Sample Question Paper 2023-24
Class XII
Biology (Subject Code-044)

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.

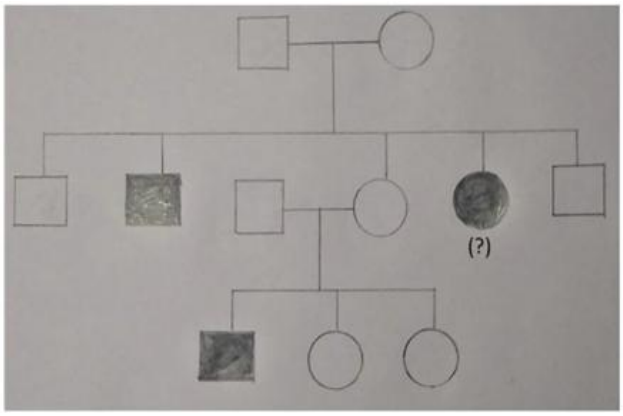
(iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.

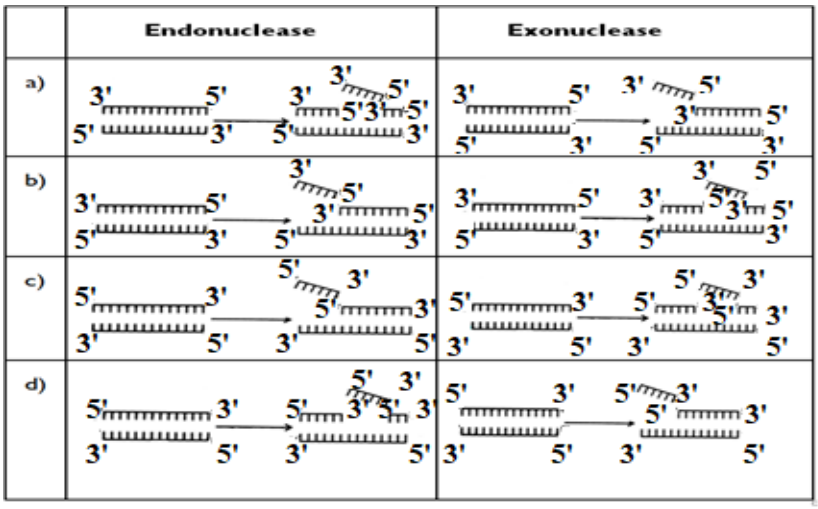
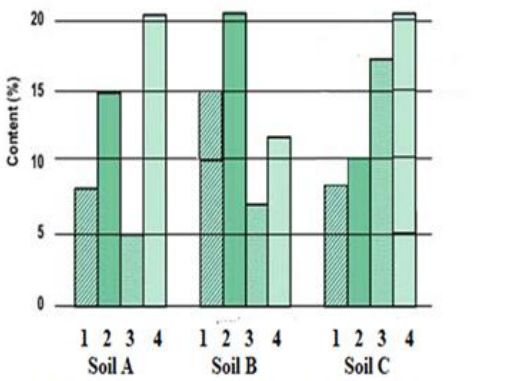
(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

Section - A

Q.No.	Question	Marks
1	Remnants of nucellus are persistent during seed development in: a) pea b) groundnut c) wheat d) black pepper	1
2	The wall layer of microsporangium which nourishes the pollen grain is: a) epidermis b) endothecium c) middle layers d) tapetum	1
3	A short piece of DNA, having 20 base pairs, was analyzed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown in the table. <table><tr><td></td><td colspan="4">Number of nucleotide bases</td></tr><tr><td></td><td>Adenine</td><td>Cytosine</td><td>Guanine</td><td>Thymine</td></tr><tr><td>Strand 1</td><td>4</td><td>4</td><td></td><td></td></tr><tr><td>Strand 2</td><td></td><td>5</td><td></td><td></td></tr></table>How many nucleotides containing Adenine were present in strand 2? a) 2 b) 4 c) 5 d) 7	1

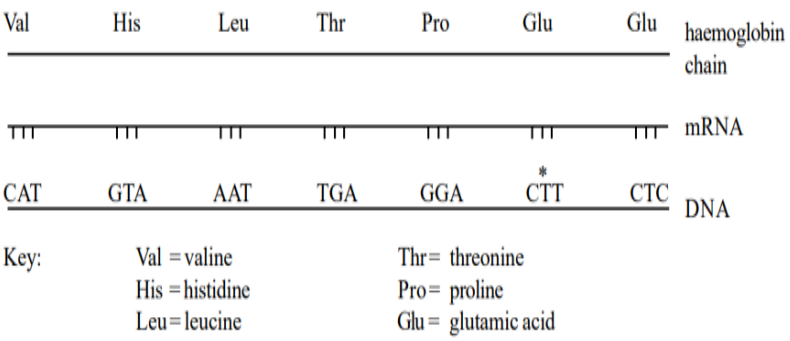
4	In a certain species of insects, some have 13 chromosomes, and the others have 14chromosomes.The 13 and 14 chromosome bearing organisms are a) males and females, respectively b) females and males, respectively c) all males d) all females	1
5	At a particular locus, the frequency of allele A is 0.8 and 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
6	Variations caused due to mutations are a) random and directionless b) random and directional c) random and small d) random, small and directional	1
7	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

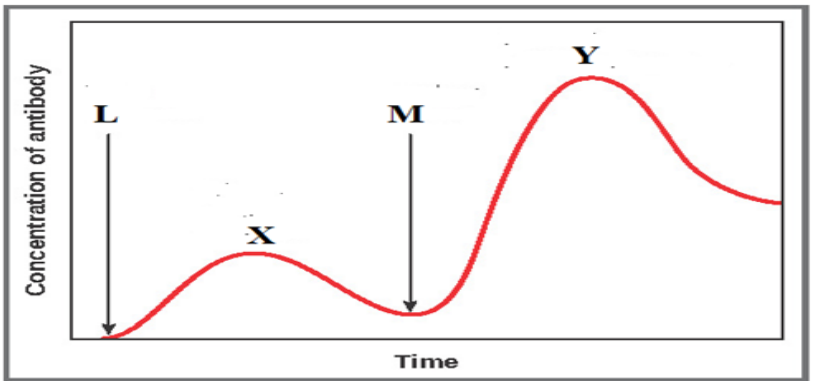
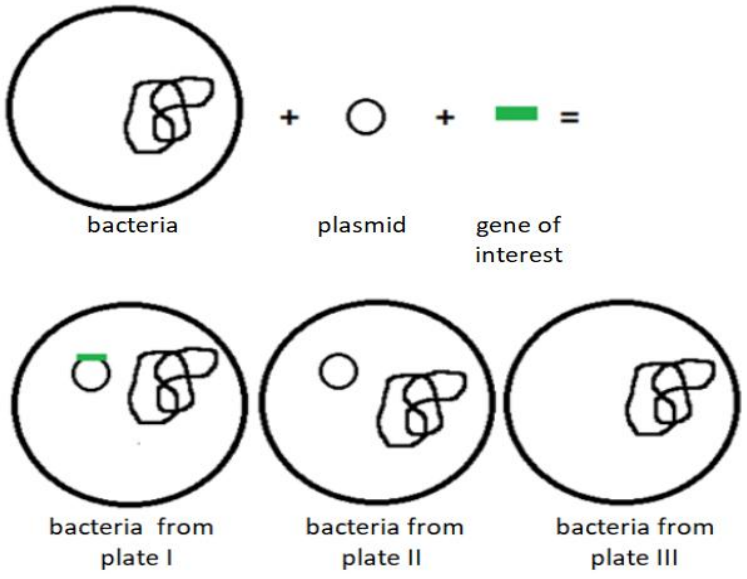
9	A patient was advised to have a kidney transplant. To suppress the immune reaction, the doctor would administer him: a) statins produced from *Monascus purpureus* b) statins produced from *Streptococcus thermophilus* c) cyclosporin A produced from *Trichoderma polysporum* d) cyclosporin A produced from *Clostridium butylicum*	1
10	Identify the activity of endonuclease and exonuclease in the given image. 	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	1

	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.

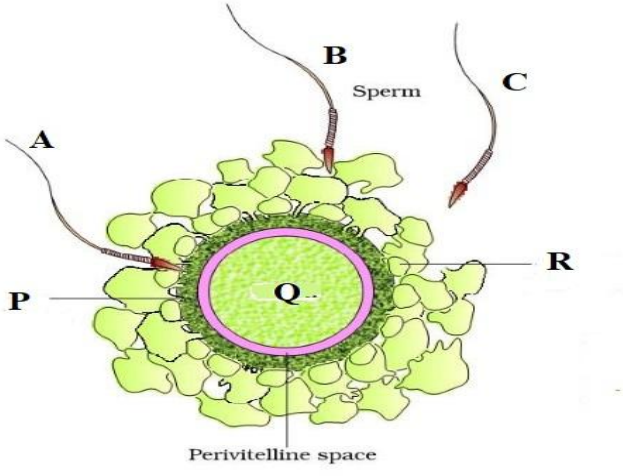
13	Assertion: Primary endosperm nucleus is diploid. Reason: It is the product of double fertilisation.	1
14	Assertion:Ribosomal RNA is synthesized in the nucleus of the cell. Reason: It is translated with the enzyme RNA polymerase III.	1
15	Assertion: Smoking can raise blood pressure and increase heart rate. 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. 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

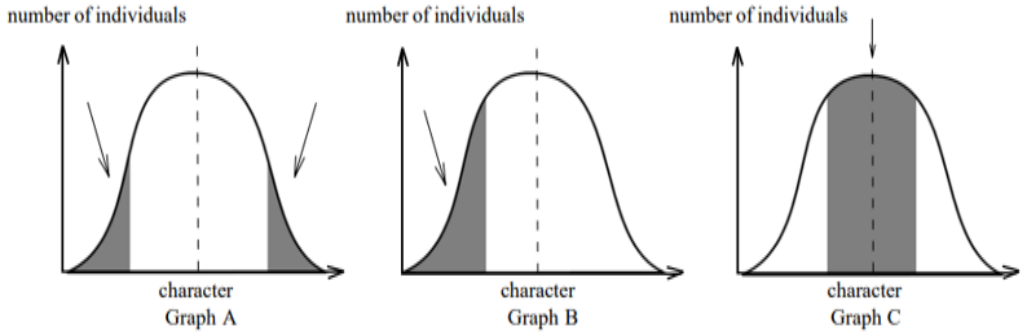
	a) If the base T* was substituted with A, how would it affect the haemoglobin chain? b) Name the condition and the effects associated with the above substitution.	
19	The graph given below indicates the administration of the first (L) and second dose (M) of a vaccine. The corresponding response of the 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.	2

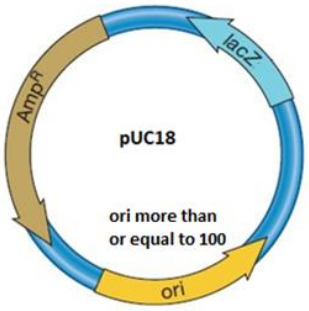
21	Biomass of a standing crop of phytoplankton is 4 kg/m^2 which supports a large standing crop of zooplankton having a biomass 11 kg/m^2. This is consumed by small fishes having biomass 25 kg/m^2 which are then consumed by large fishes with the biomass 37 kg/m^2. Draw an ecological pyramid indicating 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: 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

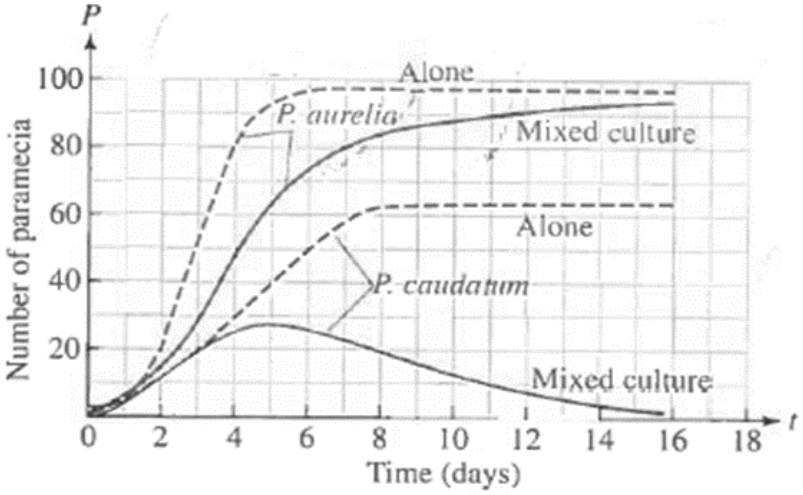
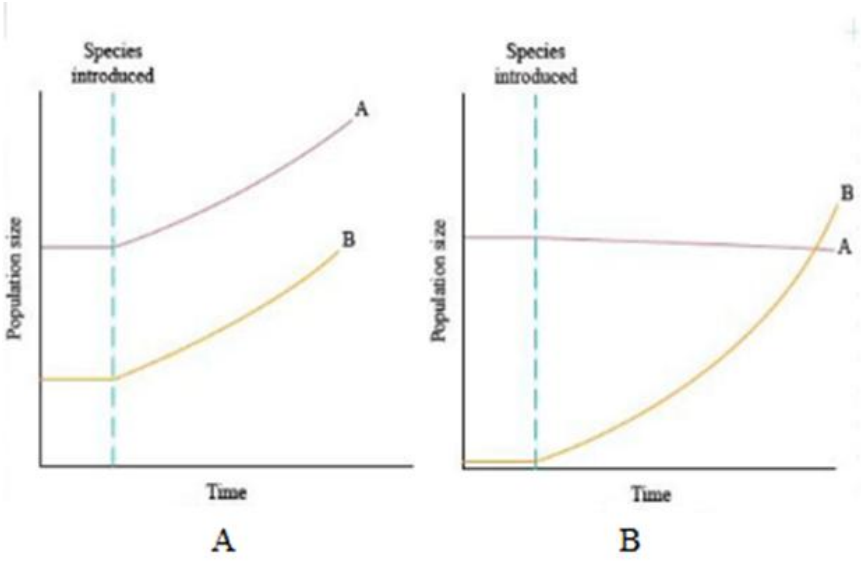
Tropic level	Net Production($KJm^{-2}y^{-1}$)	Respiration ($KJm^{-2}y^{-1}$)
Top Carnivore	50	35
Carnivores	420	378
Herbivores	4490	4041
Producers	45000	40,367

Section - C

22	The figure given below shows 3 sperms A, B and C. 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.  **Figure** . Ovum surrounded by few sperms	3

23	Explain the phases in embryonic development from the morula stage till the establishment of pregnancy in a human female.	3
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?	3
25	The graphs below 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. a) Name the gene in the spores responsible for the control of this pest. b) What effect will the spores of Bt have on the insect pest? c) 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	3

	parents (autosomal recessive). ERT (enzyme replacement treatment) is one of the treatments offered to patients with LPLD. a) (i) What procedure is followed in ERT? (ii) What could be one possible drawback of ERT? b) 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 structure below 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.  a) How are puc18 and pBR322 used in biotechnological studies? **OR** What will be the impact if *ori*in the above structure gets damaged? b) The l*ac 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. c) 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.  a) Which species is competitively superior? Support it with the data provided in the graph. b) State the underlying principle for the above result and name the scientist associated with this principle. c) 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. 5

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

OR

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

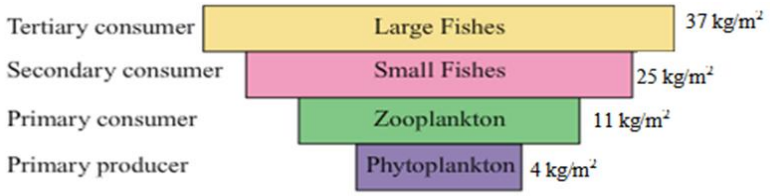
Situation	Requirement of contraceptive for -	Name of contraceptive device	Mode of action
1	blocking the entry of sperms through cervix		
2	spacing between children		
3	effective emergency contraceptive		
4	terminal method to prevent any more pregnancy in female		
5	sterilization in male		

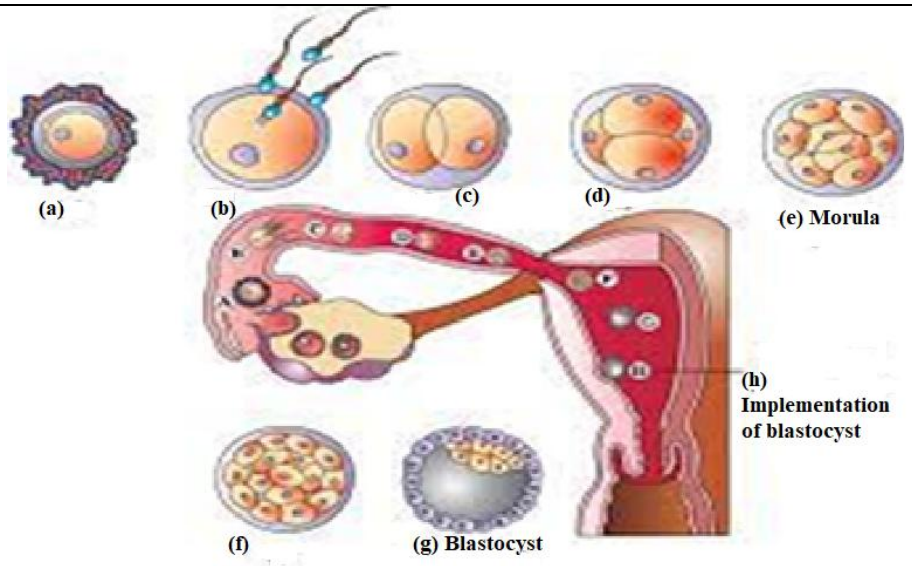
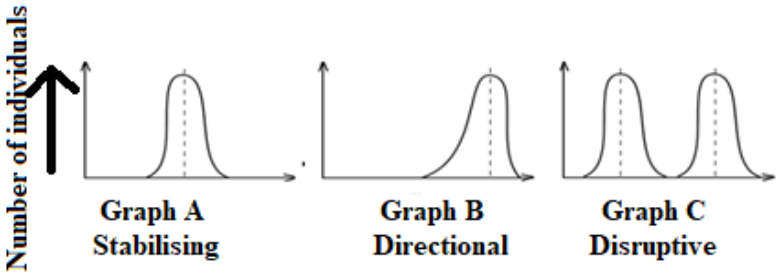
32	Given below is a stretch of DNA showing the coding strand of a structural gene of a transcription unit? 5'--ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TAA—3' a) Write the corresponding template strand and the mRNA strand that will be transcribed, along with its polarity. b) If GUA of the transcribed mRNA is an intron, depict the sequence involved in the formation of mRNA /the mature processed hnRNA strand. i. In a bacterium ii. In humans c) 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 codominance 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

****

MARKING SCHEME (2023-24
Class XII
Biology (Subject Code-044)

Q. No.	Answer	Marks
	Section - A	
1	d) black pepper	1
2	d) tapetum	1
3	d) 7	1
4	a) males and females, respectively	1
5	a) 0.32	1
6	a) random and directionless	1
7	d) Nucleotide	1
8	d) aa	1
9	c) Cyclosporin A produced from *Trichoderma polysporum*	1
10	d)	1
11	b) Reduce pesticide accumulation in food chain	1
12	d) Soil Sample C	1
13	d) A is false but R is true	1
14	c) A is true but R is false	1
15	a) Both A and R are true and R is the correct explanation of A.	1
16	a) Both A and R are true and R is the correct explanation of A.	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. [0.5] 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). [0.5] LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. [0.5] FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis. [0.5]	2
18	a) CTT would become CAT which codes for valine. Thus, valine would replace glutamic acid at that point. [0.5] b) Sickle cell anaemia [0.5], the mutant haemoglobin molecule undergoes polymerization [0.5] leading to the change in the shape of the RBC from biconcave disc to elongated sickle like structure. [0.5]	2

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]	2
20	a) **Plate 1**, **b-galactosidase enzyme is responsible for blue colou**r. Gene is inserted in the b-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 [0.5] Plate III - No plasmid [0.5]	2
21	 **Inverted Pyramid of Biomass** **OR** a) Gross Primary Productivity is 45000 + 40367 = 85367 $KJm^{-2}y^{-1}$ [1] b) Net production is gradually reducing as we move from producers to consumers due to heat loss/respiration /10% law. [1]	2
	Section – C	
22	a) Sperm A [0.5] 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. [0.5] • The secretions of the acrosome of sperm A will help it to enter into the cytoplasm of the ovum (Q) through the zona pellucid (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]	3
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** and • An inner group of cells attached to trophoblast called the **inner cell mass**. • The trophoblast layer then gets attached to the endometrium and the inner cell mass gets 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. [0.5X6=3]	3

	 Fig : Fertilisation and passage of growing embryo in fallopian tube	
24	a) The embryo has Turner's Syndrome [0.5] 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. [0.5] 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 2; 2 marks]	3
25	a) A -stabilising; B - directional; C - disruptive; [1.5] b) Graph A – Stabilising Graph B – Directional Graph C – Disruptive  [1.5]	3
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.	3

	• 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. [0.5X6=3]	
27	a) *Cry I Ab* [0.5] b) The spores of Bt contain crystalline toxin which is inactive [0.5]; for this crystalline toxin protein to become active it needs alkaline pH, which is present in insect gut [0.5] The gut lining is broken down/mid gut epithelial cells become porous/swollen/cell lysis. [0.5] 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. [0.5] (ii) This procedure is not completely curative. [0.5] b) • The disease can be treated by using Gene therapy. [0.5] • Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. [0.5] • 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]	3
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.	3
	Section – D	
29	a) **Plasmids** which can be used to **insert the geneof interest** from a desired organism into a host/ they **act as vectors to transfer gene of interest i**nto 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. [0.5+0.5=1] c) **PUC18** as it has a **higher copyrate**. [0.5+0.5=1]	4
30	a) *P. aurelia* species is competitively superior *P. aurelia* grows in numbers more quickly than *P.*	4

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' which* states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated.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 - 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. 5

Assisted Reproductive Technology:

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 fertilization (IVF) followed by IUT (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 intra-fallopian 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:

ICSI intracytoplasmic sperm injection 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 Cu T/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.	

[0.5 X 10 =5]

32 5'--ATG ACC GTA TTT TCT GTA GTG CCC GTA CTT CAG GCA TAA—3'= CODING — 5

a) 3'- TAC TGG CAT AAA AGA CAT CAC GGG CAT GAA GTC CGT ATT---5'= TEMPLATE [1 mark]

5'---AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA---3' [1 mark]

b) i. **<u>In a bacterium</u>**

5'---AUG ACC GUA UUU UCU GUA GUG CCC GUA CUU CAG GCA UAA---3' [1 mark]

ii. **<u>In humans</u>**

5'---^{m}GpppAUG ACC UUU UCU GUG CCC CUU CAG GCA UAA- Poly A tail--3' [1 mark]

c) 9 amino acids in the polypeptide because UAA is stop/terminator codon and does not code for any amino acid. [1 mark]

OR

a) Codominance [0.5]

b) Codominance 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. [0.5]

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

F1generation- 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

Parents: RR (Red) X rr (White)

Gametes: R W

	R	r
R	RR Red coat	Rr Pink coat
r	Rr Pink coat	rr (White)

F1 Generation- 1:2:1 [2]

33

- **Lymphoid organs**: These are the organs where origin and/or 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.

5

- 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. [0.5 X 10 =5]

OR

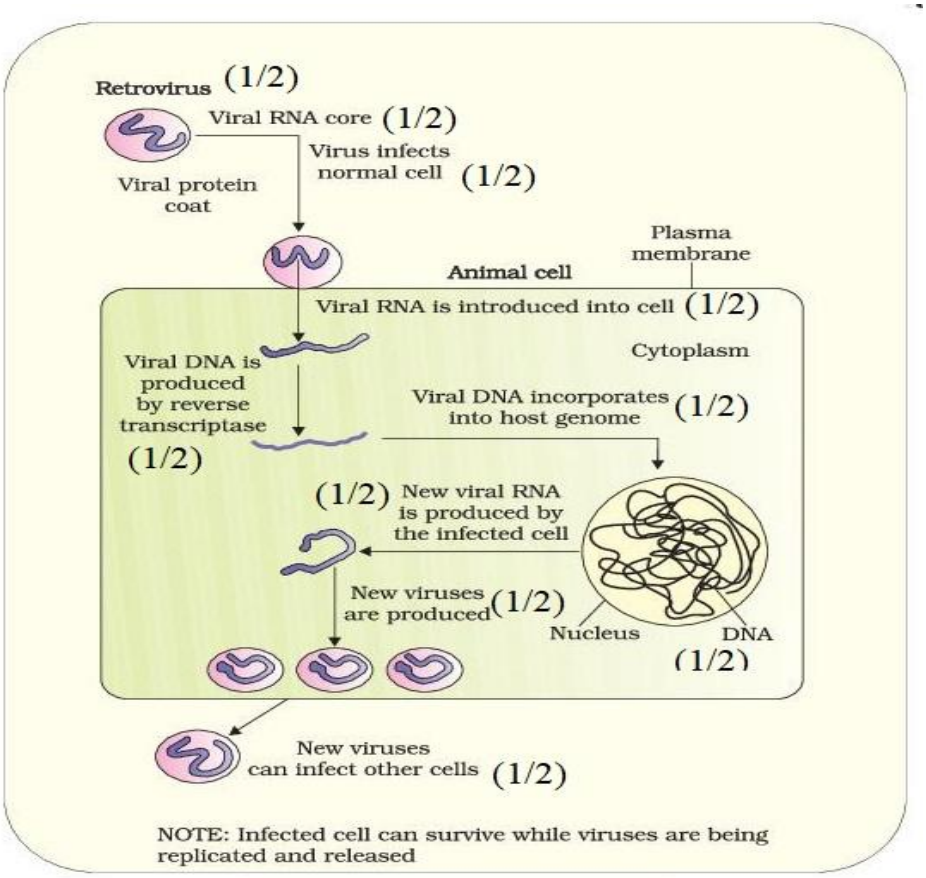


Figure Replication of retrovirus

****