

**Class XII Session 2023-24**  
**Subject - Biology**  
**Sample Question Paper – 3**

**Maximum Marks: 70**

**Time: 3 Hours**

**General Instructions:**

- (i) All questions are compulsory.
- (ii) The question paper has five sections and 33 questions. All questions are compulsory.
- (iii) Section-A has 16 questions of 1 mark each; Section-B has 5 questions of 2 marks each; Section- C has 7 questions of 3 marks each; Section- D has 2 case-based questions of 4 marks each; and Section-E has 3 questions of 5 marks each.
- (iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

**SECTION – A**

1. Which of the following is the most widely accepted method of contraception in India at present?

- (a) Cervical caps
- (d) Intra uterine devices
- (b) Tubectomy
- (c) Diaphragms

2. Match column I with column II and select the correct option from the codes given below.

	Column I		Column II
A.	Fertilisation	(i)	Morula
B.	Cleavage	(ii)	Vagina
C.	Blastocyst	(iii)	Ampulla of oviduct
D.	Parturition	(iv)	Uterine wall

- (a) A-(iv), B-(i), C-(ii), D-(iii)
- (b) A-(ii), B-(i), C-(iv), D-(iii)

- (c) A-(ii), B-(i), C-(iii), D-(iv)
- (d) A-(iii), B-(i), C-(iv), D-(ii)

3. Which one of the following codons codes for the same information as UGC?

- (a) UGU
- (b) UGA
- (c) UAG
- (d) UGG

4. The Hardy-Weinberg principle cannot operate if

- (a) the population is very large
- (b) frequent mutations occur in the population
- (c) the population has no chance of interaction with other populations
- (d) free interbreeding occurs among all members of the population.

5. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self cells, then it leads to

- (a) autoimmune disease
- (b) active immunity
- (c) allergic response
- (d) graft rejection.

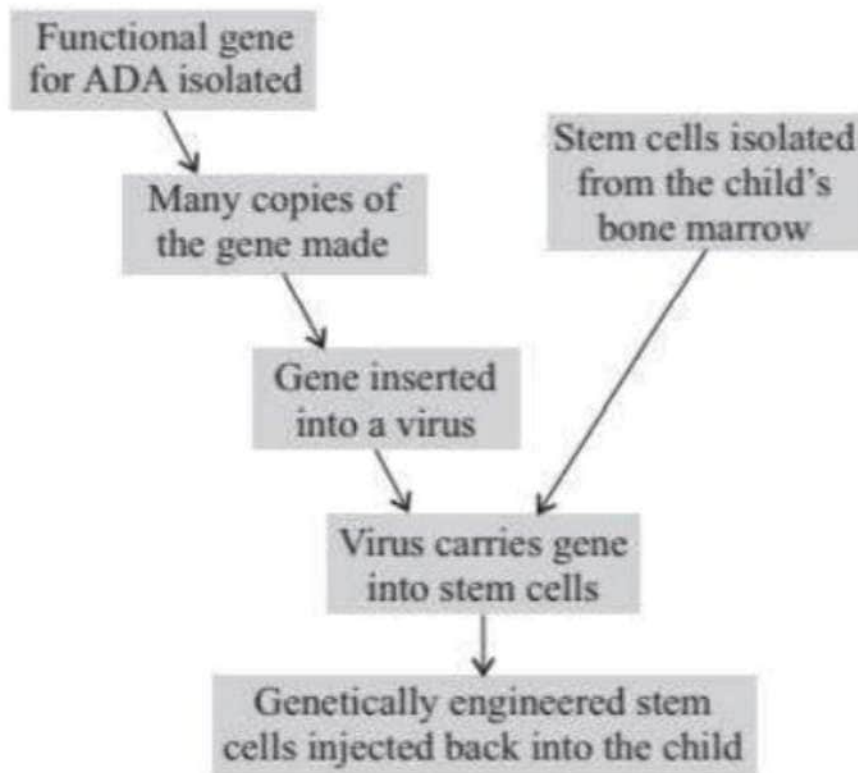
6. Select the correct option regarding a disease with its causal organism where haemozoin is released by the rupture of RBCs.

- (a) Amoebiasis, *Plasmodium vivax*
- (b) Malaria, Rhinovirus
- (c) Malaria, *Plasmodium falciparum*
- (d) Pneumonia, *Haemophilus influenzae*

7. Which among these are produced by distillation of fermented broth?

- (i) Whisky
- (ii) Wine
- (iii) Beer
- (iv) Rum
- (v) Brandy
- (a) (ii) and (iii) only
- (b) (i) and (ii) only
- (c) (iii) and (v) only
- (d) (i), (iv) and (v) only

8. Children with Severe Combined Immunodeficiency Disorder (SCID) cannot produce many types of white blood cells that fight infections. This is because they do not have the functional gene to make the enzyme Adenosine Deaminase (ADA). Some children with SCID have been treated with stem cells as shown in the given flow chart.



Why are stem cells used in this treatment?

- (a) Stem cells are capable of dividing for long periods to generate replacements for cells that are unable to produce ADA.
- (b) The stem cells used here belong to the child and there will be no triggering of immune response.
- (c) Stem cells are unspecialised and can differentiate to specialised cell types such as white blood cells to fight infection.
- (d) All of these

9. When an exotic species was introduced in an area, what may be the most probable effect?

- A. The population of native species may decrease to very low level due to invasive alien species.
- B. Introduced species may achieve highest population density due to lack of predation.

- C. Species develop favourable mutations.  
 D. New species evolved due to different environment.

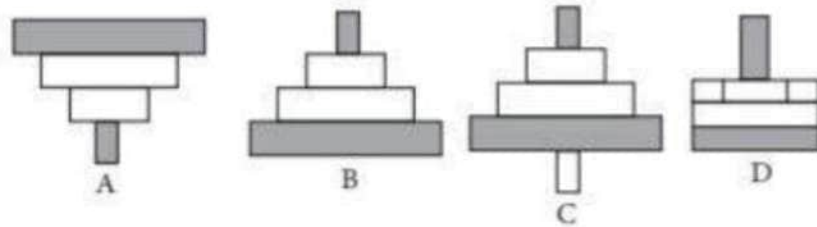
- (a) A and B are correct.  
 (b) A, C and D are correct.  
 (c) C and D are correct.  
 (d) B, C and D are correct.

10. Tight one-to one relationship between plant and pollinator is found in

- (a) fig and wasp  
 (b) fungus and roots of Pinus  
 (c) Anabaena and Azolla  
 (d) all of these.

## Biology

11. Which of the following representations shows the pyramid of numbers in a forest ecosystem?



- (a) D                      (b) A                      (c) B                      (d) C

12. Which one of the following fish is being illegally introduced for aquaculture purposes and is posing a threat to the indigenous catfishes of Indian rivers?

- (a) *Clarias gariepinus*  
 (c) *Clarias batrachus*  
 (b) Nile perch  
 (d) *Protopterus*

Question No. 13 to 16 consist of two statements - Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- (a) Both A and R are true and R is the correct explanation of A.  
 (b) Both A and R are true and R is not the correct explanation of A.  
 (c) A is true but R is false.  
 (d) A is false but R is true.

13. Assertion: All copulation lead to fertilisation and pregnancy.

Reason: Simultaneous transport of sperm and ovum in ampullary region results in fertilisation.

14. Assertion: Mendel conducted artificial pollination experiments for his genetic studies using true-breeding pea lines.

Reason: A true-breeding line shows the stable trait inheritance and expression for several generations.

15. Assertion: *Agrobacterium tumefaciens* is the causative agent of crown gall disease of dicots.

Reason: *Agrobacterium tumefaciens* transforms normal cell into tumour by inserting T-DNA.

16. Assertion: A population growing in a habitat with limited resources shows initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity.

Reason: In Verhulst-Pearl Logistic growth, plot of N (population density) at time (t) results in a sigmoid curve.

### **SECTION-B**

17. Identify the type of the given ecological pyramid and give one example each of pyramid of number and pyramid of biomass in such cases.

18. Write the basis of naming the restriction endonuclease EcoRI.

19. Write the Oparin and Haldane's hypothesis about the origin of life on Earth. How does meteorite analysis favour this hypothesis?

20. Retroviruses have no DNA. However, the DNA of the infected host cell does possess viral DNA. How is it possible?

21. Why is "Saheli" considered an effective contraceptive for women to space children?

### **OR**

List any two reasons other than physical and congenital disorders for causing infertility in couples.

### **SECTION-C**

22. Explain the hormonal control of spermatogenesis in humans.

23. Emasculation and bagging are the two important steps carried during artificial hybridisation to obtain superior varieties of desi red plants. Explain giving reasons, in which types of flowers and at what stages are the two processes carried out.



24. What are 'SNP's? Where are they located in a human cell? State any two ways the discovery of SNPs can be of importance to humans.

25. (a) Rearrange the following in the correct order of their appearance on earth between two million years and 40,000 years back.

Neanderthals, Australopithecines, Homo erectus and Homo habilis.

(b) Which one of the above

(i) had the largest brain size

(ii) ate fruits?

26. (a) Name and explain giving reasons, the type of immunity provided to the newborn by the colostrum and vaccinations.

(b) Name the type of antibody

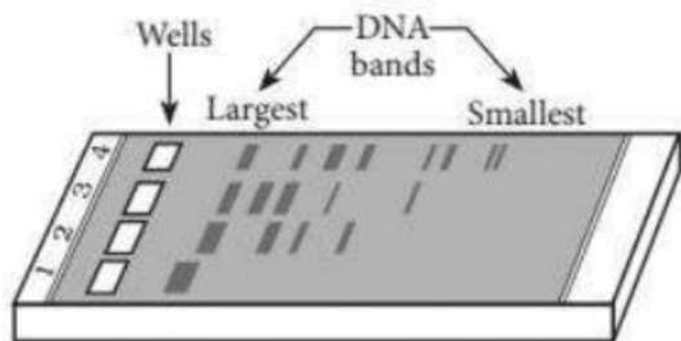
(i) present in colostrum

(ii) produced in response to allergens in human body.

**OR**

At what stage is Plasmodium picked up by the female Anopheles? Describe the life cycle of the parasite in this insect.

27. Name and describe the technique shown below that helps in separating the DNA fragments formed by the use of restriction endonuclease.



28. What are the consequences of loss of biodiversity in a region? Explain.

### **SECTION-D**

Q.No. 29 and 30 are case based questions. Each question has 3 subparts with internal choice in one subpart.

29. Read the given passage and answer the questions that follow:

In a dihybrid cross white eyed, yellow bodied female *Drosophila* is crossed with red eyed, brown bodied male *Drosophila*. 1.3% recombinants and 98.7% progeny with parental type combinations were produced in F<sub>2</sub> generation. This observation deviated from Mendelian F<sub>2</sub> phenotypic dihybrid ratio.

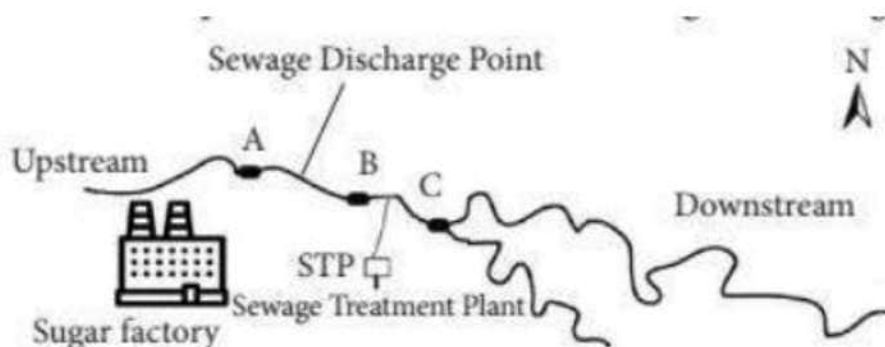
(a) What could be the most probable reason for the deviation of the cross from Mendelian ratio? Who first conducted the given cross?

**OR**

(b) How the physical distance between two genes work in such type of crosses?

(c) If number of offspring obtained in the above case is 847, then what will be the number of recombinants?

30. Water samples were collected at points A, B and C in a segment of a river near a sugar factory and tested for BOD level. The BOD levels of samples A, B and C were 400 mg/L, 480 mg/L and 8 mg/L respectively.



(a) What is high level of BOD at A and B indicative of?

(b) Explain why the BOD level gets reduced considerably at the collection point C.

(c) It was observed that fish mortality was high near point B. Give a suitable reason for this.

**OR**

Which part of river is fit for drinking and why?

### **SECTION – E**

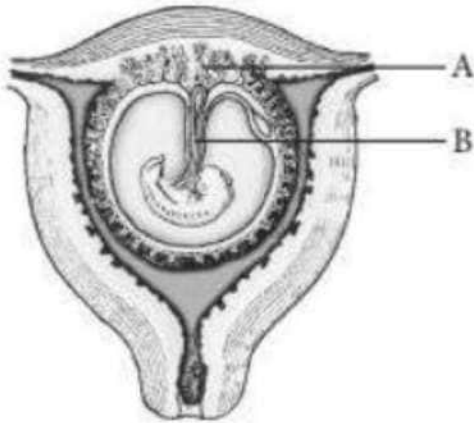
31. (a) Describe the different steps in one complete cycle of PCR.

(b) Write the applications of PCR.

**OR**

Explain the process by which a bacterial cell can be made 'competent'. Why is it essential to make bacterial cells 'competent' in recombinant DNA technology?

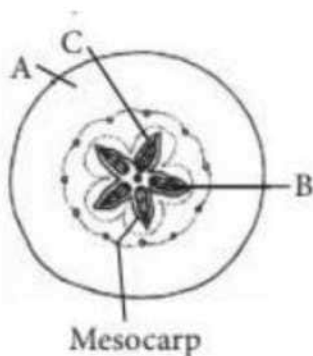
32. The given figure shows a fetus within the uterus. On the basis of the given figure, answer the questions that follow:



- (a) Mention the role of B in the development of the embryo.
- (b) Name the fluid surrounding the developing embryo. How is it misused for sex-determination?
- (c) Give a short note on 'A'.

**OR**

- (a) Given below is a T.S. of an apple. Identify A, B and C.



- (b) Why is an apple categorised as a false fruit?
- (c) Mention the ploidy levels of the cells of different parts of a maize seed.

33. Disease X is a chromosomal disorder occur due to autosomal aneuploidy. The children with this syndrome suffer from severe mental retardation, short statured with small round head,



furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease.

- (a) Name the disease 'X' and state main cause of autosomal aneuploidy in it.
- (b) How many number of chromosomes are present in the child suffering from this syndrome?
- (c) What will be the sex chromosomal complement in males suffering from this disease?

**OR**

Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked on for their experiments. Why did they select that organism to study sex linked genes for lab experiments?

## SOLUTIONS

1. (d)

2. (d)

3. (a) Both the codons UGC and UGU code for cystine amino acid. UAA, UGA and UAG are stop codons. UGG codes for tryptophan amino acid.

4. (b) The Hardy-Weinberg principle says that allele frequencies in a population are stable and constant from generation to generation as long as:

- the population is large enough and changes in allele frequencies due to chance or accident are insignificant.
- mating occurs at random.
- mutation does not occur or if it does occur it must reach a state of equilibrium.
- all the members of the population survive and have equal reproductive rates.

5. (a) Autoimmunity is a disorder of the body's defence mechanism in which an immune response is elicited against its own tissues, which are thereby damaged or destroyed. Autoimmunity may be caused due to genetic or environmental factors.

6. (c)

7. (d) Hard liquors such as gin, whisky, sake, brandy and rum are obtained by distillation of fermented broth.

8. (d)

9. (a) The population of native species may become very low due to introduction of invasive alien species. Increase in population of exotic species could be due to lack of predators.

10. (a) In many species of fig trees, there is tight one-to-one relationship with pollinator species of wasp.

11. (d): The representation of forest ecosystem in pyramid of numbers is always upright but spindle shaped because higher trophic level comprising of tertiary consumers is generally smaller than that of the lower trophic levels (i.e., secondary consumer, than primary consumer and primary producer). The pyramid of number in parasitic food chain is inverted in case of single tree producer which can provide nourishment to several herbivores such as birds which can further support larger population of ectoparasites.

12. (a) *Clarias gariepinus*, the African catfish has been illegally introduced for aquaculture in India. It is threatening native catfish (*Clarias batrachus*) of Indian rivers.

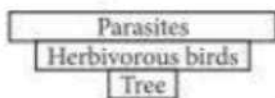
13. (d): All copulations do not lead to fertilisation and pregnancy.

14. (a): Mendel carried out hybridisation experiments on garden pea for many years. He performed various types of cross breeding and then varieties used by him were pure lines of true breeding allowed the offspring to self breed. All selected parents. These lines show the stable trait inheritance lines, i.e., they produce offspring resembling the and expression for several generations making them suitable for genetic studies.

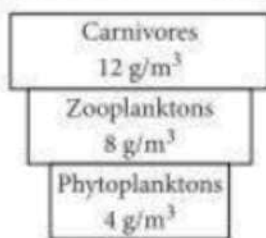
15. (a): *Agrobacterium tumefaciens* is a rod shaped, Gram -ve soil bacterium which causes crown gall disease in over 140 species of dicots but it does not infect cereals. The bacterium contains tumour inducing plasmid (Ti plasmid) which integrates a segment of its DNA (T-DNA) into the DNA of its host plant thereby inducing formation of cancerous growth called crown gall tumour usually at graft or bud union, on roots and lower stem.

16. (b)

17. The given ecological pyramid is inverted - shaped pyramid. Pyramid of number is inverted in parasitic food chain. Here, a single large sized producer like tree provides nourishment to several herbivores (e.g., fruit-eating birds) and each herbivore in turn may support a still larger population of parasites. Thus, from the producer towards consumers, the number of organisms gradually shows an increase, making the pyramid inverted in shape.



In a pond ecosystem, the pyramid of biomass is generally inverted in shape. As the producers are small organisms, their biomass is least, and this value gradually shows an increase towards the apex of the pyramid, thus making the pyramid inverted in shape.



18. Restriction enzymes are named for the bacterium from which they have been isolated. The first letter used for the enzyme is the first letter of the bacterium's genus (in italics). Then comes the first two letters of the species (in italics).

EcoRI is obtained from bacterium *Escherichia coli* RY13. The capital letter E comes from genus *Escherichia*. The letter co are from species *coli*. The letter R is from RY13 (strain). The roman number I indicates that it was the first enzyme isolated from bacterium *E.coli* RY13.

19. Oparin and Haldane proposed that life originates from pre-existing, non living organic molecules, such as RNA, proteins, etc., and formation of life was preceded by chemical evolution. Meteorite analysis confirmed presence of similar compounds elsewhere in space, maintaining that, life had reached earth in the form of spores from other heavenly bodies.

20. Retroviruses have RNA as their genome. RNA genome of virus replicates in host cell to form viral DNA with the help of reverse transcriptase enzyme.

21. 'Saheli' is an oral contraceptive pill containing non-steroidal preparation called centchroman. It has high contraceptive value with little side effects. Saheli acts by inhibiting ovulation, inhibiting the motility and secretory activity of oviducts, impairs cervix to unable transport of sperms and make uterus unsuitable for implantation. Hence, it is considered as effective contraceptive to space children.

## OR

The reasons for causing infertility in couples other than physical and congenital are drugs and diseases (immunological or psychological). Sometimes alcohol addiction among males causes defective spermatogenesis and leads to infertility.

22. During spermatogenesis, gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus, which stimulates the anterior pituitary gland to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts on the Leydig's cells of the testes to secrete testosterone while FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete androgen binding protein (ABP) and inhibin. ABP concentrates testosterone and inhibin suppresses FSH synthesis. FSH also acts on spermatogonia to stimulate sperm production.

23. Emasculation is removal of male sex organs (anther) from the floral buds of bisexual flower (possess both stamen and pistil). A breeder needs to emasculate a bisexual flower to eliminate the chances of self pollination. Breeder needs to remove anthers from the flower bud before the anther dehisces using a pair of forceps. Dehiscence results in the release of pollen which may then reach the stigma (part of pistil) and lead to germination of pollen grain. Bagging is the covering of flowers by butter paper or polythene. Bagging can be done in both bisexual and unisexual flowers. In the case of bisexual flowers emasculation is followed by bagging. Emasculated flowers must be kept covered by bags to prevent from contamination by unwanted pollen grains.

24. 'SNP's stands for single nucleotide polymorphism. About 1.4 million single base DNA differences or SNPs have been identified in humans. SNPs occur normally throughout a person's DNA almost once in every 1000 nucleotides on an average. Their number may be more than 10 million. They are helpful in finding chromosomal locations with disease associated sequences and tracing human history.

25. (a) Australopithecus → Homo habilis → Homo erectus → Neanderthals (b) (i) Neanderthals (ii) Australopithecus

26. (a) Colostrum (mother's first milk) provides natural passive immunity to new born. In passive immunity, ready-made antibodies are directly given to protect the body against foreign agents. Through vaccination, artificial active immunity will be provided to the newborn in which his own cells will produce antibodies in response to vaccine. E.g., BCG vaccine for tuberculosis. (b) (i) IgA (ii) IgE

### OR

Female Anopheles mosquito picks up Plasmodium as gametocytes with blood meal. Life cycle of Plasmodium in mosquito is as follows: The gametocytes come out of the RBCs into the lumen of the stomach of the mosquito. Inside the stomach of the mosquito, the male and female gametocytes change into male and female gametes respectively. The gametes fuse (fertilise) to form zygote called oocyst. The nucleus of oocyst divides first by meiosis and subsequently by mitosis, forming large number of small haploid nuclei. At the same time, spindle shaped bodies called sporozoites are formed. When mature oocysts rupture, the sporozoites are liberated into the haemocoel (body cavity filled with blood) of the mosquito. Being motile, the sporozoites move to different organs in the body cavity of the mosquito, but many of them penetrate the salivary glands. The mosquito now becomes infective. When the female Anopheles mosquito bites a healthy person, the sporozoites are injected in his/her blood along with saliva. These sporozoites start the cycle again in human body.

27. After the cutting of DNA by restriction enzyme, fragments of DNA are formed. Separation of DNA fragments according to their size or length is done by a technique called agarose gel electrophoresis. It is a technique of separation of molecules such as DNA, RNA or protein, under the influence of an electrical field, so that they migrate in the direction of electrode bearing the opposite charge, viz., positively charged molecules move towards cathode (–ve electrode) and negatively charged molecules travel towards anode (+ve electrode) through a medium/ matrix. Most commonly used matrix is agarose. DNA fragments separate according to size through the pores of agarose gel. Hence the smaller the fragment size, the farther it moves. The separated DNA fragments can be seen only after staining the DNA with a compound



known as ethidium bromide (EtBr) followed by exposure to UV radiation. The fragments are visible as bright orange coloured bands.

28. The loss of biodiversity in a region may lead to:

- (i) decline in ecosystems productivity (the amount of food energy that is converted into the biomass).
- (ii) lowered resistance to environmental perturbations such as drought.
- (iii) increased variability in certain ecosystem processes such as plant productivity, water use and pest and disease cycle.
- (iv) extinction of plants and animals due to habitat loss, fragmentation and biodiversity loss.
- (v) excessive exploitation of a species whether plant or animal reduces size of its population so that it becomes vulnerable to extinction.

29. (a) In the given cross, fewer recombinants are formed. This means that the genes show incomplete linkage.

**OR**

Morgan carried out several dihybrid crosses in *Drosophila* to study genes that were sex-linked.

(b) The physical distance between two genes determines the strength of the linkage and the frequency of the crossing over between two genes. The strength of the linkage increases with the closeness of the two genes. On the other hand the frequency of crossing over increases with the increase in the physical distance between the two genes.

(c) 1.3% recombinants were produced. Since total number of offspring is 847, the number of recombinants

will be  $\frac{1.3}{100} \times 847 = 11$  offsprings.

30. (a) At collection points A and B, the BOD level is high due to high organic pollution caused by sugar factory and sewage discharge.

(b) At the collection point C, the water was released after secondary treatment/biological treatment where vigorous growth of useful aerobic microbes into flocs consume the major part of the organic matter present in the river water or effluent due to sugar factory and sewage discharge.

(c) Due to high BOD level, the concentration of dissolved oxygen decreases in the water body which results in high fish mortality.

**OR**



The water after point C is fit for drinking because it is a cleaner water released from sewage treatment plant.

31. (a) Polymerase chain reaction (PCR) is a technique of synthesising multiple copies of the desired gene (DNA segment) in vitro. The basic requirements of PCR are DNA template, two oligonucleotide primers usually 20 nucleotides long, dNTPs and DNA polymerase which is stable at high temperature (usually Taq polymerase). Working mechanism of PCR is as follows:

(i) Denaturation: The target DNA (DNA segment to be amplified) is heated to high temperature (94°C). Heating results in the separation of two strands of DNA. Each of the two strands of the target DNA now act as template for synthesis of new DNA strand.

(ii) Annealing: During this step, two oligonucleotide primers hybridise to each of single stranded template DNA in presence of excess of synthetic oligonucleotides.

(iii) Extension: During this step, the enzyme DNA polymerase synthesises the DNA segment between the primers. Taq DNA polymerase, isolated from a thermophilic bacterium *Thermus aquaticus*, is used in most of the cases. This step requires presence of deoxynucleotide triphosphates (dNTPs) and  $Mg^{2+}$  and occurs at 72°C.

(b) Applications of PCR:

(i) Diagnosis of pathogens

(ii) Diagnosis of specific mutations

(iii) DNA fingerprinting

(iv) In prenatal diagnosis

(v) In gene therapy.

**OR**

Competent host is essential for biotechnology experiment. Since DNA is a hydrophilic molecule, it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA i.e., made competent. This can be achieved by:

(i) Treatment of DNA with divalent cation of  $CaCl_2$ , or rubidium chloride: Treating them with a specific concentration of a divalent cation, increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(ii) Heat shock treatment of DNA: Recombinant DNA (rDNA) can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42°C (heat shock) and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

32. (a) The labelled part B is umbilical cord. Placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo.

(b) Amniotic fluid surrounds the developing embryo. A

fetal sex determination test is based on the chromosomal pattern of the cells in the amniotic fluid surrounding the developing embryo. By analysing the allosomal chromosome pattern sex determination is completed. It is being misused to abort normal female fetuses.

(c) Part labelled A is placenta. It acts as an endocrine tissue as it produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc. It facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.

**OR**

(a) In the given figure of T.S. of an apple, A - Thalamus, B - Seed, C - Endocarp

(b) In apple, along with ovary thalamus also contributes to fruit formation therefore, apple is categorised as a false fruit.

(c) The ploidy levels of the cell of different parts of an maize seed are: Coleoptile - diploid (2n), Pericarp

- diploid (2n), Plumule - diploid (2n), Endosperm

- triploid (3n), Radicle - diploid (2n), Scutellum - diploid (2n), Coleorhiza-diploid (2n).

33. (a) X is Down's syndrome, a congenital syndrome originating from the non-disjunction of chromosomes of pair 21 during meiosis which result in an addition of extra chromosome 21.

(b) 47 chromosomes are found in the child suffering from Down's syndrome.

(c) In Down's syndrome of a male child, the sex complement is XY. Down's syndrome occurs due to trisomy of 21 chromosome.

**OR**

T.H Morgan and his colleagues worked on fruit fly, i.e., *Drosophila melanogaster*. *Drosophila melanogaster* was established as a key model organism for biomedical science due to the considerable biological similarity to mammals and an abundance of available genetic tools. Like humans, these fruit flies species have a similar distribution of chromosomes. An individual with a pair of X chromosomes is female fruit fly and an individual with one X and one Y chromosome is male. The reasons behind choosing *D. melanogaster* are as follows:

(i) The relationship between fruit fly and human genes is so close that often the sequences of newly discovered human genes, including disease genes, can be matched with equivalent genes in the fly.

(ii) *Drosophila* have a short, simple reproduction cycle. It is normally about 8-14 days, depending on the environmental temperature. This means that several generations can be observed in a matter of months.

(iii) They are inexpensive to maintain in the laboratory.

(iv) *Drosophila* have 'polytene' chromosomes, which means that they are oversized and have barcode-like banding patterns of light and dark. Earlier, research scientists could therefore easily identify chromosomal rearrangements and deletions under the microscope.