COMMON PRE-BOARD EXAMINATION 2024-25

Subject: BIOLOGY (044)

Date:12/12/2024

Max. Marks: 70 Time: 3 Hours

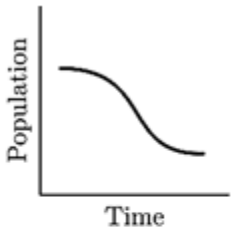
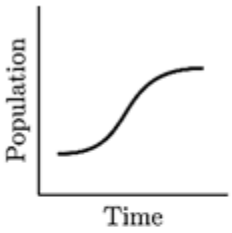
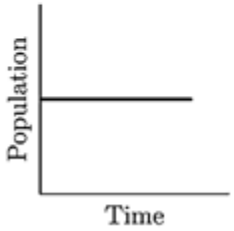
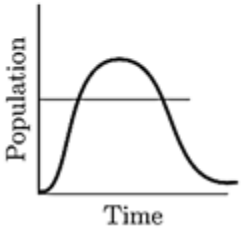
General Instructions:

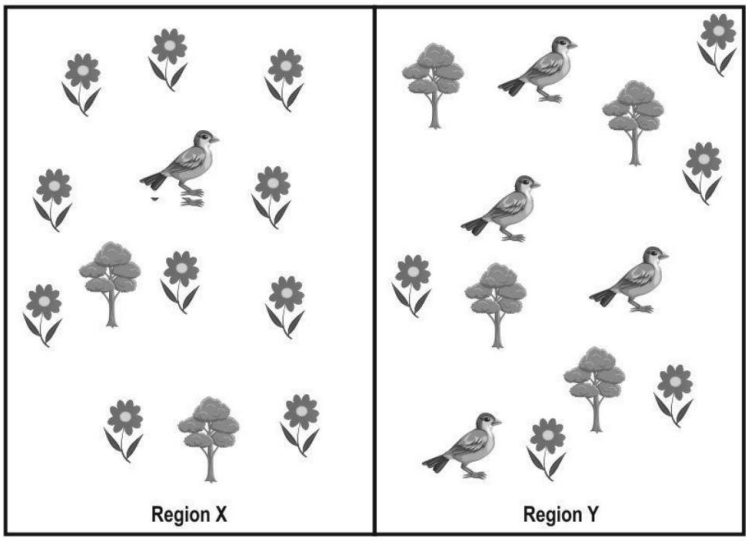
Read the following instructions carefully and follow them:
(i) This question paper contains 33 questions. All questions are compulsory.
(ii) Question paper is divided into five sections - Sections A, B, C, D and E.
(iii) Section A-questions number 1 to 16 are multiple choice type questions. Each question carries1 mark.
(iv) Section B-questions number 17 to 21 are very short answer type questions. Each question carries 2 marks.
(v) Section C-questions number 22 to 28 are short answer type questions. Each question carries 3 marks.
(vi) Section D- questions number 29 and 30 are case-based questions. Each question carries 4 marks. Each question has subparts with internal choice in one of the subparts.
(vii) Section E-questions number 31 to 33 are long answer type questions. Each question carries 5 marks.
(viii) There is no overall choice. However, an internal choice has been provided in Sections B, C and D of the question paper. A candidate has to write answer for only one of the alternatives in such questions.
(ix) Wherever necessary, neat and properly labelled diagrams should be drawn.

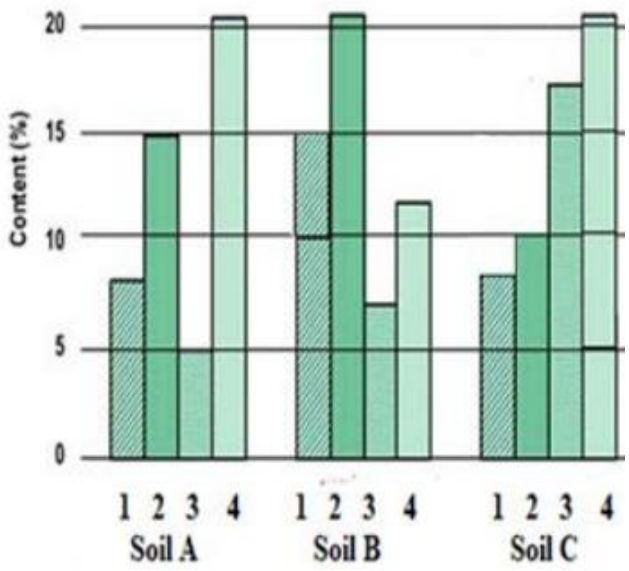
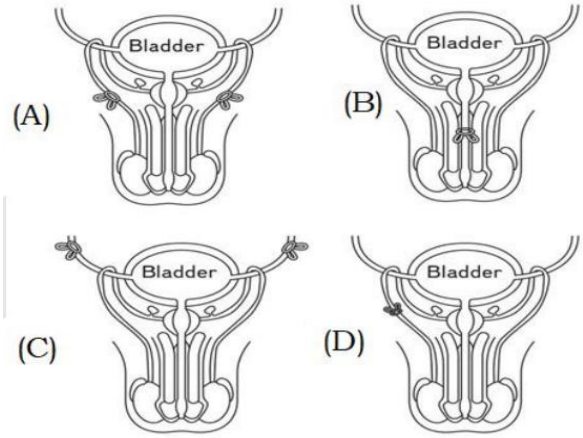
Section – A

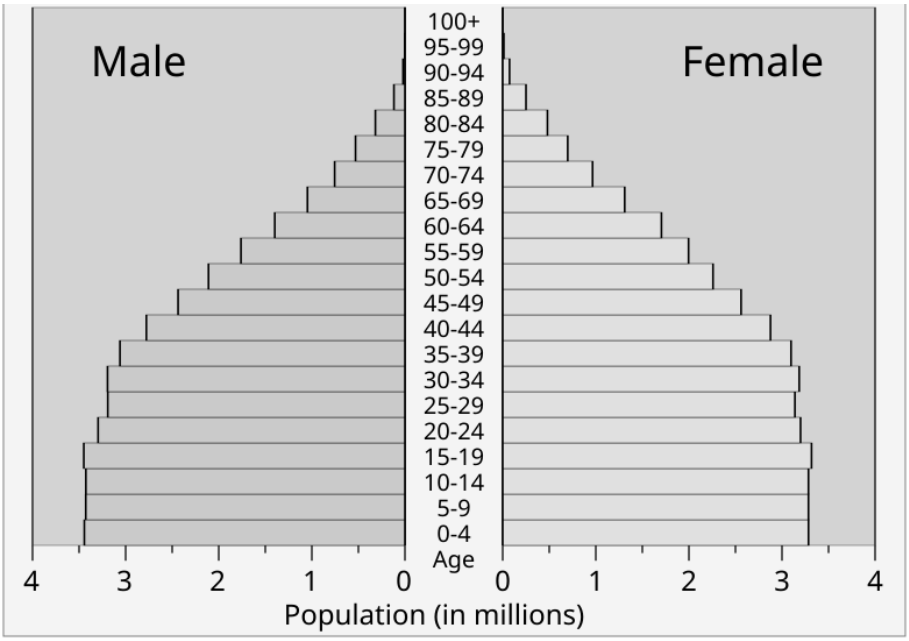
Q. No. 1 to 12 are multiple choice questions. Only one of the choices is correct. Select and write the correct choice as well as the answer to these questions.

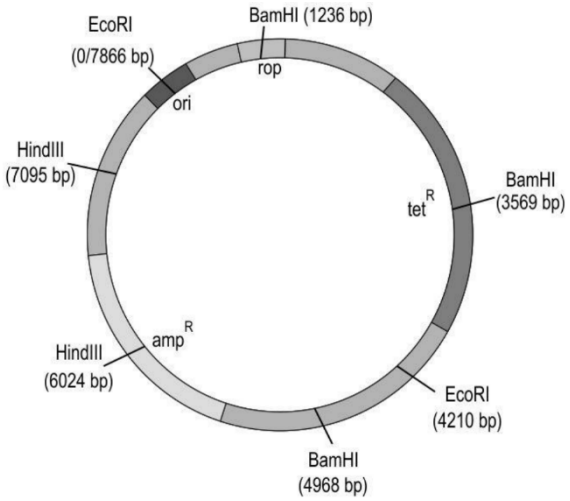
S. No	Questions	Marks
1	Kiwi is a dioecious species. Which of the following methods can be RULED OUT as a possible mode of pollination in its case? i) cleistogamous autogamy ii) chasmogamous autogamy iii) geitonogamy iv) xenogamy A. only i and iii B. only i and ii C. only ii and iv D. only i, ii and iii	1
2	 The adaptations in which of the following animals enables it to satisfy the following conditions: a. Allen's rule b. Loses body heat slowly A. 1 B. 2 C. 3 D. 4	1

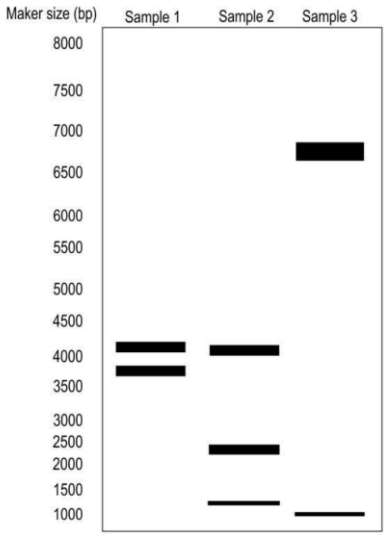
3	Which of the following phenomena significantly contributes to speciation? i. Natural Selection ii. Genetic Drift iii. Gene flow iv. Geographic Isolation v. Stabilizing Selection A. only ii and iv B. only iii and v C. only i, ii and iv D. only ii, iii and v	1
4	A biologist inoculated bacteria A, fungus B, and both bacteria A and fungus B on 3 different sterile petri dishes 1,2 and 3 respectively. After 24 hours, he observed growth in all 3. These are his observations: **Plate** | **Organisms** | **Observation** 1 | Bacteria A | 46 small round colonies 2 | Fungus B | 9 medium round colonies 3 | Bacteria A + Fungus B | 4 small round colonies + 10 medium round colonies What can the biologist conclude from this? Y) The fungus inhibits the growth of the bacteria. Z) The bacterium causes the fungus to grow better. A. only Y B. only Z C. both Y and Z D. neither Y nor Z	1
5	In a given population of 2000 individuals, 80 births and 125 deaths were reported over a given period of time. Which of the following graphs will correspond to it? **A.**  **C.**  **B.**  **D.** 	1

6	What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids? A. 24 B. 32 C. 8 D. 16	1
7	Given below is the species distribution across two different regions - X and Y. The area used to count species was the same.  Which of the following is TRUE about the biodiversity in these regions? A. Region X is more diverse than region Y even though both regions have the same species richness. B. Region X is less diverse than region Y even though both regions have the same species richness. C. Region X and region Y have the same species richness and so the same diversity. D. Region X is more diverse as it has greater species richness than region Y.	1
8	Match column I with column II and select the correct option from the given codes. **Column I** / **Column II** a. Glomus — (i) Mosquitoes b. Bacillus Thuringiensis — (ii) Phosphorus nutrition c. Root nodules — (iii) Leghemoglobin d. Ladybird — (iv) Bioinsecticide A. a-(iii), b-(i), c-(ii), d-(iv) B. a-(ii), b-(iii), c-(iv), d-(i) C. a-(ii), b-(iv), c-(iii), d-(i) D. a-(iii), b-(iv), c-(ii), d-(i)	1
9	Maximum species diversity is seen in latitudinal range of A. 23.5° N to 66.5° N B. 23.5° N to 23.5° S C. 23.5° S to 66.5° S D. 66.5° N to 90° N	1

10	 Observe the contents 1,2,3 and 4 of soil samples A, B and C shown in the graph. If the temperature and soil moisture of all soil samples are identical, which soil sample (s) will show faster decomposition? A) Soil Sample A B) Soil Sample B C) Soil Samples A and B both D) Soil Sample C 1. Indicates lignin content, 2. Indicates chitin, 3. Indicates Nitrogen content 4. Indicates sugar content	1
11	Which of the following diagram depict vasectomy accurately? 	1
12	In pigeons, one gene controls the appearance of a crest on the head. The allele C (smooth head) is dominant to allele C' (crested head). In a population of pigeons, the frequency of the allele responsible for a smooth head is 0.7 and for a crested head, it is 0.4. Which of the following conditions should be satisfied for the population to be in Hardy-Weinberg equilibrium? A. The sum total of the frequency of C and C' is equal to 1. B. The sum total of the frequency of C and C' is less than 1. C. The sum total of the frequency of C and C' is more than 1. D. Cannot be said without knowing the frequency of CC' individuals.	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	Given below is the Age Pyramid of population in one of the states in India as per 2011 census. It depicts the male population on the left-hand side, female population on the right-hand side, newborns towards the base and gradually increasing age groups as we move from base to the top, with the oldest population at the top. Study this pyramid and comment upon the appropriateness of the Assertion and the Reason.  **Assertion (A):** It is a stable population. **Reason (R):** The pre-reproductive and reproductive individuals are almost in equal numbers and the post-reproductive individuals are relatively fewer.	1
14	**Assertion (A):** The chronic use of alcohol by a person leads to cirrhosis **Reason (R):** Alcohol addiction at times becomes the cause of mental and financial distress to the entire family of the addicted person.	1
15	**Assertion (A):** In Mirabilis, selfing of F1 pink flower plants produces same phenotypic & genotypic ratio. **Reason (R):** Flower colour gene shows incomplete dominance.	1
16	**Assertion (A)**: In morula stage, cells divide without increase in size. **Reason (R):** Zona pellucida remains undivided till cleavage is complete	1
	Section – B	
17	**<u>Attempt either option A or B.</u>** A. The plasmid illustrated is 7,866 base pairs long and includes genes that provide resistance to the antibiotic's tetracycline and ampicillin. The base pair positions of the restriction sites are also indicated	2





(i) In the laboratory, Reema prepared the three plasmid samples shown above, treating each one separately with a different restriction enzyme: EcoRI, HindIII, or BamHI. In her haste, she neglected to label the samples. After performing agarose gel electrophoresis on the digested samples, she observed distinct band patterns for each. Assuming complete digestion, analyze the band patterns displayed above to help Reema identify the enzyme used for each sample.

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(ii) Next, Seema digested a target DNA and a plasmid with HindIII, ligated them together, and introduced the recombinant plasmid into bacterial cells. How can she differentiate between bacterial cells that have successfully taken up the recombinant plasmid (transformants) and those that have not (non-transformants)? Provide reasoning to support your answer.

OR

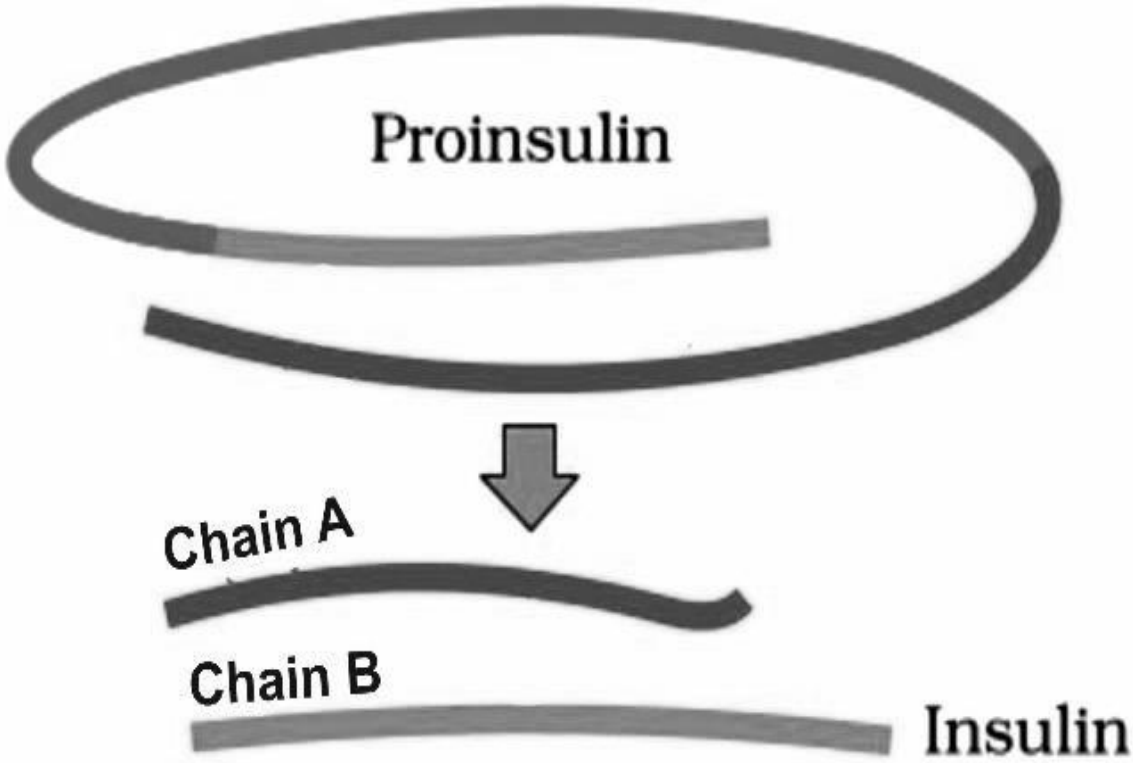
B. Vectors containing the foreign DNA have to be forced into host cells that are made competent to do so. A common method is to first treat host cells with calcium chloride and then incubate these cells on ice. This is followed by briefly placing them at 42 °C and then putting them back on ice. This enables the host cells to take up recombinant DNA and is called the heat shock treatment.

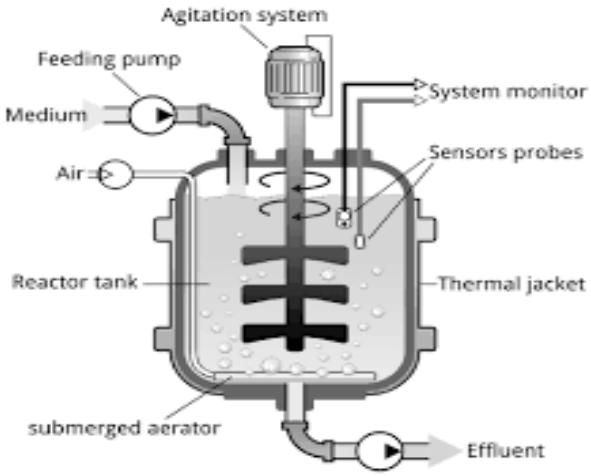
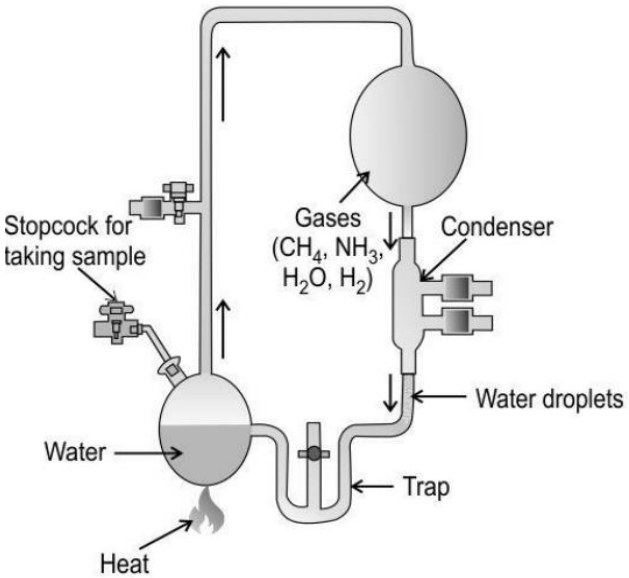
(i) Explain why DNA vectors CANNOT pass through the cell membrane like other molecules such as oxygen.

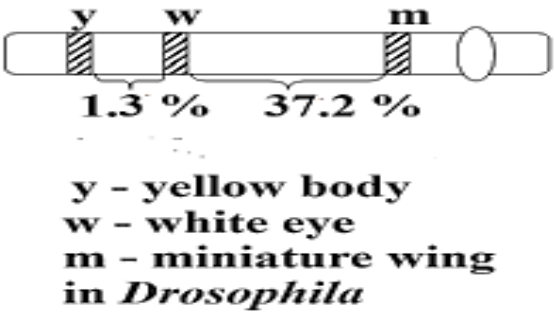
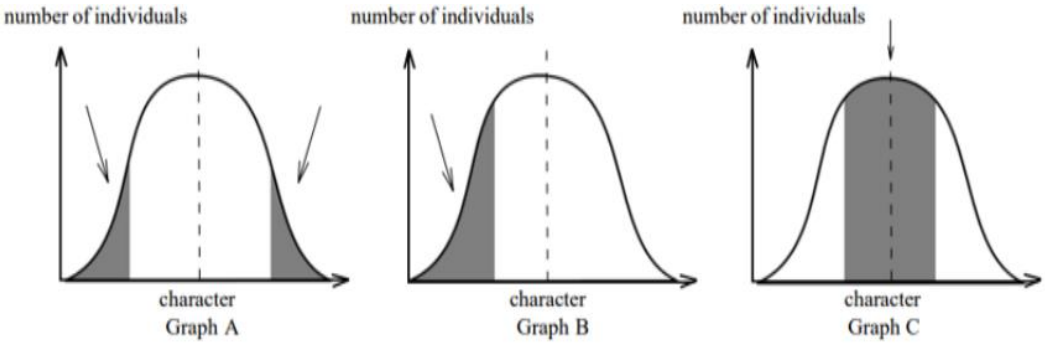
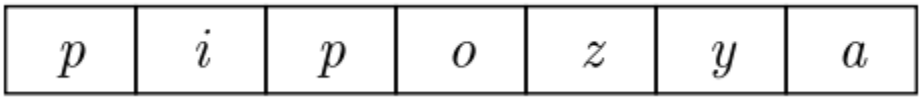
(ii) Calcium from a $CaCl_2$ solution binds to DNA making it easier for them to enter a cell. Why?

(iii) Why does the heat shock treatment make the membrane porous allowing for easy uptake of DNA?

18	**<u>Attempt either option A or B.</u>** A. State whether each of these statements given below is/are true or false. Justify your answer.	2

	i. Flocs reduce the pollution in water by increasing its BOD. ii. Mycorrhiza is a type of parasitic relationship in which only the plants benefit from fungi. **OR** B. A patient who has been undergoing chemotherapy is suffering from blood coagulations around central venous catheters that have been used to administer the related drugs. (i) Suggest one possible enzyme that could be considered for administration, with the aim of potentially restoring proper blood flow. (ii) Based on (i), mention the micro-organism that it is produced from. (iii) Pectinases are used in the textile industry as well as in wastewater treatment. Identify how pectinase can help in each of these industries.	
19	 Observe the given structure of a hormone which is produced by beta cells of pancreas and help to treat diabetes. An American company produced this hormone using rDNA technique. a) What type of bonding is present between chains of this hormone? b) Mention the chemical change that the pro hormone undergoes to be able to act as mature hormone. c) Why is the hormone produced via rDNA technique considered better than the ones used earlier by diabetic patients?	2
20	Rati plans to cultivate a variant of the Lactobacillus species, an anaerobic bacterium often used as a starter culture in dairy products, using the bioreactor available in her laboratory.	2

	 A) Identify ONE component that should NOT be present in the reactor to grow the lactobacillus species. Justify. B) Explain TWO quantities that the sensors in the bioreactor should monitor.	
21	**Attempt either option A or B.** A. (i) Name the species of Plasmodium that is the most fatal. (ii) Why does a malarial parasite invade red blood cells instead of other cells? Mention any THREE reasons to explain the same. **OR** B. From an immunological point of view, predict the consequential events arising from the following situations: (i) A person is transplanted with a kidney without tissue matching. (ii) A person with the O+ blood group receives a blood transfusion from a donor with A+ blood group.	2
	Section – C	
22	 i) A group of students designed and conducted an experiment similar to the Miller-Urey experiment but omitted one component. Observe the experimental setup shown in the diagram and identify the missing component. ii) After conducting the experiment, the students analyzed the sample. What compounds are they likely to detect in the sample? iii) This experiment provided evidence for which hypothesis regarding the origin of life on Earth?	3
23	Erythropoietin is a glycoprotein hormone that is otherwise naturally produced in the kidney when the body becomes anaemic. However, this does not happen in the case of chronic renal diseases where kidney function is lost. Epoetin alfa is a human erythropoietin produced in	3

	cell culture using recombinant DNA technology. The cell culture used is called Namalwa cells, a human cell culture. There are eight exons and seven introns in a single gene that encodes the hormone, whose sequence is known. Explain the step-by-step process that should be followed for producing human erythropoietin in culture.	
24	Above figure indicates the percentage of recombination between 2 pairs of genes – y and w; w and m. Based on this data what conclusion can you draw –  A) Which two of these genes are tightly linked? Justify your answer. B) Which scientist used such data of the frequency of recombination between gene pairs on the same chromosome to prepare genetic maps and how? C) How are genetic maps useful?	3
25	The graphs below show three types of natural selection. The shaded areas marked with arrows show the individuals in the population which are not selected. The dotted vertical lines show the statistical means.  A) What names are given to the types of selection shown in graphs A, B and C. B) After the selection has operated for several generations in the above populations indicated as Graph A, B and C, graphically illustrate the probable results.	3
26	A) Give the scientific name of the bacteria widely used in biotechnology to create a GM cotton crop resistant to bollworm attacks. B) Explain how GM cotton crop is able to resist insect attacks.	3
27	Study the schematic representation of the genes involved in the lac operon given below and answer the questions that follow:  	3

(A) Identify and name the regulatory gene in this operon. Explain its role in 'switching off' the operon.
(B) Why is the lac operon's regulation referred to as negative regulation?
(C) Name the inducer molecule and the products of the genes 'z' and 'y' of the operon. Write the functions of these gene products.

28 A tomato plant flower, through the process of sexual reproduction, produces 160 viable seeds. Complete the following table by filling in the number of each reproductive unit involved and explaining the role of each in the reproduction process. 3

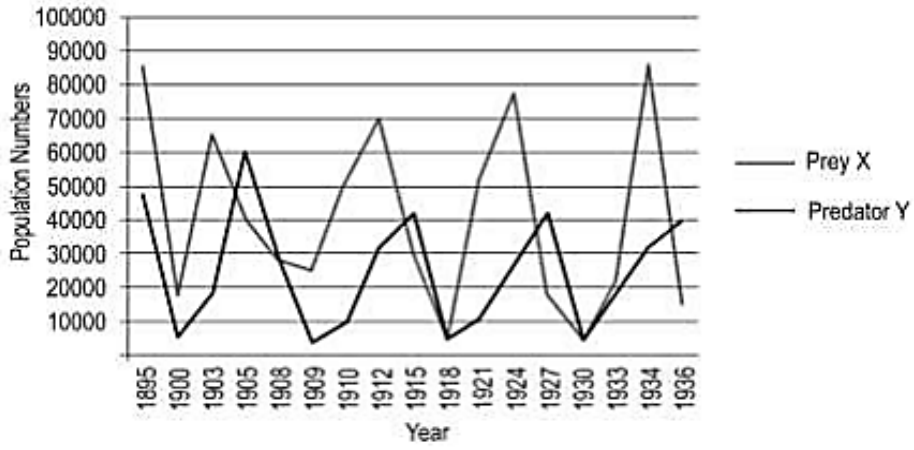
Sl. No.	Type of units involved	No. of these units involved	Provide explanation for each of your answer
1.	Pollen grains	1a.	1b.
2.	Ovules	2a.	2b.
3.	Microspore mother cells	4a.	4b.

Instructions:

- For each unit, determine how many are involved in producing the 160 seeds.
- Provide a brief explanation for the role of each unit in the table.

Section - D

29 Predator Y shown in the image below is a type of wild cat that inhabits the forests and prey primarily on prey X which are herbivores. Shown below is data on their respective populations over time. 4

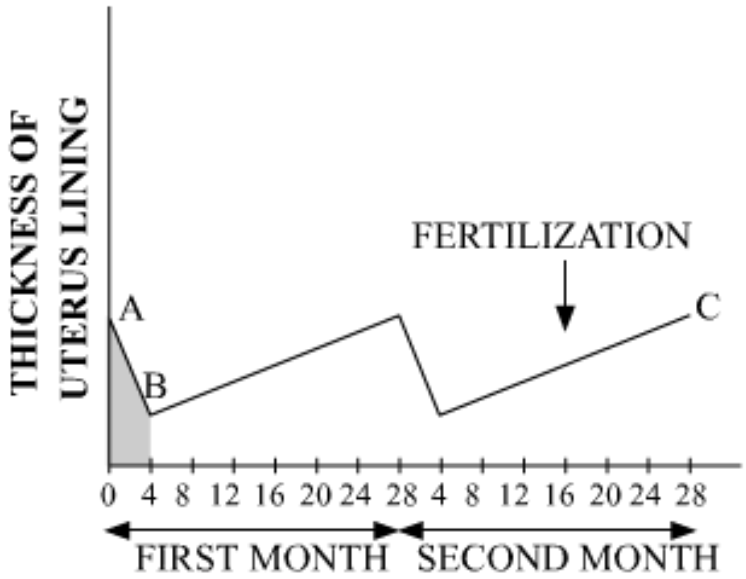


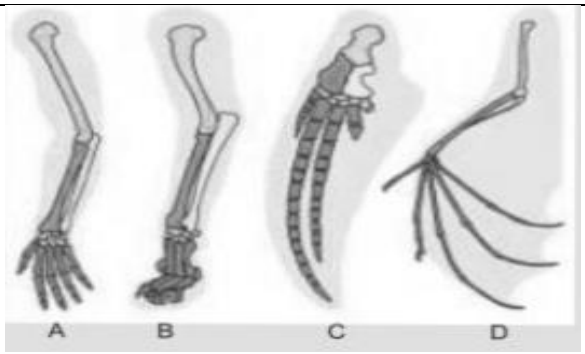
A) What is the likely cause for the pattern seen in the prey and predator populations through the years?
B) Hypothetically, if all the predators of the forests become extinct, what will happen to the vegetation of the forest?

Attempt either subpart C or D.

C) Consider a situation where another similar species of predator immigrates to the forest. What is likely to happen over time and why?

OR

	D) Juglone is a chemical produced naturally in most parts of the black walnut plant. This chemical leaches into the soil when the plant falls. This leads to the death of many plants that grow around the black walnut plant. Identify the type of ecological interaction between the black walnut and other plants growing around it. Justify.	
30	The graph given below shows how the lining of the uterus in a female who has achieved puberty varies with time. Examine the graph and answer the following questions.  A) What is happening between A and B? B) Mark the corresponding points in the second menstrual cycle when the same happens. **<u>Attempt either subpart C or D.</u>** C) Fertilization occurs on day 16 of the second menstrual cycle. How do you expect the graph to behave after point C? Will the pattern of the first and second months be followed? **OR** D) What changes occur after the 28^{th} day of the first month of the menstrual cycle, and which hormone is responsible for these changes? Why does this hormonal shift take place?	4
	Section – E	
31	**<u>Attempt either option A or B.</u>** A. Evidence supporting the evolution of life on Earth comes from multiple fields, including comparative anatomy and morphology. These fields reveal both similarities and differences between present-day organisms and those from the past. Such comparisons help determine whether organisms share a common ancestry. For instance, the forelimbs of whales, bats, cheetahs, and humans display similar bone structures but serve distinct functions in each species.	5



(a) Identify and define the type of evolution these organs demonstrate across different animals.

(b) What are such organs called? What do they indicate about ancestry?

(c) Some organs, while not anatomically similar, serve similar functions across different groups.

(i) What are these organs called, and what type of evolution do they represent?

(ii) Give two examples of such organs, one from plants and one from animals.

OR

B. 1. A child diagnosed with thalassemia is born to parents who show no symptoms of the disease. However, the mother is being unfairly blamed by the family for delivering a child with this condition.

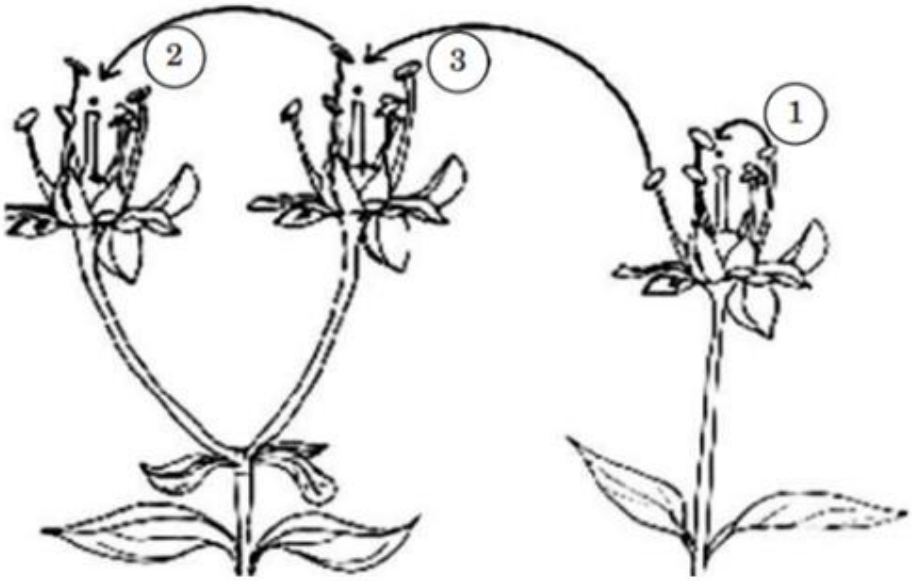
i) What are the differences between alpha and beta thalassemia?

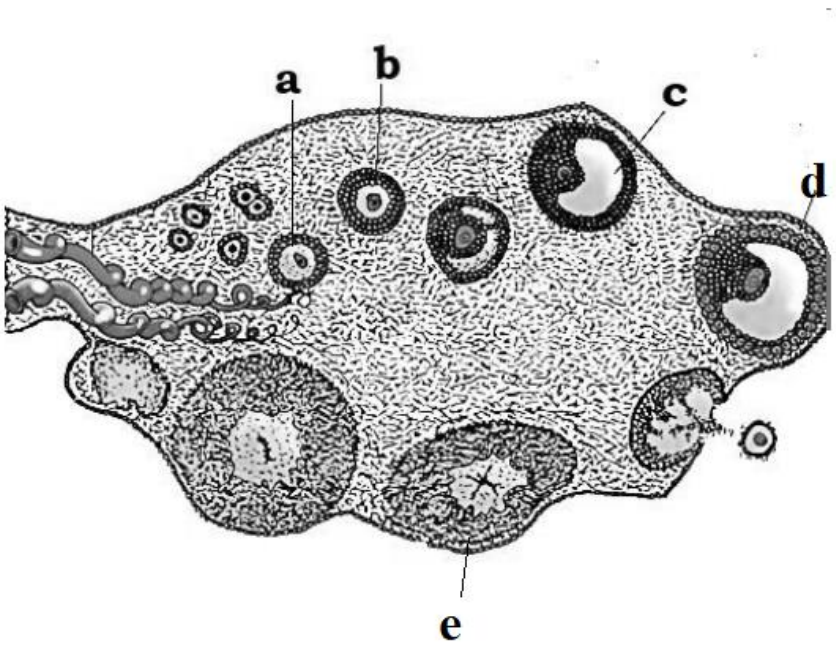
ii) How would you counsel the family to understand that the mother is not solely responsible for the child's condition? Explain.

2. Three crosses were carried out in pea plants with respect to flower colour violet/white (V/v) and flower position axial/terminal (A/a). Study in the table the crosses 'a', 'b' and 'c' where parental phenotypes and their F_1 progeny phenotypes are given.

Parental plants (Phenotypes)	*F_1 Progeny (Phenotypes)*
(a) Violet, axial × white, axial	6/16 white, axial 2/16 white, terminal 6/16 violet, axial 2/16 violet, axial
(b) Violet, axial × white, terminal	1/4 violet, axial 1/4 violet, terminal 1/4 white, axial 1/4 white, terminal
(c) Violet, axial × violet, axial	3/4 violet, axial 1/4 white, axial

Find the genotype of each of the parental pair of cross 'a', 'b' and 'c'.

32	**Attempt either option A or B.** A. Study the diagram given below showing the modes of pollination. Answer the questions that follow.  The diagram provided illustrates three different methods of pollen transfer in plants. 1. Identify the technical terms used for each of the pollen transfer methods labeled as 1, 2, and 3. 2. Explain how the following plants accomplish successful pollination: i. Water lily ii. Vallisneria 3. Flowering plants have evolved various mechanisms to prevent inbreeding depression. Describe one hereditary and one physiological mechanism that helps the plants to achieve this goal. **OR** B. 1. The given picture depicts kit for detection of pregnancy. What is the principle behind this kit? 	5

	2. In the diagram showing a section of the human ovary:  i. Identify the structures labeled 'a,' 'b,' 'c,' and 'd.' ii. Identify structure 'e' and explain its function during the menstrual cycle. iii In what stage is the oocyte released from the Graafian follicle after ovulation, and what is its subsequent fate?	
33	**Attempt either option A or B**. A i. What is the difference between viral oncogenes and proto-oncogenes? ii. What does MALT stand for? Where is it found in the body? Give two examples of its location. iii. Pneumonia and common cold are both air-borne diseases. How are they different from each other? iv. a) Define allergy and allergens. b) Give any one example of common allergens. **OR** B Give reasons for the following: i) Detergent formulations claim to effectively remove oily stains. ii) Bottled fruit juices bought from the market are clearer as compared to those made at home. iii) Microorganisms can help patients who have undergone myocardial infraction leading to heart attack. iv) Microorganisms can help patients who have undergone organ-transplant. v) Microorganisms can help people with high cholesterol levels.	5