

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

Maximum Marks: 70

Time: 3 hours

General Instructions:

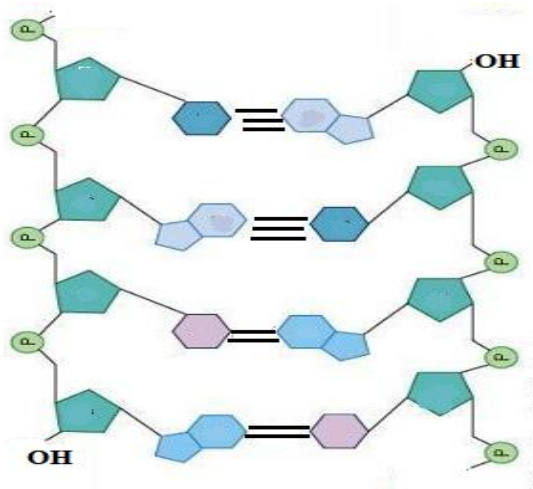
- (i) All questions are compulsory.
- (ii) The question paper has five sections and 33 questions.
- (iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E 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	Mark s
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.

1



- A. GCAT
- B. CGTA
- C. TAGC
- D. ATCG

For Visual Impaired Students

E. coli has 4.6×10^6 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

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	<p>In <i>E.coli</i>, the lac operon gets switched on when lactose is</p> <p>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.</p>	1
7	<p>Which of the following features shows the mechanism of sex determination in honey-bee?</p> <p>(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</p> <p>A. (i) and (ii) B. (ii) and (iii) C. (i) and (iv) D. (ii) and (iv)</p>	1
8	<p>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'</p> <p>After transcription the mRNA can be represented by:</p> <p>A. 5' AUUGCC 3' B. 5' AUUGCC 3' C. 5' UAACGG 3' D. 5' GGCAAU 3'</p>	1
9	<p>Idli – dosa dough rises due to production of which of the following gas?</p> <p>A. CO B. CO₂ C. NO D. NO₂</p>	1
10	<p>Adaptive radiation leads to which of the following?</p> <p>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.</p>	1

11	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:	1															
<table border="1"> <thead> <tr> <th></th> <th>Vector DNA</th> <th>Foreign DNA</th> </tr> </thead> <tbody> <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> </tbody> </table>				Vector DNA	Foreign DNA	A.	1 & 5	5 & 1	B.	2 & 4	4 & 2	C.	2 & 5	5 & 2	D.	3 & 4	4 & 3
	Vector DNA	Foreign DNA															
A.	1 & 5	5 & 1															
B.	2 & 4	4 & 2															
C.	2 & 5	5 & 2															
D.	3 & 4	4 & 3															

12	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	1
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Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

- A. Both A and R are true and R is the correct explanation of A.
- B. Both A and R are true and R is not the correct explanation of A.
- C. A is true but R is false.
- D. A is False but R is true.

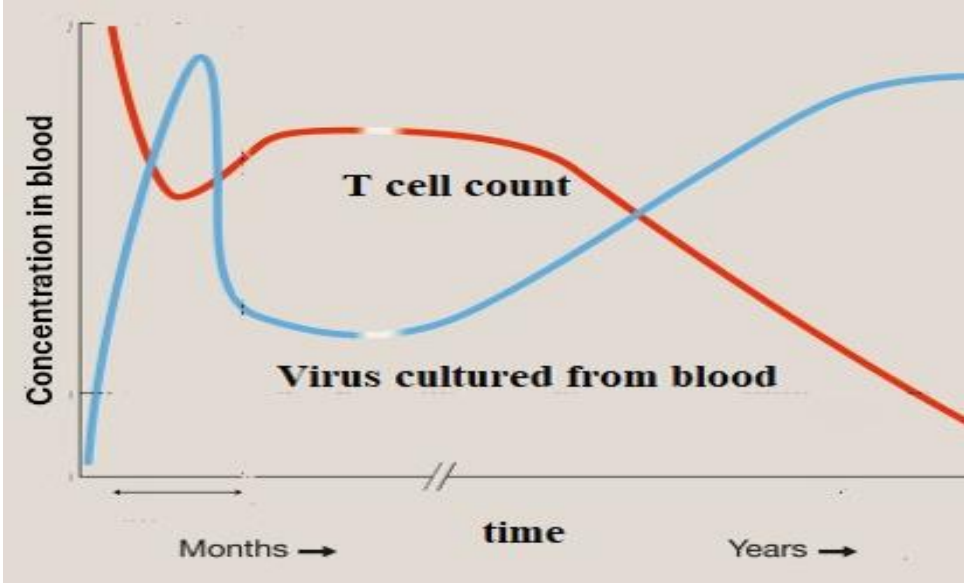
13	Assertion (A): Cells of tapetum have more than one nucleus. Reason (R): They undergo meiosis without cytokinesis.	1
14	Assertion (A): Deoxyribonucleoside triphosphates serve dual purposes. Reason (R): They act as proof readers and provide energy.	1
15	Assertion (A): A floating cover placed over the 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.	1
16	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.	1

Section - B

17	<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?	2
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	<p>(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?</p> <p style="text-align: center;">OR</p> <p>B.</p> <p>(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?</p> <p>(ii) All copulations will not lead to fertilization. Why?</p>	
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18	<p><u>Attempt either option A or B.</u></p> <p>A. The schematic representation given below shows a DNA strand and two types of mutations in the DNA strand.</p> <div style="margin-left: 40px;"> <table border="1" style="border-collapse: collapse; text-align: center; width: 100%;"> <tr> <td style="padding: 2px;">Original template</td> <td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">G</td><td style="padding: 2px;">C</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td><td style="padding: 2px;">A</td><td style="padding: 2px;">C</td><td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">C</td><td style="padding: 2px;">U</td><td style="padding: 2px;">U</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td> </tr> <tr> <td></td> <td colspan="3" style="padding: 2px;">Met</td> <td colspan="3" style="padding: 2px;">Gln</td> <td colspan="3" style="padding: 2px;">Thr</td> <td colspan="2" style="padding: 2px;">Ser</td> <td colspan="2" style="padding: 2px;">Stop</td> </tr> </table> <table border="1" style="border-collapse: collapse; text-align: center; width: 100%;"> <tr> <td style="padding: 2px;">Mutation I</td> <td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">G</td><td style="padding: 2px;">A</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td><td style="padding: 2px;">A</td><td style="padding: 2px;">C</td><td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">C</td><td style="padding: 2px;">U</td><td style="padding: 2px;">U</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td> </tr> <tr> <td></td> <td colspan="3" style="padding: 2px;">Met</td> <td colspan="3" style="padding: 2px;">Lys</td> <td colspan="3" style="padding: 2px;">Thr</td> <td colspan="2" style="padding: 2px;">Ser</td> <td colspan="2" style="padding: 2px;">Stop</td> </tr> </table> <table border="1" style="border-collapse: collapse; text-align: center; width: 100%;"> <tr> <td style="padding: 2px;">Mutation II</td> <td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">G</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td><td style="padding: 2px;">A</td><td style="padding: 2px;">C</td><td style="padding: 2px;">A</td><td style="padding: 2px;">U</td><td style="padding: 2px;">C</td><td style="padding: 2px;">U</td><td style="padding: 2px;">U</td><td style="padding: 2px;">A</td><td style="padding: 2px;">G</td> </tr> <tr> <td></td> <td colspan="3" style="padding: 2px;">Met</td> <td colspan="3" style="padding: 2px;">Arg</td> <td colspan="3" style="padding: 2px;">His</td> <td colspan="2" style="padding: 2px;">Leu</td> <td colspan="2"></td> </tr> </table> </div> <p>(i) Identify the type of mutation exhibited in I and II.</p> <p>(ii) Which of the above mutation is more harmful? Give reason.</p> <p style="text-align: center;">OR</p> <p>B. Given below is a schematic representation of a mRNA strand</p> <div style="margin-left: 40px;"> <p>5' mRNA 3'</p> <hr style="width: 80%; margin: 5px auto;"/> <p style="text-align: center; font-weight: bold; letter-spacing: 0.5em;">A G G A G G U A U G A U C U C G U A A A A U A A A</p> </div> <p>(i) In the above sequence identify the translational unit in mRNA.</p> <p>(ii) Where are UTRs found and what is their significance?</p>	Original template	A	U	G	C	A	G	A	C	A	U	C	U	U	A	G		Met			Gln			Thr			Ser		Stop		Mutation I	A	U	G	A	A	G	A	C	A	U	C	U	U	A	G		Met			Lys			Thr			Ser		Stop		Mutation II	A	U	G	A	G	A	C	A	U	C	U	U	A	G		Met			Arg			His			Leu				2
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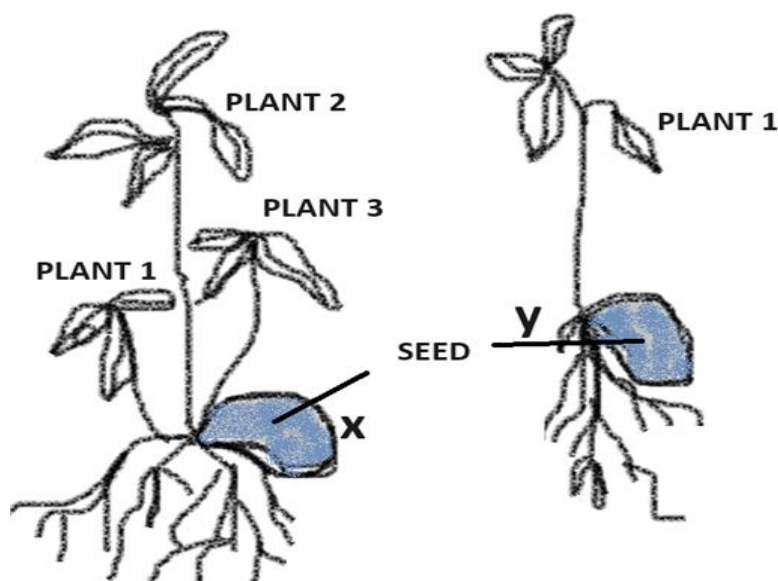
19	<p>Given below is the relationship between the HIV levels in the blood and helper T cell count in a person detected with AIDS. Study the relationship and answer the questions that follow.</p>  <p>A. What kind of relationship is observed in the virus levels and the immune response after some days of the initial infection? B. Does it completely clear the virus from the body permanently? Give reason for your answer.</p> <p style="text-align: center;">-----</p> <p><u>For visually impaired students.</u></p> <p>Write the sequence of events that occur when a retrovirus enters a human being, causing reduction in helper T-cells.</p>	2
20	<p>A culture plate of <i>Lactobacillus</i> shows blue-coloured colonies and colourless colonies. Explain the principle involved in the formation of such variance in the colour of colonies.</p>	2
21	<p><u>Attempt either option A or B.</u></p> <p>A.</p> <p>(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.</p> <p style="text-align: center;">OR</p> <p>B.</p> <p>(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</p>	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.

3



- 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

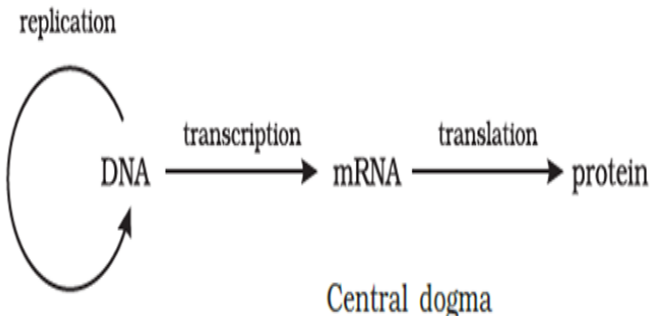
Each Mango fruit contains one seed. Two mango seeds, X and Y were sown in the soil. From Seed X, 3 plant saplings germinated but from seed Y only 1 plant sapling germinated.

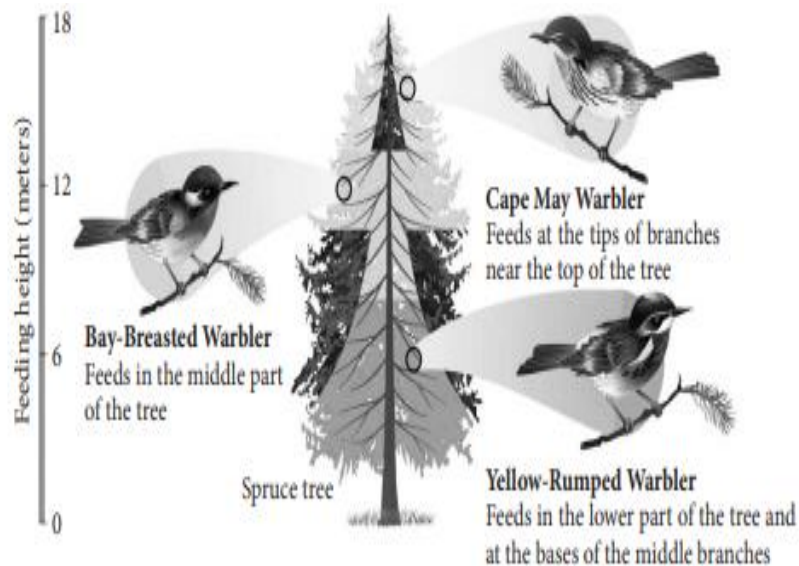
- A. For seed X which is apomictic, calculate the number of:
 - i) Embryo(s)
 - ii) Embryo sac(s)
 - iii) Ovules in this seed's ovary
- B. How multiples embryos are formed in citrus fruits?
- C. What advantage will plants developed from seed Y have over seed X?

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	<p>The schematic representation given below shows the concept of Central Dogma.</p>  <p style="text-align: center;">Central dogma</p> <p>A. During the process of replication and transcription the pairing of nitrogenous bases is not similar. Explain.</p> <p>B. How is the above process modified in a retrovirus? Name the process.</p> <p>C. Justify why during the process of transcription only a segment of DNA is copied into RNA.</p> <p style="text-align: center;">-----</p> <p><u>For visually impaired students</u></p> <p>Central Dogma explains the process of DNA transcription and translation. From DNA mRNA is transcribed and then mRNA is translated into a polypeptide.</p> <p>A. During the process of replication and transcription the pairing of nitrogen bases is not similar. Explain.</p> <p>B. How is the above process modified in viruses? Name the process.</p> <p>C. Justify why during the process of transcription only a segment of DNA is copied into RNA.</p>	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



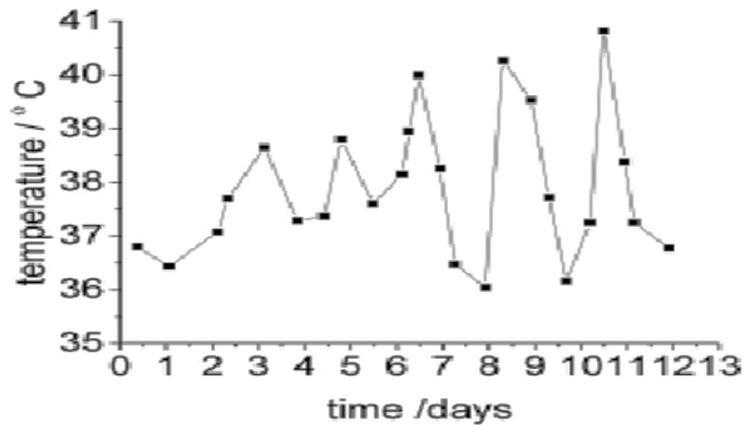
B. What does Gause's exclusion principle state? Does it apply in the case shown above? Explain.

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	<p>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).</p> <p>Given this information, answer the questions below:</p> <p>A. What is the frequency of red beetles? (1)</p> <p>B. Calculate is the percentage of beetles in the population that are heterozygous. (2)</p> <p><u>Attempt either subpart C or D.</u></p> <p>C. What is the frequency of homozygous dominant individuals? (1)</p> <p>OR</p> <p>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)</p>	4
30	<p>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:</p>	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)

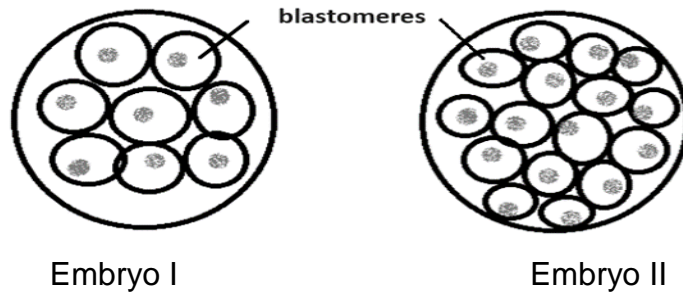
Section - E

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.
- Identify at least 3 parameters of male fertility which get affected due to cryptorchidism.
 - Which process will be affected if mature spermatids are not released from Sertoli cells?
 - Name and explain one assisted reproductive technology (ART process) in which the sperm/semen is used to assist fertilization.
 - 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.



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?

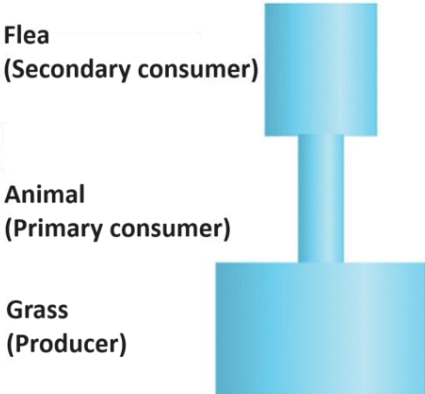
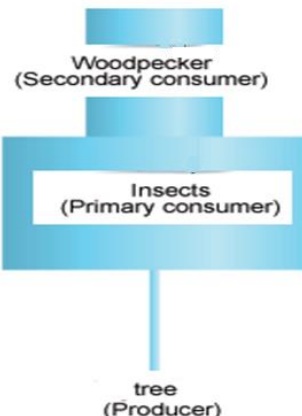
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Marking Scheme
Biology (044)
Class XII (2024 – 25)

Q. No.	Answer	Marks				
Section - A						
1	B. Both placenta as well as fully developed foetus.	1				
2	B. 2000 Formation of one seed requires fertilisation 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 $400 + 1600 = 2000$.	1				
3	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 $G = 46/2 = 23\%$	1				
4	B. CGTA ----- <u>For Visual Impaired Students</u> B. 4000 bp/s It completes replication process in 18 minutes i.e. 18×60 seconds. Rate of polymerization = 4.6×10^6 bp/ 18×60 s = $460000/108$ = 4259.1bp/s or approximately 4000 bp/sec Thus, the correct option is B.	1				
5	C. <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center; padding: 5px;">Suresh</td> <td style="width: 50%; text-align: center; padding: 5px;">Rajesh</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Sickle Cell Anaemia – Autosomal linked Recessive trait</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">Thalassemia – Autosomal Recessive blood disorder</td> </tr> </table>	Suresh	Rajesh	Sickle Cell Anaemia – Autosomal linked Recessive trait	Thalassemia – Autosomal Recessive blood disorder	1
Suresh	Rajesh					
Sickle Cell Anaemia – Autosomal linked Recessive trait	Thalassemia – Autosomal Recessive blood disorder					
6	A. present in the medium and it binds to the repressor.	1				
7	A. (i) and (ii)	1				

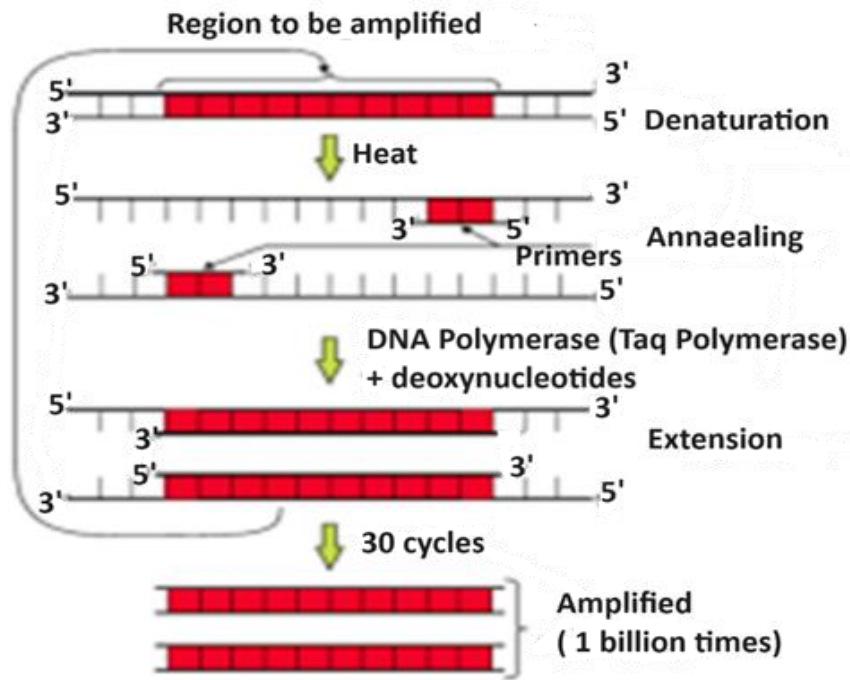
8	C. 5' UAACGG 3'	1
9	B. CO ₂	1
10	D. Rapid divergence of traits among populations inhabiting a given geographical area.	1
11	A. 1 & 5; 5 & 1	1
12	A. Reduction in BOD	1
<p>Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:</p> <p>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.</p>		
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	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <p>(i) Negative hCG implies no pregnancy (0.5); Placenta. (0.5) (ii) Human placental lactogen (hPL), estrogen, progesterone, relaxin (any two) (0.5 x 2 = 1)</p> <p style="text-align: center;">OR</p> <p>B.</p> <p>(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)</p>	2
18	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <p>(i) I is point mutation; II is Frame shift (1) (ii) II as more codons are affected; (0.5)</p> <p>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)</p> <p style="text-align: center;">OR</p>	2

	<p>B.</p> <p>(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)</p> <p>(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)</p>	
19	<p>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)</p> <p>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)</p> <p style="text-align: center;">-----</p> <p><u>For visually impaired students.</u></p> <p>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)</p> <p>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 immunodeficient. (1)</p>	2
20	<ul style="list-style-type: none"> • 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	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <p>(i) $NPP = GPP - R$; Given $GPP = 400 \text{ J/m}^2/\text{day}$ $R = 150 \text{ J/m}^2/\text{day}$ $NPP = 400 \text{ J/m}^2/\text{day} - 150 \text{ J/m}^2/\text{day} = 250 \text{ J/m}^2/\text{day}$ (1)</p> <p>(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)</p> <p style="text-align: center;">OR</p> <p>B.</p> <p>(i) If GPP is equal, then we can manipulate the NPP equation and solve.</p> <ul style="list-style-type: none"> • $NPP = GPP - \text{Respiration of plants}$; • $\text{Respiration of Plants} = GPP - NPP$. • This means that the smallest NPP corresponds to the largest respiration. That is forest C. (1) <p>(ii)</p> <p>(a)</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>(0.5)</p> </div> <div style="text-align: center;">  <p>(0.5)</p> </div> </div>	2
Section – C		
22	<p>A. Seed X- 3 embryos; 1 embryo sac; 1 ovule; (0.5 x 3=1.5)</p> <p>B. The nucellar cells grow mitotically and develop into the embryos by asexual reproduction. (0.5)</p> <p>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)</p>	3

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23	<ul style="list-style-type: none"> • 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	<p>A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5)</p> <p>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)</p> <p>C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1)</p> <p style="text-align: center;">-----</p> <p><u>For visually impaired students</u></p> <p>A. During replication, Adenine pairs with thymine in DNA; during transcription, adenine pairs with uracil in RNA. (0.5+0.5)</p> <p>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)</p> <p>C. It is a highly energy-rich process/ or as per the need only the gene coding for a specific protein is transcribed. (1)</p>	3
25	<ul style="list-style-type: none"> • 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	<p>The main sources of biofertilizers are bacteria, fungi and cyanobacteria.</p> <ul style="list-style-type: none"> - 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 <i>Azospirillum</i> and <i>Azotobacter</i>), 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 <i>Glomus</i> 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. <i>Anabaena</i>, <i>Nostoc</i>, <i>Oscillatoria</i>, 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	<p>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)</p> <p>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, <i>Thermus aquaticus</i>), 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)</p> <p>Each cycle has three steps: (i) Denaturation, (ii) Annealing and (iii) Extensions. (1)</p>	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

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	<p>indefinitely</p> <ul style="list-style-type: none"> • and the competitively inferior one will be eliminated eventually. • No <p style="text-align: right;">(0.5 x 6=3)</p>	
Section – D		
29	<p>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. $0.632 \times 0.632 = 0.4$). So, $q = 0.63$ (1)</p> <p>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)</p> <p><u>Student to attempt either subpart C or D.</u></p> <p>C. Given is $BB = p^2 = (0.37)^2 = 0.14$ (1) OR</p> <p>D. As, 1500 is the total population 40% is red population, hence the number of beetles with red colour will be $1500 \times 0.4 = 600$ (0.5) If total population is 1500 and red is 600 then black would be $1500 - 600 = 900$ (0.5)</p>	4
30	<p>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)</p> <p>B.</p> <ul style="list-style-type: none"> - 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) <p><u>Student to attempt either subpart C or D.</u></p> <p>C. The infection is caused by the bite of the female <i>Anopheles</i> mosquito which introduces the sporozoites in the human body. (1) OR</p> <p>D. Fertilisation and development take place in the mosquito's gut. (1)</p> <p style="text-align: center;">-----</p>	4

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Section – E		
31	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <p>(i)</p> <ul style="list-style-type: none"> • 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) <p>(ii) Spermiation (0.5)</p> <p>(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.</p> <p>OR</p> <p>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)</p> <p>(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)</p> <p style="text-align: center;">-----</p>	5

	<p><u>For visually impaired students</u></p> <p>(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)</p> <p style="text-align: center;">OR</p> <p>B.</p> <p>(I)</p> <p>(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)</p> <p>(ii) Different position and incompatible placement of the reproductive structure prevent successful pollination and thus autogamy in primrose. (1)</p> <p>(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)</p> <p>(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)</p>	
32	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <ul style="list-style-type: none"> - Several nematodes parasitize a wide variety of plants and animals including human beings. - A nematode <i>Meloidogyne incognitia</i> 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 <i>Agrobacterium</i> 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

	<p>double stranded (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode.</p> <ul style="list-style-type: none"> - 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) <p style="text-align: center;">OR</p> <p>B.</p> <ul style="list-style-type: none"> - 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	<p><u>Student to attempt either option A or B.</u></p> <p>A.</p> <p>(i) There are three main reasons for conserving the biodiversity which have been classified into the following categories: (Any two reasons)</p> <ul style="list-style-type: none"> - 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.	<i>In situ</i> conservation	<i>Ex situ</i> 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)	<i>e.g.</i> , national parks, biosphere reserves, wildlife sanctuaries, etc.	<i>e.g.</i> , 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)
