

# Sample Question Paper-1

## Biology

(Issued by Board on 31<sup>st</sup> March, 2023)

Class- XII, Session: 2023-24

**SOLVED**

**Time Allowed: 3 hours**

**Maximum Marks: 70**

### General Instructions:

- All questions are compulsory.
- The question paper has five sections and 33 questions. All questions are compulsory.
- 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.
- 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.
- Wherever necessary, neat and properly labeled diagrams should be drawn.

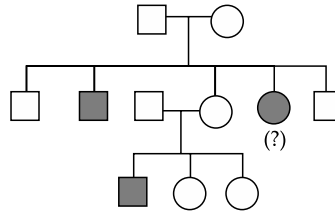
### Section – A

- Remnants of nucellus are persistent during seed development in:  
(A) pea (B) groundnut  
(C) wheat (D) black pepper 1
- The wall layer of microsporangium which nourishes the pollen grain is:  
(A) epidermis (B) endothecium  
(C) middle layers (D) tapetum 1
- A short piece of DNA, having 20 base pairs, was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown in the table.

	Number of nucleotide bases			
	Adenine	Cytosine	Guanine	Thymine
Strand 1	4	4		
Strand 2		5		

- How many nucleotides containing Adenine were present in strand 2?
- (A) 2 (B) 4  
(C) 5 (D) 7 1
- In a certain species of insects, some have 13 chromosomes, and the others have 14 chromosomes. The 13 and 14 chromosome bearing organisms are  
(A) males and females, respectively (B) females and males, respectively  
(C) all males (D) all females 1
  - At a particular locus, the frequency of allele A is 0.8 and that of allele a is 0.2. What would be the frequency of heterozygotes in a random mating population at equilibrium?  
(A) 0.32 (B) 0.16  
(C) 0.24 (D) 0.48 1
  - Variations caused due to mutations are  
(A) random and directionless (B) random and directional  
(C) random and small (D) random, small and directional 1
  - What is the smallest part of a DNA molecule that can be changed by a point mutation?  
(A) Oligonucleotide (B) Codon  
(C) Gene (D) Nucleotide 1

8. What should be the genotype of the indicated member?



- (A) AA (B) Aa  
(C) XY (D) aa

1

9. A patient was advised to have a kidney transplant. To suppress the immune reaction, the doctor would administer him:

- (A) statins produced from *Monascus purpureus*  
(B) statins produced from *Streptococcus thermophilus*  
(C) cyclosporin A produced from *Trichoderma polysporum*  
(D) cyclosporin A produced from *Clostridium butylicum*

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10. Identify the activity of endonuclease and exonuclease in the given image.

	Endonuclease	Exonuclease
a)		
b)		
c)		
d)		

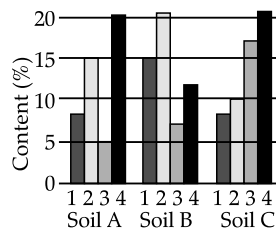
1

11. The main objective of production of pest resistant GM crops is to

- (A) encourage eco-friendly pesticides  
(B) reduce pesticide accumulation in food chain  
(C) eliminate pests from the field without the use of manual labour  
(D) retain maximum nutritional content in the crop that would be otherwise consumed by pest

1

12. Observe the contents 1,2,3 and 4 of soil samples A,B and C shown in the graph. If the temperature and soil moisture of all soil samples are identical, which soil sample (s) will show faster decomposition?



1. indicates lignin content,  
2. indicates chitin,  
3. indicates Nitrogen content and  
4. indicates sugar content

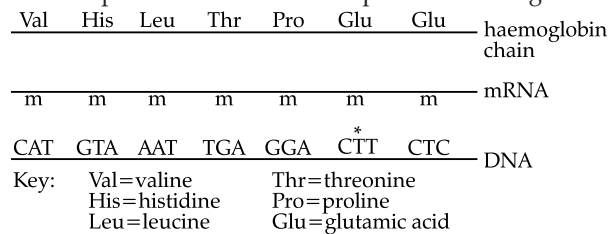
- (A) Soil Sample A (B) Soil Sample B  
(C) Soil Samples A and B both (D) Soil Sample C

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

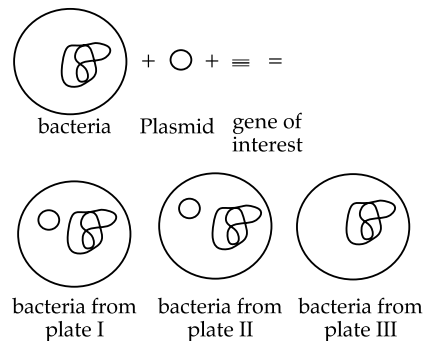
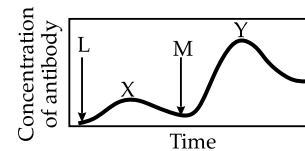
- (A) Both A and R are true and R is the correct explanation of A.  
 (B) Both A and R are true and R is not the correct explanation of A.  
 (C) A is true but R is false.  
 (D) A is false but R is true.
13. **Assertion:** Primary endosperm nucleus is diploid. 1  
**Reason:** It is the product of double fertilisation. 1
14. **Assertion:** Ribosomal RNA is synthesized in the nucleus of the cell. 1  
**Reason:** It is translated with the enzyme RNA polymerase III. 1
15. **Assertion:** Smoking can raise blood pressure and increase heart rate. 1  
**Reason:** Nicotine stimulates adrenal glands to release adrenaline and nor- adrenaline into the blood circulation, both of which raise blood pressure and increase heart rate. 1
16. **Assertion:** PCR is a powerful technique to identify genetic disorders. 1  
**Reason:** PCR can detect mutations in low amounts of DNA. 1

### Section – B

17. Explain the process of hormonal regulation of spermatogenesis. 2
18. The diagram below shows the sequence of amino acids in part of a haemoglobin molecule. 2



- (a) If the base T\* was substituted with A, how would it affect the haemoglobin chain?  
 (b) Name the condition and the effects associated with the above substitution.
19. The graph given here indicates the administration of the first (L) and second dose (M) of a vaccine. The corresponding response of the body is indicated by X and Y. Interpret the graph and explain the reason for such a response shown by the body. 2
20. The image below shows the result of plating bacteria in chromogenic medium after incorporating the gene of interest in plasmid. Some plates had blue colonies; some plates had white colonies. A single bacterium extracted from Plate I,II,III is shown below:



On the basis of your observations

- (a) Identify the plate(s) which is/are white. Give a reason.  
 (b) Identify the plate(s) which is/are blue. Give a reason.

21. Biomass of a standing crop of phytoplankton is 4 kg/m<sup>2</sup> which supports a large standing crop of zooplankton having a biomass 11 kg/m<sup>2</sup>. This is consumed by small fishes having biomass 25 kg/m<sup>2</sup> which are then consumed by large fishes with the biomass 37 kg/m<sup>2</sup>.

Draw an ecological pyramid indicating the biomass at each stage and also name the trophic levels. Mention whether it is an upright or inverted pyramid.

OR

Use the information provided in the table given below to answer the following questions:

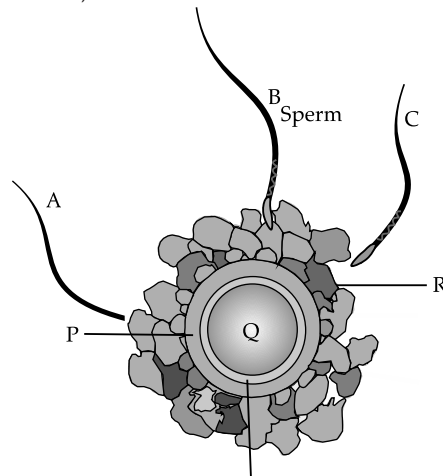
Trophic level	Net Production(kJm <sup>-2</sup> y <sup>-1</sup> )	Respiration (kJm <sup>-2</sup> y <sup>-1</sup> )
Top Carnivore	50	35
Carnivores	420	378
Herbivores	4490	4041
Producers	45000	40,367

- (a) Calculate the gross primary productivity.  
 (b) Analyze the trend in the Net Production from Producers to Top Carnivore. Give a reason for your observation.

2

### Section – C

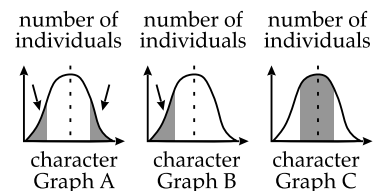
22. The figure given below shows 3 sperms A, B and C.



Perivitelline space

Fig: Ovum surrounded by few sperms

- (a) Which one of the three sperms will gain entry into the ovum?  
 (b) Describe the associated changes induced by it on P and Q.
23. Explain the phases in embryonic development from the morula stage till the establishment of pregnancy in a human female.
24. A pregnant human female was advised to undergo MTP. It was diagnosed that the fetus she was carrying had developed from a zygote having 45 chromosomes with only one X chromosome.
- (a) What is this condition called and how does it arise?  
 (b) Why was she advised to undergo MTP?
25. The given graphs show three types of natural selection. The shaded areas marked with arrows show the individuals in the population which are not selected. The dotted vertical lines show the statistical means.
- (a) What names are given to the types of selection shown in graphs A, B and C.  
 (b) After the selection has operated for several generations in the above populations indicated as Graph A, B and C, graphically illustrate the probable results.



3

26. The aeration tank of a sewage treatment plant is not functioning properly. Explain in detail the impact of this on the treatment of sewage and BOD of the effluent. 3
27. A farmer grew 2 varieties of corn crop in field A and B. He grew normal corn crops in field A and GM corn crops in field B. He observed corn borers attacked only in field A. To control it, spores of Bt were sprayed in field A.
- Name the gene in the spores responsible for the control of this pest.
  - What effect will the spores of Bt have on the insect pest?
  - How has field B developed resistance against this pest?

OR

Lipoprotein lipase deficiency (LPLD) is a genetic disorder in which a person has a defective gene for lipase. This leads to high triglycerides, stomach pain, fat deposits under the skin. It may eventually affect the liver, pancreas and may also cause diabetes. The disorder occurs if a child acquires defective genes from both parents (autosomal recessive). ERT (enzyme replacement treatment) is one of the treatments offered to patients with LPLD. 3

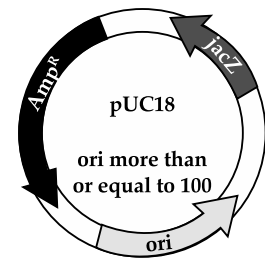
- (i) What procedure is followed in ERT?  
(ii) What could be one possible drawback of ERT?
  - How can LPLD be treated using Biotechnology? Elaborate.
28. Give three reasons as to why the prokaryotes are not given any figures for their diversity by the ecologists. 3

### Section – D

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

29. The given structure shows pUC18 which is similar to pBR322 in its function. However, they differ in some of their restriction sites and number of ori. The ori number for pBR322 is approximately 20.

- How are pUC18 and pBR322 used in biotechnological studies?



OR

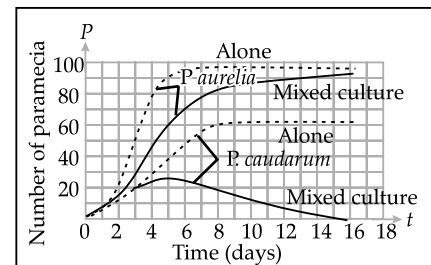
What will be the impact if ori in the above structure gets damaged?

- The lac z gene has many recognition sites. Study the segment of DNA given below and answer the questions  
5'... ATC GTA AAG CTT CAT...3'  
3'... TAG CAT TTC GAA GTA...5'
- (i) Applying your knowledge of palindrome sequences identify and mark the possible region where the restriction enzyme X will act.  
(ii) Restriction enzyme Y was used to extract gene of interest from a plant. This gene needs to be inserted in the given DNA segment which has been treated with restriction enzyme X. Will there be a successful recombination? Explain with a reason.
- Which one of the two (pUC18 and pBR322) would you prefer for biotechnological studies? Justify. 4

30. Observe the graph given below:

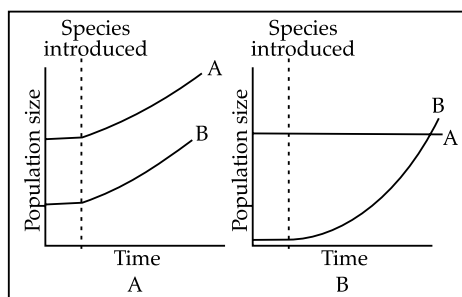
The graph represents inter-specific interaction between two species of *Paramecia* competing for the same resource in a culture medium. *Paramecium caudatum* and *Paramecium aurelia* were grown in separate cultures as well as in mixed cultures. It was found that each species grew in numbers according to the logistic equation.

- Which species is competitively superior? Support it with the data provided in the graph.
- State the underlying principle for the above result and name the scientist associated with this principle.
- Explain the mechanism in which two or more species competing with each other can co - exist.



OR

Graphs A and B shown below depict interaction of two species. Which graph indicates Mutualism? Give reason.



4

### Section – E

31. Placed below are case studies of some couples who were not able to have kids. These couples are not ready for adoption or taking gametes from donors. After thoroughly examining the cases, which Assisted Reproductive Technology will you suggest to these couples as a medical expert? Explain briefly with justification of each case.

Couple	Test reports of Female partner	Test reports of male partner
Couple 1	Normal reports	Normal sperms in testes, Missing connection in epididymis and Vas deferens
Couple 2	Blockage in the fallopian tube	Normal reports
Couple 3	Normal reports	Poor semen parameters in terms of count, motility and morphology
Couple 4	low ovarian reserve	Normal reports
Couple 5	Sterilization in male	Morphologically abnormal sperms

5

OR

Given below are certain situations. Analyse the situation and suggest the name of suitable contraceptive device along with mode of action.

Situation	Requirement of contraceptive for	Name of contraceptive device	Mode of action
1	blocking the entry of sperms through cervix		
2	spacing between children		
3	effective emergency contraceptive		
4	terminal method to prevent any more pregnancy in female		
5	sterilization in male		

32. Given below is a stretch of DNA showing the coding strand of a structural gene of a transcription unit?

5'--ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TAA--3'

- Write the corresponding template strand and the mRNA strand that will be transcribed, along with its polarity.
- If GUA of the transcribed mRNA is an intron, depict the sequence involved in the formation of mRNA /the mature processed hnRNA strand.
  - In a bacterium
  - In humans
- Upon translation, how many amino acids will the resulting polypeptide have? Justify.

OR

In shorthorn cattle, the coat colours red or white are controlled by a single pair of alleles. A calf which receives the allele for red coat from its mother and the allele for white coat from its father is called a 'roan'. It has an equal number of red and white hairs in its coat.

- (a) Is this an example of co-dominance or of incomplete dominance?
- (b) Give a reason for your answer.
- (c) With the help of genetic cross explain what will be the consequent phenotype of the calf when
  - (i) red is dominant over white
  - (ii) red is incompletely dominant.

5

- 33.** Explain the role of Primary and Secondary Lymphoid organs with the help of suitable examples.

**OR**

With the help of a flow chart illustrate how an infected animal cell can survive while viruses are being replicated or released.

5



# SOLUTIONS

## Sample Question Paper-1

### Marking Scheme- 2023-24 (Issued by Board)

#### BIOLOGY (044)

#### Section-A

**1. Option (d) is correct.**

*Explanation:* In some seeds, the nutritive tissue or nucellus present outside the sac containing the embryo persists. Such nucellus is called perisperm. It is seen in beet, black pepper and coffee. 1

**2. Option (d) is correct.**

*Explanation:* Each microsporangium has for main layers in their walls: outermost epidermis, followed by endothecium, middle layer and the innermost tapetum. The outer wall layers are involved in protection while tapetum provides nutrition to the developing pollen grains. 1

**3. Option (d) is correct.**

*Explanation:* In double stranded DNA, purines (Adenine and Guanine) pair with pyrimidines (Thymine and Cytosine). Adenine (A) pairs with Thymine (T) with two hydrogen bonds and Guanine (G) pairs with Cytosine (C) with three hydrogen bonds. Thus, amount of A is equal to T and amount of G is equal to C  
 In strand 1, 4 A are present, so in strand 2, 4 T are present.  
 In strand 1, 4 C are present, so in strand 2, 4 G are present  
 In strand 2, 5 C are present, so in strand 1, 5 G are present.

	Number of nucleotide bases			
	Adenine	Cytosine	Guanine	Thymine
Strand 1	4	4	5	
Strand 2		5	4	4

Total in strand 1 = 4+4+5 = 13  
 Total T in strand 1 = 20 - 13 = 7  
 So, in strand 1, if 7 T are present, then in strand 2, 7 A are present. Hence, the correct option is (d). 1

**4. Option (a) is correct.**

*Explanation :* The 13 and 14 chromosome-bearing organisms are males and females, respectively. It is because the sex determination in this taxon of insects is of male heterogamety with XO type.

This means females have their eggs bearing an additional X chromosome besides autosomes. And males have their sperms bearing an X chromosome whereas some do not. Therefore sperm without an X chromosome will have chromosome number to be one less than that of the females of same species. In this case males have 13 autosomes and females have 14 autosomes and one X chromosome. 1

**5. Option (a) is correct.**

*Explanation:* In a stable population, for a gene with two alleles, 'A' (dominant) and 'a' (recessive), if the frequency of 'A' is p and the frequency of 'a' is q, and then the frequencies of the three possible genotypes (AA, Aa and aa) can be expressed by the Hardy-Weinberg equation:  $p^2 + 2pq + q^2 = 1$   
 Where  $p^2$  = Frequency of A (homozygous dominant) individuals  
 $q^2$  = Frequency of aa (homozygous recessive) individuals  
 $2pq$  = Frequency of Aa (heterozygous) individuals.  
 so,  $p = 0.8$  and  $q = 0.2$  (given)  
 $\therefore 2pq$  (frequency of heterozygote) =  $2 \times 0.8 \times 0.2$   
 $= 0.32$  1

**6. Option (a) is correct.**

*Explanation:* According to Hugo de Vries, mutations are random and directionless. De Vries believed mutations caused speciation and hence called saltation (single step large mutation). 1

**7. Option (d) is correct.**

*Explanation:* Nucleotide: It is the smallest unit of DNA which consists of nucleoside and phosphate groups. It is the monomeric unit of nucleic acids such as DNA and RNA. It can be changed by a point mutation. 1

**8. Option (d) is correct.**

*Explanation:* In the given pedigree, the indicated member has a genotype of aa. As we can see, that more than 50% of the first generation progenies are not affected by the disease, it means that the disease shows a recessive trait and will only appear if both the recessive genes are present together. 1



9. Option (c) is correct.

*Explanation* : Cyclosporine A is produced by *Trichoderma polysporum* (fungus) and used as an immunosuppressive agent in organ transplant patients. 1

10. Option (d) is correct.

*Explanation* : Endonucleases is a type of restriction enzymes that make a cut within the DNA at a specific site. It is commonly used to make a cut in the sequence to obtain DNA fragments with sticky ends. Sticky ends are single stranded portions of DNA which can form hydrogen bonds with their complementary cut DNA segments. These ends are later on joined by enzyme ligase. Exonuclease is a type of restriction enzymes that remove the nucleotide from either 5' or 3' ends of the DNA molecules. 1

11. Option (b) is correct.

*Explanation* : Most of the GM plants have been developed for pest-resistance, which increases the crop productivity and therefore, reduces the reliance on chemical pesticides. 1

12. Option (d) is correct.

*Explanation*: Decomposition is the process of breaking down organic matter into simple inorganic matter. Under same environmental conditions, the rate of decomposition varies due to change in composition of detritus. If detritus is rich in lignin and chitin, the decomposition rate is slow. If detritus is rich in nitrogen, the decomposition rate is relatively high. Hence, in soil sample C, the decomposition rate will be faster as the detritus is rich in nitrogen and sugar content. 1

13. Option (d) is correct.

*Explanation*: The primary endosperm nucleus is triploid. It is formed due to the fusion of haploid male gamete with the diploid secondary nucleus or two haploid polar nuclei. It is the product of double fertilisation. 1

14. Option (c) is correct.

*Explanation*: Nucleolus is the site of synthesis of rRNA and synthesis of ribosomes. It is therefore called as ribosomal factory. RNA polymerase I is an enzyme that transcribes ribosomal RNA. 1

15. Option (a) is correct.

*Explanation*: Tobacco is smoked. It contains nicotine, an alkaloid, which stimulates adrenal gland to release adrenaline and nor-adrenaline, causing high blood pressure and increased heart rate. 1

16. Option (a) is correct.

*Explanation*: PCR is a powerful technique to identify genetic disorders as it is used to detect mutations in low amounts of DNA. 1

## Section – B

17. Spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH). This is a hypothalamic hormone.  $\frac{1}{2}$

The increased levels of GnRH then act at the anterior pituitary gland and stimulate secretion of two gonadotropins – luteinising hormone (LH) and follicle stimulating hormone (FSH).  $\frac{1}{2}$

LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis.  $\frac{1}{2}$

FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.  $\frac{1}{2}$

18. (a) CTT would become CAT which codes for valine. Thus, valine would replace glutamic acid at that point. 1

(b) Sickle cell anaemia, the mutant haemoglobin molecule undergoes polymerization leading to the change in the shape of the RBC from biconcave disc to elongated sickle like structure. 1

19. On administration of the first dose of the vaccine (L), the body shows a response of **low intensity** (X) as the immune system comes in contact with the antigenic protein of the weakened/inactivated pathogen for the first time. This is called **primary immune response**. 1

On subsequent encounter with the same antigenic protein in the second dose (M), the body elicits a **highly intensified** secondary response (Y). Because of the memory of the first contact with the antigen, the secondary immune response is **faster and stronger**, leading to more effective pathogen elimination in comparison to the primary immune response. 1

20. (a) Plate 1,  $\beta$ -galactosidase enzyme is responsible for blue colour. Gene is inserted in the  $\beta$ -galactosidase site of the plasmid thereby causing **insertional inactivation** of the enzyme, so no blue colour is made. 1

(b) Plate II - Gene of interest not inserted in the plasmid.  $\frac{1}{2}$

Plate III - No plasmid  $\frac{1}{2}$

21.

Tertiary consumer	Large Fishes	37 kg/m <sup>2</sup>
Secondary consumer	Small Fishes	25 kg/m <sup>2</sup>
Primary consumer	Zooplankton	11 kg/m <sup>2</sup>
Primary producer	Phytoplankton	4 kg/m <sup>2</sup>

Fig : Inverted Pyramid of Biomass

OR

- (a) Gross Primary Productivity is  $45000 + 40367 = 85367 \text{ kJm}^{-2}\text{y}^{-1}$  1
- (b) Net production is gradually reducing as we move from producers to consumers due to heat loss/respiration /10% law. 1

## Section – C

22. (a) Sperm A  $\frac{1}{2}$
- (b) In the figure given, Sperm 'A' has come in contact with the zona pellucida layer (P) of the ovum (Q), it will induce changes in the membrane that will block the entry of additional sperms (B and C). Thus, it ensures that only one sperm can fertilise the ovum.  $\frac{1}{2}$
- The secretions of the acrosome of sperm A will help it to enter into the cytoplasm of the ovum (Q) through the zona pellucida (P) and the plasma membrane, this will induce the completion of the meiotic division of the secondary oocyte (Q). 1
  - The second meiotic division in Q being unequal will result in the formation of a second polar body and a haploid ovum. Then, the haploid nucleus of the sperm 'A' and that of the ovum (Q) will fuse together to form a diploid zygote. 1

23. The embryo with 8 to 16 blastomeres is called a morula.
- The morula continues to divide and transforms into blastocyst as it moves further into the uterus.
  - The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast**.
  - An inner group of cells attached to trophoblast is called the **inner cell mass**.
  - The trophoblast layer then gets attached to the endometrium and the inner cell mass get differentiated as the embryo.
  - After attachment, the uterine cells divide rapidly and covers the blastocyst.
  - As a result, the blastocyst becomes embedded in the endometrium of the uterus. This is called implantation and it leads to pregnancy.

$$\frac{1}{2} \times 6 = 3$$

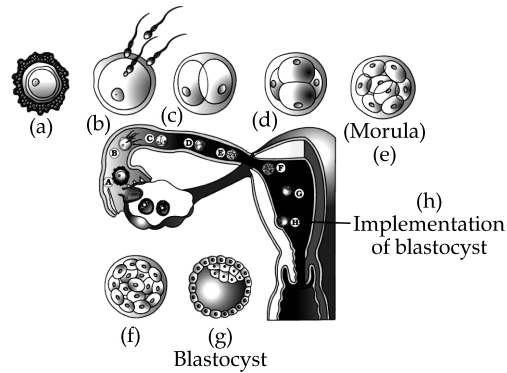
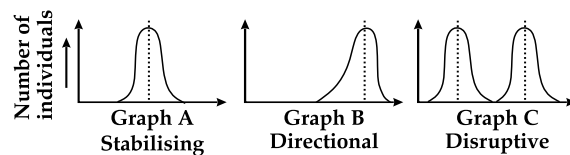


Fig : Fertilisation and passage of growing embryo in fallopian tube

24. (a) The embryo has Turner's Syndrome due to aneuploidy of the sex chromosome. Such a disorder is caused due to the absence of one of the X chromosomes, i.e., 45 with XO.  $\frac{1}{2} + \frac{1}{2}$
- (b) She was advised MTP as the child will have the following problems:
- rudimentary ovaries
  - poorly developed breasts
  - lack of other secondary sexual characters
  - delayed or no onset of the menstrual cycle and infertile.
- [(Any two)] 1+1
25. (a) A -Stabilising; B - Directional; C - Disruptive.  $1\frac{1}{2}$
- (b) Graph A – Stabilising  
Graph B – Directional  
Graph C – Disruptive



1½

26. • It will adversely affect the secondary treatment or biological treatment of sewage.
- When the aeration tank is not functional, the air will not be pumped into it.
  - This will not allow the vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures).
  - Thus, the major part of the organic matter in the effluent will not be consumed by these bacteria.
  - The BOD (biochemical oxygen demand) of the effluent will not be reduced. BOD refers to the amount of the oxygen that would be consumed if all the organic matter in one liter of water were oxidised by bacteria.

- The greater the BOD of waste water, more is its polluting potential. Thus, the effluent will remain polluted with high amount of organic matter and high BOD.  $\frac{1}{2} \times 6 = 3$

27. (a) Cry I Ab  $\frac{1}{2}$   
 (b) The spores of Bt contain crystalline toxin which is inactive. For this crystalline toxin protein to become active it needs alkaline pH, which is present in insect gut. The gut lining is broken down/mid gut epithelial cells become porous/swollen/cell lysis.  $\frac{1}{2} \times 3 = 1\frac{1}{2}$   
 (c) The **Bt-toxin gene is cloned and inserted into the plant genome by recombinant DNA technology**. These genetically modified (GM) **plants express the Bt-toxin genes** and become pest-resistant. **1**

OR

- (a) (i) Functional enzyme lipase is given to the patient by injection.  $\frac{1}{2}$   
 (ii) This procedure is not completely curative.  $\frac{1}{2}$   
 (b) • The disease can be treated by using Gene therapy.  $\frac{1}{2}$   
 • Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.  $\frac{1}{2}$   
 • Here, genes are inserted into a person's cells and tissues to treat a disease. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene. **1**

28. Prokaryotic organisms' diversity is not given any figures by ecologist because of following reasons:

- Classification and identification of vast diversity of microbes is very difficult and cannot be efficiently done with use of currently available methods.
- For many microorganisms, it is difficult to culture them under laboratory condition.
- According to current biochemical and molecular techniques, it is estimated that microbes diversity can range in billions with microbes inhabiting diverse habitat on earth, with enormous diversity present in air, water and soil. Hence, more advanced molecular and biochemical techniques are needed to classify and identify this enormous diversity of microbes. **1+1+1**

### Section – D

29. (a) Plasmids can be used to insert the gene of interest from a desired organism into a host, they act as vectors to transfer gene of interest into the host. **1**

OR

Ori- Origin of replication (ori). No replication will take place resulting in no copies of linked DNA.

- (b) (i) 5'... ATC GTA/AAG CTT /CAT...3'  
 3'... TAG CAT/TTC GAA /GTA...5' **1 mark for both strand**

OR

5'... AAG CTT ...3'  
 3'... TTC GAA ...5' **1 mark for both strand]**

- (ii) No, as the restriction enzymes need to be the same which cut the DNA of the plasmid and the gene of interest from the plant.  $\frac{1}{2} + \frac{1}{2} = 1$   
 (c) pUC18 as it has a higher copy rate.  $\frac{1}{2} + \frac{1}{2} = 1$   
 30. (a) *P. aurelia* species is competitively superior. *P. aurelia* grows in numbers more quickly than *P. caudatum* and shows more individuals in the same volume of culture/ 100 *Paramecia aurelia* in 6 days whereas 60 *P. caudatum* in 8 days. **2**  
 (b) Competitive Exclusion Principle' (or Gause principle) which states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated.  
 Name of the scientist: G.F Gause **1**  
 (c) One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing different times for feeding or different foraging patterns, to avoid competition and co-exist due to behavioural differences in their foraging activities. **1**

OR

Graph A show mutualism as both species grow simultaneously.

### Section – E

31. **Couple 1:** Normal reports of female, Normal sperms in testes, Missing connection in epididymis and Vas deferens in male.

#### Assisted Reproductive Technology (ART):

Semen will be devoid of sperms in this case. So, In-vitro fertilization (IVF) by collecting the sperms from epididymis, followed by ZIFT or IUT (Test Tube Baby) is suggested. ZIFT is transfer of zygote or early embryo up to 8 blastomeres in fallopian tube and IUT refers to transfer of embryos with more than 8 blastomeres in uterus. **1**

**Couple 2:** Blockage in the fallopian tube in the female, Normal reports of male.

#### Assisted reproductive Technology:

Blockage of Fallopian Tube will not allow transfer of sperms to the site of fertilisation. In-vitro fertilisation (IVF) followed by IUT, Intra Uterine Transfer (Test Tube Baby). It would involve transfer of embryo with more than 8 blastomeres in uterus. **1**

**Couple 3:** Normal reports of female, Poor semen parameters in terms of count, motility and morphology in male partner.

**Assisted Reproductive Technology:**

Intracytoplasmic sperm injection (ICSI) in which sperm is directly injected into the ovum. Artificial insemination procedure is used mainly when sperms have poor characteristic or low sperm count. **1**

**Couple 4:** Low ovarian reserve in female, Normal reports in male

**Assisted Reproductive Technology:**

In-vitro-fertilization (IVF) by selection of normal blastocysts from ovary followed by Zygote

intrafallopian transfer involving transfer of zygote or early embryos up to 8 blastomeres (ZIFT) or transfer of embryo with more than 8 blastomeres in the uterus (IUT). **1**

**Couple 5:** Poor ovarian reserve in female, morphologically abnormal sperms in male partner.

**Assisted Reproductive Technology:**

Intracytoplasmic sperm injection (ICSI) in which selected normal sperms will be injected into the selected blastocyst. Intracytoplasmic sperm injection (ICSI) procedure is used mainly when sperms have poor characteristic or low sperm count. **1**

OR

Situation No.	Requirement of contraceptive for	Name of contraceptive device	Mode of action
1	blocking the entry of sperms through cervix	Diaphragms/ cervical caps/ vaults	Cover the cervix during coitus
2	spacing between children	Cu or hormone releasing IUDs such as CuT/Cu7/ Multiload 375/ Progestasert/LNG 20	Cu ions from Cu containing IUDs increase phagocytosis of sperms within uterus, suppress sperm motility and fertilizing capacity/ hormone releasing IUDs make uterus unsuitable for implantation.
3	effective emergency contraceptive	Pills containing Progestogens or progestogen-estrogen combination or IUDs within 72 hours of coitus	Pills inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent the entry of sperms/IUDs - Cu ions increase phagocytosis of sperms within uterus, suppress sperm motility and fertilizing capacity/ hormone releasing IUDs make uterus unsuitable for implantation.
4	terminal method to prevent any more pregnancy in female	Tubectomy	Block gamete transport and prevent conception.
5	sterilization in male	Vasectomy	Blocks sperm transport.

 $\frac{1}{2} \times 10 = 5$ 

**32.** 5'--ATG ACC GTA TTT TCT GTA GTG CCC GTA

CTT CAG GCA TAA--3' = Coding strand

(a) 3'- TAC TGG CAT AAA AGA CAT CAC GGG  
CAT GAA GTC CGT ATT--5' = Template strand

**1**

5'---AUG ACC GUA UUU UCU GUA GUG CCC  
GUA CUU CAG GCA UAA---3'

**1**

(b) i. In a bacterium

5'---AUG ACC GUA UUU UCU GUA GUG  
CCC GUA CUU CAG GCA UAA---3'

**1**

ii. In humans

5'---mGpppAUG ACC UUU UCU GUG CCC  
CUU CAG GCA UAA- Poly A tail--3'

**1**

(c) Nine amino acids in the polypeptide because UAA is stop/terminator codon and does not code for any amino acid. **1**

OR

(a) Co-dominance  $\frac{1}{2}$

(b) Co-dominance is a condition in which two different alleles for a genetic trait are expressed. Individuals receive one version of a gene, called an allele, from each parent.  $\frac{1}{2}$

(c) (i) If pure breeding red coated cattles are represented as 'RR' and pure breeding white coated as 'rr'. If Red is dominant over White. A cross between 'RR' and 'rr' would produce red coated cattles (RR) and white coated cattle (rr) in the ratio of 3: 1

Parents: RR (Red) X rr (White)  
Gametes: R r

	R	r
R	RR Red coat	Rr Redcoat
r	Rr Red coat	rr White coat

F<sub>1</sub> generation- 3:1 2

- (ii) If the red and white coated cattles produce pink colour on a cross then, they exhibit incomplete dominance in the inheritance of coat colour due to which they produce pink coloured coat upon hybridisation.

If pure breeding red coated cattles are represented as 'RR' and pure breeding white coated as 'rr', then the pink coated cattles are 'Rr'.

A cross between 'RR' and 'rr' would produce pink coated cattles (Rr) and white coated cattle (rr) in the ratio of 1 : 2 : 1

	RR (Red) X rr (White)	
Parents:	R	r
Gametes:	R	r
	R	r
R	RR Red coat	Rr Pink coat
r	Rr Pink coat	rr White coat

F<sub>1</sub> generation- 3:1 2

33. • Lymphoid organs: These are the organs where origin, maturation and proliferation of lymphocytes occur.
- The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.
  - After maturation the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix.
  - The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.
  - The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.

- The thymus is a lobed organ located near the heart and beneath the breastbone.
- Both bone-marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.
- The spleen is a large bean - shaped organ. It mainly contains lymphocytes and phagocytes.
- It acts as a filter of the blood by trapping blood-borne micro - organisms. Spleen also has a large reservoir of erythrocytes.
- The lymph nodes are small solid structures located at different points along the lymphatic system. Lymph nodes serve to trap the micro-organisms or other antigens, which happen to get into the lymph and tissue fluid. Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

There is lymphoid tissue also located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called mucosa - associated lymphoid tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.

$\frac{1}{2} \times 10$

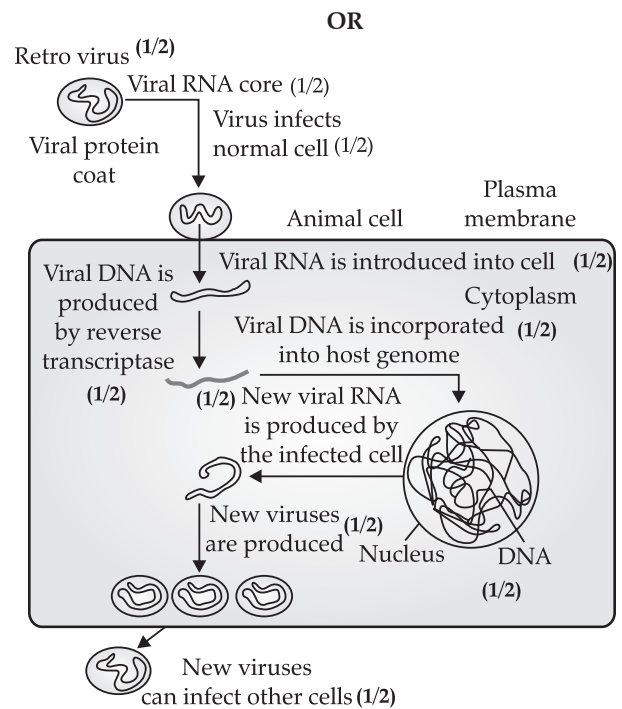


Fig: Replication of retrovirus

Note:- Infected cell can survive while viruses are being replicated and released

