



COMPETENCY-FOCUSED PRACTICE QUESTIONS

ISC-CLASS XII

BIOLOGY PAPER I (THEORY)

PREFACE

With a growing emphasis on competency-based education globally, the educational landscape in India has also steered towards high-quality learning experiences that allow learners to incorporate critical thinking and problem-solving approaches. This approach goes beyond rote memorisation and focuses on developing the skills and knowledge that students need to apply in their real-world scenarios.

The Council for the Indian School Certificate Examinations (CISCE), as a national-level progressive examination board, has taken several steps to infuse competency-based education in CISCE schools through teacher capacity-building on item development for competency-based assessments and the incorporation of competency-focused questions at the ICSE and ISC levels from the examination year 2024.

To further facilitate the adoption of competency-based assessment practices in schools and to support teachers and students towards the preparation for attempting higher-order thinking questions in future board examinations, Item Banks of **Competency-Focused Practice Questions** for selected subjects at the ICSE and ISC levels have been developed. This Item Bank consists of a rich variety of questions, both objective and subjective in categories, aimed at enhancing the subject-specific critical and analytical thinking skills of the students.

In this Item Bank, each question is accompanied by the topic and cognitive learning domain/s that it intends to capture. The cognitive domains reflected in these questions include understanding, analysis, application, evaluation and creativity, along with some questions of the higher-order recall domain. The Answer Key at the end presents the possible answers to a given question, but it is neither limiting nor exhaustive.

These practice questions are also meant to serve as teacher resources for classroom assignments and as samplers to develop their own repository of competency-focused questions. Apart from offering a good practice of higher-order thinking skills, engaging with these questions would allow students to gauge their own subject competencies and use these *assessments for learning* to develop individual learning pathways.

During the development of this Item Bank, a large pool of questions was prepared by a team of experienced CISCE teachers. The questions that were finalised by the internal and external reviewers as being higher-order competency-focused questions have been collated in this item bank.

I acknowledge and appreciate all the ICSE and the ISC subject matter experts who have contributed to the development and review of these high-quality competency-focused questions for CISCE students.

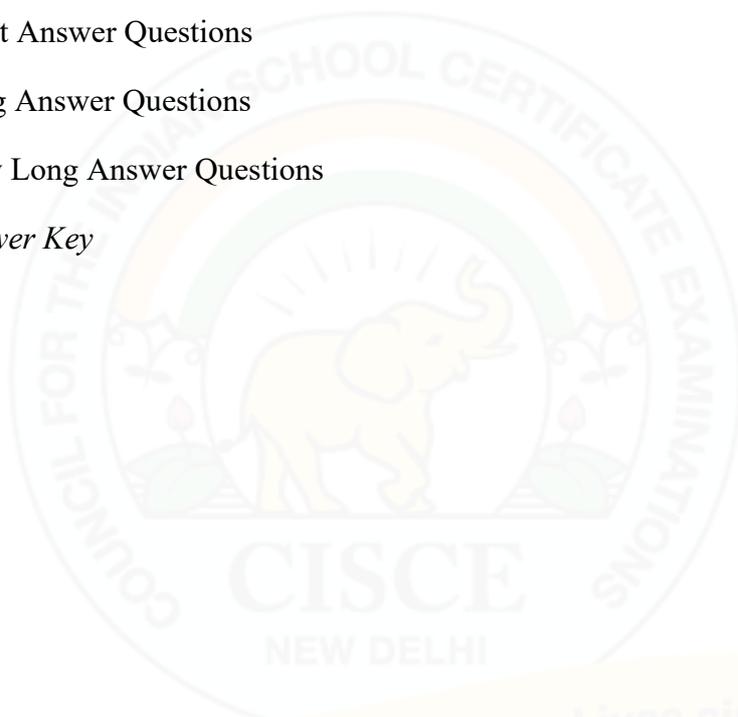
We are hopeful that teachers and students will utilise these questions to support their teaching-learning processes.

July 2024

Dr. Joseph Emmanuel
Chief Executive & Secretary
CISCE

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Empowering Minds & Transforming Lives since 1958

COMPETENCY-FOCUSED PRACTICE QUESTIONS

ISC-CLASS XII

Biology

I: Multiple Choice Questions

(1 Mark Each)

Please select **ONE** correct answer from the following options provided in MCQs.

S.No.	Questions
1.	<p>[Genetics and Evolution]</p> <p>A homozygous pea plant with axial flowers and inflated pods was crossed with another homozygous pea plant with terminal flowers and constricted pods. When the plant of F1-generation was self-pollinated, a total of 800 plants were produced in F2-generation. Among these plants, how many would have terminal flowers and inflated pods?</p> <p>(a) 50 (b) 300 (c) 150 (d) 450</p> <p style="text-align: right;">(Application)</p>
2.	<p>[Reproduction]</p> <p>In a prescribed period, the same number of oogonia and spermatogonia produced by two humans could yield different number of gametes subsequently. This occurs because of which of the following options?</p> <p>(a) The difference in the number of primary oocytes and primary spermatocytes formed. (b) The difference in the number of secondary oocytes and secondary spermatocytes formed. (c) The difference in the number of polar bodies formed. (d) The difference in their mode of cell divisions.</p> <p style="text-align: right;">(Analysis)</p>

S.No.	Questions
3.	<p>[Biology and Human Welfare]</p> <p>When an infected female mosquito bites a human, it transmits a pathogen, causing swelling in the arms, legs and genitals.</p> <p>Name the organism that causes the above-mentioned symptoms.</p> <p>(a) <i>Salmonella typhi</i> (b) <i>Corynaebacterium diphtheriae</i> (c) <i>Wuchereria bancrofti</i> (d) <i>Ascaris lumbricoides</i></p> <p style="text-align: right;">(Recall)</p>
4.	<p>[Biology and Human Welfare]</p> <p>Why is the incubation period especially important in the epidemiology of HIV infection?</p> <p>(a) The load of virus in the body is the heaviest. (b) The individual is normally asymptomatic during this stage. (c) Transmission of HIV is easiest during this stage. (d) This is the only infective stage for HIV transmission.</p> <p style="text-align: right;">(Understanding)</p>
5.	<p>[Biology and Human Welfare]</p> <p>In a laboratory, a Biochemical Oxygen Demand (BOD) test was conducted with three water samples. These were marked as follows: A-River water B-Untreated sewage water C- Discharged water from a sewage treatment plant.</p> <p>However, the attendant conducting the experiment forgot to note down names of the samples with BOD values. The BOD values recorded are given below: 6mg/L, 300mg/L, 25mg/L</p> <p>Identify the correct water sample with the BOD value from below:</p> <p>(a) A-6mg/L, B-25mg/L, C-300mg/L (b) A-25mg/L, B-300mg/L, C-6mg/L (c) A-300mg/L, B-25mg/L, C-6mg/L (d) A-300mg/L, B-6mg/L, C-25mg/L</p> <p style="text-align: right;">(Analysis)</p>
6.	<p>[Biology and Human Welfare]</p> <p>An experiment conducted by the students of class XII found that secondary treatment of municipal and residential waste in their locality could produce biogas. The presence of which of the following in the given waste would account for it?</p> <p>(a) Anaerobic bacteria (b) Aerobic bacteria (c) Yeast (d) Algae</p> <p style="text-align: right;">(Understanding)</p>

S.No.	Questions																								
7.	<p>[Biology and Human Welfare]</p> <p>A doctor advised his patient who was suffering from indigestion to include curd in his diet for early recovery. Identify the medicinal role of curd and the organism involved in its production from the options given below:</p> <p>(a) Antacid-<i>Clostridium</i> sp. (b) Antalkali-<i>Lactobacillus acidophilus</i> (c) Antakali-<i>Propionibacterium shermani</i> (d) Antacid - <i>Lactobacillus acidophilus</i></p> <p style="text-align: right;">(Recall)</p>																								
8.	<p>[Genetics and Evolution]</p> <p>Riya, Ali and John were asked to study the following cases and interpret them.</p> <table border="1" data-bbox="440 831 1321 1070"> <thead> <tr> <th>Case</th> <th>Mother</th> <th>Father</th> <th>Children</th> </tr> </thead> <tbody> <tr> <td>Case 1</td> <td>Normal</td> <td>With disease</td> <td>Son always normal</td> </tr> <tr> <td>Case 2</td> <td>Normal</td> <td>With disease</td> <td>Son and daughters could show disease</td> </tr> </tbody> </table> <p>They interpreted these cases by suggesting a possible disease for each as tabulated below:</p> <table border="1" data-bbox="561 1173 1198 1391"> <thead> <tr> <th></th> <th>Case 1</th> <th>Case 2</th> </tr> </thead> <tbody> <tr> <td>Riya</td> <td>Colour blindness</td> <td>Sickle cell anaemia</td> </tr> <tr> <td>Ali</td> <td>Thalassemia</td> <td>Haemophilia</td> </tr> <tr> <td>John</td> <td>Down's syndrome</td> <td>PKU</td> </tr> </tbody> </table> <p>Whose interpretation(s) is/ are correct?</p> <p>(a) Riya (b) Ali (c) John (d) Both Riya and John</p> <p style="text-align: right;">(Evaluate)</p>	Case	Mother	Father	Children	Case 1	Normal	With disease	Son always normal	Case 2	Normal	With disease	Son and daughters could show disease		Case 1	Case 2	Riya	Colour blindness	Sickle cell anaemia	Ali	Thalassemia	Haemophilia	John	Down's syndrome	PKU
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9.	<p data-bbox="316 253 654 293">[Genetics and Evolution]</p> <p data-bbox="316 309 1449 454">Given below is the graphical representation of Meselson and Stahl's experiment wherein <i>E. coli</i> cultured in $^{15}\text{NH}_4\text{Cl}$ medium was transferred to a medium containing $^{14}\text{NH}_4\text{Cl}$ and allowed to multiply for some time. Study it carefully and answer the question that follows.</p> <div data-bbox="432 477 1173 949" style="text-align: center;"> <table border="1" data-bbox="432 477 1173 949"> <caption>Data points from the Meselson and Stahl experiment graph</caption> <thead> <tr> <th>Time (minutes)</th> <th>% of DNA molecules (Curve P)</th> <th>% of DNA molecules (Curve Q)</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>0</td> <td>100</td> </tr> <tr> <td>40</td> <td>50</td> <td>50</td> </tr> <tr> <td>60</td> <td>75</td> <td>25</td> </tr> <tr> <td>80</td> <td>88</td> <td>12</td> </tr> </tbody> </table> </div> <p data-bbox="316 996 1053 1037">Identify the type of DNA indicated by curve 'P' and 'Q'.</p> <p data-bbox="316 1048 702 1216"> (a) P: $^{14}\text{N} \ ^{14}\text{N}$ and Q: $^{15}\text{N} \ ^{15}\text{N}$ (b) P: $^{15}\text{N} \ ^{15}\text{N}$ and Q: $^{14}\text{N} \ ^{14}\text{N}$ (c) P: $^{14}\text{N} \ ^{15}\text{N}$ and Q: $^{14}\text{N} \ ^{14}\text{N}$ (d) P: $^{14}\text{N} \ ^{14}\text{N}$ and Q: $^{14}\text{N} \ ^{15}\text{N}$ </p> <p data-bbox="1305 1176 1449 1216" style="text-align: right;">(Analysis)</p>	Time (minutes)	% of DNA molecules (Curve P)	% of DNA molecules (Curve Q)	20	0	100	40	50	50	60	75	25	80	88	12
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S.No.	Questions																									
<p>10.</p>	<p>[Genetics and Evolution]</p> <p>The given Venn diagram represents two processes (P and Q) of the central dogma with some missing components (R and S).</p> <div data-bbox="475 398 1289 855" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> </div> <p>Identify P, Q, R and S.</p> <table border="1" data-bbox="320 922 1321 1115" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th></th> <th>P</th> <th>Q</th> <th>R</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>(a)</td> <td>Translation</td> <td>Replication</td> <td>Amino acids</td> <td>DNA polymerase</td> </tr> <tr> <td>(b)</td> <td>Replication</td> <td>Transcription</td> <td>Leading strand</td> <td>Releasing factor</td> </tr> <tr> <td>(c)</td> <td>Transcription</td> <td>Translation</td> <td>mRNA</td> <td>Rho factor</td> </tr> <tr> <td>(d)</td> <td>Replication</td> <td>Transcription</td> <td>Okazaki fragments</td> <td>Sigma factor</td> </tr> </tbody> </table> <p style="text-align: right; color: green; font-weight: bold;">(Understanding)</p>		P	Q	R	S	(a)	Translation	Replication	Amino acids	DNA polymerase	(b)	Replication	Transcription	Leading strand	Releasing factor	(c)	Transcription	Translation	mRNA	Rho factor	(d)	Replication	Transcription	Okazaki fragments	Sigma factor
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(d)	Replication	Transcription	Okazaki fragments	Sigma factor																						
<p>11.</p>	<p>[Genetics and Evolution]</p> <p>What will happen if the 'o' gene of lac operon is mutated such that it loses affinity for the 'i' gene product?</p> <p>(a) No transcription of structural genes will take place. (b) Continuous transcription of structural genes will take place. (c) β-galactosidase and permease will be synthesized, but transacetylase will not be synthesized. (d) RNA polymerase will be unable to bind to the promoter.</p> <p style="text-align: right; color: green; font-weight: bold;">(Analysis)</p>																									

S.No.	Questions
12.	<p>[Genetics and Evolution]</p> <p>Given below are <i>four</i> statements regarding the steps involved in Deoxyribonucleic acid (DNA) fingerprinting. Identify the INCORRECT statement.</p> <ol style="list-style-type: none"> 1. Sample size of the DNA is increased by electrophoresis. 2. DNA fragments are denatured by restricting endonuclease. 3. Separated DNA fragments are fixed by Ultraviolet (UV) light. 4. Double-stranded DNA (dsDNA) is hybridised with radiolabelled variable number tandem repeats (VNTR) probe. <p>(a) 1 and 2 (b) 2 and 3 (c) 1, 3 and 4 (d) 1, 2 and 4</p> <p style="text-align: right;">(Recall)</p>
13.	<p>[Biotechnology and its Applications]</p> <p>Golden Rice was made by adding two special genes to rice, one from daffodils and one from a soil bacterium. These genes help the rice produce more vitamin A. Which cloning vector from below was used for the process of transfer of gene?</p> <p>(a) <i>Agrobacterium</i> (b) <i>pBR322</i> (c) <i>Retrovirus</i> (d) BAC</p> <p style="text-align: right;">(Understanding)</p>
14.	<p>[Biotechnology and its Applications]</p> <p>During the synthesis of recombinant insulin, the gene for alpha and beta polypeptides are inserted into the plasmid by the side of which of the following gene?</p> <p>(a) Antibiotic resistant gene (b) Lac Z promoter gene (c) Beta galactosidase gene (d) Replication gene</p> <p style="text-align: right;">(Recall)</p>
15.	<p>[Ecology and Environment]</p> <p>The Atlantic cod (<i>Gadus callarias</i>) is a fish which lays about 5,000,000 eggs in its lifetime. On average, only two of these eggs survive to become an adult cod. How does this promote evolution?</p> <p>(a) All offsprings are genetically identical, so become better adapted. (b) Laying many eggs provides food for other species to survive and become better adapted. (c) Some young cod change to become adapted to the environment and survive and pass on their genes. (d) Offsprings with favourable variation survive and pass on their genes.</p> <p style="text-align: right;">(Understanding)</p>

II. Assertion-Reason Questions

(1 Mark Each)

The questions in this section have two statements marked Assertion and Reason. Read both the statements carefully and choose the correct option.

S.No.	Questions
16.	<p>[Ecology and Environment]</p> <p>Assertion: The population growth rate is negative for urn-shaped type of population. Reason: A declining population has low birth rate compared to death rate.</p> <p>(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion. (c) Assertion is true and Reason is false. (d) Both Assertion and Reason are false.</p> <p style="text-align: right;">(Analysis)</p>
17.	<p>[Biotechnology and its Applications]</p> <p>Assertion: In Polymerase chain reaction (PCR), DNA Polymerase is used to amplify (replicate) a piece of DNA by <i>in vitro</i> enzymatic replication. Reason: As the Polymerase chain reaction (PCR) process progresses, the DNA generated is itself used as a template for replication.</p> <p>(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion. (c) Assertion is true and Reason is false. (d) Both Assertion and Reason are false.</p> <p style="text-align: right;">(Understanding)</p>
18.	<p>[Reproduction]</p> <p>Assertion: Double fertilisation produces the precursor of endosperm. Reason: Embryo develops after the endosperm.</p> <p>(a) Both Assertion and Reason are true, and Reason is the correct explanation of the Assertion. (b) Both Assertion and Reason are true, and Reason is not the correct explanation of the Assertion. (c) Assertion is true but Reason is false. (d) Both Assertion and Reason are false.</p> <p style="text-align: right;">(Application)</p>

S.No.	Questions
19.	<p>[Genetics and Evolution]</p> <p>Assertion: The interphase nucleus of a female child suffering from Down's syndrome shows 45 autosomes.</p> <p>Reason: Down's syndrome occurs due to trisomy of autosomes and not sex chromosomes.</p> <p>(a) Both Assertion and Reason are true, and Reason is the correct explanation of the Assertion.</p> <p>(b) Both Assertion and Reason are true, and Reason is not the correct explanation of the Assertion.</p> <p>(c) Assertion is true but Reason is false.</p> <p>(d) Both Assertion and Reason are false. (Application)</p>
20.	<p>[Genetics and Evolution]</p> <p>Assertion: Darwin's finches show a variety of beaks suited for eating large seeds, flying insects and cactus seeds.</p> <p>Reason: Ancestral seed-eating stock of Darwin's finches radiated out from South America mainland to different geographical areas of the Galapagos Islands.</p> <p>(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.</p> <p>(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.</p> <p>(c) Assertion is true, but Reason is false.</p> <p>(d) Both Assertion and Reason are false. (Application)</p>

III: Very Short Answer Questions

(1 Mark Each)

S.No.	Questions
21.	<p>[Genetics and Evolution]</p> <p>A chimpanzee can hold objects with its hand whereas the elephant can hold the object by its trunk.</p> <p>How would you classify the organs, hand and trunk based on evolution?</p> <p style="text-align: right;">(Understanding)</p>
22.	<p>[Ecology and Environment]</p> <p>Why is there a reduced biodiversity richness at higher altitudes in comparison to equatorial regions?</p> <p style="text-align: right;">(Understanding)</p>
23.	<p>[Genetics and Evolution]</p> <p>In mice, yellow coat (YY) and white coat (yy) are homozygous, while cream coloured mice are heterozygous.</p> <p>If a cream-coloured mouse is crossed with a yellow-coloured mouse what will be the possible genotypic ratio of their offsprings?</p> <p style="text-align: right;">(Application)</p>
24.	<p>[Genetics and Evolution]</p> <p>How is it that only one DNA strand is copied during transcription, and not both?</p> <p style="text-align: right;">(Evaluate)</p>
25.	<p>[Genetics and Evolution]</p> <p>‘Spliceosomes formed during RNA splicing are present in the fungal cell but absent in a bacterial cell’. Justify this statement.</p> <p style="text-align: right;">(Analysis)</p>
26.	<p>[Genetics and Evolution]</p> <p>Riya studied the following three mRNAs:</p> <p>(a) AUGUUUGAU (b) UAAUGGGAC (c) UAGUUUGAU</p> <p>She was confused to see that out of these mRNAs, only the <i>first</i> (a) mRNA could be translated whereas others could not. Help Riya understand the reason for this.</p> <p style="text-align: right;">(Analysis)</p>
27.	<p>[Biotechnology and its Applications]</p> <p>To link alien DNA with the cloning vector, why should the vector have a single recognition site for the commonly used restriction enzymes?</p> <p style="text-align: right;">(Analysis)</p>

S.No.	Questions
28.	<p>[Biotechnology and its Applications]</p> <p>What is the advantage of pBR322 containing recognition sites for many different Restriction enzymes? (Recall)</p>
29.	<p>[Reproduction]</p> <p>How many chromosomes are present in the pollen and Primary Endosperm Nucleus of a plant which has 36 chromosomes in its sporogenous cell? (Application)</p>
30.	<p>[Reproduction]</p> <p>Suggest an Assisted Reproductive Technique (ART) each for the following individuals to bear children.</p> <p>(a) A woman who cannot produce fertile eggs.</p> <p>(b) A woman whose fallopian tube is blocked. (Understanding)</p>
31.	<p>[Biology and Human Welfare]</p> <p>An antibody molecule is represented as H_2L_2. Explain. (Understanding)</p>
32.	<p>[Ecology and Environment]</p> <p>Ali was growing a bacterial colony in a culture flask under ideal laboratory conditions where the resources were replenished. Which growth curve equation would represent the growth in this case? (Analysis)</p>
33.	<p>[Genetics and Evolution]</p> <p>Predict the consequences when both the template and the coding strands of a DNA segment participate in transcription process? (Evaluate)</p>

S.No.	Questions
<p>34.</p>	<p>[Biotechnology and its Applications]</p> <p>Shown below are two forms of insulin named X and Y. Which one of the <i>two</i> is biologically active and why?</p> <div style="text-align: center;"> </div> <p style="text-align: center;">X Y</p> <p style="text-align: right;">(Analysis)</p>
<p>35.</p>	<p>[Ecology and Environment]</p> <p><i>Vanda</i> orchids were seen on specific branches of a <i>Lagerstroemia</i> trees in a park, with its roots hanging in the air.</p> <p>Identify the type of ecological interaction between <i>Vanda</i> and <i>Lagerstroemia</i>.</p> <p style="text-align: right;">(Understanding)</p>
<p>36.</p>	<p>[Genetics and Evolution]</p> <p>When both the parents are heterozygous for Phenylketonuria (PKU), what will be the probability of their first child being phenotypically normal but a carrier?</p> <p style="text-align: right;">(Understanding)</p>

S.No.	Questions
<p>37.</p>	<p>[Genetics and Evolution]</p> <p>If protein was the genetic material, then according to Hershey and Chase experiment the pellet in the diagram given below will show the presence of which radioactive element?</p> <div data-bbox="523 389 1241 869" style="text-align: center;"> <p>The diagram shows a test tube with a light pink liquid in the upper portion, labeled 'Supernatant'. At the bottom of the tube is a small, dark red solid mass, labeled 'Pellet'.</p> </div> <p style="text-align: right; color: green;">(Application)</p>
<p>38.</p>	<p>[Genetics and Evolution]</p> <p>The pedigree chart given below represents the pattern of inheritance of polydactyly in a family. Study it carefully and write the genotype of individual 1.</p> <div data-bbox="416 1099 1347 1637" style="text-align: center;"> <p>The pedigree chart shows three generations. Generation I consists of an unaffected male (square) and an affected female (shaded circle) labeled '1'. They have three children in Generation II: an unaffected male, an affected male, and an affected female. The unaffected male in Generation II has two children in Generation III, both unaffected females. The affected male in Generation II has two children in Generation III, one affected female and one affected male. The affected female in Generation II has two children in Generation III, one affected male and one unaffected male.</p> </div> <p style="text-align: right; color: green;">(Application)</p>

IV. Short Answer Questions **(2 Marks Each)**

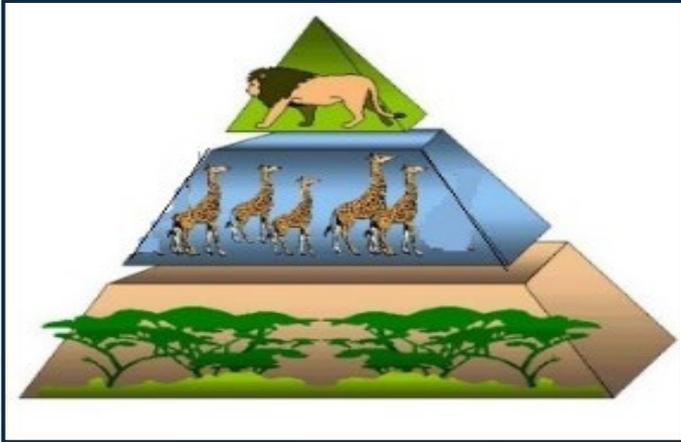
S.No.	Questions																		
39.	<p>[Genetics and Evolution]</p> <p>Two insects, 'A' and 'B' belonged to different families. A few cells from the antennae of these insects were scraped and subjected to karyotyping and other investigations. The following data was obtained. Study it carefully and answer the questions that follow:</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;">Karyotype and other investigation report</th> </tr> <tr> <th style="width: 50%;"></th> <th style="width: 25%; text-align: center;">A</th> <th style="width: 25%; text-align: center;">B</th> </tr> </thead> <tbody> <tr> <td>Number of chromosomes</td> <td style="text-align: center;">16</td> <td style="text-align: center;">8</td> </tr> <tr> <td>Sex chromosome</td> <td style="text-align: center;">Absent</td> <td style="text-align: center;">XX</td> </tr> <tr> <td>Parthenogenesis</td> <td style="text-align: center;">Seen</td> <td style="text-align: center;">Not seen</td> </tr> <tr> <td>Gamete formation</td> <td style="text-align: center;">Mitosis</td> <td style="text-align: center;">Meiosis</td> </tr> </tbody> </table> <p>(a) Identify 'A' and 'B'. (b) Mention the sex of 'A' and 'B.'</p> <p style="text-align: right;">(Analysis)</p>	Karyotype and other investigation report				A	B	Number of chromosomes	16	8	Sex chromosome	Absent	XX	Parthenogenesis	Seen	Not seen	Gamete formation	Mitosis	Meiosis
Karyotype and other investigation report																			
	A	B																	
Number of chromosomes	16	8																	
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Gamete formation	Mitosis	Meiosis																	
40.	<p>[Biotechnology and its Applications]</p> <p>Study the following diagram and answer questions given below:</p> <div style="text-align: center; border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"> <p style="text-align: center;">mRNA</p> </div> <p>(a) Identify 'A' and 'B'. (b) Biotechnologists synthesised a cDNA from 'X' RNA using reverse transcriptase and inserted this cDNA into the plasmid of <i>E. coli</i> for insulin production. Will they be successful in getting insulin? Justify your answer.</p> <p style="text-align: right;">(Application)</p>																		

S.No.	Questions
41.	<p>[Genetics and Evolution]</p> <p>Tisha and Ravi were discussing about DNA replication in the given DNA sequence and made two statements.</p> <p style="text-align: center;">3' TAGCCCAGC 5' 5' ATCGGGTCG 3'</p> <p>Tisha: "Each of the two new daughter strands formed after DNA replication would have an identical base sequence".</p> <p>Ravi: "The nucleotide sequence of one daughter strand would be identical to that of the coding strand".</p> <p>(a) Who made a correct statement? Give a reason for your answer.</p> <p>(b) Due to the absence of certain enzymes, the parental DNA strands showed certain defects mentioned below during replication. Identify the enzyme in each case.</p> <p>(i) The parental DNA strand supercoils and eventually breaks.</p> <p>(ii) The growing DNA strand had a lot of mismatched nucleotides. (Application)</p>
42.	<p>[Genetics and Evolution]</p> <p>Find out the number of base pairs in <i>E. coli</i> DNA, if its DNA is 1.02 mm long. (Application)</p>
43.	<p>[Reproduction]</p> <p>A couple struggled with infertility for an extended period. Subsequently, it was discovered that neither partner was capable of producing viable gametes. Give <i>two</i> reasons which could have contributed to this issue. (Understanding)</p>
44.	<p>[Reproduction]</p> <p>"The process of sexual reproduction differs between closed flowers and open flowers." Explain. (Recall)</p>
45.	<p>[Reproduction]</p> <p>How does self-incompatibility restrict autogamy? How does pollination occur in such plants? (Understanding)</p>
46.	<p>[Ecology and Environment]</p> <p>Which trophic level in a food chain is known as 'transducers' and why? (Understanding)</p>

S.No.	Questions
47.	<p>[Biotechnology and its Applications]</p> <p>(a) How does the activity of <i>HindII</i> contrast with that of <i>EcoRI</i>? (b) Which <i>one</i> of these enzymes can be preferably used in <i>Rdt</i>? Give a reason.</p> <p style="text-align: right;">(Recall & Application)</p>
48.	<p>[Biotechnology and its Applications]</p> <p>While doing a Polymerase chain reaction (PCR), “<i>extension</i>” step is missed. What will be its effect on the process?</p> <p style="text-align: right;">(Understanding)</p>
49.	<p>[Biology and Human Welfare]</p> <p>A passenger met with a minor accident and started bleeding through the skin. He was immediately rushed to the nearby hospital. The doctor immediately gave tetanus antitoxin to him.</p> <p>(a) Why did the doctor not administer a tetanus vaccine? (b) Explain the basic difference between vaccination and immunisation.</p> <p style="text-align: right;">(Understanding & Recall)</p>
50.	<p>[Genetics and Evolution]</p> <p>Bring out the difference between de Vries mutation theory and Darwinian variations?</p> <p style="text-align: right;">(Analysis)</p>
51.	<p>[Genetics and Evolution]</p> <p>If there are 303 bases in an RNA that codes for a protein with 100 amino acids and the base at position 241 is deleted, reducing the RNAs length to 302 bases.</p> <p>(a) How many amino acids will be altered during translation? (b) What will such type of mutation be called?</p> <p style="text-align: right;">(Application & Recall)</p>
52.	<p>[Biotechnology and its Applications]</p> <p>Observe the given sequence of nitrogen bases in a DNA fragment and answer the following questions.</p> <p>5’ATTGTCGACGGG3’ 3’TAACAGCTGCCC5’</p> <p>(a) Identify the palindrome in the given sequence. (b) Name the restriction enzyme and its source that will cleave the palindromic sequence identified above.</p> <p style="text-align: right;">(Application)</p>

S.No.	Questions									
53.	<p>[Genetics and Evolution]</p> <p>(a) Why does the lac operon shut down some time after the addition of lactose in the medium where <i>E. coli</i> was growing?</p> <p>(b) What is the constant necessity for a minimal level of expression in the lac operon?</p> <p style="text-align: right;">(Application)</p>									
54.	<p>[Genetics and Evolution]</p> <p>Explain why RNA, which initially served as the focal point for transmission of hereditary characters, was eventually replaced by DNA throughout the course of evolution.</p> <p style="text-align: right;">(Analysis)</p>									
55.	<p>[Biotechnology and its Applications]</p> <p>Genotypes of Sickle cell anaemia can be determined due to differences in the size of the DNA bands produced by digesting the Haemoglobin gene DNA with restriction enzyme. The gel electrophoresis depicts the DNA fragments produced after genotyping <i>two</i> siblings' 'X' and 'Y'. Study it carefully and answer the following questions.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 45%; text-align: center;">X</th> <th style="width: 45%; text-align: center;">Y</th> </tr> </thead> <tbody> <tr> <td style="text-align: right; padding-right: 10px;">Hb S</td> <td style="text-align: center;"></td> <td style="text-align: center;"></td> </tr> <tr> <td style="text-align: right; padding-right: 10px;">Hb A</td> <td style="text-align: center;"></td> <td></td> </tr> </tbody> </table> <div style="text-align: right; margin-top: 10px;">  </div> </div> <p>(a) Determine if the given statement is accurate or not. Provide reasoning for the same. 'The parents of individuals X and Y are heterozygous.'</p> <p>(b) Identify the allele which gives a DNA fragment of:</p> <ol style="list-style-type: none"> 1. larger size 2. smaller size <p style="text-align: right;">(Evaluate)</p>		X	Y	Hb S			Hb A		
	X	Y								
Hb S										
Hb A										

S.No.	Questions
56.	<p data-bbox="336 248 671 282">[Genetics and Evolution]</p> <p data-bbox="336 302 1449 409">Ritu and Ali performed an experiment as depicted where all the parameters were kept constant except that, Ritu added papaya pulp to her test tube whereas Ali added an unknown enzyme 'X' to his test tube.</p> <div data-bbox="429 427 1353 1267" style="border: 1px solid black; padding: 10px;"> </div> <p data-bbox="344 1285 1214 1321">(a) In Ritu's case, name the process responsible for the conversion.</p> <p data-bbox="344 1328 667 1364">(b) Identify enzyme 'X'.</p> <p data-bbox="344 1368 1230 1404">(c) Give a possible reason for the observation made by Ritu and Ali.</p> <p data-bbox="1305 1413 1445 1449" style="text-align: right;">(Analysis)</p>

S.No.	Questions
57.	<p data-bbox="336 248 710 286">[Ecology and Environment]</p> <p data-bbox="336 302 1445 371">Study the figure of an ecological pyramid given below and then answer the questions that follow:</p> <div data-bbox="549 389 1230 831"></div> <p data-bbox="344 853 1110 976">(a) Identify the type of pyramid. (b) Give <i>two</i> examples of pyramids mentioned in (a). (c) Which is the topmost trophic level shown in the figure?</p> <p data-bbox="1214 981 1445 1019">(Understanding)</p>
58.	<p data-bbox="336 1059 743 1097">[Biology and Human Welfare]</p> <p data-bbox="336 1113 1445 1216">A doctor prescribed a drug as a sedative and pain killer to a patient who had undergone a surgery. Even after recovery, he indiscriminately took the medicines and later craved for the same.</p> <p data-bbox="344 1238 1169 1317">(a) What do you conclude about his condition? (b) Suggest any <i>two</i> measures to him to overcome this problem.</p> <p data-bbox="1259 1339 1445 1377">(Application)</p>

V: Long Answer Questions

(3 Marks Each)

S.No.	Questions										
59.	<p>[Ecology and Environment]</p> <p>An ecologist, David Tilman, proposed that in an ecosystem the stability of a biological community depends on its species richness. How was it supported by Paul Ehrlich?</p> <p style="text-align: right;">(Analysis)</p>										
60.	<p>[Biology and Human Welfare]</p> <p>The graph illustrates the concentration of Biochemical Oxygen Demand (BOD) in various samples, including (A) untreated sewage, (B) secondary effluent, (C) river water, and (D) primary effluent.</p> <p>(a) Which sample contains the highest level of Pathogenic microbes? (b) Name the sample that contains the lowest level of pathogenic microbes. (c) Which sample can be used for domestic purposes?</p> <div data-bbox="571 913 1193 1249" style="text-align: center;"> <table border="1" style="margin-left: auto; margin-right: auto;"> <caption>Data from BOD Level Graph</caption> <thead> <tr> <th>Sample</th> <th>Level of BOD (mg/L)</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>~120</td> </tr> <tr> <td>B</td> <td>~20</td> </tr> <tr> <td>C</td> <td>~250</td> </tr> <tr> <td>D</td> <td>~400</td> </tr> </tbody> </table> </div> <p style="text-align: right;">(Analysis)</p>	Sample	Level of BOD (mg/L)	A	~120	B	~20	C	~250	D	~400
Sample	Level of BOD (mg/L)										
A	~120										
B	~20										
C	~250										
D	~400										
61.	<p>[Biotechnology and its Applications]</p> <p>(a) Name <i>one</i> cloning vector that causes tumour in plant cells and the other cloning vector that causes cancer in animal cells. (b) Elaborate on how biotechnologists have utilized these cloning vectors for human benefit?</p> <p style="text-align: right;">(Recall & Understanding)</p>										

S.No.	Questions
62.	<p data-bbox="327 246 662 280">[Genetics and Evolution]</p> <p data-bbox="327 302 1444 369">The weight of a tomato plant is controlled by 3 pairs of alleles in a cumulative manner. Saloni crossed a tomato plant 'X' with plant 'Y'.</p> <div data-bbox="327 392 1412 1131" style="border: 1px solid black; padding: 10px;"><p data-bbox="383 952 766 1086">Plant 'X' Genotype: AABBCC Weight: 90 g</p><p data-bbox="941 996 1276 1131">Plant 'Y' Genotype: aabbcc Weight 54 g</p></div> <p data-bbox="327 1198 1444 1456">(a) Identify the type of inheritance shown by the tomato plant. What will be the total types of allelic combinations in the gametes of a tomato plant heterozygous for all three genes? (b) What will be the weight of the progeny plant obtained by crossing plant 'X' with 'Y'? (c) Find the weight of the tomato plant with genotype AAbbcc.</p> <p data-bbox="1260 1467 1444 1512" style="text-align: right;">(Application)</p>

S.No.	Questions																								
63.	<p>[Genetics and Evolution]</p> <p>A geneticist discovers a new gene in a fungal genome. Given below is a stretch of DNA of a structural gene of a transcription unit.</p> <p>5'--- ATG GTC TCT CAG GTC CCC ---3'</p> <p>(a) Write the sequence of nucleotides in the corresponding mRNA strand that will be transcribed, along with its polarity.</p> <p>(b) If GUC of the transcribed mRNA is an intron, then how many bases will be present in the mRNA?</p> <p>(c) If 'C' of 4th codon is replaced by 'T', then it will lead to which type of mutation? Choose from the options given below:</p> <ol style="list-style-type: none"> 1. Same sense mutation 2. Missense mutation 3. Nonsense mutation <p>(d) How many amino acids will be present in the polypeptide chain obtained from this mutated DNA?</p> <p>(e) Consider a hypothetical situation, if this type of mutation occurs in the 'y' gene of lac operon in E. coli, then what effect will it have on the synthesis of all the three enzymes? Give a reason for your answer.</p> <p style="text-align: right;">(Application)</p>																								
64.	<p>[Genetics and Evolution]</p> <p>You have obtained a sample of DNA, and you synthesise mRNA from this DNA and purify it. You then separate the two strands of the DNA and analyse the base composition of each strand and of the mRNA. You obtain the data shown in the table below:</p> <table border="1" data-bbox="576 1429 1190 1648"> <thead> <tr> <th></th> <th>A</th> <th>G</th> <th>C</th> <th>T</th> <th>U</th> </tr> </thead> <tbody> <tr> <td>NA strand 1</td> <td>16.1</td> <td>24.0</td> <td>29.0</td> <td>21.9</td> <td>0</td> </tr> <tr> <td>NA strand 2</td> <td>22.2</td> <td>28.8</td> <td>17.3</td> <td>17.3</td> <td>0</td> </tr> <tr> <td>RNA</td> <td>16.0</td> <td>23.9</td> <td>28.8</td> <td>0</td> <td>22.3</td> </tr> </tbody> </table> <p>Answer the following questions.</p> <p>(a) Which strand of the DNA is the non-coding strand, serving as a template for mRNA synthesis? Give a reason for your answer.</p> <p>(b) What would be the polarity of the DNA strand 1 and 2?</p> <p>(c) If you isolate the genetic material from a retrovirus, then name the processes that would be carried out to obtain the above shown data.</p> <p style="text-align: right;">(Analysis)</p>		A	G	C	T	U	NA strand 1	16.1	24.0	29.0	21.9	0	NA strand 2	22.2	28.8	17.3	17.3	0	RNA	16.0	23.9	28.8	0	22.3
	A	G	C	T	U																				
NA strand 1	16.1	24.0	29.0	21.9	0																				
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RNA	16.0	23.9	28.8	0	22.3																				

S.No.	Questions
65.	<p>[Ecology and Environment]</p> <p>Study the statements given below and classify them into the categories of narrowly utilitarian, broadly utilitarian and ethical reasons related with the conservation of biodiversity.</p> <p>(a) Sustenance of all species is a requirement for the survival of man on earth. (b) We derive lubricants, tannins, firewood and fibre from nature. (c) Plants of forests produce food for all by photosynthesis and purify air.</p> <p style="text-align: right;">(Understanding)</p>
66.	<p>[Reproduction]</p> <p>Majority of flowering plants release the pollen grains in two-celled stage.</p> <p>(a) Write the functional roles of the two cells. (b) Plants need the pollinators to help in the transfer of pollen grains. Yet, some plants are ready to offer pollen grains as food to them. How is this possible?</p> <p style="text-align: right;">(Recall & Understanding)</p>
67.	<p>[Reproduction]</p> <p>(a) The process of fertilisation is a link between two generations. Justify. (b) Why is fertilisation genetically important in a species?</p> <p style="text-align: right;">(Application)</p>
68.	<p>[Biology and Human Welfare]</p> <p>The diagram given below represents an immune response/mechanism in the human body.</p> <div data-bbox="593 1330 1230 1722" data-label="Diagram"> <p>The diagram shows a cell labeled 'B' on the left, which is engulfing a 'BACTERIA' (indicated by a dashed line and arrows). The resulting cell is labeled 'C' on the right. Another cell is labeled 'A' above 'C'. The diagram illustrates the process of phagocytosis, where a cell engulfs a foreign particle (bacteria) and digests it.</p> </div> <p>(a) What is the mechanism's name and significance in the human body? (b) What is the difference between primary and secondary lymphoid tissues?</p> <p style="text-align: right;">(Understanding)</p>

S.No.	Questions
69.	<p>[Biology and Human Welfare]</p> <p>Why is no inoculum necessary when mixing cow dung and water for digestion in the biogas plant? Explain the role of microbes in this process. Identify the conditions under which they exhibit optimal activity and effectiveness.</p> <p style="text-align: right;">(Understanding)</p>
70.	<p>[Biotechnology and its Applications]</p> <p>(a) What is the term for the plant resulting from the introduction of <i>CryIAb</i> to prevent corn borer infestation? (b) Summarise the action of the introduced gene.</p> <p style="text-align: right;">(Understanding)</p>
71.	<p>[Biology and Human Welfare]</p> <p>Observe the diagram and answer the questions that follow:</p> <div data-bbox="379 817 1396 1205" style="text-align: center;"> </div> <p>(a) Identify the type of cellular proliferation given in the diagram? (b) Name the disease associated with this mode of cell division. (c) State <i>one</i> method for detection of the disease given in (b) and a treatment approach.</p> <p style="text-align: right;">(Understanding & Application)</p>

S.No.	Questions												
<p>72.</p>	<p>[Genetics and Evolution]</p> <p>Blood samples of three individuals (A, B and C) were collected and sent for DNA analysis to look out for mutated genes. The given image represents the different alleles for globin chains on their chromosomes and the number of α, β, γ and δ chains of haemoglobin formed from their respective alleles. Study it carefully and answer the following questions.</p> <div data-bbox="347 499 1418 1014" style="border: 1px solid black; padding: 10px; text-align: center;"> </div> <p>Source (edited): https://www.mdpi.com/2218-273X/11/5/755</p> <p>(a) Interpret the above information by completing the following table:</p> <table border="1" data-bbox="363 1167 1402 1431"> <thead> <tr> <th>Individual</th> <th>Condition (Normal / Genetic disorder)</th> <th>Clinical description</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Normal</td> <td>Normal Haemoglobin</td> </tr> <tr> <td>B</td> <td>-----</td> <td>-----</td> </tr> <tr> <td>C</td> <td>-----</td> <td>-----</td> </tr> </tbody> </table> <p>(b) Consider a hypothetical situation, wherein individual ‘B’ undergoes test cross, what percent of the off springs will be suffering from the major genetic disorder?</p> <p>(c) What type of mutation leads to the genetic disorder depicted above?</p> <p style="text-align: right;">(Application)</p>	Individual	Condition (Normal / Genetic disorder)	Clinical description	A	Normal	Normal Haemoglobin	B	-----	-----	C	-----	-----
Individual	Condition (Normal / Genetic disorder)	Clinical description											
A	Normal	Normal Haemoglobin											
B	-----	-----											
C	-----	-----											
<p>73.</p>	<p>[Biotechnology and its Applications]</p> <p>X-gal (also abbreviated BCIG) is an organic compound consisting of galactose linked to a substituted indole. This compound was synthesized by Jerome Horwitz and collaborators.</p> <p>(a) Name the method that uses the above compound to select recombinants.</p> <p>(b) On which principle is this method based on?</p> <p>(c) Which enzyme’s presence is tested by using X-gal in molecular biology?</p> <p style="text-align: right;">(Understanding)</p>												

VI: Very Long Answer Questions

(5 Marks Each)

S.No.	Questions
74.	<p data-bbox="320 398 655 434">[Genetics and Evolution]</p> <p data-bbox="320 450 1445 557"><i>E. coli</i> is grown in a nutrient medium containing equal amounts of glucose and lactose. The graph below shows the growth curve of <i>E. coli</i> growing in it. Study it carefully and answer the following questions.</p> <div data-bbox="555 573 1206 1066" style="text-align: center;"> </div> <p data-bbox="328 1137 1445 1429"> (a) Identify sugar 'X' and 'Y'. (b) Why is sugar 'X' the preferred carbon source by <i>E. coli</i>? (c) What is the significance of the short lag phase? (d) Diagrammatically explain the major steps involved in the lac operon when glucose is completely removed from this medium. (e) lac mRNA is monocistronic or polycistronic? Justify your answer by giving a reason. </p> <p data-bbox="1305 1451 1445 1487" style="text-align: right;">(Analysis)</p>

S.No.	Questions									
<p>75.</p>	<p>[Biology and Human Welfare]</p> <p>Observe the given diagram and answer the questions that follow.</p> <p>What is the causative agent of the disease? Describe its mode of transmission along with <i>two</i> preventive measures for controlling it?</p> <div data-bbox="453 461 1310 1077" style="border: 1px solid black; padding: 10px; text-align: center;"> </div> <p style="text-align: right; color: green;">(Understanding)</p>									
<p>76.</p>	<p>[Ecology and Environment]</p> <p>Given below is a table depicting population interactions between species A and species B.</p> <table border="1" data-bbox="576 1346 1187 1518" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Type of interaction</th> <th>Species A</th> <th>Species B</th> </tr> </thead> <tbody> <tr> <td>(a)</td> <td>(-)</td> <td>(+)</td> </tr> <tr> <td>(b)</td> <td>(+)</td> <td>(-)</td> </tr> </tbody> </table> <p>(i) Name the <i>two</i> types of population interactions (a) and (b) depicted in the above table. (ii) Justify giving <i>three</i> reasons, how the type of interaction (b) is important in an ecological context.</p> <p style="text-align: right; color: green;">(Application)</p>	Type of interaction	Species A	Species B	(a)	(-)	(+)	(b)	(+)	(-)
Type of interaction	Species A	Species B								
(a)	(-)	(+)								
(b)	(+)	(-)								

S.No.	Questions
77.	<p>[Reproduction]</p> <p>Read the given Summary and answer the questions that follow:</p> <ul style="list-style-type: none"> • The menstrual cycle is complex and controlled by many different glands and the hormones that these glands produce. • The four phases of the menstrual cycle are menstruation, the follicular phase, ovulation, and the luteal phase. • The common menstrual problems include heavy or painful periods and premenstrual syndrome (PMS). • Knowing when in the menstrual cycle a woman is most likely to conceive can increase the chance of pregnancy. <p><i>Source:</i> https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/menstrual-cycle</p> <p>(a) Why is menstrual cycle indispensable for sexual reproduction in humans? (b) Write any <i>four</i> conditions in which a female may not have menstruation. (c) In a nursing mother menstrual cycle stops temporarily. What could be the possible natural reason?</p> <p style="text-align: right;">(Recall & Understanding)</p>
78.	<p>[Genetics and Evolution]</p> <p>Okazaki fragments are small sections of DNA that are formed during the process of DNA replication in the prokaryotic and eukaryotic cells. However, in his research laboratory, when Rishabh tried to generate multiple copies of a segment of DNA under <i>in vitro</i> conditions, Okazaki fragments were not formed.</p> <p>(a) Name and describe the techniques used by Rishabh for generating multiple copies of DNA under <i>in vitro</i> conditions. (b) Why were no Okazaki fragments produced during this process?</p> <p style="text-align: right;">(Analysis)</p>

ANSWER KEY

Q.No.	Expected Answers										
1.	(c) 150										
2.	(b) the difference in the number of secondary oocytes and secondary spermatocytes formed.										
3.	(c) <i>Wuchereria bancrofti</i>										
4.	(b) The individual is normally asymptomatic during this stage										
5.	(a) A-6mg/L, B-25mg/L, C-300mg/L										
6.	(a) Anaerobic bacteria										
7.	(d) Antacid- <i>Lactobacillus acidophilus</i>										
8.	(a) Riya										
9.	(d) P: $^{14}\text{N } ^{14}\text{N}$ and Q: $^{14}\text{N } ^{15}\text{N}$										
10.	<table border="1"> <thead> <tr> <th></th> <th>P</th> <th>Q</th> <th>R</th> <th>S</th> </tr> </thead> <tbody> <tr> <td>(d)</td> <td>Replication</td> <td>Transcription</td> <td>Okazaki fragments</td> <td>Sigma factor</td> </tr> </tbody> </table>		P	Q	R	S	(d)	Replication	Transcription	Okazaki fragments	Sigma factor
	P	Q	R	S							
(d)	Replication	Transcription	Okazaki fragments	Sigma factor							
11.	(b) Continuous transcription of structural genes will take place.										
12.	(d) 1, 2 and 4										
13.	(a) <i>Agrobacterium</i>										
14.	(c) Beta galactosidase gene										
15.	(d) Offsprings with favourable variation survive and pass on their genes.										
16.	(a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.										
17.	(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.										
18.	(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.										
19.	(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.										

Q.No.	Expected Answers
20.	(b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
21.	Analogous
22.	The decrease in temperature, unstable and unpredictable climates contribute reduced biodiversity richness at higher altitudes.
23.	1:1 (1 YY: 1 Yy)
24.	If both the strands are copied, two complementary RNA strands will be produced which forms dsRNA. (0.5 mark) Both RNA strands would code for two different types of proteins. (0.5 mark)
25.	Fungal cells are eukaryotic, splicing of introns are carried out by spliceosomes. (0.5 mark) Bacterial cells are prokaryotic where introns are absent as the genes are non-split. (0.5 mark)
26.	The first mRNA begins with the start codon (AUG) which codes for methionine. (0.5 mark) Other mRNAs begin with a stop codon (UAA/UAG) which do not code for any amino acid. (0.5 mark)
27.	Presence of more than one recognition site within the vector will generate several fragments, which will complicate gene cloning.
28.	It contains recognition sites for many different Restriction Enzymes (REs) and thus, it is easy to find a suitable RE which can cut the plasmid as well as foreign DNA at the same recognition site and thus foreign DNA can be easily ligated with the plasmid.
29.	Pollen-18 chromosomes; (0.5 mark) Primary Endosperm Nucleus-54 chromosomes. (0.5 mark)
30.	(a) Gamete Intra Fallopian Transfer. (0.5 mark) (b) In Vitro Fertilisation / Intra Cytoplasmic Sperm Injection. (0.5 mark)
31.	2 heavy polypeptide chains and 2 light polypeptide chains joined by sulphide bonds.
32.	$dN/N = rt(K-N/K)$
33.	Both act as template, a dsRNA would be formed which would prevent protein formation.
34.	<ul style="list-style-type: none"> • Y is biologically active insulin. (0.5 mark) • Mature insulin contains only A and B chains without C. (0.5 mark)

Q.No.	Expected Answers
35.	This is a case of interaction called Commensalism /Ectocommensalism. (in which <i>vanda</i> is benefitted and the tree is neither benefitted nor harmed.) <i>(may be accepted as equivalent answer)</i>
36.	½ or 50%
37.	S35
38.	Genotype of individual 1: Aa
39.	(a) 'A': Honeybee. <i>(0.5 mark)</i> 'B': <i>Drosophila melanogaster</i> <i>(0.5 mark)</i> (b) 'A': Male. <i>(0.5 mark)</i> 'B': Female. <i>(0.5 mark)</i>
40.	(a) A: Exon B: Intron. <i>(0.5 mark)</i> (b) No, since cDNA is synthesised from (X RNA) hnRNA. It will have introns which cannot be spliced in <i>E. coli</i> as it does not have an enzyme for it. <i>(0.5 mark)</i>
41.	(a) Ravi <i>(0.5mark)</i> <u>Reason:</u> <i>(0.5mark)</i> 3'TAGCCCAGC5' 3'TAGCCCAGC5' (daughter strand) (daughter strand) 5'ATCGGGTCG3' 5'ATCGGGTCG3' (b) (i) Topoisomerase. <i>(0.5mark)</i> (ii) DNA polymerase. <i>(0.5mark)</i>
42.	No. of base pairs = <u>Length of DNA</u> Dist. Between bp No. of base pairs = $\frac{1.02 \times 10^7}{3.4}$ <i>(1mark)</i> No. of base pairs = 3×10^6 bp <i>(1mark)</i>
43.	The male partner's inability to produce sperm could be attributed to tight undergarments or issues with pituitary secretions (LH, FSH), cryptorchidism, alcoholism, etc. Similarly, the female partner's inability to produce eggs might stem from problems with her pituitary secretions (FSH, LH), issues with fimbriae collecting the egg, health issues affecting egg production, etc. <i>(Any two valid points -2X1= 2 marks)</i>

Q.No.	Expected Answers
44.	<ul style="list-style-type: none"> • In the closed flowers, only autogamy is possible. (1 mark) • In the open flowers, all the three types of pollinations/autogamy, geitonogamy and xenogamy are possible. (1 mark) • In the closed flowers, no genetic variability/evolution is possible. (1 mark) • In the open flowers, there is possibility of genetic variability/evolution. (1 mark) <p style="text-align: center;">(Any one point to be accepted for each type of flower.)</p>
45.	<p>Self -incompatibility restricts autogamy by a process known as self-sterility. (1 mark)</p> <p>Such plants pollinate by cross pollination. (1 mark)</p>
46.	<p>(i) Transducers refer to producers /algae or plants. (1 mark)</p> <p>(ii) They convert solar energy /energy from sunlight into chemical energy or food energy through photosynthesis. So, known as transducers.</p> <p style="text-align: center;">OR</p> <p>They convert solar energy into a form that can be used by other organisms in the food chain. (1 mark)</p>
47.	<p>(a) <i>HindII</i> produces blunt/flush ends and <i>EcoRI</i> produces cohesive or overhanging or sticky ends on cutting the DNA.</p> <p>(b) Foreign DNA cannot be ligated with the smooth ends produced by <i>HindII</i>, hence <i>EcoRI</i> is preferred. (2X1 = 2 marks)</p>
48.	<p>Synthesis and polymerisation of DNA will be arrested. DNA will not get amplified. (2X1 = 2 marks)</p>
49.	<p>(a) To provide immediate immunity, whereas with vaccine immunity, it takes time. (1 mark)</p> <p>(b) Vaccination is the term used for getting a vaccine — that is, actually having the injection or taking an oral vaccine dose. Immunisation is the process of both getting the vaccine and becoming immune to the disease after vaccination. (Any relevant point -1mark)</p>
50.	<p>(a) Mutations are large heritable changes in the characteristics of a population that arise suddenly and cause speciation in a single step while evolution for Darwin is gradual and occurs due to variations over a number of generations.</p> <p>(b) Mutations are random and directionless while variations are small and directional. (Any two points explained-2marks)</p>
51.	<p>(a) 240 bases code for 80 amino acids.</p> <p style="padding-left: 40px;">$100 - 80 = 20$ amino acids. (1mark)</p> <p>(b) Frame shift mutation (1mark)</p>

Q.No.	Expected Answers									
52.	<p>(a) 5'...GTCGAC...3' 3'...CAGCTG...5'</p> <p>(b) <i>HindII</i> and source <i>Haemophilus influenzae</i> strain D.</p>									
53.	<p>(a) After addition of lactose, complete breakdown of lactose to glucose and galactose takes place. Therefore, there is no more lactose to bind to the repressor protein and the <i>lac operon</i> shuts down. (1 mark)</p> <p>(b) A very low level of expression of <i>lac operon</i> has to be present in the cell all the time, otherwise lactose cannot enter the cells. (1 mark)</p>									
54.	<p>Since RNA was unstable and prone to mutations, DNA evolved from RNA with chemical modifications that made it more stable. DNA has double stranded nature and has complementary strands. These further resist changes by evolving a process of repair.</p> <p>(Any two relevant points of DNA being more stable than RNA) (2X1 = 2 marks)</p>									
55.	<p>(a) True</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Hb A</th> <th>Hb S</th> </tr> </thead> <tbody> <tr> <th>Hb A</th> <td>Hb A Hb A</td> <td>Hb A Hb S</td> </tr> <tr> <th>Hb S</th> <td>Hb A Hb S</td> <td>Hb S Hb S</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Since X is heterozygous (HbA HbS) and Y is homozygous (HbS HbS). • Both parents must be heterozygous. <p>(b) 1. larger size: Hb S. 2. smaller size: Hb A.</p>		Hb A	Hb S	Hb A	Hb A Hb A	Hb A Hb S	Hb S	Hb A Hb S	Hb S Hb S
	Hb A	Hb S								
Hb A	Hb A Hb A	Hb A Hb S								
Hb S	Hb A Hb S	Hb S Hb S								
56.	<p>(a) Transformation (0.5 mark)</p> <p>(b) DNase (0.5 mark)</p> <p>(c) Ritu: Papaya pulp contains protease which will digest protein, but DNA is intact. So, transformation occurs. (0.5 mark)</p> <p>Ali: DNase will digest DNA so transformation will not occur. (0.5 mark)</p>									
57.	<p>(a) Pyramid of number. (½ X 1 = ½ mark)</p> <p>(b) Grassland ecosystem, Pond ecosystem. (½ X 2 = 1 mark)</p> <p>(c) Secondary consumer / Carnivore. (½ X 1 = ½ mark)</p>									

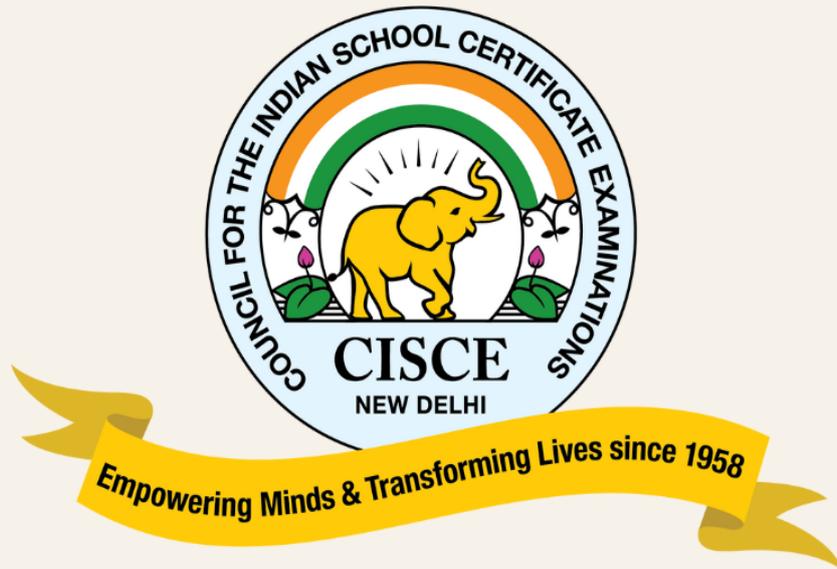
Q.No.	Expected Answers
58.	<p>(a) Drug dependence/ addiction is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs is abruptly discontinued / because of perceived benefits, drugs are frequently used repeatedly from which the person may not be able to get out. (1 mark)</p> <p>(b) <u>Measures:</u></p> <ul style="list-style-type: none"> • Education and counselling- to face problems and stresses • To channelize the energy into healthy pursuits like reading, music, yoga and other extracurricular activities • Seeking help from parents. • to guide the person appropriately and immediately. • Seeking professional and medical help. • To help the person to get rid of the problem completely with sufficient efforts and will power. <p style="text-align: right;">(any two points) (½ mark each)</p>
59.	<p>(i) Paul Ehrlich proposed ‘Rivet popper hypotheses’ to support the assertion of David Tilman.</p> <p>(ii) According to this, an aeroplane is compared to ecosystem which is joined by a number of rivets which are equal to species.</p> <p>(iii) If every passenger starts popping a rivet initially that may not affect the safety of the flight and the same way if the removal of species will lead to its extinction and the loss of keystone species will then dangerously affect the stability of ecosystem.</p> <p style="text-align: right;">(3X1=3 marks)</p>
60.	<p>(a) Sample D contains the highest level of Pathogenic microbes.</p> <p>(b) Sample B contains the lowest level of pathogenic microbes.</p> <p>(c) Sample B can be used for domestic purposes.</p> <p style="text-align: right;">(3X1=3marks)</p>
61.	<p>(a) The tumour inducing (Ti) plasmid of <i>Agrobacterium tumefaciens</i> (Natural Genetic Engineer) has now been modified into a cloning vector which is no more pathogenic to the plants but is still able to use the mechanisms to deliver genes of our interest into a variety of plants as in RNAi. (2X1=2marks)</p> <p>(b) Similarly, retroviruses have also been disarmed and are now used to deliver desirable genes into animal cells as in gene therapy for diseases like Severe combined immunodeficiency (SCID). (1mark)</p>
62.	<p>(a) Polygenic inheritance. 8 types of combinations of alleles in the gametes.</p> <p>(b) Weight of progeny plant (AaBbCc) = $90 + 54 / 2$ (0.5 mk) = 72g</p> <p>(c) Weight of plant with genotype AAbbcc Weight of dominant allele = $90/6 = 15g$ Weight of recessive allele = $54/6 = 9g$ Weight with genotype AAbbcc = $15 + 15 + 9 + 9 + 9 + 9 = 66g$</p>

Q.No.	Expected Answers
63.	<p>(a) 5'--- AUG GUC UCU CAG GUC CCC --- 3' (0.5mark)</p> <p>(b) $18 - 6 = 12$ bases. (0.5mark)</p> <p>(c) 3. Nonsense mutation. (0.5 mark)</p> <p>(d) 3 amino acids. (0.5 mark)</p> <p>(e) β galactosidase will be synthesised, Permease and Transacetylase will not be synthesised. (0.5 mark)</p> <p>Lac z gene will be translated however, lac y and a will not be translated due to non-sense mutation in y gene. (0.5 mark)</p>
64.	<p>(a) DNA strand 2 because DNA strand 1 and mRNA have almost same base composition. (0.5X2 = 1 mark)</p> <p>(b) DNA strand 1 : 5' to 3' DNA strand 2 : 3' to 5' (0.5X2 =1 mark)</p> <p>(c) Reverse transcription to obtain DNA. Transcription to obtain mRNA. (0.5X2 = 1 mark)</p>
65.	<p>(a) Ethical argument.</p> <p>(b) The narrowly utilitarian argument.</p> <p>(c) The broadly utilitarian argument.</p>
66.	<p>(a) The smaller generative cell divides (mitotically) to produce two male gametes. (1 mark)</p> <p>The larger vegetative cell nourishes the generative cell. (1 mark)</p> <p>(b) Those plants produce large number of pollen grains / In those plants' pollination is not that easier compared to the other plants, so the price is paid. (anyone) (1 mark)</p>
67.	<p>(a) Fertilisation (fusion of male and female gametes) results in zygote which is a product from two parents of the present generation. (1 mark)</p> <p>Zygote is the first cell from which an organism of the next generation is formed. Thus, fertilisation is a link between two generations. (1 mark)</p> <p>(b) Fertilisation helps in maintaining the same chromosome number of a species / Fertilisation ensures the maintenance of diploid chromosomes in a species. (1 mark)</p>
68.	<p>(a) It's a defensive mechanism of the body and they destroy the invading microorganisms by phagocytosis. (1mark +1mark)</p> <p>(b) Proliferation and maturation of lymphocytes occurs in the primary lymphoid tissues.</p> <p>Antigens are localised and the adaptive immune response is initiated in the secondary lymphoid tissues. (2X0.5=1 mark)</p>
69.	<p>Methanogens are present in cow dung so there is need to add inoculum. (1 mark)</p> <p>Breakdown of cellulose. (1 mark)</p> <p>Anaerobic conditions. (1 mark)</p>

Q.No.	Expected Answers												
70.	(a) Bt corn. ($\frac{1}{2}$ mark) (b) <i>Cry I Ab</i> / Bt toxin gene codes for crystal protein; the Bt toxin protein (<i>Cry</i>) exists as an inactive protein, but once an insect ingests it, it gets converted into an active form due to the alkaline pH of the gut which solubilizes the crystal. The activated toxin binds to the surface of mid gut and creates pores that cause swelling, lysis and eventually death of the insect. ($\frac{1}{2} \times 5 = 2\frac{1}{2}$mark)												
71.	(a) Metastasis refers to the migration of cancer cells from the primary tumour site to distant parts of the body. (1mark) (b) leading to the spread of malignant disease/ cancer. (1mark) (c) Diagnosis involves techniques like biopsy, histological examinations, and Pap tests, while treatment options include surgery, chemotherapy, and radiotherapy. (Any $2 \times 0.5 = 1$mark)												
72.	(a) <table border="1" data-bbox="279 869 1398 1122" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th data-bbox="279 869 501 943">Individual</th> <th data-bbox="501 869 995 943">Condition (Normal / Genetic disorder)</th> <th data-bbox="995 869 1398 943">Clinical description</th> </tr> </thead> <tbody> <tr> <td data-bbox="279 943 501 981">A</td> <td data-bbox="501 943 995 981">Normal</td> <td data-bbox="995 943 1398 981">Normal Haemoglobin</td> </tr> <tr> <td data-bbox="279 981 501 1025">B</td> <td data-bbox="501 981 995 1025">Thalassemia minor</td> <td data-bbox="995 981 1398 1025">Mild anaemia</td> </tr> <tr> <td data-bbox="279 1025 501 1122">C</td> <td data-bbox="501 1025 995 1122">Thalassemia major</td> <td data-bbox="995 1025 1398 1122">Severe anaemia poor oxygen carrying capacity</td> </tr> </tbody> </table> (b) 50% of the offsprings. (c) Frame shift mutation.	Individual	Condition (Normal / Genetic disorder)	Clinical description	A	Normal	Normal Haemoglobin	B	Thalassemia minor	Mild anaemia	C	Thalassemia major	Severe anaemia poor oxygen carrying capacity
Individual	Condition (Normal / Genetic disorder)	Clinical description											
A	Normal	Normal Haemoglobin											
B	Thalassemia minor	Mild anaemia											
C	Thalassemia major	Severe anaemia poor oxygen carrying capacity											
73.	(a) Blue-white method. (b) This method is based on the insertional inactivation of Lac Z gene, present on the vector, which can cleave a colourless X-gal into a blue coloured product. (c) β -galactosidase. (3X1=3marks)												

Q.No.	Expected Answers
74.	<p>(a) 'X': Glucose 'Y': Lactose</p> <p>(b) <u>Reasons:</u></p> <ul style="list-style-type: none"> • Glycolysis starts with glucose (X). Glucose is the only carbon source bacteria can use for ATP production. • Using lactose requires spending cellular energy to make enzymes that can break them down. <p>(c) Lag phase indicates that glucose is utilized and that's the time taken by the bacteria to synthesize enzymes to breakdown lactose.</p> <div data-bbox="331 667 1264 943" data-label="Diagram"> </div> <p>(d) Repressor protein. Binding of repressor protein with inducer. Translation of 3 enzymes.</p> <p>(e) Polycistronic. This mRNA carries information for the synthesis of all three proteins (<i>galactosidase, permease, transacetylase</i>).</p>
75.	<p>The causative agent is <i>Ascaris lumbricoides</i>. (1 mark)</p> <p>The female <i>Ascaris</i> lays as many as 2,70,00,000 eggs in its lifetime and deposits about 2,00,000 eggs daily. The eggs are laid along with faeces. These contaminate food, water and raw vegetables. Man gets infected by swallowing raw vegetables. (Any 2 XI=2 marks)</p> <p><u>Preventive Measures:</u></p> <p>(i) Disposal of human faeces by underground sewage system.</p> <p>(ii) Children should be asked to wash their hands carefully and properly before handling food. (Any two relevant points XI=2 marks)</p>

Q.No.	Expected Answers
76.	<p>(i) (a)– Amensalism. (1 mark)</p> <p>(b)– Predation / parasitism. (1 mark)</p> <p><u>(ii) Justifications-</u></p> <ul style="list-style-type: none"> • Nature’s way of transferring energy fixed by plants to higher trophic levels/conduits for energy transfer. • Keep prey population under control. • Predators help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. (1X3 Points = 3 marks)
77.	<p>(a) Menstrual cycle helps in the production of female gamete/egg which is involved in the fertilisation; Menstrual cycle prepares the uterus of the female for the implantation of the embryo. (1+1 marks)</p> <p>(b) Mental/emotional stress, physical stress, pregnancy, poor health, disorders, abnormality in the reproductive parts (<i>any four</i>). (4 X ½ = 2 marks)</p> <p>(c) It is nature’s way of recovery for the woman after delivering a baby. (1 mark)</p>
78.	<p>(a) Polymerase chain reaction which involves the following steps:</p> <ul style="list-style-type: none"> • Denaturation- Denaturation is required to separate the double-stranded DNA sample. It is done at 94-98 °C for 20-30 seconds. It breaks the hydrogen bonds present between base pairs. • Annealing-2 sets of primers, one each added to 3 prime ends of each DNA strand. • Polymerisation/Elongation – Addition of complementary bases to the 3-prime end of each strand is done by DNA polymerase. (1 mark X 4) <p>(b) Rishabh did not get Okazaki fragments because his lab method copies DNA smoothly and continuously, not in the piece-by-piece way that happens inside cells.</p> <p>Rishabh probably used Polymerase Chain Reaction (PCR), a common lab method.</p> <ul style="list-style-type: none"> • Process: In PCR, the DNA is heated to separate the strands, then cooled to allow new DNA to be built continuously on each strand. • Result: Because PCR copies DNA in a single, continuous manner for both strands, there's no need to make small sections like Okazaki fragments. <p>Whereas normal method in cells follows a replication process where in one strand running in the 3’ to 5’ direction addition of complementary nucleotide sequence is continuous and in the other strand it is discontinuous forming Okazaki fragments. (1mark)</p>



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