce **44 female gametophytes**, **44 meiotic divisions** are needed.

Question 1.2: If the codon on m-RNA is AUG, the compatible anticodon on t-RNA is

\_\_\_\_\_. [1]

(A) UAG

(B) UAC

(C) GUA

(D) AUC

Solution: (B) UAC

Question 1.3: \_\_\_\_\_\_ enzymes are used as biological scissors in r-DNA technology. [1]

(A) Restriction endonucleases

(B) DNA ligases

(C) DNA polymerases

(D) Reverse transcriptases

Solution: (A) Restriction endonucleases

**Question 1.4:** Vegetative propagation takes place with the help of leaves in \_\_\_\_\_ plant. [1]

(A) Kalanchoe

Marks: 80

(B) Oxalis

(C) Cynodon

(D) Dahlia

Solution: (A) Kalanchoe

Question 1.5: Trichoderma konigi is a source of \_\_\_\_\_ enzyme. [1]

(A) invertase

(B) lipase

(C) pectinase

(D) cellulase

Solution: (D) cellulose

**Question 1.6:** What is the correct sequence of the stages in bacteriophage lytic cycle? [1]

(A) Attachment, Penetration, Lysis, Multiplication

(B) Attachment, Penetration, Multiplication, Lysis

(C) Lysis, Penetration, Multiplication, Attachment

(D) Attachment, Lysis, Multiplication, Penetration

Solution: (B) Attachment, Penetration, Multiplication, Lysis

Question 1.7: Edible fruiting bodies are produced by \_\_\_\_\_. [1]

- (A) Yeast
- (B) Rhizopus
- (C) Nostoc
- (D) Agaricus

Solution: (D) Agaricus

## Question 2.1: Answer each question in 'One' sentence only: [6]

## Question 2.1.1: Give reason: [2]

Emasculation is done in a flower which is selected as female parent.

- Emasculation is the process of removal of the male reproductive organs from an organism. In plants, it is done by removing the stamens of a flower before they achieve reproductive maturity.
- This is usually done in bisexual flowers to prevent self-pollination. Emasculation is followed by bagging the flower and then the desired pollen grains are introduced on the stigma for hybridisation.

• It is done in the flower which is selected as the female parent because after emasculation only the female reproductive parts of the flower remain in it.

Question 2.1.2: Label the parts (1) and (2) in budding of yeast cell. [2]



Solution: 1. Parent cell 2. Bud

Question 2.1.3: Enlist types of DNA library. [2]

Solution: The types of DNA library are:

a. Genomic library

b. cDNA library

Question 2.1.4: Define parthenocarpy. [2]

Solution: Parthenocarpy is the production and development of seedless fruits.

Question 2.1.5: What is ecological succession? [2]

**Solution:** The gradual (and predictable) change in the species composition of a given area is called ecological succession.

Question 2.1.6: Give the role of VAM related to soil fertility. [2]

**Solution:** The association of VAM (Vesicular Arbuscular Mycorrhizae) with crop plants helps in converting a less productive field into a more productive one.

Question 2.2: Give diagrammatic representation of pyramid of numbers. [2]



## Question 2.3: Attempt any TWO of the following: [4]

Question 2.3.1: With the help of a suitable example, explain protandry. [2]

**Solution:** Protandry is a type of dichogamy in which anthers mature first, but stigma of the same flower is not receptive at that time.

eg. Sunflower, Cotton, Salvia

Question 2.3.2: How depletion of ozone layer affects living organisms? [2]

## Solution:

- The thinning of the ozone layer results in an increase in the levels of UV radiation reaching the earth's surface. In humans, increased UV radiation causes ageing of skin, damage/injuries to skin cells and skin cancers including melanoma.
- It also causes cataract and even permanent damage to cornea, weakening of immune system. UV radiation also causes mutations in living organisms.
- DNA and proteins of living cells absorb the UV rays, high energy of UV radiation breaks the chemical bonds of these molecules, thus affecting the normal metabolism.
- UV radiation inhibits photosynthesis in most phytoplanktons as it penetrates through the ocean water. This affects the entire food chain in aquatic ecosystem.

Question 2.3.3: Give graphic representation of cyclic photophosphorylation. [2]

## Solution:

- The thinning of the ozone layer results in an increase in the levels of UV radiation reaching the earth's surface. In humans, increased UV radiation causes ageing of skin, damage/injuries to skin cells and skin cancers including melanoma.
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- DNA and proteins of living cells absorb the UV rays, high energy of UV radiation breaks the chemical bonds of these molecules, thus affecting the normal metabolism.
- UV radiation inhibits photosynthesis in most phytoplanktons as it penetrates through the ocean water. This affects the entire food chain in aquatic ecosystem.

Question 2.3.4: Explain the role of microbes in sewage treatment. [2]

**Solution:** Microbes play a significant role during secondary and tertiary sewage treatment.

- During secondary treatment, primary effluent is continuously agitated in a large tank due to which vigorous growth of useful aerobic microbes into flocs takes place. These microbes consume major part of the organic matter in the effluent as they grow. Due to this, BOD of the effluent is significantly reduced.
- During tertiary treatment, bacterial flocs are allowed to sediment. Small part of it is passed back into the aeration tank and a large part is pumped into large tanks called

anaerobic sludge digesters. These anaerobic bacteria digest the bacteria and fungi in sludge.

• Thus, use of microbes in sewage treatment helps to remove organic matter from waste water before it is discharged in water bodies like rivers.

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

Question 3.1.1: Describe the steps of PCR technique. [3]

**Solution 1:** One cycle of Polymerase Chain Reaction involves three basic steps: a. Denaturation b. Annealing c. Polymerization

## a. Denaturation:

The desired DNA is heated to a high temperature of about 91°C and forms a single stranded DNA. It results in the separation of the two strands of DNA, each of which would function as a template for the synthesis of a new molecule of DNA.

b. Annealing:

1. It is the process in which the two primers (oligonucleotides) hybridise to each of the strands of DNA. It requires a temperature of 55°C.

c. Polymerization:

In this step, the Taq polymerase carries out the synthesis of DNA region between the two primers by using deoxy ribonucleotides (dNTPs) and Mg2+. The optimum temperature for this polymerization reaction is 72°C.



Solution 2: The three essential steps of PCR technique are -

1) **Heat denaturation**: This step involves heating of DNA at about 91°C. The heating breaks the hydrogen bonds to make ssDNA. The DNA molecule with more G-C pairs needs the higher temperature.

2) **Annealing**: It is pairing of primers to the ssDNA segment. The primers have to be designed as per the requirement. This step requires temperature at about 55°C

3) **Polymerisation**: The temperature is raised to 72°C. The Taq polymerase adds dNTPs behind the primer on the ssDNA. These three steps constitute one cycle of the reaction (3-5 mins). The process is carried out for about 28-30 cycles beyond which its reliability decreases.

**Question 3.1.2:** Write a note on multiple alleles considering example of human blood groups. [3]

## Solution: Multiple Allelism:

a. More than two alternative forms (alleles) of gene in a population occupying the same locus on a chromosome or its homologue are known as multiple alleles.

b. ABO blood group system in humans is an example of multiple allelism, because gene I exists in three allelic forms  $I^A$ ,  $I^B$  and  $I^0$ .

c. Here, allele  $I^A$  codes for type A blood, allele  $I^B$  codes for type B blood and allele  $I^0$  codes for type O blood.

d. Allele  $I^{O}$  is recessive to the alleles  $I^{A}$  and  $I^{B}$ .

e. Thus, with these three alleles, we can have 6 different genotypes and 4 different phenotypes for blood groups.

	Genotype	Phenotype (Blood group)
1	I <sup>A</sup> I <sup>A</sup> or I <sup>A</sup> I <sup>O</sup>	Туре А
2	I <sup>B</sup> I <sup>B</sup> or I <sup>B</sup> I <sup>O</sup>	Туре В
3	I <sup>A</sup> I <sup>B</sup>	Type AB
4	lo lo	Туре О

Question 3.1.3: What is 'bio fortification'? [3]

**Solution 1:** Bio fortification is the method of breeding of crops to produce varieties which have increased nutritional value.

**Solution 2:** Bio fortification is a process of breeding crops with higher levels of vitamins, minerals, proteins, and fat content. This method is employed to improve public health. Breeding of crops with improved nutritional quality is undertaken to improve the content of proteins, oil, vitamins, minerals, and micro-nutrients in crops. It is also undertaken to upgrade the quality of oil and proteins. An example of this is a wheat variety known as Atlas 66, which has high protein content in comparison to the existing wheat. In addition, there are several other improved varieties of crop plants such as rice, carrots, spinach etc. which have more nutritious value and more nutrients than the existing varieties.

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



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

**Question 4.1**: Describe the process of glycolysis with the help of schematic representation.

Solution: Glycolysis consists of two major phases:

- a. Preparatory phase and cleavage. b. Oxidative and payoff phase.
- a. Preparatory phase and cleavage:

In this step, glucose molecule is activated by phosphorylation and then cleaved into two molecules of triose phosphates, namely 3-PGAL and DHAP. In the next step, only 3-PGAL participates and hence DHAP gets converted into 3-PGAL. Thus, 2 molecules of 3-PGAL are formed.

It includes the following reactions:

i. Phosphorylation I: A glucose molecule is phosphorylated to glucose 6-phosphate in presence of enzyme hexokinase. In this reaction, ATP supplies the phosphate and gets converted into ADP.

ii. Isomerisation: Glucose-6-phosphate is isomerised to fructose-6-phosphate in presence of enzyme phosphoglucoisomerase.

iii. Phosphorylation II: Fructose-6-phosphate is phosphorylated to fructose-1,6diphosphate. Phosphate is supplied by ATP which gets converted to ADP. Reaction is catalyzed by enzyme phosphofructokinase.

iv. Cleavage: Fructose-1,6-diphosphate splits up into two inter-convertible compounds, i.e. Dihydroxy acetone phosphate (DHAP) and 3-phosphoglyceraldehyde (3-PGAL). Reaction occurs in presence of enzyme aldolase.

v. Isomerization : DHAP is isomerised into 3–PGAL with the help of enzyme phosphotriose isomerase, thus two molecules of PGAL are obtained.

b. Oxidative and payoff phase:

In this phase, oxidation or removal of hydrogen takes place and then there is ATP generation.

i. Oxidative Phosphorylation: 3-PGAL undergoes oxidation and phosphorylation to form 1,3-diphosphoglyceric acid (1,3-DPGA). Hydrogen released combines with NAD to form NADH2. Phosphate is supplied for the reaction by phosphoric acid (H3PO4).

ii. ATP generation I / Dephosphorylation I: 1,3-diphosphoglyceric acid is dephosphorylated to 3-phosphoglyceric acid (3-PGA). Phosphate released combines with ADP to form ATP.

Reaction takes place in presence of enzyme phosphoglycero-kinase.

iii. Isomerisation: In presence of enzyme phosphoglycero-mutase, 3-Phosphoglyceric acid is isomerised to 2-phosphoglyceric acid.

iv. Dehydration: 2-Phosphoglyceric acid loses a water molecule to form phosphoenol pyruvic acid. The enzyme enolase catalyses the reaction.

v. ATP generation II / Dephosphorylation II: Phosphoenol pyruvic acid is dephosphorylated to pyruvic acid in presence of enzyme pyruvate kinase. Phosphate released combines with ADP to form ATP.



Question 4.2: Explain semi-conservative replication of eukaryotic DNA. [7]

Solution: Semiconservative method of replication:

After replication, each daughter DNA molecule has one old and other new strand. As parental DNA is partly conserved in each daughter DNA, the process of replication is called semiconservative.

The model of semiconservative replication was proposed by Watson and Crick. Mechanism of DNA replication: i. Activation of nucleotides:

All the four types of DNA nucleotides are found in the nucleoplasm in the form of their monophosphates namely dAMP, dGMP, dTMP and dCMP.

They are activated using ATP to form triphosphates, namely dATP, dGTP, dTTP and dCTP respectively.

It occurs in presence of enzyme phosphorylase and the process is called activation of nucleotides. [dAMP + ATP  $\longrightarrow$  dATP + AMP]

ii. Origin (Initiation):

The replication starts at a specific point on DNA molecule called origin or initiation point.

In prokaryotes, DNA has single origin point, while in eukaryotes, there are several origin points.

iii. Incision:

At the origin, DNA molecule breaks because of formation of an incision (nick). This incision is made by the activity of endonuclease enzyme, hence hydrogen bonds get broken.

iv. Unwinding of DNA molecule: The two strands start unwinding.

This takes place with the help of DNA unwinding protein, i.e. helicase enzyme. By the action of topoisomerase, two strands get separated from each other. Now, the DNA molecule appears as inverted 'Y' shaped structure called replication fork. The portion or unit of DNA undergoing replication is called replicon.

The two separated strands of the DNA are stabilized by Single Strand Binding Protein (SSBP) or helix destabilizing protein.

v. Synthesis of new strand:

For synthesis of a complementary new strand, each separated strand acts as a template (site) or mould.

It is initiated by a small RNA molecule called RNA primer.

Synthesis of this RNA primer is controlled by enzyme RNA primase. The RNA primer attaches itself at the 3' end of the template strand and attracts the new nucleotides from nucleoplasm.

Appropriate nucleotides are selected and are attached by H-bond to their respective complementary bases on the old strand.

Synthesis of new strand occurs in the presence of enzyme DNA Polymerase. The successive nucleotides are joined to each other with the help of phosphodiester linkages forming a new strand.

vi. Leading and Lagging strand:

During DNA replication, the strand which opens from 3'-5' is called leading template and its complementary strand is called leading strand or continuous strand. It is constructed

continuously at a faster rate.

The other strand which opens from 5'-3' is called lagging template and its complementary strand is called lagging strand. It is constructed discontinuously at a slower rate.

The lagging strand is constructed in the form of short segments called Okazaki fragments which are later joined by the enzyme DNA ligase.

The replication of DNA strands always takes place in 3' to 5' direction of template strand, while construction of new strand occurs in 5' to 3' direction, as DNA polymerase shows 5' to 3'direction activity.

vii. Formation of new DNA chains: In this way for each old strand, a new complementary strand is constructed.

Now, one old strand and the other new strand undergo coiling to form two identical daughter DNA molecules at the end of the process.



Question 5: Select and write the most appropriate answer from the given alternatives for each subquestion: [7]

Question 5.1: Elephantiasis is caused by \_\_\_\_\_. [1]

(A) Wuchereria bancrofti

- (B) Plasmodium vivax
- (C) Bedbug

(D) Elephant

Solution: (A) Wuchereria bankrofti

**Question 5.2**: Genetically engineered human insulin is obtained by inserting the gene in \_\_\_\_\_. [1]

(A) Pancreatic cells

- (B) E. coli
- (C) Agrobacterium tumefaciens
- (D) Drosophila melanogaster

#### Solution: (B) E. coli

Question 5.3: Urea splitting bacteria are responsible for \_\_\_\_\_ types of stones. [1]

- (A) calcium oxalate
- (B) calcium phosphate
- (C) calcium carbonate
- (D) struvite

Solution: struvite

Question 5.4: The connecting link between 'ape' and 'man' is \_\_\_\_\_. [1]

- (A) Dryopithecus
- (B) Australopithecus
- (C) Homo erectus
- (D) Homo neanderthalensis

**Solution:** (B) Australopithecus

**Question 5.5**: Crippling disease is caused due to poisoning of \_\_\_\_\_. [1]

- (A) Arsenic
- (B) Lead
- (C) Mercury
- (D) Selenium

Solution: (C) Mercury

**Question 5.6**: The genetic marker used as key factor in DNA fingerprinting is \_\_\_\_\_. [1]

- (A) VNTRs
- (B) Exons
- (C) Introns
- (D) DNA probes

Solution: (A) VNTRs

**Question 5.7**: The trophoblast cells in contact with embryonal knob are called \_\_\_\_\_. [1]

- (A) Inner mass cells
- (B) Blastomere
- (C) Amniogenic cells
- (D) Cells of Rauber

Solution: (D) Cells of Rauber

#### Question 6.1: Answer the following in 'One' sentence each: [6]

Question 6.1.1: Mention any 'two' methods used to prevent spoilage of fish [1]

**Solution:** Deep freezing and Sun drying are two methods used to prevent spoilage of fish.

Question 6.1.2: Define the term 'genome'. [1]

**Solution:** Genome is defined as the total number of genes present on the haploid set of chromosomes.

Question 6.1.3: Define organic evolution. [1]

**Solution:** Organic evolution is a slow, gradual, continuous and irreversible change through which the present-day complex forms have descended from their simple pre-existing forms of the past.

Question 6.1.4: What is criss-cross inheritance? [1]

**Solution:** The inheritance of characters from the father to his grandson through his daughter is called crisscross inheritance.

Question 6.1.5: Mention any 'two' functions of uterus. [1]

**Solution:** The functions of uterus are: a. It receives the ovum from fallopian tube. b. It forms placenta for the development of foetus.

Question 6.1.6: What is Red Data Book? [1]

**Solution 1:** Red Data Book is the state document created by International Union for Conservation of Nature and Natural Resources (IUCN) for documenting rare and endangered species of animals and plants.

**Solution 2:** Red data book: The Red data book is the state document established for documenting rare and endangered species of animals, plants and fungi as well as some local sub-species that exist within the territory of the state or country.

Question 6.2: Sketch and label the structure of chromosome. [1]



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

Question 6.3.1: Explain the concept 'survival of the fittest'. [2]

Solution: Survival of the fittest (Natural selection):

a. The organisms having favourable variations succeed in the struggle for existence.

b. The organisms with unfavourable variations are unfit to survive and they perish.

c. This means survival of the fittest.

d. Nature selects the organisms with favourable variations and these are fittest to survive, hence, the theory is known as Theory of Natural selection.

Question 6.3.2: Give economic importance of apiculture [2]

Solution: Economic importance of Apiculture:

a. Major products of apiculture are honey and beeswax.

b. Honey has high nutritive value. It contains levulose, dextrose, maltose, enzymes, minerals, vitamins and water.

c. Honey also has medicinal importance. Honey is used as an antiseptic and sedative. It is used in gastrointestinal disorders.

d. Honey bees are pollinating agents. They help to increase crop yield by pollination.

e. Beeswax is used in cosmetics, paints and ointments.

f. Honey is used in manufacturing of cakes and as a flavouring agent.

g. Venom from sting is used in the treatment of rheumatoid arthritis and snake bite.

Question 6.3.3: Give the importance/significance of transgenic animals. [2]

Solution 1: Importance of transgenic animals:

**a. To understand the normal physiology and development:** Specifically designed transgenic animals help us to understand the mechanism of gene regulation. It is used to study how genes affect the normal functions and development of the body. For e.g. study of biological role of insulin, role of growth factor in regulating body's growth.

**b. To test vaccine safety:** Transgenic animals are used as laboratory animals to test efficiency of newly discovered vaccines before it is used on human beings. Mice are used to test polio vaccines

**c. To test chemical or toxin safety:** For this, transgenic animals with foreign genes are produced so that the transgenic animals become more sensitive to toxic chemicals than the non-transgenic animals. These animals are exposed to toxic chemicals and their effects are observed.

**d. To serve as a model for study of diseases:** Transgenic animals help us to study how genes contribute to development of disease and for

investigation of new treatments for diseases. Transgenic animals are now available to study cancer, rheumatoid arthritis, cystic fibrosis, Alzheimer's disease, etc.

**e. To obtain biological products:** Transgenic animals are created to produce biological compounds or molecules that are useful in various ways. It is accomplished by introducing the gene coding for a particular molecule, into the animal. For e.g. Rosie, first transgenic cow was produced which produced milk containing human protein, alpha lactalbumin.

Solution 2: Transgenic animals have great importance as

(1) to study the normal physiology and development, working of genes, their regulation etc.

(2) study of diseases susceptibility to different diseases has been found to the genetically controlled, transgenic animals can be used to study how genes take part in the development of diseases,

(3) By inserting genes for some important biological products especially milch animals, transgenic animals can be used for molecular farming or molecular harvesting, e.g., Protein a-1 antitrypsin for treating emphysema, lactoferrin (cow),

(4) Vaccine safety testing on transgenic animals before marketing,

(5) Chemical safety testing,

(6) Transgenic cattle with the extra gene for growth hormone and casein gives a very high yield of milk. Transgenic cow Rosie yielded milk with a high protein having human alpha-lactalbumin a highly nutritionally balanced diet for human babies.

Question 6.3.4: Explain sex determination in human beings. [2]

## Solution 1: Sex determination in human beings:-

- In human beings, the chromosomal mechanism of sex determination is of the XX-XY type.
- In humans, the nucleus of each cell contains 46 chromosomes or 23 pairs of chromosomes. Of these, 22 pairs are of autosomes and 1 pair is of sex chromosomes.
- Females possess two homomorphic sex chromosomes, XX.
- Males contain two heteromorphic sex chromosomes, XY.
- Females are homogametic and produce only one type of egg, (22+X).
- Males are heterogametic and produce two types of sperms, (22+X) and (22+Y).

- During fertilisation, if the sperm containing X chromosome fertilises the egg having X chromosome, then the resulting offspring would be a female (XX).
- If the sperm containing Y chromosome fertilises the egg having X chromosome, then the resulting offspring would be a male (XY).
- The sex ratio produced in the progeny is 1:1.
- This chromosomal mechanism of sex determination is called heterogamesis. It may be male heterogamety or female heterogamety.

**Solution 2:** Sex Determination in human being:

a. Human diploid cell has 46 chromosomes, i.e. 23 pairs in each cell. Out of these, 22 pairs of chromosomes are called autosomes and one pair of chromosome is called sex chromosomes. They are X and Y chromosomes.

b. Every individual gets one set of chromosomes from his mother and one from his father. A human male thus has 44 +XY chromosomes, whereas a female has 44 + XX chromosomes.

c. During gamete formation; meiosis or reductional division takes place and a gamete gets only one set of chromosomes and thus it is haploid.

e.g. Female gamete (ovum) 22 + X, Male gamete (sperm) 22 + X or 22 + Y. When the male and female gametes unite to form a zygote, the chromosomes again become diploid.

d. Thus, the offspring gets the same number of chromosomes as his parents. Sex of the baby is determined by the nature of sperm (X or Y) that fertilizes the ovum. Thus, in human being, it is the male which determines the sex of the baby.

Solution 3: Determination of sex in human beings:

- In human beings, the male possess 44 autosomes and a pair of heteromorphic sex chromosomes, XY, while the female possess 44 autosomes and a pair of homomorphic sex chromosomes, XX.
- At the time of gamete formation, meiosis occurs.
- The male parent produces X-bearing and Y-bearing gametes or sperms. The female parent produces only X-bearing gametes or eggs.
- During reproduction, the combination of one X-bearing gamete from the male with one X-bearing gamete from the female results in offspring with the genetic constitution XX. The child produced is a female or a daughter.
- The combination of a Y chromosome from the male with one X chromosome from the female results in an offspring with genetic constitution XY. The child produced is a male or a son.
- The offspring produced are always in equal proportion, and hence, the chance of having a daughter or a son is 50%.



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

Question 7.1.1: Describe T.S. of the spinal cord. [3]

Solution: T.S. of spinal cord shows the following features:

a. Spinal cord is externally covered by the three meninges (dura mater, arachnoid mater and pia mater). It is cylindrical but dorsoventrally flattened.

b. It shows deep ventral fissure and shallow dorsal fissure. From dorsal fissure, there extends a thin sheet of connective tissue called dorsal septum which extends inward.

c. It shows a central space called central canal. The central canal is continuous with the 4th ventricle of brain and contains cerebro-spinal fluid. The central canal is lined by a single layer of ependymal cells.Central canal is surrounded by inner, grey matter containing cytons or cell bodies of neurons.

d. Two dorsolateral horns and two ventrolateral horns give 'H'-shaped appearance to the grey matter. Dorsal horns extend in dorsal roots, while ventral horns extend in ventral roots of spinal nerves.

Grey matter is surrounded by white matter which divides into three columns or funiculi on either side. These are dorsal funiculi, lateral funiculi and ventral funiculi.





Solution:

	Dollutonto	Effects on human being
	Follutarits	
1	Carbon monoxide	a) It reduces oxygen carrying capacity of haemoglobin which leads to hypoxia
	monoxide	b) It causes headache, muscular weakness, nausea,
		exhaustion.
		c) Excess formation of Carboxyhaemoglobin leads to death due to CO poisoning.
2	Hydrogen	a) Headache, nausea, collapse, conjunctivitis, irritation of
	sulphide	mucus membrane, colic diarrhoea, bronchial pneumonia,
		coma and even death.
		b) Loss of appetite
3	Tobacco	a) Lung cancer, pulmonary and heart diseases.
	smoke	b) Thickening of bronchial epithelial layer.
		c) Loss of ciliated cells.
		d) Appearance of cells with bizarre nuclei (cancerous
		cells)
4	Sulphur	Increases chances of occurrence of asthma, bronchitis,
	dioxide	emphysema,
		etc.
5	N <sub>2</sub> O	Long exposure causes acute respiratory diseases.

Question 7.2: Sketch and label 'L.S. of human kidney' [3]



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

**Question 8.1**: With the help of a labelled diagram describe the internal structure of human heart. [7]

**Solution:** Internal structure of human heart: There is no connection/communication at all between the right and left sides of the heart. The right and left sides of the heart are separated by a partition called septum formed of myocardium covered by endocardium. Intraarticular septum is relatively thin, while interventricular septum is thick. Human heart is four chambered. It has two atria towards the base and two ventricles towards the apex.

Atria/Auricles: These are receiving chambers. These are thin walled, upper chambers of the heart. There are two atria, viz. right atrium and left atrium separated from each other by means of a thin partition called inter atrial septum. Inter atrial septum bears a oval shaped depression called fossa ovalis. Fossa ovalis is a remnant of an embryonic aperture foramen ovale between the two atria in the foetus. It closes at the time of birth. Right atrium:

It receives deoxygenated blood by three veins:

- i. The superior vena cava (precaval)
- ii. The inferior vena cava (post caval)
- iii. Coronary sinus

Coronary sinus carries blood from wall of the heart. Openings of these blood vessels are present in right atrium. The opening of inferior vena cava is guarded by a muscular flap, the Eustachian valve.

Opening of coronary sinus is guarded by valvular fold called valve of Thebesius or Thebesian valve.

The right atrium opens in right ventricle by means of an opening called right atrio ventricular opening.

It is guarded by a valve made up of connective tissue. This valve has three flaps, hence called Tricuspid valve.



Left auricle/atrium:

It is the upper left chamber of the heart.

It is comparatively smaller and thick walled than right atrium.

It receives oxygenated blood from lungs by four pulmonary veins, two from each lung. The left atrium opens into left ventricle by means of left atrio–ventricular opening.

The left atrio–ventricular opening is guarded by two flexible flaps called bicuspid valve. Ventricles:

The ventricles are lower or inferior chambers of the heart. Ventricles are thick walled and are distributing chambers. There are two ventricles, viz. right ventricle and left ventricle.

Right ventricle is separated from the left ventricle by means of a thick, slightly curved partition called interventricular septum.

It prevents mixing of oxygenated and deoxygenated blood in the ventricular part of heart. The inner surface of the ventricle is thrown into a series of muscular ridges. Ridges are of two types.

Small ridges are called columnae carnae or trabeculae carnae.

They divide the cavity of ventricle into smaller space as fissures.

Bicuspid and tricuspid valves are connected to papillary muscles by special fibrous cords Chordae tendinae. Other end of chordae tendinae are attached to special muscles called papillary muscles.

Right ventricle: It is smaller than left ventricle and its wall is also thick. It receives deoxygenated blood from right atrium. It opens into pulmonary arch.

Opening of pulmonary arch is guarded by three semilunar valves. These valves permit the flow of blood from right ventricle to pulmonary arch. Pulmonary arch is divided into left and right pulmonary arteries, which carry deoxygenated blood to lungs

Left ventricle:

It is longer and more conical than the right ventricle and form the apex of the heart. It is larger and thick walled than right ventricle as it has to pump blood to the entire body.

It gets oxygenated blood from left auricle.

It opens into aortic arch, this opening is guarded by three semilunar valves which permit flow of blood from left ventricle to aortic arch. These valves prevent back flow of blood, i.e. aortic arch to left ventricle.

Question 8.2: Describe the stages during three trimesters of pregnancy. [7]

Solution: Three Trimesters of Pregnancy:

i. The first trimester:

It is the time of most radical change for both the mother and the embryo. During its first 2-4 weeks of development, the embryo obtains nutrients directly from the endometrium.

The first trimester is the main period of organogenesis and the development of body organs. At 8 weeks, all the major structures of the adult are present in the rudimentary form and the embryo is called a foetus. It is only 5 cms long. High levels of progesterone initiate changes in the mother's reproductive system, the maternal part of placenta grows, the uterus becomes larger, ovulation and menstrual cycle stops.

ii. Second trimester:

In second trimester, the uterus grows enough for the pregnancy to become obvious. The foetus is very active and grows to about 30 cms in length. Hormone levels stabilize as HCG declines, the corpus luteum deteriorates and the placenta completely takes over the production of progesterone which maintains the pregnancy.

#### iii. Third (final) trimester:

In third trimester, the foetus grows to about 3-4 kg in weight and 50 cms in length. As the foetus grows, the uterus expands around it. The mother's abdominal organs become compressed and displaced, leading to frequent urination, digestive blockages and strain in the back muscles.

Question 8.2: Explain the process of parturition.

Solution: Process of Parturition:

i. First Stage (Dilation):

a. It lasts for about 12 hours.

b. Regular peristaltic contractions of the uterine wall begin, passing from its top downward.

c. These contractions move the foetus down towards the cervix which expands fully.

d. Amnion and chorion rupture.

e. The amniotic fluid passes out, lubricating the vagina.

f. The foetal placenta is pulled out from the uterine wall, making the baby free.

ii. Second Stage (Expulsion):

a. It lasts for about 20 minutes to one hour. The uterine contractions become more powerful and are accompanied by contractions of the abdominal wall.

b. With these contractions, the baby is gradually pushed outward through the dilated cervix and vagina, with the head foremost, and is finally "delivered" (born) out of the cervix.

c. The umbilical cord is ligatured at two places close to the baby and cut between the ligatures. This frees the baby totally from the mother. Cervix and vagina are dilated and the ligaments of the pelvic girdle are relaxed by the hormone relaxin from the corpus luteum for easy birth of the baby.

iii. Third (Placental) Stage:

a. It lasts for just 10-45 minutes after the infant's birth. Now, the placenta, umbilical cord and foetal membrane are expelled by a series of uterine contractions. These structures are referred to as the "after birth".

b. Further contractions of the uterus close the cervix and prevent excessive bleeding. Bleeding, throughout the process, is kept low by contraction of smooth muscle fibres of uterine blood vessels supplying the placenta.

Question 8.2: Add a note on lactation.

## Solution: Lactation:

Lactation is the process of producing milk from mammary glands at the end of pregnancy.

i. Milk produced during initial few days of lactation is called colostrum which is rich in proteins and calories.

ii. It also contains certain antibodies which provides passive immunity to the new born baby.