BIOLOGY – CODE NO. 044
SAMPLE QUESTION PAPER*
CLASS – XII (2026-27)

Maximum Marks: 70 **Time: 3 hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions.
(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. Answer all 33 questions. 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. Nos. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

Q. No.	Question	Marks
1	A researcher observes that in a particular flowering plant, the pistil matures several days before the stamens in all flowers of the plant. What is the most significant consequence of this timing difference? A. It guarantees self-pollination B. It promotes autogamy C. It ensures cross-pollination D. It leads to geitonogamy	1
2	A male patient undergoes a medical procedure where a small section of the vas deferens is cut and tied at both ends. Which of the following effects is the intended and direct result of this procedure? A. Blockage of sperm transport into the ejaculatory duct and urethra. B. Inhibition of testosterone production by the testes. C. Suppression of the formation of seminal plasma by accessory glands. D. Prevention of spermatogenesis in the seminiferous tubules.	1
3	During the early stage of human embryonic development, the blastomeres are arranged into an outer layer and an inner group of cells known as the Inner Cell Mass (ICM). What is the fundamental significance of the outer layer, the trophoblast? A. It is responsible for forming the primary germ layers (ectoderm, mesoderm, endoderm).	1

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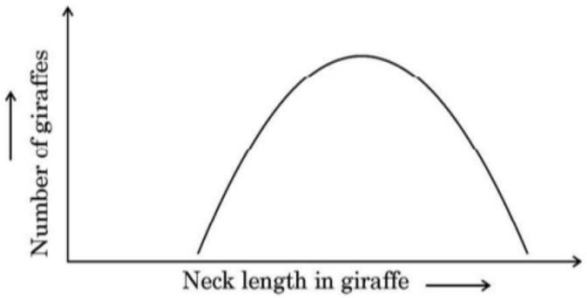
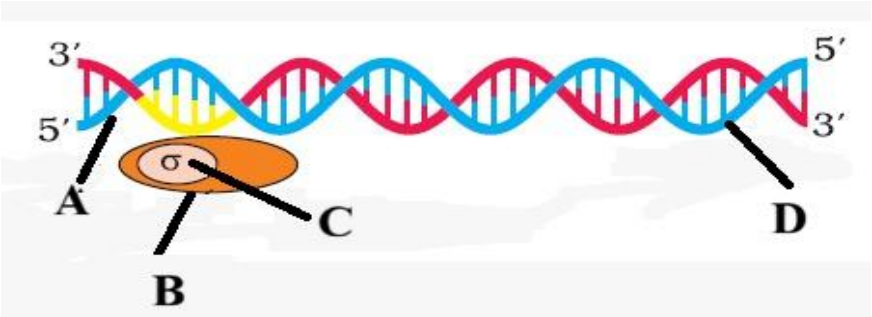
	B. It provides essential nutrients to developing embryo and helps in its implantation. C. It secretes colostrum which contains antibodies. D. It gives rise to all the organs of the future embryo (organogenesis).	
4	Select the option that gives the correct description of the process of natural selection with respect to the length of the neck of the giraffe.  A. Stabilising selection as giraffes with longer neck lengths are selected further. B. Disruptive selection as giraffes with smaller and longer neck lengths are selected. C. Directional selection as giraffes with longer neck lengths are selected. D. Stabilising selection as giraffes with medium neck lengths are selected. - - - - - - - - - - - - - - - - - - - *For Visually impaired students* Evolution of antibiotic-resistant bacterial population signifies the information that A. Acquired traits are inherited. B. Nature selects for fitness. C. Genetic variations are not a prerequisite factor for natural selection. D. The theory of spontaneous generation of life holds true.	1
5	The initiation step during the process of transcription in bacteria is shown below. Identify A, B, C and D by selecting the option:  A. A-RNA polymerase, B-Promoter, C-Sigma factor, D-DNA helix B. A-Promoter, B-Sigma factor, C-RNA polymerase, D-DNA helix C. A-Promoter, B-RNA polymerase, C-DNA helix, D-Sigma factor D. A-Promoter, B-RNA polymerase, C-Sigma factor, D-DNA helix	1

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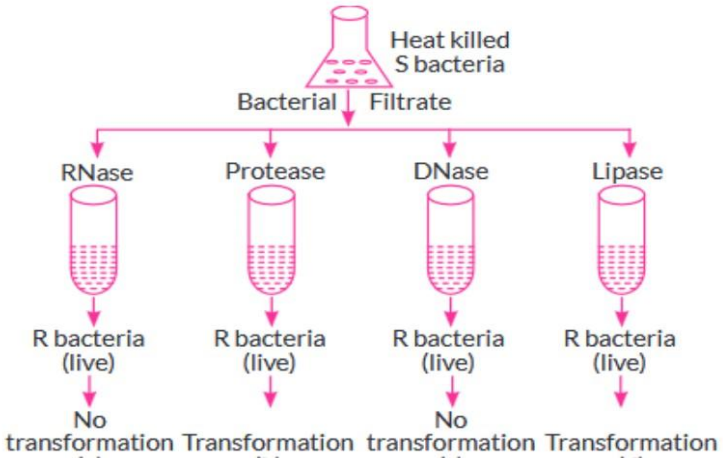
	- - - - - - - - - - - - - - - - - - *For Visually impaired students* The promoter site and the terminator site for transcription are located at: A. 3′ (downstream) end and 5′ (upstream) end, respectively of the transcription unit B. 5′ (upstream) end and 3′ (downstream) end, respectively of the transcription unit C. the 5′ (upstream) end D. the 3′ (downstream) end	
6	Given below is the illustration of the different steps of experiments conducted by MacLeod, McCarty and Avery to find the chemical nature of the 'transforming principle' as DNA. Select the option that **incorrectly** depicts the step of the experiment.  A B C D - - - - - - - - - - - - - - - - - - *For Visually impaired students* In the Griffith experiment, which of the following, when injected into mice, did not cause pneumonia? A. Heat-killed S strain only B. Live R strain only C. Both (A) and (B) D. Live S strain only	1
7	A scientist was culturing *E.coli* in a $^{15}NH_4Cl$ medium initially, then he shifted *E.coli* to a $^{14}NH_4Cl$ medium. The DNA was extracted from *E.coli* after 60 minutes of transfer to $^{14}NH_4Cl$ Medium and performed density gradient centrifugation to check the isotope distribution in newly replicated DNA. What will be the densities of DNA molecules formed? A. 25% hybrid and 75% light B. 50% hybrid and 50% light C. 75% hybrid and 25% light D. 85% hybrid and 15% light	1

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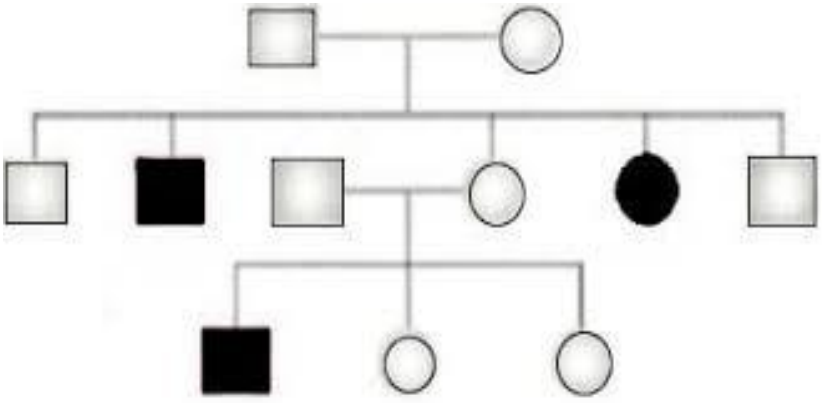
8	Study the given pedigree and identify the disease represented  A. Myotonic Dystrophy B. Sickle cell anaemia C. Haemophilia D. Colour blindness - - - - - - - - - - - - - - - - - - - *For Visually impaired students* If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny the disease is: A. Autosomal dominant B. Autosomal recessive C. Sex-linked dominant D. Sex-linked recessive	1
9	A patient with fever, chest pain, cough and breathing difficulty undergoes a chest X-ray. The film shows patchy opacities and reduced clarity of lung fields. Which observation best supports pneumonia? A. Enlarged heart size B. Inflammation or fluid buildup in the lungs C. Fractured ribs D. Air pockets in the lungs	1
10	A stretch of an euchromatin has 200 nucleosomes, how many base pairs (bp) will be there in the stretch and what would be the length of the typical euchromatin? A. 20,000 bp and $13{,}000 \times 10^{-9}$ m B. 10,000 bp and $10{,}000 \times 10^{-9}$ m C. 40,000 bp and $13{,}600 \times 10^{-9}$ m D. 40,000 bp and $13{,}900 \times 10^{-9}$ m	1
11	A biotechnology company grew Streptomyces in a fermenter to produce an antibiotic. It was observed that Day 7 onwards, the actual yield drops sharply, even though nutrient level, temperature, and aeration remain	1

	unchanged. Also, Microscopy revealed new colonies of bacteria which were not present in the original culture. So the fermenter was stopped. What measures should be taken to prevent the fall in yield in future fermentations? A. Increasing temperature only at the end of fermentation to kill contaminants. B. Adding antibiotics to the culture so unwanted microbes cannot grow. C. Ensuring sterile handling, sterilised equipment, and aseptic transfer before and during fermentation. D. Using a genetically modified strain designed to grow faster than contaminants.	
12	A rice farmer's field, which typically thrives in waterlogged conditions and requires soil rich in nutrients like phosphorus, is experiencing a severe drought this year. The crop is also susceptible to root infestation by pathogens. Which of the following techniques is best to address all these issues? A. Adding nitrogen-fixing bacteria to the soil B. Applying chemical fertilizers C. Adding spores of *Glomus* to the soil D. Flooding the field artificially to mimic normal conditions	1

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 but 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** (A): Spermatogenesis is an ongoing process throughout the reproductive life of a human male, while oogenesis is a discontinuous process. **Reason** (R): Oogenesis begins during the embryonic stage, gets arrested at prophase-I, resumes after puberty, and is arrested again at metaphase-II.	1
14	**Assertion** (A)**:** There is no variation in the percentage recombination due to loosely or tightly linked genes. **Reason** (R): Linked genes result in occurrence of higher proportion of parental gene combinations.	1
15	**Assertion** (A)**:** The primary goal of sewage treatment is to eliminate all organic matter from the effluent. **Reason** (R)**:** High BOD indicates a low level of organic matter in the water, which can lead to increased oxygen consumption by microorganisms, potentially harming aquatic life.	1
16	**Assertion** (A)**:** Tissue culture is used when traditional breeding technique is insufficient to keep pace with the demand of crop improvement.	1

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	Reason (R)**:** Totipotency is the ability of a single plant cell or explant to regenerate into a whole plant under sterile conditions in nutrient media.	
	Section - B	
17	***Attempt either option A or B.*** A. Geitonogamy can be compared with cross-pollination as well as self-pollination. Comment. **OR** B. Mohit wants to produce hybrid seeds in a plant in his field in which male and female flowers mature at the same time and are close together. Suggest one strategy to promote only desired cross pollination and justify your answer.	2
18	The movement of landmasses over geological time changed the distribution and evolution of animals. Explain this idea using two examples from different regions of the world.	2
19	The following is a realistic example dataset and not a real world patient dataset: A. Interpret the relationship between tumor size and glucose level. B. Evaluate the data to determine how tumor progression may affect the viability/vitality of neighboring cells. Provide a brief explanation.	2
20	***Attempt either option A or B.*** A. The table below shows hypothetical data comparing α-lactalbumin concentration in three types of milk, including that of Rosie, a transgenic cow designed to express human milk proteins.	2

Sample ID	Tumor size (mm^3)	Glucose level mM/litre	Oxygen level (mmHg)	Neighboring cell's viability/ vitality (%)
1	150	2.0	15	60
2	50	4.5	30	85
3	200	1.3	10	50
4	100	3.0	20	70
5	250	0.9	7	40

Source of Milk	α-lactalbumin Content approximately (g/L)
Normal cow's milk	0.1
Rosie cow's milk	2.4
Human milk	3.5

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I. Assuming all other nutritional components are identical, which milk would provide the lowest nutritional contribution from α-lactalbumin?.

II. If further genetic modification increases α-lactalbumin levels in Rosie to 3.5 g/L, predict one ethical concern that might arise from such a development.

OR

B. A farmer replaces the GM crop with a conventional variety. Predict any two challenges she/he may face. Support your answer with two reasons.

21 ***Attempt either option A or B.*** 2

A. The table below is a hypothetical data on Seasonal Temperatures seen over two different zones

Region	Temp. in Spring (^oC)	Temp. in Summer (^oC)	Temp. in Autumn (^oC)	Temp. in Winter (^oC)	Primary Productivity (GPP) (g/m^2/ year)	Respiration (R) (g/m^2/year)
Region X	27	28	27	26	3500	1300
Region Y	12	20	14	4	2000	800

I. Justify which region will have greater species diversity based on the given data?

II. Calculate the net primary productivity (NPP) of the region mentioned in (I) and give its significance?

OR

B. Following is a hypothetical data on Plant Pollinator interaction

Plant	Main Pollinator	Seed set (%) with pollinator	Seed set (%) without pollinator
P1	H1 (Bee)	80	40
P2	H2 (Butterfly)	75	45
P3	H3 (Moth)	85	35

I. From the data above, justify which plant shows the highest dependence on its main pollinator?

II. What kind of ecological interaction is shown in the table above? Define it in one sentence.

Section - C

22 A couple, A and B, visit a fertility clinic. Examination reveals that female A has a blockage in her fallopian tubes, but her ovaries can produce viable ova. Male B produces sperm with a very low sperm count, making natural fertilization unlikely. 3

Which two different Assisted Reproductive Technologies (ARTs) would a doctor

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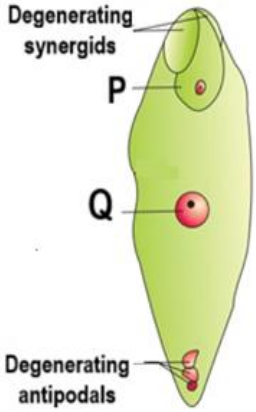
	most likely recommend for this couple to increase their chances of conceiving? Justify your selection by briefly stating the principle behind each chosen technique concerning the couple's specific issues.	
23	In the post-fertilization embryo sac shown in figure, structure 'P' results from the fusion of one male gamete with the egg cell, and structure 'Q' results from the fusion of the other male gamete with the polar nuclei.  Figure: Fertilised embryo sac in a flowering plant A. Identify structure 'P' and structure 'Q' and state their ploidy. B. Evaluate the following statement: "The division of 'P' always precedes the division of 'Q'." Justify your evaluation based on the nutritional requirements for seed development. C. Which characteristic feature of endosperm helps in its nutritive role? - - - - - - - - - - - - - - - - - - - *For Visually impaired students* A. Which two products are formed after double fertilization in the embryo sac of a flowering plant? B. State the ploidy of these two structures. C. Which of these two structures develops first during embryonic development? State its significance.	3
24	In mice, the traits for running ability and hair colour assort independently. Running (R) is dominant over walking in circles (r). Black hair (B) is dominant over brown hair (b). A heterozygous running, brown-haired female mouse was artificially inseminated using sperm from a heterozygous running, heterozygous black male. A. Write the genotypes of both parents and draw a Punnett square showing all possible offspring combinations. (1) B. Using the Punnett square, state the phenotypic ratio for: Running–Black, Running–Brown, Walking–Black, Walking–Brown. (1) C. If 64 offspring were produced, calculate how many would be expected to show the Running–Black phenotype. (1)	3

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25	How can a single gene defect caused by the mutation result in Phenylketonuria (PKU)? Explain the molecular mechanism underlying pleiotropy.	3
26	Drug-use disorders often begin with occasional consumption but may progress into a compulsive state. Analyse how addiction differs from dependence in both origin and consequence, and justify why long-term drug intake forces the user to increase dose over time.	3
27	Pathogens are often considered harmful, yet they have been adapted as powerful tools in genetic engineering. Explain how pathogens have been modified into useful vectors. Describe the role of a similarly modified plant vector and animal vector.	3
28	The nematode *Myrmeconema neotropicum* lives inside the abdomen of certain tropical ants (*Cephalotes atratus*). Inside the ant's body, the nematode develops slowly without killing it. Once mature, it changes the color of the ant's abdomen to bright red, making it resemble a berry. Birds, mistaking it for a fruit, eat the ant. The nematode's eggs survive in the bird's digestive system and pass out in droppings, which other ants contact while foraging, starting the cycle again. A. Why would harming the ant too early be disadvantageous for the nematode? (1) B. How is natural selection playing a vital role in maintaining this interaction? (1) C. What kind of ecological interaction is seen between nematode and ant? Define it in one sentence. (1)	3
	Section - D	
29	Madhuri, a 17-year-old girl, has been experiencing irregular periods for the past one year. Sometimes, her cycles are as short as 20 days and sometimes as long as 45 days. She occasionally has very heavy bleeding that lasts over a week, causing fatigue and weakness. A doctor reviews her menstrual diary and explains that these changes can be linked to hormonal fluctuations in the hypothalamic-pituitary-ovarian (HPO) axis. He shows Madhuri the lack of a clear ovulation peak and low progesterone levels in her recent cycles. A. Madhuri experiences heavy bleeding lasting over a week causing fatigue. What possible complication could arise from this condition? (1) B. Examine how the absence of a distinct LH (luteinizing hormone) surge in the menstrual cycle might explain both the irregularity and heaviness of Madhuri's periods. (2) *Attempt either subpart C or D.* C. Madhuri's cycles vary between 20 and 45 days. What might this irregularity indicate about her ovarian function? (1)	4

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	OR D. If a doctor suspects hypothalamic-pituitary dysfunction in Madhuri, which hormone secretion pattern would you expect to be disrupted? (1)	
30	A tribal farmer is cultivating *Brassica oleracea* (cabbage) in a forest region rich in pollinators and rare butterflies. Recently, his crops have been heavily damaged by cabbage looper caterpillars. To manage the pest outbreak, he applies Nucleopolyhedrovirus (NPV). After a few weeks, the pest population decreases significantly without affecting other insects or animals in the area. A. Justify with reasons why the use of Nucleopolyhedrovirus (NPV) was a suitable choice for controlling cabbage looper caterpillars. (1) B. Suggest another IPM strategy suitable for controlling caterpillar pests, and briefly describe its mode of action. (2) *Attempt either subpart C or D.* C. Name the group of pathogens to which *Nucleopolyhedrovirus* belong. (1) **OR** D. Justify why the use of NPV is considered a biocontrol method. (1)	4
	Section - E	
31	***Attempt either option A or B.*** A. A short stretch of DNA strand that codes for a polypeptide is shown below: 3'—TACAAAAAGAAGAAAAAGAAGATT--5' Due to exposure to harmful UV radiation two different types of errors occurred during DNA replication affecting their sequences of bases in the DNA in two different cells. I. What is the term given to a segment of DNA that codes for a polypeptide? II. Which type of mutation could have occurred in each of the following due to the error during replication? a) 3'-- TACAAAAAGAAGAAAAAGAAAATT--5' b) 3'-- TACAAAAAGAAGAAAAAGAGATT--5' III. If DNA strand (a) codes for Methionine and sequences of Phenylalanine, mention the sequence of amino acids that will constitute the polypeptide chain after translation. How many amino acids will be translated from this strand? IV. If all the codons of the stretch code for Phenylalanine excluding the initiator codon which feature does it depict? **OR** B. I. If GUA is an intron how many amino acids will be translated from the mature or processed RNA. Pick out the untranslated region from the following messenger RNA and mention their location and sequence.	5

	What is its significance? 5'ACGUCGAUGACCGUAGCGUUUGUAUCUUUAGUAGUGGUAUUA GUAGGCUAAAAA3' II. If AAA is the anticodon of phenylalanine, draw the tRNA adaptor molecule, Mention the position of amino acid Phenylalanine in the sequence of polypeptide counting the triplet codons.	
32	***Attempt either option A or B.*** A. A scientist is screening bacterial transformants engineered with DNA fragments of the β-globin gene. A radioactive DNA probe complementary to the normal β-globin sequence is used. After autoradiography: • Plates A and C show strong and week radioactive signals respectively. • Plate B shows no radioactivity. Answer the following: I. Why does plate B fail to show radioactivity, while A and C do? (2) II. How can this experiment help in distinguishing a normal individual, a carrier, and a patient of sickle cell anaemia? (2) III. Name one other commonly used technique (apart from autoradiography) to differentiate recombinants from non-recombinants. (1) **OR** B. A student placed DNA from three different sources: bacteria, plant tissue, and fungal cells in a test tube A, B and C respectively. During the process of isolating and purifying DNA, the student added cellulase to all test tubes. I. Predict and explain in which trial(s) DNA isolation would fail, and why? Also suggest how it could be corrected. (2) II. After rectifying the mistake made in 'a', outline the steps to obtain visible spooled DNA from the sample. (2) III. Suggest one application of the spooled DNA in biotechnology. (1)	5
33	***Attempt either option A or B.*** A. A Green Valley *X*, home to rare medicinal plants and several migratory bird species, is facing multiple environmental challenges. I. A luxury brand of cosmetics with little regulation has been sourcing wild medicinal plants from the valley. II. The company has introduced an ornamental grass species from another country, which has taken over large areas of native grassland. III. There is also a reported drastic decline in the endemic trees. IV. Large scale forest fire in a part of the valley. a) From the above hypothetical case, identify and explain the four major biodiversity threats. (4) b) Suggest one in-situ conservation practice that could help protect the biodiversity of Green Valley *X*, and justify your choice. (1)	5

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	OR B. At a composting ground, after a community clean-up drive, large amounts of vegetable peels, garden leaves, and other organic waste are piled up. Over the next few weeks, the volume of the waste decreases noticeably. I. Explain the sequence of processes that could have led to this transformation, and name the major organisms involved at each step. (4) II. If a prolonged dry spell occurs during this composting period, explain how it could affect the rate of the above processes. (1)	

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MARKING SCHEME
CLASS – XII (2026–27)

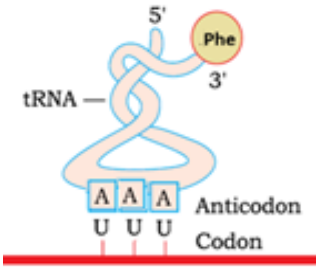
Q. No.	Answer	Marks
	Section - A	
1	C. It ensures cross-pollination	1
2	A. Blockage of sperm transport into the ejaculatory duct and urethra	1
3	B. It provides essential nutrients to developing embryo and helps in its implantation.	1
4	C. Directional selection as giraffes with longer neck lengths are selected. *For Visually impaired students* B. Nature selects for fitness.	1
5	D. A - Promoter, B - RNA polymerase, C - Sigma factor, D-DNA helix *For Visually impaired students* B. 5′ (upstream) end and 3′ (downstream) end, respectively of the transcription unit	1
6	A. No transformation *For Visually impaired students* C. Both (A) and (B)	1
7	A. 25% hybrid and 75% light	1
8	B. Sickle cell anaemia *For Visually impaired students* D. Sex-linked recessive	1
9	B. Inflammation or fluid buildup in the lungs	1
10	C. 40,000 bp and $13{,}600 \times 10^{-9}$ m	1
11	C. Ensuring sterile handling, sterilised equipment, and aseptic transfer before and during fermentation.	1
12	C. Adding spores of *Glomus* to the soil	1
13	A. Both **Assertion** (A) and **Reason** (R) are true, and **Reason** (R) is the correct explanation of **Assertion** (A).	1
14	D. A is false but R is true.	1
15	C. A is true but R is false.	1
16	B. Both A and R are true but R is not the correct explanation of A.	1

Section - B		
17	***Attempt either option A or B.*** A. Geitonogamy involves transfer of pollen grains from the anther to the stigma of another flower of the same plant. (1) Although geitonogamy is functionally cross-pollination involving pollinating agents, genetically it is similar to autogamy since the pollen grains come from the same plant. (1) **OR** B. Mohit can emasculate (remove anthers) from selected flowers before pollen release and then manually pollinate them with pollen from the chosen male parent, followed by bagging. (1) This prevents self-pollination and unwanted pollen and ensures that only the desired cross produces seeds. (1)	2
18	There were in South America mammals resembling horse, hippopotamus, bear and rabbit. Due to continental drift, when South America joined North America, these animals were overridden by North American fauna. (1) Due to continental drift, a number of Australian marsupials, each different from the other, evolved from an ancestral stock, but all within the Australian island continent. These pouched mammals of Australia survived because of lack of competition from any other mammals. (1)	2
19	A. As tumor size increases, glucose levels decrease, suggesting that larger tumors consume more glucose due to higher metabolic demand, possibly indicating a more aggressive growth pattern. (1) B. As tumor size increases, the viability of neighboring cells decreases suggesting that growing tumors create a hostile microenvironment, due to nutrient competition and less oxygen is available leading to stress or death of surrounding normal cells. /As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients. (1)	2
20	***Attempt either option A or B.*** A. I. Normal cow's milk (~0.1 g/L) is least suitable. Reason: Very low α-lactalbumin compared to human milk. (1) II. (i) Going beyond morality genetical modification of organisms can have long term unpredictable results. (ii) patenting for resource (iii) loss of genetic diversity of natural cows (iv) economic exploitation Any one (1) **OR** B. (i) Increased pesticide use due to lack of pest resistance. (ii) Lower yield under abiotic stress conditions. (iii) Faster depletion of soil nutrients due to inefficient mineral usage. Any two (1+1)	2

21	***Attempt either option A or B.*** A. I. Region X will have greater species diversity/Tropical region because Temperatures are near-constant across seasons in X (27–28–27–26 °C), which supports stable conditions / higher diversity/ Higher productivity/GPP 3500/ higher NPP in X vs lower productivity in Y. (1) II. NPP of Region X = GPP − R = 3500 − 1300 = 2200 g/m²/year. Net primary productivity is the available biomass for the consumption to heterotrophs (herbiviores and decomposers) (1) **OR** B. I. P3 → drop of over 50 percentage points without main pollinator/ other plants show comparatively less drop in seed set without pollinator. (1) II. The relationship is Mutualism as both species benefit; here, plants gain pollination and pollinators obtain nectar/food. (1)	2
	Section – C	
22	ART 1: Intracytoplasmic Sperm Injection (ICSI) Justification: ICSI is required to address Male B's low sperm count. It is an advanced procedure to form the embryo in vitro, where a sperm is directly injected into the ovum. (1.5) ART 2: In vitro fertilisation followed by Intrauterine Transfer (IUT) Justification: IVF followed by IUT is required to address Female A's blocked fallopian tubes. Since the natural path for the egg is blocked, the embryo (formed via IVF/ICSI) must be transferred directly to the uterus. (1.5)	3
23	A. Structure P (Zygote) is diploid and Structure Q (Primary Endosperm Nucleus) is triploid. (1) B. The statement is False. The Primary Endosperm Nucleus (PEN/'Q') divides much earlier than zygote ('P') to form the endosperm tissue for nutrition of embryo. (1) C. The cells of endosperm tissue are filled with reserve food materials which act as the primary source of nutrition for the developing embryo. (1) - - - - - - - - - - - - - - - - - - *For Visually impaired students* A. Zygote/Embryo and Primary Endosperm Nucleus/Endosperm. (1) B. Zygote/Embryo is diploid and Primary Endosperm Nucleus/Endosperm is triploid. (1) C. The Primary Endosperm Nucleus (PEN) divides much earlier than zygote to form the endosperm tissue. The cells of endosperm tissue are filled with reserve food materials which act as the primary source of nutrition for the developing embryo. (1)	3

<table>
<tr><td>24</td><td>A. Female mice: Heterozygous for running (Rr) and brown hair (bb), so its genotype is Rrbb. Male mice: Heterozygous for running (Rr) and heterozygous for black hair (Bb), so its genotype is RrBb.
Possible gametes
Female (Rrbb): Rb, Rb, rb, rb Male (RrBb): RB, Rb, rB, rb (1)
Punnett square
<table><tr><td></td><td>RB</td><td>Rb</td><td>rB</td><td>rb</td></tr><tr><td>Rb</td><td>RRBb</td><td>RRbb</td><td>RrBb</td><td>Rrbb</td></tr><tr><td>Rb</td><td>RRBb</td><td>RRbb</td><td>RrBb</td><td>Rrbb</td></tr><tr><td>rb</td><td>RrBb</td><td>Rrbb</td><td>rrBb</td><td>rrbb</td></tr><tr><td>rb</td><td>RrBb</td><td>Rrbb</td><td>rrBb</td><td>rrbb</td></tr></table>B. Probable phenotypes of the progeny
Running black (RRBb x 2, RrBb x 4,): 6/16
Running brown (RRbb x 2, Rrbb x 4): 6/16
Walking black (rrBb x 2,): 2/16
Walking brown (rrbb x 2): 2/16 Ratio will be 6:6:2:2 OR 3:3:1:1 (1)
C. 24 will show running black phenotype. (1)</td><td>3</td></tr>
<tr><td>25</td><td>The disease is caused by a single gene mutation resulting in an inborn error of metabolism where the affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine. (1)
As a result of this phenylalanine is accumulated and converted into phenyl pyruvic acid and other derivatives. Accumulation of these in the brain results in mental retardation. (1)
In pleiotropy a single gene can exhibit multiple phenotypic expressions by affecting metabolic pathways in different ways. (1)</td><td>3</td></tr>
<tr><td>26</td><td>Addiction - – Psychological attachment to effects of drugs/alcohol (½) → driven by desire for euphoria/well-being even when not needed (½). (1)
Dependence – Physical tendency of the body → manifests withdrawal symptoms (anxiety, shakiness, nausea, sweating) when drug is stopped. (1)
Reason for increased intake – Repeated drug use increases tolerance level of body receptors → receptors respond only to higher doses for the same effect. (1)</td><td>3</td></tr>
<tr><td>27</td><td>I. Certain pathogens naturally have the ability to transfer their DNA into host cells. Scientists have modified these pathogens by removing their disease-causing genes, while retaining their ability to deliver DNA, making them useful cloning vectors. (1)
II. In animals, retroviruses have been engineered to remove cancer-causing genes, while keeping their capacity to integrate DNA into the host genome, making them effective vectors for gene delivery. (1)</td><td>3</td></tr>
</table>

	III. In transgenic plants, nematode-specific genes were introduced via Ti plasmid of *Agrobacterium tumefaciens* to produce dsRNA, which triggered RNA interference (RNAi) and silenced nematode mRNA, protecting the plant from the parasite. (1)	
28	A. If the ant dies too soon, the nematode won't complete its development and won't be transmitted to new hosts. (1) B. Natural selection favors nematodes that keep the ant alive until it can be eaten by a bird, ensuring better dispersal and survival of the nematode. The birds eat only the red-bellied ant. This ensures complete maturation of nematode and its dispersal and protects the other ants from predation. (1) C. Type: Parasitism, Definition: An interaction where one organism benefits and the other is harmed. (1)	3
	Section – D	
29	A. Anaemia due to excessive blood loss. (1) B. Without a distinct LH surge, ovulation may not occur, so no corpus luteum forms to secrete progesterone. As a result, the endometrial lining grows excessively under unopposed estrogen and is then unpredictably or heavily shed, causing irregular and heavy periods. (2) *Attempt either subpart C or D.* C. It suggests lack of ovulation due to hormonal imbalance affecting ovarian function. (1) **OR** D. GnRH secretion from hypothalamus and subsequent LH/FSH secretion from pituitary would be disrupted. (1)	4
30	A. NPV is species-specific and affects only target insect pests, narrow spectrum insecticide; causes no harm to plants, pollinators, mammals, birds, fish, or non-target insects. (1) B. He could have sprayed the spores of Bacillus thuringiensis, in the gut of the larvae, the bacterial toxin is released and the larvae get killed. (2) C. Baculovirus (1) **OR** D. Because it is a biological method for controlling plant diseases and pests. (1)	4
	Section – E	
31	***Attempt either option A or B.*** A. I. The term given to a segment of DNA that codes for a polypeptide is Cistron. (0.5) II. (a) 3'-- TACAAAAAGAAGAAAAAGAAAATT--5'—Point Mutation. (1) (b) 3'—TACAAAAAGAAGAAAAAGAAATT--5'—Deletion / Frameshift mutation. (1)	5

	III. Methionine -Phenylalanine -Phenylalanine -Phenylalanine - Phenylalanine -Phenylalanine –Phenylalanine; 7 amino acids. (2) IV. Degenerate. (0.5) **OR** B. I. AUGACC**GUA**GCGUUU**GUA**UCUUUA**GUA**GUG**GUA**UUA**GUA**GGC Nine amino acids will be translated from the mature or processed RNA. (1) 5'**ACGUCG** ---------- **UAAAAA**3' Location of the untranslated region from the above messenger RNA will be at the 5' end and 3'prime end and their sequences are 5'ACGUCG and 3' end UAAAAA. (2) They are required for efficient translation process. (0.5) II.  (1) 4th triplet codon codes for phenylalanine. (0.5)	
32	***Attempt either option A or B.*** A. I. Plate B fails to show radioactivity because the probe could not hybridise with its DNA sequence, indicating the presence of the mutated β-globin gene (sickle mutation). Plates A and C show signals since their DNA has the normal complementary sequence. (2) II. ● Normal individual: Probe binds fully → strong radioactivity observed ● Carrier (heterozygote): Both normal and mutated sequences present → partial hybridisation (mixed pattern). ● Patient (homozygous mutant): No hybridisation with the probe → no radioactivity seen. (2) III. Insertional inactivation (1) **OR** B. I. Test tube A (bacteria): DNA isolation will fail because bacteria require lysozyme, not cellulase, to digest the peptidoglycan cell wall. ● Test tube B (plant): DNA isolation will succeed because plants require cellulase to digest cellulose walls. ● Test tube C (fungus): DNA isolation will fail because fungi require chitinase to digest chitin walls. ● Correction: Use lysozyme for bacteria, cellulase for plants, and chitinase for fungi. (2)	5

II. The further steps are
- Break open cells → DNA released with RNA, proteins, polysaccharides, and lipids.
- Remove contaminants:
  - RNase digests RNA
  - Protease digests proteins
- Remove polysaccharides and lipids by specific treatments.
- Add chilled ethanol → DNA precipitates as white threads, spooled on a glass rod. (2)

III. Spooled DNA can be used in genetic engineering, PCR amplification, DNA fingerprinting, or sequencing. (1)

33 ***Attempt either option A or B.*** 5

A.

(a)

Biodiversity Threat	**Explanation of the effect it will have**
Overexploitation	Unsustainable sourcing of wild medicinal plants by the cosmetic brand threatens plant species/may lead to depletion and extinction of valuable species. (1)
Invasion by alien species	Ornamental grass from another country spreading aggressively into native grassland/outcompetes native grasses, reduces local biodiversity. (1)
Co-extinction	Disappearance of nesting tree species causing sharp decline in migratory bird population/ disrupts ecological balance, loss of niches. (1)
Habitat loss and fragmentation	Forest fires lead to habitat loss and fragmentation by destroying forest vegetation and breaking continuous habitats into smaller, isolated patches. This forces species to migrate, reduces population sizes, and alters species distribution, often resulting in local extinction and decline in biodiversity. (1)

(b) Example: Declaration of *Green Valley X* as a **protected area** (wildlife sanctuary/national park/biosphere reserve/sacred grove/hotspot). Justification: Maintains species in their natural habitat, preserves ecological interactions, and allows long-term protection of genetic, species, and ecosystem diversity. (1)

OR

B.

I.

Step / Process	**Description**
Fragmentation	Breaking down of waste into smaller particles by detritivores (e.g., earthworms, termites). (1)
Leaching	Soluble inorganic nutrients dissolve in water and percolate into the composting soil. (1)

Catabolism	Enzymatic breakdown of complex organic matter into simpler inorganic substances by bacteria/fungi. (1)
Humification & Mineralisation	Formation of humus and release of inorganic nutrients into the compost by microbes. (1)

II. A dry spell would lower moisture content, slowing microbial activity and enzymatic breakdown, thereby reducing the rate of decomposition and delaying the reduction in waste volume. (1)

****

BIOLOGY – Code No. 044
SAMPLE QUESTION PAPER*
CLASS – XII (2025-26)

Maximum Marks: 70 **Time: 3 hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions.
(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. Answer all 33 questions. 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. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

Q. No	Question	Marks
1	The male gametes in plants are formed by: A. Mitotic division of nucleus of vegetative cell B. Meiotic division of nucleus of vegetative cell C. Mitotic division of nucleus of generative cell D. Meiotic division of nucleus of generative cell	1
2	The primary endosperm nucleus is formed by fusion of which of the following? A. A male gamete and a female gamete B. A male gamete and two polar nuclei C. A female gamete and two synergids D. Two male gametes and an egg cell	1
3	During the menstrual cycle of a human female, formation of graafian follicle is stimulated by secretion of which of the following gonadotropin hormones? A. Estrogen and progesterone B. FSH and Estrogen C. FSH and LH D. Progesterone and LH	1

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

4	The experimental proof on the thermal stability of genetic material was first provided by experiments of A. Hershey and Chase B. Meselson and Stahl C. Frederick Griffith D. Jacob an Monod	1
5	Short stretches of DNA used to identify complementary sequences in a sample are called A. Probes B. Markers C. Primers D. Minisatellites	1
6	Select the **incorrect statement** among the following. A. $p^2+2pq+q^2 = 1$. This is binomial expansion of $(p+q)^2$. B. When frequency measured differs from expected values, the difference (direction) indicates the extent of evolutionary change. C. Hardy-Weinberg principle says that phenotype frequencies in a population are stable and are constant from generation to generation. D. The gene pool (total genes and their alleles in a population) remains constant. This is called genetic equilibrium. Sum total of all the allelic frequencies is 1.	1
7	Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino? A. 100% B. 25% C. 50% D. 75%	1
8	"In Cricket species, the sound produced by rubbing the wings or legs together play a crucial role in attracting mates, any change in the morphology of Cricket legs could potentially affect their ability to produce sound". A mutant Cricket had thicker hind legs. What would you expect for this cricket species? A. The leg mutation will not lead to speciation if they diversify into new habitats. B. The leg mutation will have little effect on other external features, and therefore have little effect on speciation. C. The leg mutation will have no effect on behavior, and thus have little effect on speciation. D. The leg mutation might lead to reproductive isolation and speciation due to an effect on the mating call.	1

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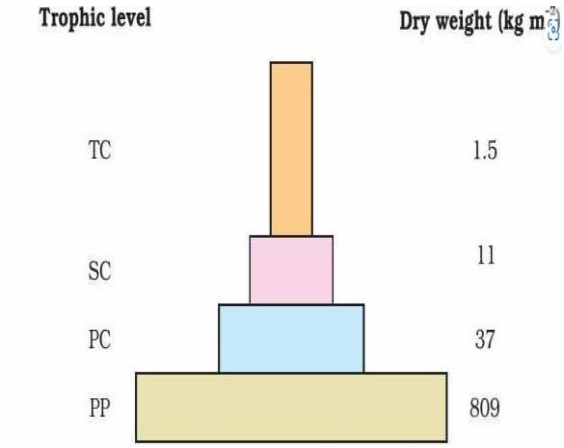
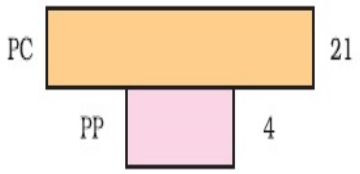
<table>
<tr><td>9</td><td>Plasmodium is a pathogen that causes malaria. Identify the correct sequence of transmission of the pathogen.
<table>
<tr><th></th><th>I
Stage of pathogen as it is transferred by vector bite</th><th>II
First site in the host body where the pathogens infect and proliferates</th><th>III
Second site in the host body where the pathogen infects and manifests clinical symptoms</th><th>IV
Stage of pathogen as it is transferred to a new vector</th></tr>
<tr><td>A</td><td>Sporozoites</td><td>Erythrocyte infection</td><td>Liver infection</td><td>Gametocytes</td></tr>
<tr><td>B</td><td>Gametocytes</td><td>Erythrocyte infection</td><td>Liver infection</td><td>Sporozoites</td></tr>
<tr><td>C</td><td>Gametocytes</td><td>Liver infection</td><td>Erythrocyte infection</td><td>Sporozoites</td></tr>
<tr><td>D</td><td>Sporozoites</td><td>Liver infection</td><td>Erythrocyte infection</td><td>Gametocytes</td></tr>
</table></td><td>1</td></tr>
<tr><td>10</td><td>Which mRNA will be translated to a polypeptide chain containing 8 amino acids?
A. AUGUUAAUAGACGAGUAGCGACGAUGU
B. AUGAGACGGACUGCAUUCCCAACCUGA
C. AUGCCCAACCGUUAUUCAUGCUAG
D. AUGUCGACAGUCUAAAACAGCGGG</td><td>1</td></tr>
<tr><td>11</td><td>In order to isolate genetic material of a bacterium, the cell must be treated with
A. Lysozyme, ribonuclease, protease, chilled ethanol
B. Cellulase, ribonuclease, protease, chilled ethanol
C. Chitinase, ribonuclease, chilled ethanol, water
D. Ribonuclease, protease, chilled ethanol, water</td><td>1</td></tr>
<tr><td>12</td><td>Integrated Pest Management involves
I. Using pesticides/insecticides judiciously
II. Using biocontrol agents
III. Engaging in organic farming
A. Only I
B. Only II
C. Both I and II
D. Only III</td><td>1</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>13</td><td>Assertion (A): The ability of the pistil to recognise the pollen is the result of a continuous dialogue between pollen and pistil.
Reason (R): This electrical dialogue allows only compatible pollen to germinate.</td><td>1</td></tr>
</table>

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

<table>
<tr><td>14</td><td>Assertion (A): Some organisms are better adapted to survive in an otherwise hostile environment.
Reason (R): Adaptive ability is inherited and has a genetic basis.</td><td>1</td></tr>
<tr><td>15</td><td>Assertion (A): Excess dose of coke or crack produces a sense of euphoria, increased energy and causes hallucinations.
Reason(R): It interferes with the transport of dopamine</td><td>1</td></tr>
<tr><td>16</td><td>Assertion (A): Rosie was the first transgenic cow to make more nutritionally balanced milk for consumption by human babies.
Reason (R): The milk of Rosie cow contained human beta- lactalbumin which made the milk rich in protein.</td><td>1</td></tr>
<tr><td colspan="3">Section – B</td></tr>
<tr><td>17</td><td><u>Attempt either option A or B.</u>
A. During artificial hybridization, it is important to ensure that only desired pollen grains are used for pollination. How is it ensured?
OR
B. Why is manual transfer of desired pollen grains relatively easy in pea plants for hybridization, but in wheat, pollen grains are often utilized from pollen banks for hybridization purposes?</td><td>2</td></tr>
<tr><td>18</td><td>How is the rate of initiation of RNA polymerase at a given promoter in a transcriptional unit of prokaryotes regulated?</td><td>2</td></tr>
<tr><td>19</td><td>The table below shows a hypothetical blood report of a patient.
<table>
<tr><th>Test description</th><th>Observed value</th><th>Unit</th><th>Reference range</th></tr>
<tr><td>Leucocytes</td><td></td><td></td><td></td></tr>
<tr><td>Total leucocyte count</td><td>1100</td><td>Per Microliter</td><td>4400-11000</td></tr>
<tr><td>Neutrophils</td><td>31</td><td>%</td><td>55-70</td></tr>
<tr><td>Lymphocytes</td><td>25</td><td>%</td><td>20-40</td></tr>
<tr><td>Basophils</td><td>0.5</td><td>%</td><td>0.5 - 1</td></tr>
<tr><td>Eosinophils</td><td>02</td><td>%</td><td>1-4</td></tr>
<tr><td>Monocytes</td><td>0</td><td>%</td><td>1-8</td></tr>
</table>
A. Looking at the values suggest which defense mechanism/ immunity is affected and state how this defense mechanism provides immunity.
B. Name the barrier with least count and enumerate its role in providing immunity.</td><td>2</td></tr>
</table>

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

20	***Attempt either option A or B.*** A. A cheese maker claims to be a biotechnologist. How will you support the same? **OR** B. Why does the 'insertional inactivation' method to detect recombinant DNA is preferred to 'antibiotic resistance' procedure?	2
21	***Attempt either option A or B.*** A. (i) Compare the two ecological pyramids of biomass I and II given below and explain the situations in which this is possible.  **Fig. I**  **Fig. II** (ii) Construct an ideal pyramid of energy if 200,000 joules of sunlight are available. - - - - - - - - - - - - - - - - - - *For Visually impaired students*: A. (i) Compare the upright and inverted ecological pyramids of biomass and explain the situations in which this is possible. (ii) Construct an ideal pyramid of energy if 200,000 joules of sunlight is available. **OR** B. A tropical rainforest in South America is home to more than 40,000 species of plants, 3,000 of fishes, 1,300 of birds, 427 of mammals, 427 of amphibians, 378 of reptiles and 1,25,000 insects, snails and worms. From the given data, calculate the total number of known vertebrate species in the rainforest. (i) Give a reason to justify the huge difference in the number of plant and animal species.	2

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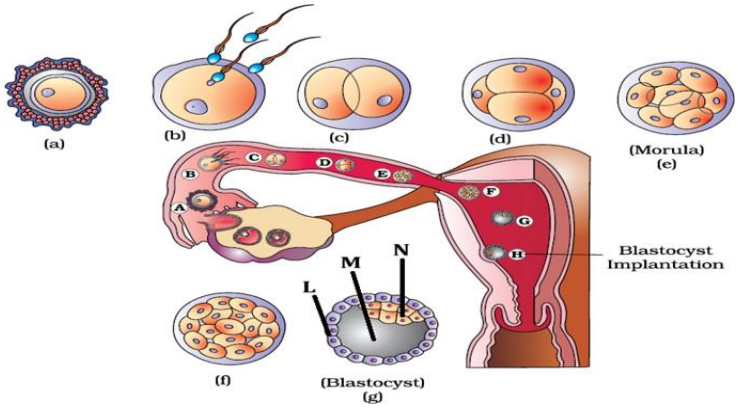
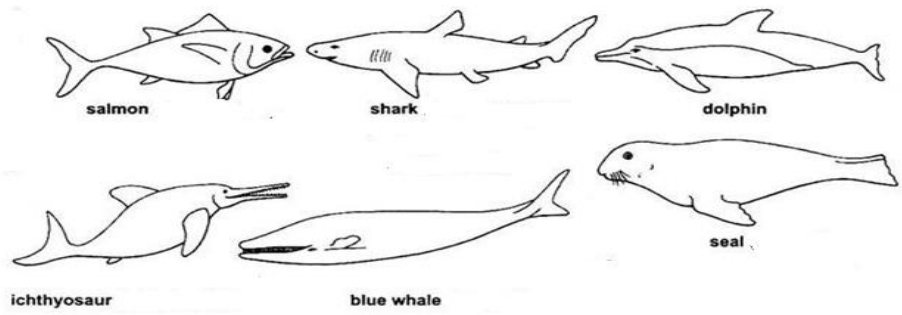
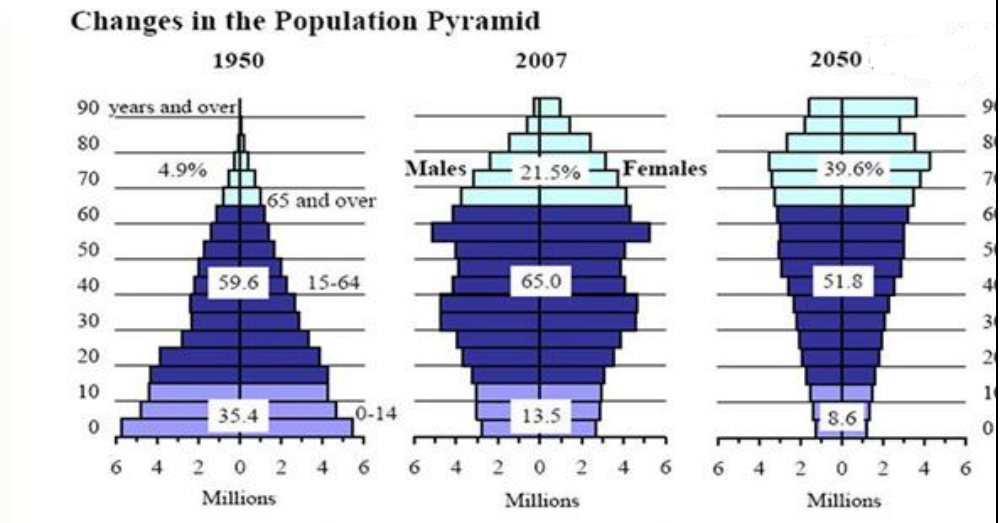
Section - C		
22	Suggest a suitable contraceptive device for the following cases with justification. (i) Mohini does not want to take the risk of conception and sexually transmitted infections (STIs). (ii) Lalita has two children and does not want any more children. (iii) Geeta wants a contraceptive that she can take till she wants to avoid conception and can resume back to her fertile life without the intervention of the doctor. Also, it should have a lower failure rate.	3
23	Given below is a figure showing transport of ovum, fertilisation and passage of growing embryo through fallopian tube in a human female. Answer the questions that follow: (i) What will be the ploidy of cells shown in (a) and (c) stage in the figure given below? (ii) What will happen if component L as shown in the figure (g) given below does not attach properly to the endometrium? (iii) In a pregnant mother (case X), during early pregnancy, the fertilised egg splits into two embryos at stage C shown in the figure given below, resulting in the formation of twins. Will the genome of cells of these two embryos exhibit variation? Justify your answer.  - - - - - - - - - - - - - - - - - - *For Visually impaired students* Explain the events and journey of an ovum in the fallopian tube of a mother from fertilisation stage to implantation.	3
24	In guinea pigs, black coat colour (G) dominates over white (g) and brown eyes (B) dominate over blue (b). The alleles for coat colour and eye colour are not linked. What will be the probability of the offspring having blue eyes and a white coat if both parents are heterozygous for eye and coat colour? Find the probability using a Punnett square	3

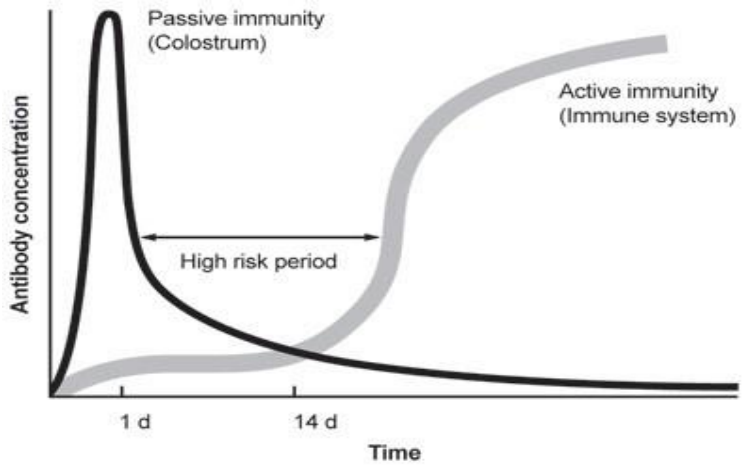
**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

25	Shown below are certain aquatic vertebrates, where natural selection has favoured them to develop certain characteristics which enable them to live in water.  A. Name and explain the phenomenon exhibited by the above animals. B. Which one of the above is the most primitive one? What is its significance? - - - - - - - - - - - - - - - - - - - *For Visually impaired students* A. What are the basic conceptual similarities and differences between Lamarckian and Darwinian theory of evolution? B. Give an example that supports any one of the above two theories.	3
26	The Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment is reduced. Enlist the process of how this is achieved.	3
27	Expand ELISA. On what principle is the ELISA test based? List two ways by which an infection can be detected by this test.	3
28	The population pyramids of Japan for the years 1950, 2007 and on the basis of the estimated value for 2050 have been shown below to answer the questions that follow:  A. Comment upon the growth status of the population on the basis of shape of the age pyramids.	3

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

<table>
<tr><td></td><td>B. What insights can you gain about their population dynamics?
- - - - - - - - - - - - - - - - - - -
<u>For visually impaired students</u>
The population pyramids of Japan for the years 1950, 2007 and on the basis of the estimated value for 2050 have broad-based, inverted bell and urn shape, respectively. Answer the following questions:
A. Comment upon the growth status of the population on the basis of shape of the age pyramids.
B. What insights can you gain about their population dynamics?</td><td></td></tr>
<tr><td colspan="3">Section – D</td></tr>
<tr><td>29</td><td>Given below is a set of information about some fruits and seeds.
<table>
<tr><th>Fruit</th><th>Fruit and seed formation</th></tr>
<tr><td>P</td><td>Nucellar cells surrounding the embryo sac develop into embryos.</td></tr>
<tr><td>Q</td><td>Ovary develops into the fruit by the application of growth hormones.</td></tr>
<tr><td>R</td><td>Thalamus contributes to fruit formation.</td></tr>
<tr><td>S</td><td>Ovary matures into a fruit after fertilisation.</td></tr>
</table>
On the basis of the information provided above, answer the following questions with justification for each answer.
A. How many embryo sacs will be present in each ovule of S before maturation and how many egg(s) will be present in each embryo sac when the embryo sac is developed from a single megaspore? (1)
B.
(i) Which of these fruits exhibits polyembryony? Will their embryos exhibit genetic variation? Justify.
(ii) What will be ploidy of the embryonic cells in the above case? (2)
<u>Attempt either subpart C or D.</u>
C. Which of these fruits can be considered as parthenocarpic? Give a reason. (1)
OR
D. Which of the fruits P, Q, R or S is a true fruit with seeds? Give reason. (1)</td><td>4</td></tr>
<tr><td>30</td><td>The graph below shows the Antibody concentration in young calves. Study the graph and answer the questions that follow:</td><td>4</td></tr>
</table>

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*



A. What do you think is the difference between passive and active immunity **i**n this case? (1)

B. What kind of immunity will be observed when a vaccine is administered to the calf and why? (2)

Attempt either subpart C or D.

C. What kind of trend does passive immunity show and why? (1)

OR

D. Why does active immunity start after 14 days as per the above graph?

- - - - - - - - - - - - - - - - - -

For visually impaired students

The antibody concentration in a young calf was studied. It was found that the antibodies derived from colostrum (passive immunity) decreased from day 1 to 14, while the antibodies derived from immune cells (active immunity) increased between day 1 to day 14 and remained steady thereafter.

A. What do you think is the difference between passive and active immunity **i**n this case? (1)

B. What kind of immunity will be observed when a vaccine is administered to the calf and why? (2)

Attempt either subpart C or D.

C. What kind of trend does passive immunity show and why? (1)

OR

D. Why does active immunity start after 14 days as per the above graph?

Section – E

31 A. Construct a complete transcription unit with promoter and terminator on the basis of the hypothetical template strand given below. 5



B. How is transcription a more complex process in eukaryotic cells?

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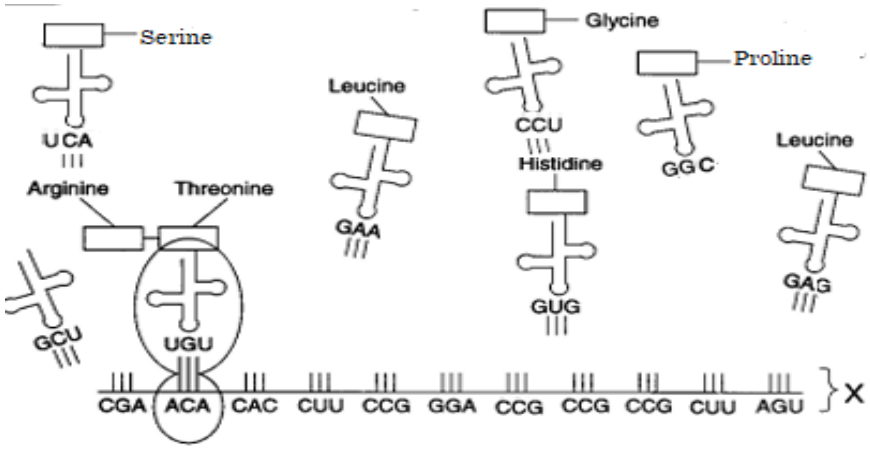
	Explain the additional processes that a precursor mRNA has to undergo in these organisms. - - - - - - - - - - - - - - - - - - - *For visually impaired students* A. Why are both the strands not copied during transcription? B. How is transcription a more complex process in eukaryotic cells? Explain the additional processes that a precursor mRNA has to undergo in these organisms. **OR** A. Explain the process of aminoacylation of tRNA. Mention its role in translation. B. How do ribosomes in the cells act as factories for protein synthesis? C. Given below is a strand of mRNA undergoing the process of translation, what will be the sequence of Amino acids that will be translated? Name the triplet codons that should be added to bring to the end of translation at X.  - - - - - - - - - - - - - - - - - - - *For visually impaired students* C. Explain the phenomenon that forms the genetic basis to prove that codon is a triplet and it is read in a contiguous manner.	
32	Some plant and animal pathogens serve as one of the tools of recombinant DNA (rDNA) technology.' A. Name one animal and one plant pathogen and discuss the pathogenic nature of both. State how they serve as a tool in rDNA technology. B. What are the enzymes needed for rDNA technology? C. A farmer owns a cotton farm land which is getting infested with coleopteran pests. He is not willing to use the microbes to protect his farm. i. Name an alternate method to introduce the gene of interest the pathogen would have otherwise delivered and discuss how the alternate method would deliver the gene. ii. State how this gene would control the pest.	5

**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

<table>
<tr><td></td><td>

OR

BamH1 is a restriction enzyme which recognizes the sequence-
5' - GGATCC - 3'. The restriction activity of this enzyme is between G and G.

A. Construct the palindrome for the above sequence.
B. Draw a labeled diagram to show the formation of recombinant DNA (rDNA) using BamH1.
C. PBR322 is a plasmid that has a restriction site for this enzyme at the tetracycline resistant gene. If BamH1 were to be used, how will it impact the response of the transformant with rDNA to antibiotics- ampicillin and tetracycline. Justify.

</td><td></td></tr>
<tr><td>33</td><td>

Justify the following statements with suitable proof/examples: -

A. ‘competition is not limited to closely related species’
B. ‘competition is not always dependent on resources being limiting’
C. ‘competitive exclusion occurs in nature’
D. ‘competing species may evolve mechanisms for co-existence’
E. ‘competition in nature comes from what is called ‘competitive release’’

OR

A. How does a simple food chain exemplify the First Law of Thermodynamics?
B. The table below shows the number of species in different parts of the world.

Name of Place	Number of Bird species
Columbia	1400
India	1200
Northern South America	1300
New York	105
Denmark	504

Identify the common factor in regions with a higher number of bird species and suggest at least two reasons for this greater diversity.

</td><td>5</td></tr>
</table>

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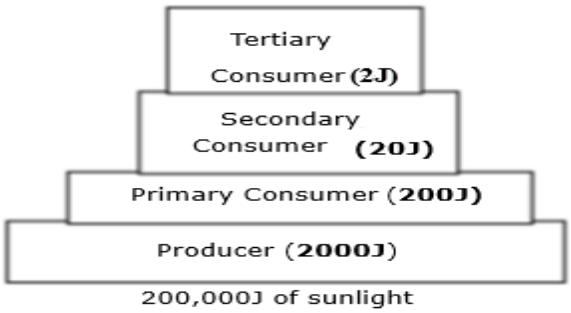
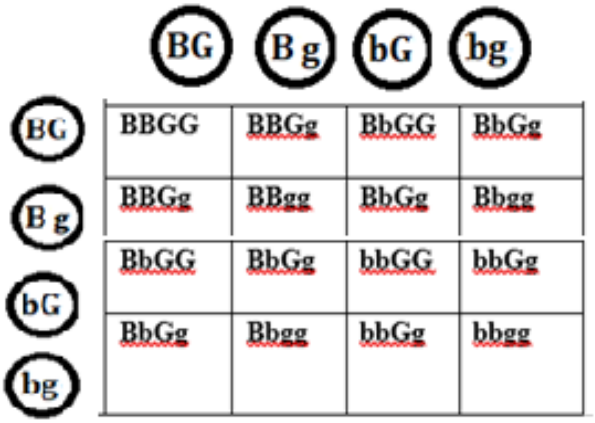
**Please note that the assessment scheme of the Academic Session 2024-25 will continue in the current session i.e. 2025-26.*

BIOLOGY Code no. 044
MARKING SCHEME
CLASS – XII (2025–26)

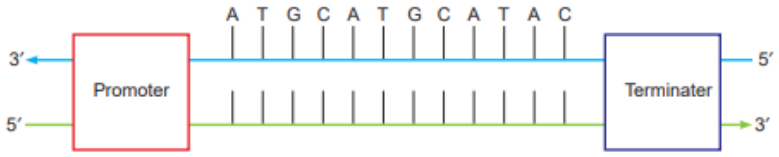
Q. No.	Answer	Marks
	Section - A	
1	C. Mitotic division of nucleus of generative cell	1
2	B. A male gamete and two polar nuclei	1
3	C. FSH and LH	1
4	C. Frederick Griffith	1
5	A. Probes	1
6	C. Hardy-Weinberg principle says that phenotype frequencies in a population are stable and are constant from generation to generation.	1
7	B. 25%	1
8	D. The leg mutation might lead to reproductive isolation and speciation due to an effect on the mating call.	1
9	D. Sporozoites, Liver infection, Erythrocyte infection, Gametocytes	1
10	B AUGAGACGGACUGCAUUCCCAACCUGA	1
11	A. Lysozyme, ribonuclease, protease, chilled ethanol	1
12	C. Both I and II	1
13	C. A is true but R is false	1
14	A. Both A and R are true and R is the correct explanation of A	1
15	A. Both A and R are true and R is the correct explanation of A	1
16	C. A is true but R is false	1
	Section - B	
17	A. It is achieved by emasculation and bagging techniques. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary. This step is referred to as emasculation. Emasculated flowers have to be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging. (1 x 2 = 2) **OR** B. In pea plants, manual emasculation is easier and pollen grains are viable for months as it belongs to Leguminosae. In wheat flowers (spikelets) pollen grain loses its viability half an hour after release. (1 x 2 = 2)	2

18	In a transcription unit, the activity of RNA polymerase at a given promoter is regulated by accessory proteins that have an ability to recognise start sites. (1) These regulatory proteins can act both positively (activators) and negatively (repressors) with the operator which is adjacent to the promoter in an operon unit. (1)	2
19	A. Innate immunity/ non-specific type of defense/immunity present at the time of birth is effected. It provides different types of barriers to the entry of the foreign agents into our body/destroys microbes/ prevents microbial growth. (1) B. Cellular barrier-monocytes is with least count and it can phagocytose and destroy microbes. (1)	2
20	Anyone who can use/modify any living organism or their products using technology is considered to be a biotechnologist. (1) Thus, cheese maker can be a biotechnologist as he uses microbes like bacteria, fungi to make cheese for commercial purpose (1) **OR** Selection of recombinants due to inactivation of antibiotics is a cumbersome procedure because it requires simultaneous plating on two plates having different antibiotics. (1) In insertional inactivation method, insertion of recombinant DNA within the coding sequence of the enzyme beta galactosidase results into inactivation of this enzyme and the colonies do not produce any colour. The presence of a chromogenic substrate gives blue coloured colonies in absence of an insert. (1)	2
21	A. (i) The first (upright) pyramid of biomass corresponds to a terrestrial ecosystem. Producers have maximum biomass, decreasing with herbivores (primary consumer), secondary consumer and tertiary consumer. Second (inverted) pyramid refers to a small standing crop of phytoplankton supporting a large standing crop of zooplankton/aquatic ecosystem. (1) (ii)  (1) - - - - - - - - - - - - - - - - - - *For Visually impaired students* (Answer same as (i) and (ii) above) **OR** B.	2

	(i) 3000+1300+427+427+378= 5532 (1) (ii) (a) Animals are mobile and can migrate to escape harsh conditions or explore new areas. (b) Animals have adapted to changing environments, developing complex nervous systems and receptors. Their responses are adaptive and ensure survival. Iii. Plants, being fixed, have fewer evolutionary adaptations for water, minerals, and sunlight. (Anyone, 1)	
Section – C		
22	(i) Condoms; these act by blocking the entry of microbes and sperms in the cervix. (ii) Surgical methods such as Tubectomy by her or vasectomy by her husband as these are highly effective but irreversible methods. (iii) Oral pills containing progestogens or progestogen – estrogen combination are very effective and can be repeated as long as the female derives to prevent conception. (1 x 3 =3)	3
23	(i) (a) ovum is haploid (n) and (c) – blastomeres are diploid(2n). (ii) If the trophoblast (L) does not attach to the endometrium properly, it can lead to implantation failure, pregnancy loss, and other pregnancy complications. (iii) In case X, the cells of these embryos will have identical genome as they have developed from the same zygote. (1 x 3 =3) - - - - - - - - - - - - - - - - - - - <u>*For Visually impaired students*</u> • The mitotic division called cleavage starts as the zygote moves through the isthmus of the oviduct towards the uterus and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 to 16 cell blastomeres is called a morula. (1) • The morula transforms into blastocyst and 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. (1) • The trophoblast layer then gets attached to the endometrium of the uterus and the inner cell mass gets differentiated as the embryo. After attachment, the uterine cells divide rapidly and cover the blastocyst which gets embedded in the endometrium leading to implantation. (1)	3
24	BbGg Male is crossed with BbGg female which are both heterozygous of both the characters for eye and coat colour. (1)	3

	 Punnett square (1) 1/16 or 6.25 % - blue eyes and white coat (1)	
25	A. These animals exhibit convergent evolution, structures that are not anatomically similar are evolved to perform similar functions adapted to the same habitat, the fins of Salmon and Shark, flippers of Dolphins, Seals and whales. One can say that it is the similar habitat that has resulted in selection of similar adaptive features in different groups of organisms but toward the same function: hence, analogous structures are a result of convergent evolution. (2) B. Ichthyosaurs. Some of the land reptiles went back into water to evolve into fish like reptiles probably 200 mya. (1) - - - - - - - - - - - - - - - - - - - *For Visually impaired students* A. Both Lamarck and Darwin believed that living things had hereditary traits, traits they could pass on to their offspring. They believed that some traits were more useful than others, and that over time the more useful trait would become more common. (1) The difference is that Lamarck believed that the changes in an organism experienced during its life could be passed on to succeeding generations/Inheritance of acquired characters. So, for instance Giraffe stretched its neck its entire life to eat leaves on tall plants, it would have longer-necked offspring (or any other example of Lamarckian theory). (1) Darwin believed that small, random and gradual genetic variations followed by natural selection lead to evolution- that some giraffes just naturally had longer necks, and these were the ones who had more children. So over time natural selection led to evolution of Giraffes with long neck were fitter than short-necked. (1)	3
26	'Flocs' and 'activated sludge' in sewage treatment help to reduce the BOD. (i) Flocs: These are masses of bacteria held together by slime and fungal filaments to form mesh-like structures. These are used during the secondary sewage treatment in the aeration tank to increase the rate of decomposition. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As a result, the	3

	BOD of sewage is reduced. As the BOD of waste is reduced to 1% of raw sewage. it is passed into the settling tank. In these tanks, flocs are allowed to undergo sedimentation. (ii) Activated sludge: The sediment of the settling tank is called activated sludge. A part of it is used as an inoculum in aeration tanks. The remaining part is passed into a large tank called an anaerobic sludge digester. In these tanks, anaerobic microbes are present that digest the organic mass as well as aerobic microbes of activated sludge. The remaining sludge is used as manure or compost.	
27	ELISA-Enzyme Linked Immunosorbent Assay. (1) ELISA is based on antigen-antibody interaction. (1) The ways to detect the presence of infection or disease by ELISA are as follows: The presence of antigens (proteins, glycoproteins, etc.) is detected. / Antibodies produced against the pathogens are detected. (1)	3
28	1950 – Expanding - The population structure in 1950 exhibits a broad-based pyramid with a wider base, indicating a higher percentage of young individuals. This suggests a population with a higher birth rate. (1) 2007 – Stable - The narrowing of the pyramid towards the top signifies a lower proportion of elderly individuals. By 2007, the population was more stable with the number of pre reproductive and reproductive age nearly being the same. Bell shape indicates static population. (1) 2050– Declining - By 2050 urn shaped pyramid shows a declining population where birth rates are very less and the populations of elderly people will increase. (1) - - - - - - - - - - - - - - - - - - <u>*For Visually impaired students*</u> Answer same as above	3
	Section – D	
29	A. One embryo sac is present in each ovule and one egg is present in each embryo sac when the embryo sac is developed from a single megaspore. (1) B. (i) P exhibits polyembryony due to occurrence of more than one embryo in a seed. Embryos developed from nucellar cells by apomixis, a form of asexual reproduction, don't show genetic variation. (1) (ii) Cells of embryos developed from diploid nucellar cells are diploid (2n) as these are formed by apomixis, a form of asexual reproduction. (1) <u>*Student to attempt either subpart C or D.*</u> C. Q, because this fruit is developed without fertilisation and will thus be seedless. (1) **OR** D. Fruit S is a true fruit with seeds. True fruits develop from the ripened ovary after fertilisation and fertilised ovules mature into seeds. (1)	4

30	A. Passive immunity – Ready made antibodies from colostrum / less effective / transient / no memory cells involved Active Immunity – Made by host's immune system/ Lag phase/ memory based/ largely effective. (1) B. Active immunity. As the vaccine contains a weakened or inactivated form of the pathogen (microbe), which is harmless but still recognized by the immune system as foreign. The immune system responds by activating lymphocytes, which produce specific antibodies to fight the pathogen. This process also leads to the creation of memory cells, which provide long-term protection by "remembering" to fight this pathogen if the person is exposed again. (2) *Attempt either subpart C or D.* C. This passive immunity peaks at day 1 and declines as the calf ag as the antibodies are used up to develop immunity against diseases/no memory. (1) **OR** D. Active immunity is slow, and it takes time to give its full effective response. (1) - - - - - - - - - - - - - - - - - - - *For Visually impaired students* Same answers as given in parts A - D.	4
Section – E		
31	A.  B. (2) • Transcription in eukaryotes involves one of three types of polymerases, depending on the gene being transcribed. RNA polymerase II transcribes all of the protein-coding genes, whereas RNA polymerase I transcribes rRNA genes, and RNA polymerase III transcribes rRNA, tRNA, and small nuclear RNA genes. (1) • The primary transcripts contains the coding region, exon, and non-coding region, intron, hnRNA undergoes a process where the introns are removed and exons are joined to form mRNA by the process called splicing. (1) • The hnRNA undergoes two additional processes called capping and tailing. In capping, an unusual nucleotide, methyl guanosine triphosphate, is added to the 5′-end of hnRNA. In tailing, adenylate residues (about 200–300) are added at 3′-end in a template independent manner. (1) - - - - - - - - - - - - - - - - - - - *For visually impaired students* A. If both strands act as a template, they will code for RNA molecules with	5

different sequences as complementarity does not mean the strands are identical and hence, the sequence of amino acids in the proteins would be different. Hence, one segment of the DNA would be coding for two different proteins, and this would complicate the genetic information transfer machinery. (1)

The two RNA molecules if produced simultaneously would be complementary to each other, hence would form a double stranded RNA. This would prevent RNA from being translated into protein and the exercise of transcription would become a futile one. (1)

B. Transcription in eukaryotes involves one of three types of polymerases, depending on the gene being transcribed. RNA polymerase II transcribes all of the protein-coding genes, whereas RNA polymerase I transcribes rRNA genes, and RNA polymerase III transcribes rRNA, tRNA, and small nuclear RNA genes. (1)

The primary transcripts contain the coding region, exon, and non-coding region, intron, hnRNA undergoes a process where the introns are removed and exons are joined to form mRNA by the process called splicing. (1)

The hnRNA undergoes two additional processes called capping and tailing. In capping, an unusual nucleotide, methyl guanosine triphosphate, is added to the 5′-end of hnRNA. In tailing, adenylate residues (about 200–300) are added at 3′-end in a template independent manner. (1)

OR

A. Aminoacylation is the process by which amino acids become activated by binding with its aminoacyl tRNA synthetase in the presence of ATP. If two charged tRNAs come close during translation process the formation of peptide bond between them is energetically favourable. (1)

B. The cellular factory responsible for synthesising proteins is the ribosome. In its inactive state it exists as two subunits: a large subunit and a small subunit. When the small subunit encounters an mRNA the process of translation of the mRNA to protein begins. There are two sites in the large subunit for subsequent amino acids to bind to and thus be close enough to each other for the formation of a peptide bond. The ribosome also acts as a catalyst 23S rRNA in bacteria is the enzyme-ribozyme for the formation of peptide bonds. (2)

C. ARGININE, THREONINE, HISTIDINE, LEUCINE, PROLINE, GLYCINE, PROLINE PROLINE, PROLINE, LEUCINE SERINE (1)

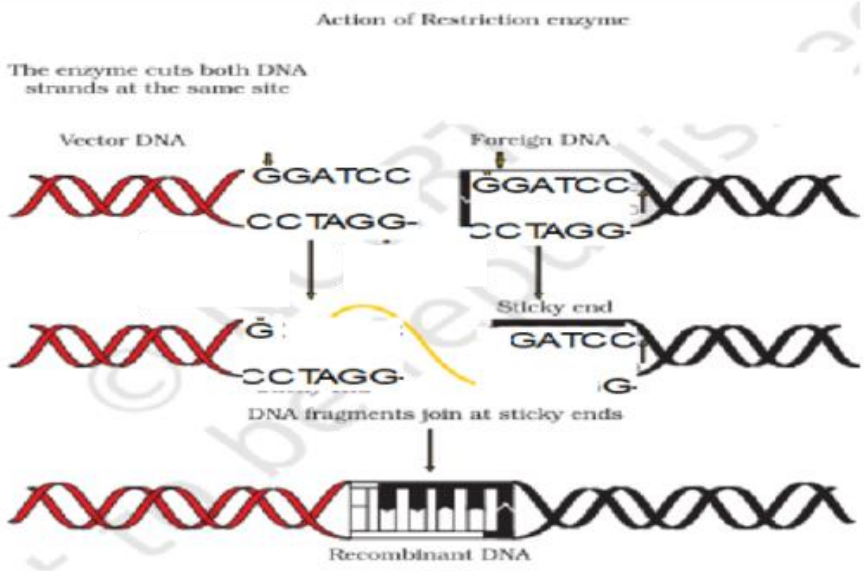
Stop codon UGA/UAG/UAA (1)

- - - - - - - - - - - - - - - - - - -

For visually impaired students

A and B as above

C. Insertion or deletion of one or two bases changes the reading frame from the point of insertion or deletion. Such mutations are referred to as frame-shift mutations. Insertion or deletion of three or multiple of three bases does not alter the frame. However, the mutation takes place. This proves that codon is a triplet and it is read in a contiguous manner. (2)

32	A. Retrovirus in animals and *Agrobacterium tumefaciens* can transform normal cells into cancerous cells/*Agrobacterium tumefaciens* is responsible for causing crown gall disease/ it can transfer its T-DNA to transform normal plant cell into tumorous cells (1). They are used as cloning vectors to deliver desirable genes into animal/plant cells. (1) B. restriction enzyme and ligase. (1). C. (i) Biolistic/ gene guns can be used. The plant cells are bombarded with high velocity micro particles of gold or tungsten coated with DNA. (1) (ii) the cry gene will create Bt toxin inside the pest which will get activated in the alkaline gut of the pest and cause the gut epithelial lining to disintegrate. (1) **OR** A. 5' - GGATCC - 3'. 3'- CCTAGG-5' (1) B. drawing and labelling (2)  C. If ampicillin is added, the bacteria will show resistance as the gene is intact and will survive; if tetracycline is added, the bacteria will die as it will show insertional inactivation/ gene is not functional owing to insertion of the gene of interest in the tetracycline region of selectable marker. (2)	5
33	A. Totally unrelated species could also compete for the same resource. For instance, in some shallow South American lakes, visiting flamingoes and resident fishes compete for their common food, the zooplankton in the lake. (1) B. Resources need not be limiting for competition to occur; in interference competition, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources (food and space) are abundant. (1) C. Gause and other experimental ecologists believed when resources are limited the competitively superior species will eventually eliminate the other species. The Abingdon tortoise in Galapagos Islands became	5

extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats. (1)

D. One such mechanism is 'resource partitioning'. If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns. MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities. (1)

E. A species whose distribution is limited to a smaller area because of the presence of a competitively superior organism, is found to increase its range when the competing species is experimentally removed. For example, in the coasts of Scotland the superior barnacle (*Balanus*) dominates the intertidal region and excludes the smaller barnacle from that zone. (1)

OR

A. Food chain and the first law of thermodynamics. The solar energy trapped by the plants is transformed to chemical energy through the process of photosynthesis. When the plants are consumed by the animals, the organic matter (chemical energy) is transferred to the animal, some amount of this organic matter is lost as heat through the process of respiration. Death of the producers or consumers will result in the organic matter getting transferred to detritivores. As demonstrated, energy is not created nor destroyed but transformed from one form to another. (2)

B. Greater diversity is seen in regions closer to equator/ tropics (latitudinal range of 23.5° N to 23.5° S) harbour more species. (1)

Reasons for this greater diversity are: (Any two reason)

- Speciation is generally a function of time, unlike temperate regions subjected to frequent glaciations in the past, tropical latitudes have remained relatively undisturbed for millions of years and thus, had a long evolutionary time for species diversification
- Tropical environments, unlike temperate ones, are less seasonal, relatively more constant and predictable. Such constant environments promote niche specialisation and lead to a greater species diversity
- There is more solar energy available in the tropics, which contributes to higher productivity; this in turn might contribute indirectly to greater diversity. (2, any two)

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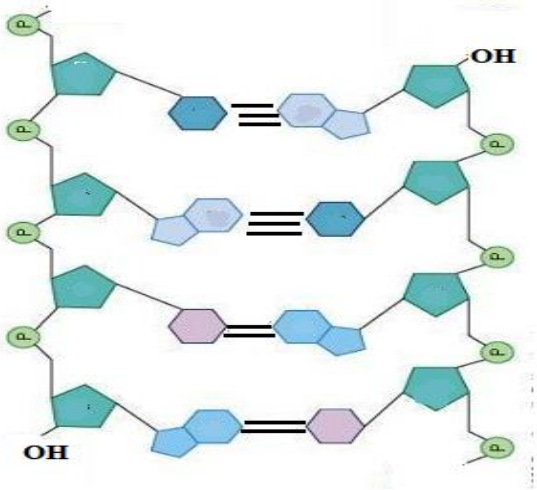
Sample Question Paper
Class XII
044 Biology (2024-25)

Maximum Marks: 70 **Time: 3 hours**

General Instructions:

(i) All questions are compulsory.
(ii) The question paper has five sections and 33 questions.
(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.

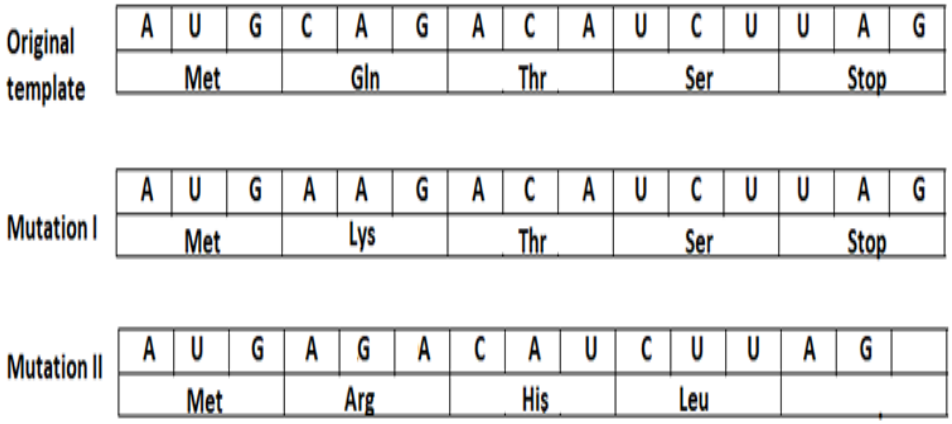
Section – A **Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.**		
Q. No	**Question**	**Marks**
1	Signals for parturition in human female originate from A. Fully developed foetus only B. Both placenta as well as fully developed foetus C. Placenta only D. Oxytocin released from maternal pituitary	1
2	To produce 1600 seeds, the number of meiotic divisions required will be A. 2400 B. 2000 C. 1600 D. 1800	1
3	A sample of normal double-stranded DNA was found to have thymine content of 27%. What will be the expected proportion of guanine in this strand? A. 23% B. 32% C. 36% D. 73%	1

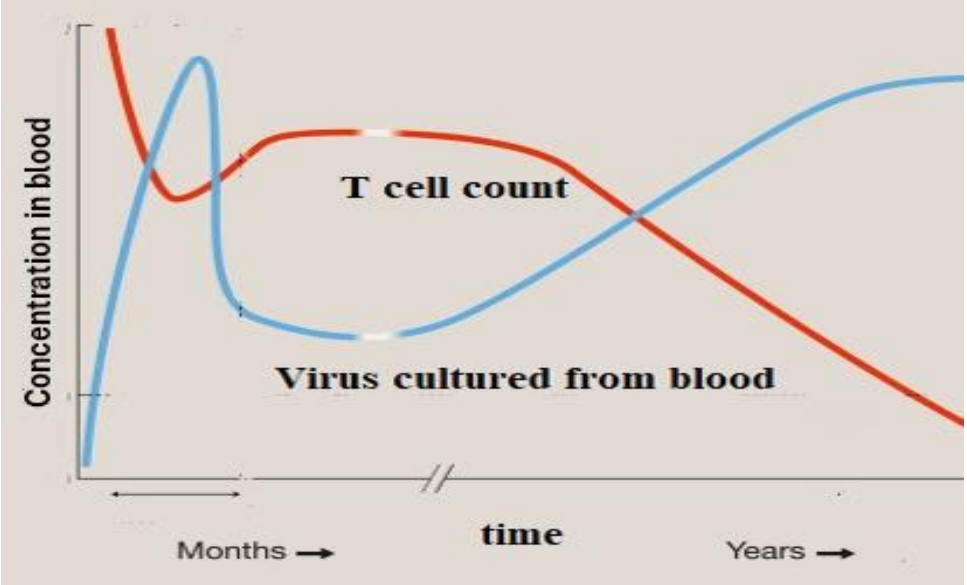
4	Observe the schematic diagram that depicts a small section of nucleic acid. The bases in two strands are paired through hydrogen bonds that are shown by the dark lines. Identify the correct sequence of nucleotide in the 5'-3' direction.  A. GCAT B. CGTA C. TAGC D. ATCG - - - - - - - - - - - - - - - - - - - *For Visual Impaired Students* *E. coli* has 4.6 X 10^{6} base pairs and completes the process of replication in 18 minutes, then the average rate of polymerization is approximately A. 2000 bp/s B. 4000 bp/s C. 3000 bp/s D. 1000 bp/s	1
5	Suresh and Rajesh have defective haemoglobin due to genetic disorders. In Suresh, the problem is qualitative as he is having incorrectly functioning globin molecules while in Rajesh the problem is quantitative as he is having very few globin molecules. Identify the disorder they are suffering from.	1

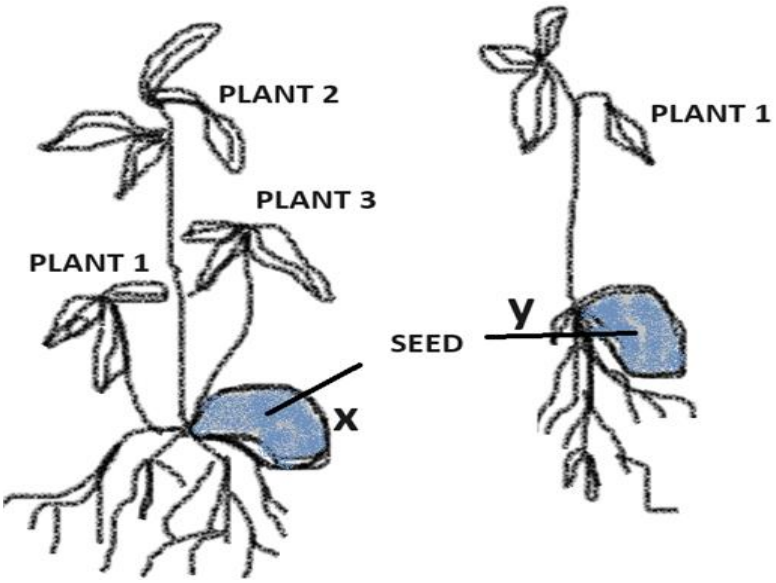
	Suresh	Rajesh
A	Thalassemia - Autosomal Dominant blood disorder	Sickle Cell Anaemia - Autosomal linked Recessive trait
B	Sickle Cell Anaemia - Autosomal linked Dominant trait	Thalassemia - Autosomal Recessive blood disorder
C	Sickle Cell Anaemia – Autosomal linked Recessive trait	Thalassemia – Autosomal Recessive blood disorder
D	Thalassemia - Autosomal Dominant blood disorder	Sickle Cell Anaemia - Autosomal linked Dominant trait

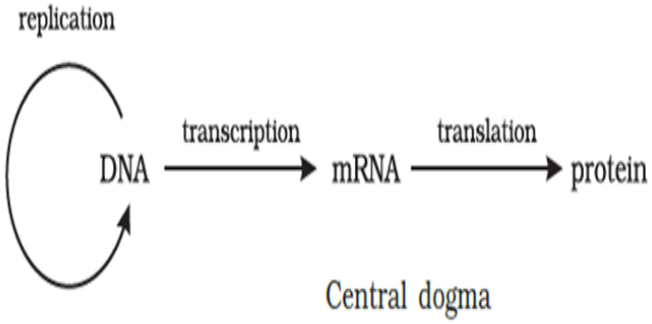
6	In *E.coli*, the lac operon gets switched on when lactose is A. present in the medium and it binds to the repressor. B. not present in the medium and the repressor binds to the operator. C. not present in the medium and RNA polymerase binds to the operator. D. Active lactose present in the medium binds to RNA polymerase.	1
7	Which of the following features shows the mechanism of sex determination in honey-bee? (i) An offspring formed from the union of a sperm and egg develops as a female. (ii) Males have half the number of chromosomes than that of female. (iii) The males are haploid having 32 chromosomes. (iv) All workers and males are diploid having 16 chromosomes A. (i) and (ii) B. (ii) and (iii) C. (i) and (iv) D. (ii) and (iv)	1
8	The following diagram shows a fragment of DNA which is going to be transcribed, the upper strand with polarity 3' to 5' is the template strand: 3´ ATTGCC 5´ 5´ TAACGG 3´ After transcription the mRNA can be represented by: A. 5´ AUUGCC 3´ B. 5´ AUUGCC 3' C. 5´ UAACGG 3´ D. 5´ GGCAAU 3´	1
9	Idli – dosa dough rises due to production of which of the following gas? A. CO B. CO_2 C. NO D. NO_2	1
10	Adaptive radiation leads to which of the following? A. Increased competition among species B. Decreased speciation rates C. Limited morphological diversity among species D. Rapid divergence of traits among populations inhabiting a given geographical area.	1

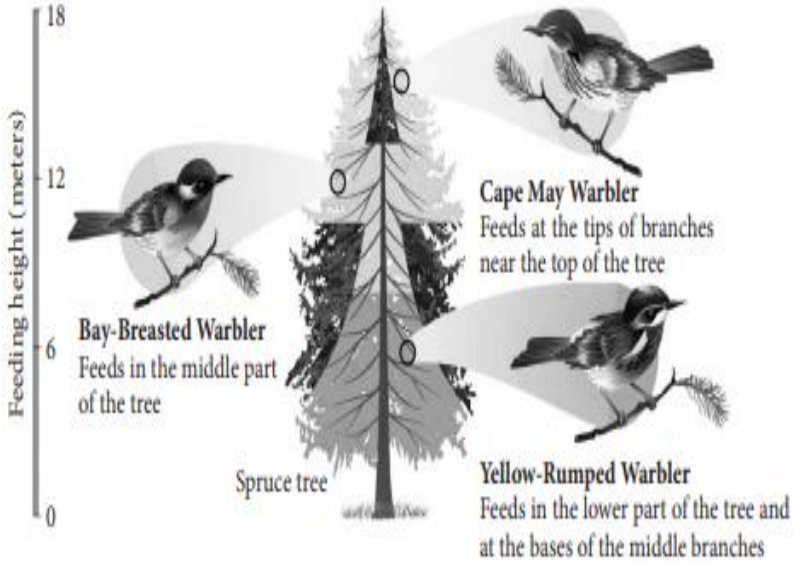
<table>
<tr><td>11</td><td>Eco R1 cuts the DNA between bases G and A only when the sequence of GAATTC is present. The number of nucleotides present in the resultant sticky ends that will be formed in each of the two strands of DNA after this enzyme cuts the DNA will be:
<table>
<tr><th></th><th>Vector DNA</th><th>Foreign DNA</th></tr>
<tr><td>A.</td><td>1 & 5</td><td>5 &1</td></tr>
<tr><td>B.</td><td>2 & 4</td><td>4 &2</td></tr>
<tr><td>C.</td><td>2 & 5</td><td>5 & 2</td></tr>
<tr><td>D.</td><td>3 & 4</td><td>4 & 3</td></tr>
</table></td><td>1</td></tr>
<tr><td>12</td><td>During the secondary treatment of sewage, which of the following change in the effluent occur due to flocs?
A. Reduction in BOD
B. Increase in BOD
C. Decrease in DO
D. No change in DO or BOD</td><td>1</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>13</td><td>Assertion (A): Cells of tapetum have more than one nucleus.
Reason (R): They undergo meiosis without cytokinesis.</td><td>1</td></tr>
<tr><td>14</td><td>Assertion (A): Deoxyribonucleoside triphosphates serve dual purposes.
Reason (R): They act as proof readers and provide energy.</td><td>1</td></tr>
<tr><td>15</td><td>Assertion (A): A floating cover placed over the slurry in a biogas plant keeps on rising.
Reason (R): This cover keeps on rising due to the gas produced in the tank by the microbial activity.</td><td>1</td></tr>
<tr><td>16</td><td>Assertion (A): DNA fragments can be isolated by Gel electrophoresis on the basis of their size.
Reason (R): The larger the fragment size, the faster it moves.</td><td>1</td></tr>
<tr><td colspan="3">Section - B</td></tr>
<tr><td>17</td><td><u>Attempt either option A or B.</u>
A.
(i) A blood test reported negative for hCG.
What does negative hCG imply? Name the tissue which produces hCG?</td><td>2</td></tr>
</table>

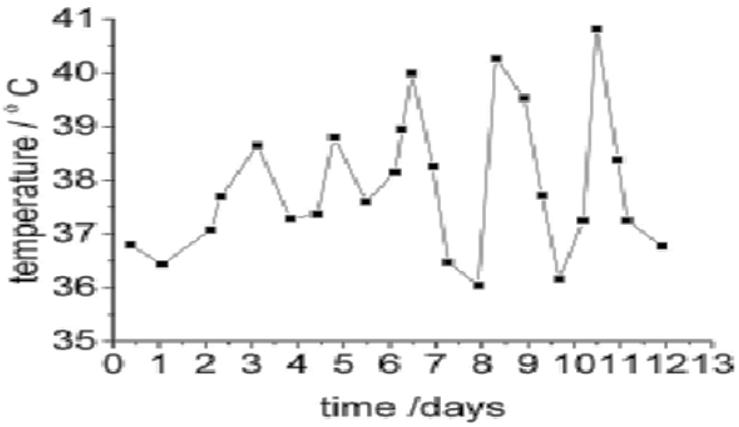
	(ii) If a blood test reported positive for hCG in a person, then which other hormones would also be secreted by the tissue secreting hCG? **OR** B. (i) The human male ejaculates about 200 to 300 million sperm during a coitus, however the ovum is fertilized by only one sperm. How does the ovum block the entry of additional sperms? (ii) All copulations will not lead to fertilization. Why?	
18	*Attempt either option A or B.* A. The schematic representation given below shows a DNA strand and two types of mutations in the DNA strand.  (i) Identify the type of mutation exhibited in I and II. (ii) Which of the above mutation is more harmful? Give reason. **OR** B. Given below is a schematic representation of a mRNA strand  (i) In the above sequence identify the translational unit in mRNA. (ii) Where are UTRs found and what is their significance?	2

19	Given below is the relationship between the HIV levels in the blood and helper T cell count in a person detected with AIDS. Study the relationship and answer the questions that follow.  A. What kind of relationship is observed in the virus levels and the immune response after some days of the initial infection? B. Does it completely clear the virus from the body permanently? Give reason for your answer. - - - - - - - - - - - - - - - - - - - *For visually impaired students.* Write the sequence of events that occur when a retrovirus enters a human being, causing reduction in helper T-cells.	2
20	A culture plate of *Lactobacillus* shows blue-coloured colonies and colourless colonies. Explain the principle involved in the formation of such variance in the colour of colonies.	2
21	*Attempt either option A or B.* A. (i) It was estimated that if an evergreen forest has a GPP of 400 J/m^2/day and 150 J/m^2/day worth of carbon dioxide flows out of that forest, what is the NPP in that forest? (ii) Explain why pyramids of energy must always be upright. **OR** B. (i) Assume that, GPP Forest A = GPP Forest B = GPP Forest C, If Forest A has NPP = 1254 J/m^2/day; Forest B, NPP =2157 J/m^2/day; and Forest C, NPP = 779 J/m^2/day, which one of these forests has maximum energy loss by respiration? Give reason. (ii) Draw an ecological pyramid of number of the following food chains a. Grass — Animal —Fleas on the host animal b. Tree — Insects — Woodpecker	2

Section - C		
22	The image below shows two germinated seeds X and Y which belong to the same species. Seed X is produced by apomixis whereas seed Y is a product of sexual reproduction.  A. Write the number of embryo(s), embryo sac(s) and ovules in the ovary of seed X. B. How multiples embryos are formed in citrus fruits? C. What advantage will plants developed from seed Y have over seed X? - - - - - - - - - - - - - - - - - - - *For visually impaired students* Each Mango fruit contains one seed. Two mango seeds, X and Y were sown in the soil. From Seed X, 3 plant saplings germinated but from seed Y only 1 plant sapling germinated. A. For seed X which is apomictic, calculate the number of: i) Embryo(s) ii) Embryo sac(s) iii) Ovules in this seed's ovary B. How multiples embryos are formed in citrus fruits? C. What advantage will plants developed from seed Y have over seed X?	3
23	Name the place in human ovary where the first meiotic division is completed during oogenesis. What are the products of this division? Give the chromosome number of each type of cells involved in the process.	3

24	The schematic representation given below shows the concept of Central Dogma.  Central dogma A. During the process of replication and transcription the pairing of nitrogenous bases is not similar. Explain. B. How is the above process modified in a retrovirus? Name the process. C. Justify why during the process of transcription only a segment of DNA is copied into RNA. - - - - - - - - - - - - - - - - - - - *For visually impaired students* Central Dogma explains the process of DNA transcription and translation. From DNA mRNA is transcribed and then mRNA is translated into a polypeptide. A. During the process of replication and transcription the pairing of nitrogen bases is not similar. Explain. B. How is the above process modified in viruses? Name the process. C. Justify why during the process of transcription only a segment of DNA is copied into RNA.	3
25	Describe the steps involved in Southern blot hybridization using radiolabeled VNTR as a probe.	3
26	Bio-fertilisers are organisms that enrich the nutrient quality in the soil. Explain the role of three main sources of bio-fertilisers.	3
27	Explain how PCR technique can be used for amplification of a small amount of DNA template.	3
28	A. Diagram given below depicts different species of Warbler birds feeding on different regions on a Spruce tree. Explain the mechanism which helps them to co-exist.	3

	 B. What does Gause's exclusion principle state? Does it apply in the case shown above? Explain. - - - - - - - - - - - - - - - - - - - *For visually impaired students* A. Name and explain the mechanism where two species competing for the same resource co-exist. B. What does Gause's exclusion principle state? Does it apply in the above situation? Explain.	
Section - D		
29	Assuming that within a population of beetles where Hardy Weinberg conditions are met, the colour black (B) is dominant over the colour red (b). 40% of all beetles are red (bb). Given this information, answer the questions below: A. What is the frequency of red beetles? (1) B. Calculate is the percentage of beetles in the population that are heterozygous. (2) *Attempt either subpart C or D.* C. What is the frequency of homozygous dominant individuals? (1) **OR** D. Assuming that Hardy Wienberg conditions are met in the beetle population consisting of 1500 beetles. How many beetles would you expect to be black and red in colour respectively? (1)	4
30	Given below is the pattern of temperature in a person suffering from a non-viral disease transmitted by mosquitoes. Study the graph and answer the questions that follow:	4



A. Explain the factor(s) responsible for this pattern of temperature. (1)
B. How does this pathogen multiply in the human body? (2)

Attempt either subpart C or D.

C. How is this infection transmitted to humans? (1)

OR

D. Which stages of the life cycle of this pathogen are completed in the mosquito's gut? (1)

- - - - - - - - - - - - - - - - - - -

For visually impaired students

A. A non-viral disease that is transmitted by mosquitoes causes recurring fever in an infected person. Explain giving reason(s). (1)
B. How does this pathogen multiply in the human body? (2)

Attempt either subpart C or D.

C. How is this infection transmitted to humans? (1)

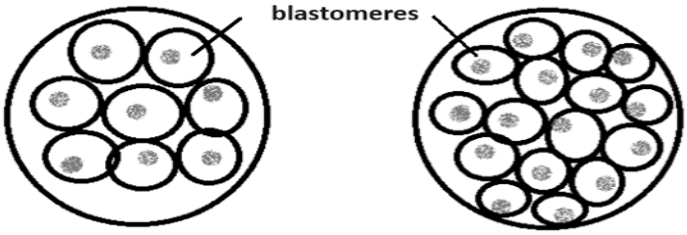
OR

D. Which stages of the life cycle of this pathogen are completed in the mosquito's gut? (1)

Section - E

31 *Attempt either option A or B.* 5

A. Cryptorchidism is a condition in which the testes fail to descend into the scrotum. It can also lead to compromised Sertoli cell function and has an impact on Leydig cell function.
   (i) Identify at least 3 parameters of male fertility which get affected due to cryptorchidism.
   (ii) Which process will be affected if mature spermatids are not released from Sertoli cells?
   (iii) Name and explain one assisted reproductive technology (ART process) in which the sperm/semen is used to assist fertilization.
   (iv) Name and explain the assisted reproductive technology that should be used to complete the development of embryos I and II shown in the figure given below.

	 Embryo I Embryo II - - - - - - - - - - - - - - - - - - - *For visually impaired students* (iv) An infertile couple decided to use ART to conceive. After IVF they decided for Embryo transfer of the following 2 embryos. Embryo 1 consisted of 8 blastomeres and Embryo 2 consisted of 16 blastomeres. Name and explain the techniques they should deploy to complete further development of the given embryos. **OR** B. (i) Explain the significance of each of the following features present in plants given below: a) In rose-bay plant the stamens ripen before the stigma. b) In certain species of primrose, the flowers have short stamen and long style. c) The bisexual flower of mustard exhibits rejection of self-pollen grain. (ii) Explain how autogamy is prevented in castor and papaya plant respectively.	
32	*Attempt either option A or B.* A. Explain how advent of biotechnology has helped in preventing infestation by nematodes and thereby increasing crop yield. **OR** B. In the future, genetic therapies may be used to prevent, treat, or cure certain inherited disorders in humans. Justify the statement with a suitable example.	5
33	*Attempt either option A or B.* A. (i) Why is there a need to conserve biodiversity? (Any two reasons) (ii) Name and explain any two causes that are responsible for the loss of biodiversity. **OR** B. (i) Name the two types of desirable approaches to conserve biodiversity? Explain with examples bringing out the difference between the two types. (ii) State the features of a stable biological community?	5

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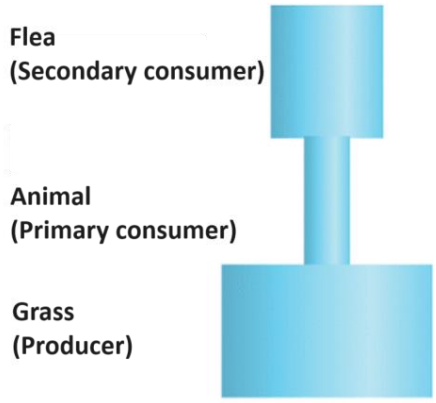
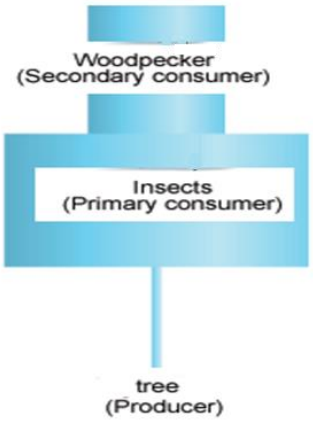
Marking Scheme
Biology (044)
Class XII (2024 – 25)

<table>
<tr><th>Q. No.</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">Section - A</td></tr>
<tr><td>1</td><td>B. Both placenta as well as fully developed foetus.</td><td>1</td></tr>
<tr><td>2</td><td>B. 2000
Formation of one seed requires fertilsation between one pollen grain and one egg. To produce 1600 seeds, 1600 pollen grains and 1600 eggs will be required. Each microspore mother cell results in the formation of 4 pollen grains after one cycle of meiotic division. So, 400 meiotic divisions will result in the production of 1600 pollen grains. One megaspore mother cell after one cycle of meiotic division results in the formation of 1 egg; so, 1600 meiotic divisions will take place to form 1600 eggs. Thus, total number of meiotic divisions required for the formation of 1600 seeds will be 400 + 1600 =2000.</td><td>1</td></tr>
<tr><td>3</td><td>A. 23%
According to Chargaff’s rules, in DNA, A =T and G=C;
Thus, A +T+G+C =100
Given T = 27% so A=T =27%
Thus A+T = 27 +27 =54%
Thus, G+C =100 – 54 = 46%
Since G = C so G = 46/2 =23%</td><td>1</td></tr>
<tr><td>4</td><td>B. CGTA
- - - - - - - - - - - - - - - - - - -
<u>For Visual Impaired Students</u>
B. 4000 bp/s
It completes replication process in 18 minutes i.e. 18x 60 seconds.
Rate of polymerization = 4.6 x 10^6 bp/ 18x 60 s
= 460000/108
= 4259.1bp/s or approximately 4000 bp/sec Thus, the correct option is B.</td><td>1</td></tr>
<tr><td>5</td><td>C.
Suresh | Rajesh
Sickle Cell Anaemia – Autosomal linked Recessive trait | Thalassemia – Autosomal Recessive blood disorder</td><td>1</td></tr>
<tr><td>6</td><td>A. present in the medium and it binds to the repressor.</td><td>1</td></tr>
<tr><td>7</td><td>A. (i) and (ii)</td><td>1</td></tr>
</table>

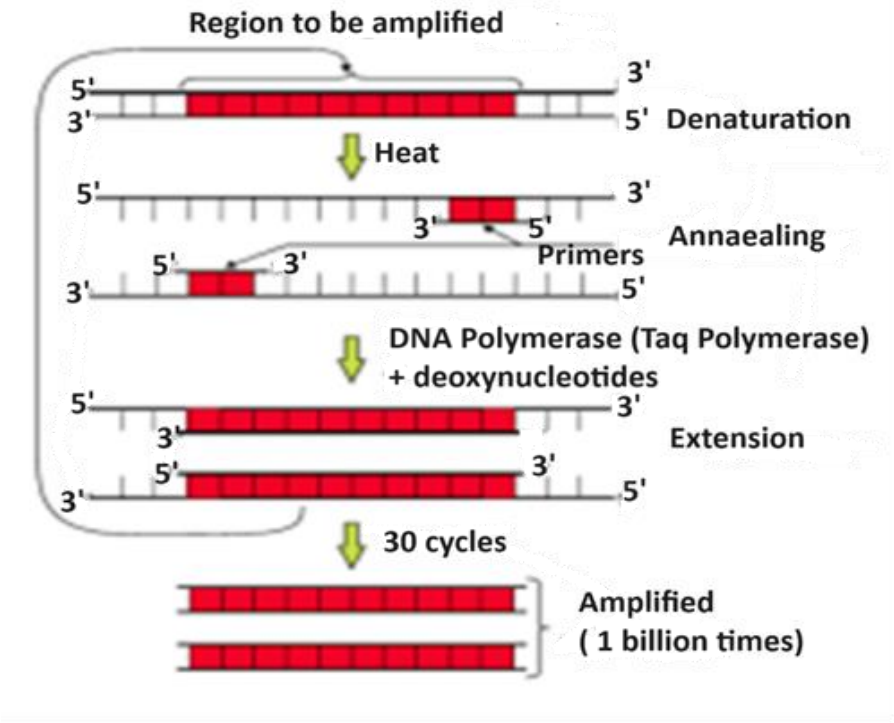
8	C. 5´ UAACGG 3´	1
9	B. CO_2	1
10	D. Rapid divergence of traits among populations inhabiting a given geographical area.	1
11	A. 1& 5; 5 &1	1
12	A. Reduction in BOD	1
Question No. 13 to 16 consist of two statements – **Assertion** (A) and **Reason** (R). Answer these questions selecting the appropriate 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	C. A is true but R is false.	1
14	C. A is true but R is false.	1
15	A. Both A and R are true and R is correct explanation of A.	1
16	C. A is true but R is false.	1
Section - B		
17	*Student to attempt either option A or B.* A. (i) Negative hCG implies no pregnancy (0.5); Placenta. (0.5) (ii) Human placental lactogen (hPL), estrogen, progestogens, relaxin (any two) (0.5 x 2 = 1) **OR** B. (i) A sperm induces changes in the zona pellucida membrane on contact, blocking entry of other sperms. (1) (ii) Ovum and sperms should be transported simultaneously to the ampullary region for fertilization. (1)	2
18	*Student to attempt either option A or B.* A. (i) I is point mutation; II is Frame shift (1) (ii) II as more codons are affected; (0.5) It is extremely likely to lead to large-scale changes to polypeptide length and chemical composition/ resulting in a non-functional protein that often disrupts the biochemical processes of a cell/Incorrect amino acids are inserted/ often premature termination occurs when a nonsense codon is read/ Frameshifts have very severe phenotypic effects. (any one) (0.5) **OR**	2

	B. (i) Translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon (UAA) and codes for a polypeptide/ AUG AUC UCG UAA. (1) (ii) Untranslated regions (UTR). The UTRs are present at both 5' -end (before start codon) and at 3' -end (after stop codon). They are required for an efficient translation process. (1)	
19	A. As the adaptive immune response gears up, there is a reciprocal relationship between virus levels in the blood and helper T lymphocytes levels. As the level of helper T levels rises, the virus levels decline. (1) B. Several years later, if untreated, HIV patient will lose the adaptive immune response, including the ability to make antibodies, as gradually the HIV enters the helper T lymphocytes leading to a progressive decrease in the number of helper T lymphocytes. (1) - - - - - - - - - - - - - - - - - - - *For visually impaired students.* After getting into the body of the person, the virus enters into macrophages where the RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. The viral DNA gets incorporated into the host cell's DNA and directs the infected cells to produce virus particles. Macrophages continue to produce virus particles; in this way they act like HIV factory. (1) Simultaneously, HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny virus released in blood attack other T lymphocytes leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. Due to decrease in the number of helper T lymphocytes, the person becomes immuno-deficient. (1)	2
20	• The variation in colour of colonies is due to the principle of insertional inactivation. (0.5) • In this, a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the enzyme, which is referred to as insertional inactivation. (0.5) • The presence of a chromogenic substrate gives blue-coloured colonies if the plasmid in the bacteria does not have an insert. (0.5) • Presence of insert results into insertional inactivation of the β -galactosidase and the colonies do not produce any colour, these are identified as recombinant colonies. (0.5)	2

21	*Student to attempt either option A or B.* A. (i) NPP = GPP – R; Given GPP = 400 J/m^2/day R = 150 J/m^2/day NPP = 400 J/m^2/day – 150 J/m^2/day = 250 J/m^2/day (1) (ii) Pyramid of energy is always upright. As energy flows from one trophic level to the next trophic level some amount of energy is lost in each trophic level in the form of heat. Therefore, the pyramid of energy is always upright and can never be inverted. (1) **OR** B. (i) If GPP is equal, then we can manipulate the NPP equation and solve. • NPP = GPP – Respiration of plants; • Respiration of Plants = GPP – NPP. • This means that the smallest NPP corresponds to the largest respiration. That is forest C. (1) (ii) (a) (b)   (0.5) (0.5)	2
	Section – C	
22	A. Seed X- 3 embryos; 1embryo sac; 1ovule; (0.5 x 3=1.5) B. The nucellar cells grow mitotically and develop into the embryos by asexual reproduction. (0.5) C. The plants growing from seed X will have to share the resources/endosperm so there is a possibility of some plant being undernourished/; only one plant in seed Y will use the entire endosperm for its growth **or** as the plants of seed X are clones they will not show variation and may succumb to environmental stress;/ plants from seed Y will have genetic variation and so can show greater adaptability. (1)	3

	- - - - - - - - - - - - - - - - - - *For visually impaired students* A. Seed X- 3 embryos; 1embryo sac; 1ovule; (0.5 x 3=1.5) B. The nucellar cells grow mitotically and develop into the embryos by asexual reproduction. (0.5) C. The plants growing from seed X will have to share the resources/endosperm so there is a possibility of some plant being undernourished/; only one plant in seed Y will use the entire endosperm for its growth **or** as the plants of seed X are clones they will not show variation and may succumb to environmental stress;/ plants from seed Y will have genetic variation and so can show greater adaptability. (1)	
23	• The first meiotic division is completed in the primary oocyte during oogenesis. (1) • Then primary oocyte undergoes first meiotic division to form a large haploid secondary oocyte and a tiny first polar body. (1) • The primary oocyte comprises of 46 chromosomes, whereas secondary oocyte and first polar body have 23 chromosomes each. (1)	3
24	A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5) B. In retrovirus the nucleic acid is RNA and it is used to synthesize DNA; the process is called reverse transcription. (0.5+0.5) C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1) - - - - - - - - - - - - - - - - - - *For visually impaired students* A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5) B. In retrovirus the nucleic acid is RNA and it is used to synthesize DNA; the process is called reverse transcription. (0.5+0.5) C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1)	3
25	• isolation of DNA, • digestion of DNA by restriction endonucleases, • separation of DNA fragments by electrophoresis, • transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon, • hybridisation using labelled VNTR probe, and • detection of hybridised DNA fragments by autoradiography. (0.5 x 6 =3)	3

26	The main sources of biofertilizers are bacteria, fungi and cyanobacteria. - The nodules on the roots of leguminous plants are formed by the symbiotic association of Rhizobium. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as a nutrient. Other bacteria can fix atmospheric nitrogen while free-living in the soil (examples *Azospirillum* and *Azotobacter*), thus enriching the nitrogen content of the soil. (1) - Fungi are also known to form symbiotic associations with plants (mycorrhiza). Many members of the genus Glomus form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development. (1) - Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen, e.g. Anabaena, Nostoc, Oscillatoria, etc. In paddy fields, cyanobacteria serve as an important biofertiliser. Blue green algae also add organic matter to the soil and increase its fertility. (1)	3
27	PCR stands for Polymerase Chain Reaction. In this reaction, multiple copies of the gene (or DNA) of interest are synthesised in vitro using two sets of primers (small chemically synthesised oligonucleotides that are complementary to the regions of DNA) and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reaction and the genomic DNA as template. (1) If the process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times, i.e., 1 billion copies are made. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, *Thermus aquaticus*), which remains active during the high temperature induced denaturation of double stranded DNA. The amplified fragment if desired can now be used to ligate with a vector for further cloning. (1) Each cycle has three steps: (i) Denaturation, (ii) Annealing and (iii) Extensions. (1)	3

		
28	A. • They are able to co-exist by mechanism of 'resource partitioning'. • If two species compete for the same resource, they could avoid competition by choosing different foraging patterns. • MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities. B. • Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely • and the competitively inferior one will be eliminated eventually. • No (0.5 x 6=3) - - - - - - - - - - - - - - - - - - - *For visually impaired students* A. • They are able to co-exist by mechanism of 'resource partitioning'. • If two species compete for the same resource, they could avoid competition by choosing different foraging patterns. • MacArthur showed that five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioural differences in their foraging activities. B. • Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist	3

	indefinitely • and the competitively inferior one will be eliminated eventually. • No (0.5 x 6=3)	
Section – D		
29	A. Given is bb = q^2 = 0.4. To determine q, which is the frequency of the recessive allele in the population, simply take the square root of q^2 which works out to be 0.632 (i.e. 0.632 x 0.632 = 0.4). So, q = 0.63 (1) B. As we know that p + q = 1, then p must be 1 - 0.63 = 0.37. (1) The percentage of beetles in the population that are heterozygous would be 2pq. 2 (0.37) (0.63) = 0.47 (1) *Student to attempt either subpart C or D.* C. Given is BB= p^2 = $(0.37)^2$= 0.14 (1) **OR** D. As, 1500 is the total population 40% is red population, hence the number of beetles with red colour will be 1500x0.4= 600 (0.5) If total population is 1500 and red is 600 then black would be 1500-600=900 (0.5)	4
30	A. The rupture of RBCs associated with the release of toxic substance haemozoin is responsible for the chills and fever/recurring every 3 - 4 days. (1) B. - The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood. (1) - Parasite further reproduces asexually in red blood cells. Released parasite infects new red blood cells. Sexual stages (gametocytes) develop in red blood cells. (1) *Student to attempt either subpart C or D.* C. The infection is caused by the bite of the female *Anopheles* mosquito which introduces the sporozoites in the human body. (1) **OR** D. Fertilisation and development take place in the mosquito's gut. (1) - - - - - - - - - - - - - - - - - - -	4

	For visually impaired students A. The rupture of RBCs associated with the release of toxic substance haemozoin is responsible for the chills and fever/recurring every 3-4 days. (1) B. - The parasite reproduces asexually in liver cells, bursting the cell and releasing into the blood. (1) - Parasite further reproduces asexually in red blood cells. Released parasite infects new red blood cells. Sexual stages (gametocytes) develop in red blood cells. (1) *Student to attempt either subpart C or D.* C. The infection is caused by the bite of the female *Anopheles* mosquito which introduces the sporozoites in the human body. (1) **OR** D. Fertilisation and development take place in the mosquito's gut. (1)	
Section – E		
31	*Student to attempt either option A or B.* A. (i) • Sperm count decreases, spermatogenesis is impaired; • Spermatids do not get nourishment to develop into spermatozoa thus spermiogenesis will be affected; • Leydig cells synthesize and secrete androgen hormones (like testosterone) so secretion of androgens will be affected. (0.5 x 3 = 1.5) (ii) Spremiation (0.5) (iii) Artificial insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra – uterine insemination) of the female. **OR** Intra cytoplasmic sperm injection (ICSI) is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum. (1) (iv) The zygote or early embryos (with upto 8 blastomeres) could be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer); embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. (1+1) - - - - - - - - - - - - - - - - - - -	5

	For visually impaired students (iv) The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer); embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. (1+1+0.5 mark for ZIFT with full form) **OR** B. (I) (i) In rose – bay plant, the time of maturation of stamen and pistil is not same, the pollen will not be able to germinate on the stigma. This prevents autogamy in rose-bay. (1) (ii) Different position and incompatible placement of the reproductive structure prevent successful pollination and thus autogamy in primrose. (1) (iii) Pollen pistil interaction for same species is not possible; this is a genetic mechanism which prevent the pollen grain from forming pollen tube on the pistil of the same flower. (1) (II) The male and female flowers are present in the same plant but are not in proximity preventing self-fertilization in castor. In papaya, the male flower and female flowers are in different plants, it prevents autogamy. (2)	
32	*Student to attempt either option A or B.* A. - Several nematodes parasitize a wide variety of plants and animals including human beings. - A nematode *Meloidegyne incognitia* infects the roots of tobacco plants and causes a great reduction in yield. - A novel strategy was adopted to prevent this infestation which was based on the process of RNA interference (RNAi). - RNAi takes place in all eukaryotic organisms as a method of cellular defense. - This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). - The source of this complementary RNA could be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate. - Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant. - The introduction of DNA was such that it produced both sense and anti-sense RNA in the host cells. - These two RNA's being complementary to each other formed a	5

	double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. - The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore got itself protected from the parasite. (0.5 x 10 =5) **OR** B. - Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. 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. - The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. This enzyme is crucial for the immune system to function. - The disorder is caused due to the deletion of the gene for adenosine deaminase. - In some children ADA deficiency can be cured by bone marrow transplantation; in others it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection. - But the problem with both of these approaches is that they are not completely curative. - As a first step towards gene therapy, lymphocytes from the blood of the patient are grown in a culture outside the body. - A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently returned to the patient. - However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes. - However, if the gene isolate from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure. (0.5 x 10 =5)	
33	*Student to attempt either option A or B.* A. (i) There are three main reasons for conserving the biodiversity which have been classified into the following categories: (Any two reasons) - Narrowly utilitarian arguments. Human beings derive direct economic benefits from nature, like food, firewood, fibre, construction material, industrial products (resins, gums, dyes, tannins, etc.) and medicinally important products. - Broadly utilitarian arguments. Biodiversity plays a major role in maintaining and sustaining supply of goods and services from	5

various species as well as ecological systems. The different ecological services provided are:

- Amazon forest is estimated to contribute 20 per cent of the total oxygen in the atmosphere on earth.
- Pollinators like bee, bumble bees, birds and bats pollinate plants to form fruits and seeds.
- Aesthetic pleasures like bird watching, spring flowers in full bloom, walking through the thick forest, waking up to a bulbul's song, etc. are some other benefits of the ecosystem.

- Ethical reasons there are thousands of plants, animals and microbes on this earth which are not useless. Everyone has some intrinsic value even if it is not of any economic value to us. It is, therefore, our moral duty to ensure well-being of all the living creatures for the utilisation of future generations. (1+1)

(ii) There are four major causes of biodiversity loss. These are also known as 'The Evil Quartet'. (Any two Ways) (1.5 +1.5)

- Habitat loss and fragmentation Destruction of habitat is the primary cause of extinction of species. When large-sized habitats are broken or fragmented due to human settlements, building of roads, digging of canals, etc., the population of animals requiring large territories and some animals with migratory habitats declines.
- Over-exploitation When biological system is over-exploited by man for the natural resources, it results in degradation and extinction of the resources. For example, Stellar's sea cow, passenger pigeon and many marine fishes.
- Alien (exotic) species invasions Some alien (exotic) species when introduced unintentionally or deliberately, become invasive and cause harmful impact, resulting in extinction of the indigenous species. Nile perch, a large predator fish when introduced in Lake Victoria (East Africa) caused the extinction of an ecologically unique species of Cichlid fish in the lake.
- Co-extinctions When a species becomes extinct, the plant and animal species associated with it in an obligatory manner, also become extinct. For example, if the host fish species becomes

extinct, all those parasites exclusively dependent on it, will also become extinct

OR

B.

(i)

S. No.	*In situ* conservation	*Ex situ* conservation
(*i*)	It is conservation and protection of biodiversity in its natural habitat.	It is conservation of selected threatened plant and animal species in places outside their natural habitat.
(*ii*)	Population is conserved in the surroundings where they have developed their distinctive features.	Population is conserved under simulated conditions that closely resemble their natural habitats.
(*iii*)	*e.g.*, national parks, biosphere reserves, wildlife sanctuaries, etc.	*e.g.*, botanical gardens, zoological parks, wildlife safari, gene banks, etc.

(2)

(ii) A stable community should not show too much variation in productivity from year to year; it must be either resistant or resilient to occasional disturbances (natural or man-made), and it must also be resistant to invasions by alien species. (3)

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