CBSE EXAMINATION PAPER-2025

BIOLOGY

(Solved)

Time allowed : 3 hours | Maximum Marks : 83

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **40 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 3** are case based questions

iv. **Section B** – questions number **4 to 19** are multiple choice questions

v. **Section C** – questions number **20 to 27** are very short answer

vi. **Section D** – questions number **28 to 34** are short answer

vii. **Section E** – questions number **35 to 40** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1.

Question 2.

Immunity in our body is of two types : (i) Innate immunity and (ii) acquired immunity. Innate immunity is a non-specific defence mechanism, whereas acquired immunity is pathogen-specific; it is called specific immunity too. Acquired immunity is characterised by memory. Antibodies are specific to antigens and there are different types of antibodies produced in our body : they are IgA, IgE, IgG and

IgM. It shows primary response when it encounters the pathogen for the first time and secondary response during the subsequent encounters with the same Antigen/Pathogen.

(1)

Name the two types of specialised cells which carry out the primary and secondary immune response.

[1 Marks]

Answer: The two types of specialised cells that carry out the primary and secondary immune responses are B-lymphocytes and T-lymphocytes. B-lymphocytes are responsible for producing antibodies during the immune response to pathogens, while T-lymphocytes play a crucial role in directly attacking infected cells and modulating immune responses.

Key Points: B-lymphocytes produce antibodies-T-lymphocytes directly attack infected cells-pathogen-specific immunity

(2)

Why is the antibody-mediated immunity also called as humoral immune response ?
Attempt either sub-part (c) or (d) :

[1 Marks]

Answer: Antibody-mediated immunity is referred to as humoral immune response because the antibodies, which are crucial in fighting pathogens, are found in the body fluids or humors such as blood and lymph. These antibodies are produced by B-lymphocytes in response to specific antigens. When a pathogen is detected, these B-lymphocytes transform into plasma cells that release antibodies into the bloodstream. The term 'humoral' stems from the Latin word 'humor' which refers to bodily fluids. This humoral response is crucial for targeting extracellular pathogens, thereby providing a specific defense mechanism.

Key Points: Antibodies are found in blood; B-lymphocytes produce antibodies; term 'humoral' refers to body fluids; response targets extracellular pathogens.

(3)

The organ transplants are often rejected if not taken from suitable compatible persons.

(i) Mention the characteristic of our immune system that is responsible for the graft rejection.

(ii) Name the type of immune response and the cell involved in it.

[2 Marks]

Answer: The characteristic of our immune system responsible for graft rejection is its ability to differentiate between 'self' and 'nonself.' This recognition is vital because when a graft (organ transplant) is perceived as 'nonself' by the immune system, it triggers a rejection response. The type of immune response involved in this process is known as 'cell-mediated immune response.' In this response, T-lymphocytes are the primary cells involved, as they recognize and attack the foreign antigens present in the transplanted organ.

Key Points: Ability to differentiate 'self' and 'nonself' - Cell-mediated immune response - T-lymphocytes involved

(4)

How is active immunity different from passive immunity ?

[1 Marks]

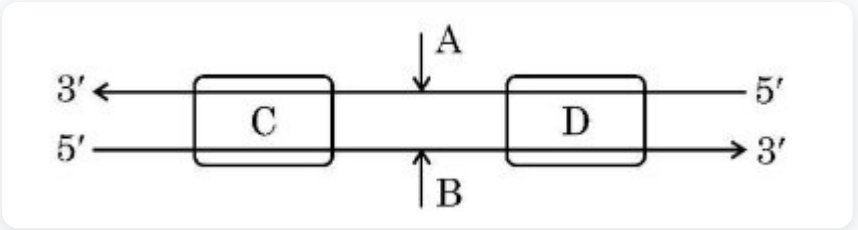
Answer: Active immunity involves the production of antibodies by the immune system in response to an antigen. This can occur through natural infection or through vaccination. It is a slower process as the immune system needs time to recognize the pathogen and develop a response. In contrast, passive immunity involves the direct transfer of antibodies from one individual to another, such as from mother to child through breast milk or through antibody injections. Passive immunity provides immediate but temporary protection, as the body does not produce its own antibodies. Therefore, the main difference lies in the way antibodies are obtained: active immunity is created by the individual's own immune response, while passive immunity is acquired through external sources.

Key Points: Active immunity involves the host's immune response-antibodies are produced by the host-Active immunity is long-lasting-Passive immunity involves direct transfer of antibodies-Immediate but temporary protection.

Question 3.

The process of copying the genetic information from one strand of DNA into RNA is termed as transcription. The principle of complementarity of bases governs the process of transcription, also except that uracil comes in place of thymine.

Study the complete transcription unit given below and answer the following questions :



(1)

Name the main enzyme involved in the process of transcription.

[1 Marks]

Answer: The main enzyme involved in the process of transcription is RNA polymerase. This enzyme is responsible for synthesizing RNA from the DNA template strand during transcription, following the principle of base complementarity except that uracil replaces thymine.

Key Points: RNA polymerase - synthesizes RNA - from DNA template - follows base complementarity

(2)

Identify coding strand and template strand of DNA in the transcription unit.

[1 Marks]

Answer: In the given transcription unit, the coding strand of DNA is the strand that runs from 5' to 3' and has the sequence 5' - TACGTACGTACGTACGTACGTACG - 3'. In contrast, the template strand, which provides the actual template for RNA synthesis, runs from 3' to 5' and has the sequence 3' - ATGCATGCATGCATGCATGCATGC - 5'. The RNA transcribed will be complementary to the template strand and will match the coding strand except for the substitution of uracil for thymine.

Key Points: Coding Strand: 5' - TACGTACGTACGTACGTACGTACG - 3' - Template Strand: 3' - ATGCATGCATGCATGCATGCATGC - RNA complementary to template strand

(3)

Identify (C) and (D) in the diagram, mention their significance in the process of transcription.

[2 Marks]

Answer: (C) represents the template strand of DNA, which serves as the guiding strand during transcription. It is essential as it provides the necessary sequence that dictates the RNA synthesis. (D) corresponds to the RNA molecule being synthesized, which is complementary to the template strand and contains uracil instead of thymine. This RNA is crucial as it carries the genetic code required for protein synthesis.

Key Points: C is the template strand - guides RNA synthesis; D is the RNA molecule - complementary to the template strand.

(4)

Describe the location of (C) and (D) in the transcription unit.

[2 Marks]

Answer: (C) represents the promoter region, which is located at the beginning of the transcription unit. It serves as the binding site for RNA polymerase, initiating the transcription process. (D), on the other hand, refers to the terminator region, which is found at the end of the transcription unit. It signals the end of transcription and causes RNA polymerase to detach from the template strand, thus completing the process of RNA synthesis.

Key Points: C is the promoter location which initiates transcription-D is the terminator location which signals the end of transcription-Transcription unit consists of promoter, structural gene, and terminator

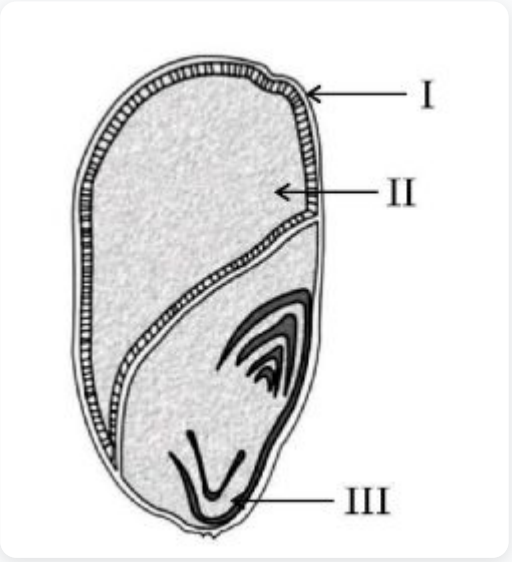
Section B

Question 4.

Given below is a diagram of T.S. of a monocot seed with parts I, II & III labelled:

Choose the option where parts I, II and III are identified correctly.

[1 Marks]



(A) Pericarp, Endosperm, Scutellum

(B) Pericarp, Endosperm, Coleorhiza

(C) Scutellum, Pericarp, Coleorhiza

(D) Coleorhiza, Scutellum, Pericarp

Explanation:

The correct option is 'Pericarp, Endosperm, Scutellum'. In a monocot seed, the pericarp is the fruit wall surrounding the seed, the endosperm serves as the food storage for the embryo, and the scutellum is a specialized cotyledon that absorbs nutrients from the endosperm during seed germination.

Question 5.

The number of autosomes present in a human secondary spermatocyte?

[1 Marks]

(A) 44

(B) 23

(C) 22

(D) 46

Explanation:

A human secondary spermatocyte is haploid and contains 23 chromosomes in total, which include 22 autosomes and 1 sex chromosome. Therefore, the correct number of autosomes present in a secondary spermatocyte is 22.

Question 6.

A child with blood group A has father with blood group B and the mother with blood group AB. Choose the option that gives the correct genotypes of father, mother and the child:

[1 Marks]

(A) Father - $I^B I^B$, Mother -$I^A I^B$, Child - $I^A I^A$

(B) Father - I^B i , Mother - $I^A I^B$, Child - I^A i

(C) Father - $I^A I^B$, Mother - I^A i , Child - $I^A I^A$

(D) Father - I^A i, Mother - I^B i, Child - I^A i

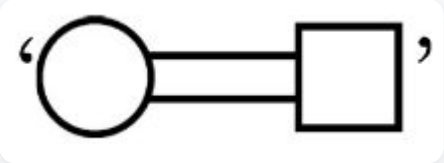
Explanation: The correct option is: Father - I^B i , Mother - $I^A I^B$, Child - I^A i. The father with blood group B can have genotype I^B i, while the mother with blood group AB has the genotype $I^A I^B$. The

child has blood group A, which can result from inheriting I^A from the mother and i from the father.

Question 7.

In a pedigree chart represents:

[1 Marks]



(A) affected individuals

(B) unrelated mating

(C) Non-identical twins

(D) mating between relatives (consanguineous mating)

Explanation: A pedigree chart represents mating between relatives (consanguineous mating), as it is used to analyze the inheritance of traits over generations within a family. This allows for tracing the transmission of genetic disorders and other traits, which often occurs when relatives mate.

Question 8.

Which one of the following options shows the correct evolutionary order of the plants mentioned below?

(i) Ferns

(ii) Ginkgo

(iii) Zosterophyllum

(iv) Gnetales

[1 Marks]

(A) (i), (iii), (ii), (iv)

(B) (iii), (i), (ii), (iv)

(C) (iv), (ii), (i), (iii)

(D) (i), (ii), (iii), (iv)

Explanation: The correct evolutionary order is (iii), (i), (ii), (iv). Zosterophyllum is considered more primitive and one of the earliest vascular plants. Ferns are pteridophytes that evolved next, followed

by gymnosperms like Ginkgo, and finally Gnetales, which are more advanced gymnosperms. This progression aligns with the understanding of plant evolution.

Question 9.

The phosphoester linkage in the nucleotides is between:

[1 Marks]

(A) phosphate group and OH of 3'C of a nucleoside.

(B) phosphate group and H of 5'C of a nucleoside.

(C) phosphate group and OH of 5'C of a nucleoside.

(D) phosphate group and H of 3'C of a nucleoside.

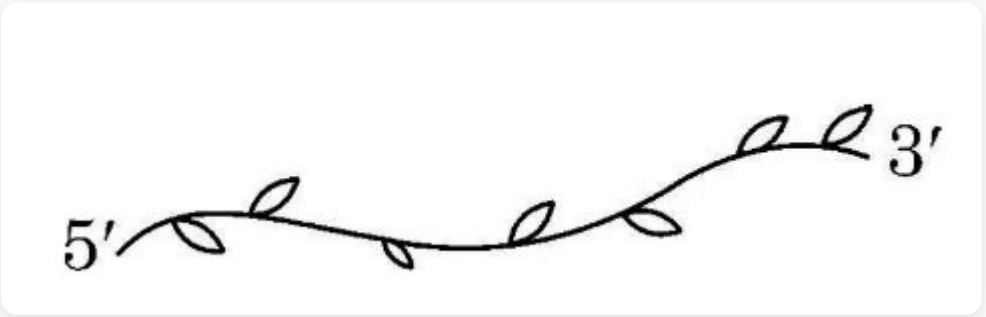
Explanation: The correct answer is 'phosphate group and OH of 5'C of a nucleoside.' This is because, as mentioned in the context, the phosphate group forms a linkage with the hydroxyl group (OH) of the 5' carbon in a nucleoside, resulting in the formation of a nucleotide.

Question 10.

Given below is a heterogeneous RNA formed during Eukaryotic transcription:

How many introns and exons respectively are present in the hnRNA?

[1 Marks]



(A) 8,8

(B) 7,7

(C) 7,8

(D) 8,7

Explanation: The correct option is '8,7'. In eukaryotic transcription, hnRNA (heterogeneous nuclear RNA) contains both introns and exons. During the splicing process, introns are removed and exons are joined to form a functional mRNA. The context implies that there are distinct numbers of introns

and exons in hnRNA, and it indicates the presence of at least several introns and exons due to the complexity mentioned. Therefore, the answer '8,7' likely denotes this ratio.

Question 11.

Study the items of Column-I and those of Column-II:

Choose the option that correctly matches the items of Column-I with those of Column-II :

[1 Marks]

	Column-I		Column-II
(a)	RNA polymerase I	(i)	18s rRNA
(b)	RNA polymerase II	(ii)	SnRNAs
(c)	RNA polymerase III	(iii)	hnRNA

(A) (a) (ii), (b) (i), (c) (iii)

(B) (a) (ii), (b) (iii), (c) (i)

(C) (a) (i), (b) (iii), (c) (ii)

(D) (a) (i), (b) (ii), (c) (iii)

Explanation:

The correct matching is

(a) RNA polymerase I- (i) 18s rRna

(b) RNA polymerase II- (iii) hnRNA

(c) RNA polymerase III- (ii) SnRNAs

Question 12.

For commercial and industrial production of citric acid, which one of the following microbes is used?

[1 Marks]

(A) Aspergillus niger

(B) Saccharomyces cerevisiae

(C) Clostridium butylicum

(D) Lactobacillus sp.

Explanation: Aspergillus niger is the correct answer because it is specifically mentioned in the context as a fungus that produces citric acid, making it the suitable microbe for commercial production.

Question 13.

If Meselson and Stahl's experiment is continued for 80 minutes (till III generation) then what would be the ratio of DNA containing N^{15}/N^{15} : N^{15}/N^{14} : N^{14}/N^{14} in the medium?

[1 Marks]

(A) 0 : 1 : 3

(B) 0 : 1 : 8

(C) 1 : 1 : 0

(D) 1 : 4 : 0

Explanation: After 80 minutes, which corresponds to three generations (since E. coli divides every 20 minutes), the generated DNA will consist of hybrids and light DNA. By the III generation, the expected ratio of the DNA types will be 0 : 1 : 3. This is because, after one generation in a 14N medium, half will be hybrid (N^{15}/N^{14}) and the other half light (N^{14}/N^{14}), and after the second generation, the light DNA will increase significantly, leading to the final ratio of 0 : 1 : 3.

Question 14.

Select the correct statement from the following biotechnological procedures:

[1 Marks]

(A) PCR is used for isolation and separation of gene of interest.

(B) The polymerase enzyme joins the gene of interest and the vector DNA.

(C) Gel electrophoresis is used for amplification of a DNA segment.

(D) Plasmid DNA acts as vector to transfer the piece of DNA attached to it.

Explanation: The correct statement is 'Plasmid DNA acts as vector to transfer the piece of DNA attached to it.' This is accurate because plasmids are commonly used as vectors in recombinant DNA technology to carry and transfer the gene of interest into host cells for cloning and expression, as indicated in the context provided.

Question 15.

The decrease in the T-Lymphocytes count in human blood will finally result in:

[1 Marks]

(A) decrease in antigens

(B) decrease in antibodies

(C) increase in antibodies

(D) increase in antigens

Explanation: A decrease in T-Lymphocytes, particularly helper T-lymphocytes, leads to a weakened immune response. This impairment decreases the production of antibodies since T-Lymphocytes play a crucial role in stimulating B-cells to produce antibodies that combat antigens. Therefore, the correct answer is 'decrease in antibodies.'

Question 16.

Assertion (A): Corpus luteum secretes the hormone, progesterone.

Reason (R): Hormone Progesterone is essential for maintenance of the endometrium.

[1 Marks]

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) (A) is true, but (R) is false.

(C) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(D) (A) is false, but (R) is true.

Explanation: Both (A) and (R) are true and (R) is the correct explanation of (A) because the corpus luteum does secrete progesterone, which plays a critical role in maintaining the endometrium for implantation and support of pregnancy, as stated in the context.

Question 17.

Assertion (A): The number of white-winged moths decreased after industrialisation in England.

Reason (R): Effects of industrialisation were more marked in rural areas of England.

[1 Marks]

(A) (A) is false, but (R) is true.

(B) (A) is true, but (R) is false.

(C) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(D) Both (A) and (R) are true and (R) is the correct explanation of (A).

Explanation:

The statement "The number of white-winged moths decreased after industrialisation in England" is true, but the reason "Effects of industrialisation were more marked in rural areas of England" is false. Therefore, the correct answer is (C): **(A) is true, but (R) is false**.

Therefore, while the number of white-winged moths decreased due to industrialization, the reason provided (that the effects were more pronounced in rural areas) is incorrect. The change was driven by the environmental impact of industrialization in urban centers. Several educational resources note this.

Question 18.

Assertion (A): Streptococcus pneumoniae and Haemophilus influenzae are responsible for causing infectious disease in human beings.

Reason (R): A healthy person acquires the infection by inhaling the aerosols released by an infected person.

[1 Marks]

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) (A) is false, but (R) is true.

(C) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(D) (A) is true, but (R) is false.

Explanation: Both (A) and (R) are true, and (R) is the correct explanation of (A). Streptococcus pneumoniae and Haemophilus influenzae are indeed known to cause infectious diseases, and the reasoning correctly describes the transmission method through inhalation of aerosols from infected individuals, as indicated in the context.

Question 19.

Assertion (A): Restriction endonuclease recognises palindromic sequence in DNA and cuts them.

Reason (R): Palindromic sequence has two unique recognition sites PstI and PvuI recognised by restriction endonuclease.

[1 Marks]

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) (A) is true, but (R) is false.

(C) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(D) (A) is false, but (R) is true.

Explanation:

T**he assertion is true, but the reason is false**. Restriction endonucleases do indeed recognize and cut palindromic sequences in DNA. However, a palindromic sequence doesn't inherently have two unique recognition sites for PstI and PvuI. These are specific restriction enzymes with their own unique palindromic recognition sequences.

Section C

Question 20.

(i) Write two crucial changes, the seed undergoes while reaching maturity that enable them to be in a viable state until the onset of favourable conditions.

(ii) Name the oldest viable seed excavated from Arctic Tundra as per the records.

[2 Marks]

Answer: Two crucial changes that seeds undergo while reaching maturity are dehydration and the development of a hard seed coat. Dehydration reduces the water content of the seed, allowing it to enter a dormant state, which is essential for longevity. The hard seed coat provides protection to the embryo from external elements and environmental stressors. The oldest viable seed excavated from the Arctic Tundra is the lupine, Lupinus arcticus, which was found to have germinated after an astonishing 10,000 years of dormancy.

> **Key Points: dehydration-hard seed coat-lupinus arcticus**

Question 21.

(i) Pea flower produce assured seed sets. Give reason.

(ii) In case of Polyembryony, an embryo ‘P’ develops from a synergid and the embryo ‘Q’ develops from the nucellus. State the ploidy of embryo ‘P’ and ‘Q’.

[2 Marks]

Answer: Pea flowers can produce assured seed sets primarily due to their apomictic nature, which allows seeds to develop without fertilization. This mechanism ensures genetic consistency and stability in offspring, as the seeds are produced from the maternal tissues. For the second part, regarding polyembryony, embryo 'P', which develops from a synergid, is haploid (1n), while embryo 'Q', derived from the nucellus, is diploid (2n) since it comes from the ovule tissues. Thus, the ploidy levels are 1n for 'P' and 2n for 'Q'.

Key Points: Apomixis ensures seeds develop without fertilization-Embryo P is haploid (from synergid)-Embryo Q is diploid (from nucellus)

Question 22.

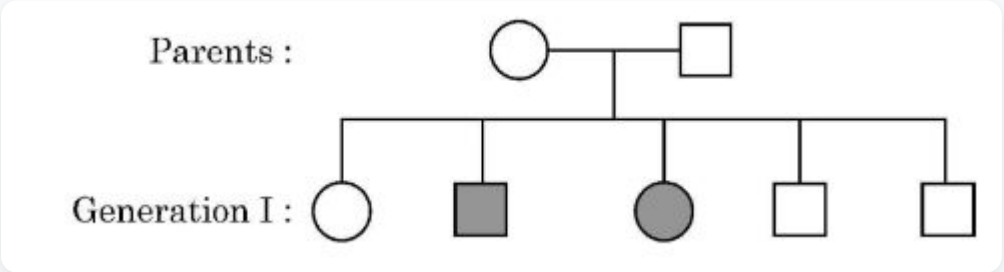
Study the given pedigree chart in which neither of the parents shows the trait but the trait is present in both male and female children.

Answer the following questions :

(a) Write about the trait, also explain the inheritance of such trait in the

(b) Give one example of such trait in human beings.

[2 Marks]



Answer: The trait described is likely an autosomal recessive trait, which can skip generations. In pedigree analysis, this means that both parents do not show the trait but can be carriers, allowing them to pass it on to their offspring. As a result, both male and female children can express the trait, typical for autosomal recessive inheritance patterns. An example of such a trait in humans is Sickle-cell anaemia, which arises from a mutation affecting hemoglobin.

Key Points: autosomal recessive trait-carriers may not express trait-both genders affected-example: Sickle-cell anaemia

Question 23.

Describe any two situations where a medical doctor would recommend injection of a pre-formed antibodies (antitoxins) into the body of a patient.

[2 Marks]

Answer: A medical doctor may recommend the injection of pre-formed antibodies in situations such as tetanus and snake bites. In the case of tetanus, when a person is infected with the tetanus toxin, immediate injection of antitoxin is necessary to provide rapid immunity against the effects of the toxin. Similarly, for snakebites, antivenom containing pre-formed antibodies against snake venom is administered to neutralize the venom quickly, preventing severe damage.

Key Points: tetanus treatment-antitoxin injection-snakebite antivenom

Question 24.

The symptoms of malaria do not appear immediately after the entry of sporozoites into the human body when bitten by female Anopheles mosquito. Explain why it happens.

[2 Marks]

Answer: The symptoms of malaria do not appear immediately because the sporozoites introduced by the mosquito must first travel to the liver, where they mature into merozoites. This incubation period typically lasts about 7 to 14 days, allowing the parasites to multiply significantly in number before re-entering the bloodstream. It's only when they infect red blood cells and cause immune reactions that the characteristic symptoms, such as fever and chills, emerge.

Key Points: incubation period; sporozoites travel to liver; maturation into merozoites; multiplication before symptoms; infection of red blood cells

Question 25.

Observe the given sequence of nitrogenous bases on a DNA fragment and answer the following questions :

(a) Name the restriction enzyme which can recognise the DNA sequence.

(b) Write the sequence after restriction enzyme cut the palindrome.

(c) Why are the ends generated after digestion called as 'Sticky Ends' ?

[2 Marks]

5'	C	A	G	A	A	T	T	C	T	T	A	3'
3'	G	T	C	T	T	A	A	G	A	A	T	5'

Answer: The restriction enzyme that can recognize the given palindromic DNA sequence 5' —— GAATTC —— 3' is EcoRI. After the restriction enzyme cuts the palindrome, the resultant sequence will have sticky ends: 5' —— G AATTC —— 3' and 3' —— CTTAA G —— 5'. The ends generated

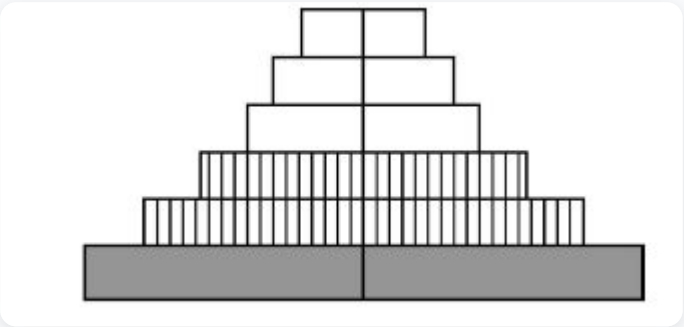
after digestion are called ‘Sticky Ends’ because they have single-stranded overhangs that can easily form hydrogen bonds with complementary sequences, allowing for efficient joining of DNA fragments.

Key Points: EcoRI - palindromic sequence recognition - sticky ends formed - single-stranded overhangs - complementary bonding

Question 26.

Identify the type of pyramid given below and write two identifying features of such a pyramid :

[2 Marks]



Answer: The pyramid described could be any of the ecological pyramids: pyramid of numbers, pyramid of biomass, or pyramid of energy. Two identifying features are that the base of the pyramid represents the producers or the first trophic level, while the apex represents the top-level consumers. The pyramid's shape illustrates the decreasing number, biomass, or energy as one moves from the base to the apex.

Key Points: Base represents producers; Apex represents top-level consumers

Question 27.

(i) Construct an ideal pyramid of energy when 10,00,000 Joules of sunlight is available.

(ii) Mention the energy obtained by the fourth level of this pyramid.

[2 Marks]

Answer: In an ideal pyramid of energy with 10,00,000 Joules of sunlight, primary producers (first trophic level) convert 1% into net primary productivity (NPP), yielding 10,000 Joules. The energy available for herbivores (second level) is 10% of the first level, totaling 1,000 Joules. For carnivores (third level), it's 10% of 1,000 Joules, equating to 100 Joules. The fourth level, top carnivores, receives 10% of 100 Joules, resulting in 10 Joules.

Key Points: 10,00,000 Joules sunlight - 1% productivity - Level 1: 10,000 Joules - Level 2: 1,000 Joules - Level 3: 100 Joules - Level 4: 10 Joules

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Section D

Question 28.

(a) A bilobed dithecous anther has 200 microspore mother cells per microsporangium. How many male gametophytes can be produced by this anther ?

(b) Write the composition of intine and exine layers of a pollen grains.

[3 Marks]

Answer: To determine the number of male gametophytes produced by the bilobed dithecous anther, we first note that each microspore mother cell (or microsporocyte) undergoes meiosis to form four microspores. Given there are 200 microspore mother cells in each microsporangium and two microsporangia per lobe, the calculation is as follows: 200 microspore mother cells × 4 microspores each = 800 microspores per microsporangium. Since there are four microsporangia in total, this results in 800 microspores × 4 = 3200 male gametophytes. As for the composition of pollen grains, the intine is mainly composed of cellulose and pectin, while the exine is made up of sporopollenin, a tough and resistant substance that protects the pollen grain's contents.

Key Points: Each microspore mother cell forms four microspores;Total microspore production per anther can be calculated;Intine is composed of cellulose and pectin;Exine is made up of sporopollenin

Question 29.

(a) List two reasons that make copper releasing IUDs as effective contraceptives.

(b) Explain how the intake of oral contraceptive pills prevent pregnancy in humans.

[3 Marks]

Answer: Copper releasing IUDs are effective contraceptives for a couple of reasons. Firstly, they release copper ions which create an environment in the uterus that is hostile to sperm, thereby inhibiting sperm motility and function, which reduces the likelihood of fertilization. Secondly, these IUDs induce an inflammatory response that increases phagocytosis of sperm within the uterus, effectively preventing sperm from reaching an egg. Regarding oral contraceptive pills, they prevent pregnancy primarily by inhibiting ovulation. These pills contain hormones that regulate the menstrual cycle and prevent the ovaries from releasing eggs. Additionally, oral contraceptives thicken cervical

mucus, making it more challenging for sperm to enter the uterus, and they alter the uterine lining to prevent implantation if fertilization occurs.

> **Key Points: Copper ions create hostile environment for sperm; increases phagocytosis of sperm within uterus; oral pills inhibit ovulation; thicken cervical mucus; alter uterine lining to prevent implantation.**

Question 30.

Using a Punnett square workout the distribution of an autosomal phenotypic feature in the first filial generation after a cross between a homozygous female and a heterozygous male for a single locus.

[3 Marks]

Answer: To determine the distribution of phenotypes in the first filial generation (F1) following a cross between a homozygous female (AA) and a heterozygous male (Aa), we can use a Punnett Square. The homozygous female (AA) can only produce gametes with the dominant allele (A), while the heterozygous male (Aa) can produce gametes with either the dominant (A) or the recessive (a) allele. Setting this up in the Punnett square, the top will have A and A, and the side will have A and a. This gives us four squares: AA, AA, Aa, Aa. Thus, the phenotypic ratio of the F1 generation will show that 100% will express the dominant phenotype. Therefore, the expected genotypic ratio is 2 homozygous dominant (AA) to 2 heterozygous (Aa), but since both express the dominant trait, the phenotypic ratio is 100% dominant features.

> **Key Points: Set up Punnett square with AA and Aa gametes-Calculate the offspring genotypes-AA and Aa-Determine phenotypic ratio (100% dominant phenotype)**

Question 31.

How does the process of Natural Selection affect Hardy-Weinberg equilibrium ? Explain with the help of graphs.

[3 Marks]

Answer: Natural selection influences Hardy-Weinberg equilibrium by causing changes in allele frequencies, indicating evolution. According to the Hardy-Weinberg principle, allele frequencies remain stable in a population under ideal conditions. However, natural selection introduces three forms of selection: stabilizing, directional, and disruptive. In stabilizing selection, individuals with average traits are favored, leading to a more consistent allele frequency. Directional selection shifts the frequency towards one extreme, while disruptive selection favors individuals at both extremes, potentially leading to speciation. Graphically, these selections are represented by normal distribution curves, where the height reflects allele frequency over generations. The disturbance in equilibrium provoked by natural selection implies that evolutionary changes are continuous, correlating with selective pressures in the environment.

Key Points: Natural selection alters allele frequencies; Hardy-Weinberg principle states stable allele frequencies; stabilizing selection favors mean traits; directional selection shifts frequency to one extreme; disruptive selection favors extremes; graphs illustrate normal distribution and shifts in allele frequency.

Question 32.

Samples of blood and urine of a sportsperson are collected before any sports event for drug tests.

(a) Why there is a need to conduct such tests ?

(b) Name the drugs the authorities usually look for.

(c) Write the generic names of two plants from which these drugs are obtained.

[3 Marks]

Answer: Conducting drug tests for sportspersons is essential to maintain fairness and integrity in sports. Performance-enhancing drugs like anabolic steroids, narcotic analgesics, diuretics, and hormones can give athletes an unfair advantage, compromising the spirit of competition. Authorities typically screen for drugs that enhance muscle mass, strength, and endurance. Commonly tested substances include steroids, amphetamines, and cannabinoids. These drugs can be derived from plants; for instance, anabolic steroids are often synthesized from the wild yam (Dioscorea villosa) and hormones like testosterone can be obtained from the sarsaparilla plant (Smilax spp.).

Key Points: Need for fairness in sports-Common drugs tested include steroids and cannabinoids-Plants include Dioscorea villosa and Smilax spp.

Question 33.

(a) The insulin synthesised in our body is different from that synthesised by Eli Lilly company using recombinant DNA technology. Differentiate between them.

(b) Why the insulin extracted from an animal source is not in use these days ?

[3 Marks]

Answer: The insulin synthesized in the human body is a natural hormone composed of two polypeptide chains (A and B) linked by disulfide bonds. Eli Lilly's recombinant DNA insulin, however, is produced in E. coli bacteria after inserting human insulin gene sequences into plasmids. Although both forms are chemically identical, the method of production and possible impurities differ, as bacterial systems can introduce contaminants not found in human insulin. In terms of effectiveness, recombinant insulin is more beneficial for patients since it is genetically identical to human insulin, reducing the risk of immunogenic reactions. Regarding animal-sourced insulin, its use is declining due to issues of compatibility and purity; animal insulin can provoke allergic reactions or immune

responses in humans. Additionally, with the advancement of biotechnology, recombinant insulin is more accessible and ethically preferable over animal-derived options.

Key Points: Natural human insulin structure; Eli Lilly's recombinant DNA method; both insulin forms are chemically identical; animal insulin can cause allergic reactions; recombinant insulin avoids immune responses; biotechnological advancements improved insulin production.

Question 34.

(a) Draw a graph for a population whose population density has reached the carrying capacity.

(b) Out of the two population growth curves, which one is considered a more realistic for most populations ? Why ?

(c) Draw a growth curve where resources are not limiting for the growth of a population and give its equation.

[3 Marks]

Answer: For part (a), the graph of a population reaching its carrying capacity is represented as a logistic growth curve. Initially, the population grows exponentially, but as it approaches the carrying capacity (K), growth slows down and eventually stabilizes at K. In part (b), the logistic growth curve is more realistic for most populations due to environmental constraints and limited resources, which result in competition and survival of the fittest. In part (c), the growth curve for unlimited resources is an exponential curve, represented by the equation dN/dt = rN, where N is the population size and r is the intrinsic growth rate.

Key Points: Graph of logistic growth curve showing carrying capacity; Logistic curve more realistic due to resource limits; Exponential growth equation dN/dt = rN for unlimited resources.

Section E

Question 35.

(i) Describe the process of megasporogenesis in an angiosperm.

(ii) Draw a diagram of a mature embryo sac of an angiosperm.

[5 Marks]

Answer: Megasporogenesis is the process by which megaspores are formed from the megaspore mother cell (MMC) in an angiosperm ovule. The MMC, which is located in the micropylar region of the

nucellus, is a large cell characterized by dense cytoplasm and a prominent nucleus. During megasporogenesis, the MMC undergoes meiosis to produce four haploid megaspores; however, typically only one megaspore survives while the other three degenerate, marking the beginning of monosporic development. The functional megaspore then undergoes three rounds of mitotic division. The first division yields two nuclei, leading to the formation of a 2-nucleate embryo sac. This is followed by further mitotic divisions that create a 4-nucleate sac and subsequently an 8-nucleate embryo sac, with the nuclei positioned at opposite ends. The mature embryo sac contains seven cells, including one egg cell, two synergids, three antipodal cells, and one central cell consisting of two polar nuclei, all responsible for fertilization and subsequent development. A diagram of the mature embryo sac illustrates these seven cells organized within the structure of the ovule, demonstrating key aspects of female gametophyte formation in angiosperms.

Key Points: Process begins with megaspore mother cell (MMC); MMC undergoes meiosis to yield four haploid megaspores; only one megaspore survives (monosporic development); functional megaspore undergoes mitosis to form 2, 4, and then 8 nucleate stages; mature embryo sac consists of seven cells (egg cell, synergids, antipodal cells, and central cell).

Question 36.

The reproductive cycle in the female primates is called menstrual cycle. The first menstruation begins at puberty.

Answer the following questions :

(i) Name the four phases of menstrual cycle in a proper sequence.

(ii) How long does the menstrual phase last in a menstrual cycle ?

(iii) When and why hormones estrogen and progesterone reach their peak levels respectively, in the menstrual cycle ?

(iv) Give the significance of LH surge.

[5 Marks]

Answer: The menstrual cycle is a complex process divided into four phases: the menstrual phase, follicular phase, ovulation, and luteal phase. The menstrual phase lasts about 3 to 5 days, characterized by the shedding of the uterine lining. Estrogen peaks during the follicular phase just before ovulation to stimulate follicle maturation, while progesterone peaks in the luteal phase post-ovulation to maintain the endometrium for potential implantation. The surge of Luteinizing Hormone (LH) is significant because it triggers ovulation, signaling that an ovum is ready for fertilization, marking the transition between the follicular and luteal phases.

Key Points: Four phases: menstrual, follicular, ovulation, luteal - Menstrual phase lasts 3-5 days - Estrogen peaks before ovulation, progesterone peaks post-ovulation - LH surge triggers ovulation, leading to reproductive readiness

Question 37.

(i)Explain how is a bacterial cell made ‘competent’ to take up recombinant DNA from the medium.

(ii) Explain the steps of amplification of gene of interest using PCR technique.

[5 Marks]

Answer: Bacterial cells are made 'competent' to take up recombinant DNA through a process known as transformation. This involves treating the cells with a divalent cation, such as calcium chloride, which facilitates the formation of pores in the bacterial cell wall. The increased permeability allows the cells to absorb extracellular DNA, including plasmids containing the desired recombinant DNA sequences. Once competent, these bacteria are exposed to the plasmids, and some cells take up the DNA, leading to the incorporation of the new genetic material. \n\nThe amplification of the gene of interest using the Polymerase Chain Reaction (PCR) technique involves several key steps. First, DNA containing the target gene is denatured by heating, resulting in two single strands. Then, specific primers that flank the target gene are annealed to the DNA strands at a lower temperature. This is followed by the extension phase, where a heat-stable DNA polymerase synthesizes new DNA strands by elongating from the primers. Repeating these cycles (denaturation, annealing, and extension) generates millions of copies of the target gene, significantly amplifying the DNA for further analysis or application.

Key Points: Making bacterial cells competent; Treatment with calcium chloride; Formation of pores in the cell wall; Uptake of recombinant DNA; PCR technique; Denaturation of DNA; Annealing of primers; Extension by DNA polymerase; Cycles of PCR for amplification

Question 38.

(i) What are transgenic animals ?

(ii) Why are these animals being produced ? Explain any four reasons.

[5 Marks]

Answer: Transgenic animals are organisms whose DNA has been genetically modified to include a foreign gene, allowing them to express traits that are not naturally theirs. These modifications have various applications that can greatly benefit humanity. One key reason for producing transgenic animals is to enhance our understanding of gene regulation and its impact on normal physiological processes. Additionally, transgenic animals serve as vital models for studying human diseases such

as cancer and Alzheimer's, leading to the development of new therapies. They also facilitate the creation of biological products like medicines, which can be essential yet costly to produce otherwise. Lastly, transgenic animals can contribute to agricultural advances by improving livestock traits such as growth rates and disease resistance.

Key Points: Definition of transgenic animals - genetically modified with foreign genes; Study of normal physiology and gene regulation; Models for understanding and treating diseases; Production of biological products for medicines; Agricultural improvements in livestock traits.

Question 39.

(i) Explain giving three reasons why tropics show greatest levels of species diversity.

(ii) Draw a graph showing species-area relationship. Name the naturalist who studied such relationship. Write the observation made by him.

[5 Marks]

Answer: The tropics exhibit the greatest levels of species diversity due to several key factors. Firstly, they have experienced more evolutionary time compared to temperate regions, which have been subjected to glaciation events. This prolonged stability allows for the accumulation of species. Secondly, the relatively constant environmental conditions in the tropics promote niche specialization, allowing various species to thrive in diverse ecological roles. Lastly, the abundance of solar energy in these regions supports high productivity, leading to greater biomass and, consequently, more complex food webs that can support a more diverse array of species. Regarding species-area relationships, the notable German naturalist Alexander von Humboldt documented that species richness tends to increase with the area sampled up to a certain limit. This relationship demonstrates how larger habitats can support a greater number of species, influencing biodiversity patterns globally.

Key Points: 1. Greater evolutionary time in the tropics due to less glaciation. 2. Constant environmental conditions allow niche specialization. 3. Abundant solar energy promotes high productivity and biodiversity.

Question 40.

(i) The world is facing the accelerated rate of species extinctions due to human activities. Explain any three major causes of biodiversity losses.

(ii) Describe ‘Ex situ’ approach for conserving biodiversity. Give any two examples.

[5 Marks]

Answer: The accelerated loss of biodiversity is primarily due to human activities, leading to an alarming rate of species extinctions. One major cause is habitat loss and fragmentation, primarily due

to urbanization and deforestation, which disrupts ecosystems and displaces wildlife. Secondly, over-exploitation, such as overfishing and illegal poaching, severely depletes species populations. Lastly, biological invasions, where non-native species disrupt local ecosystems, threaten native biodiversity. Regarding the 'Ex situ' conservation approach, it involves preserving species outside their natural habitats. Two examples include botanical gardens, which conserve plant species, and seed banks, which store genetic material to protect against extinction. These methods help maintain biodiversity and can aid in restoring ecosystems.

Key Points: Habitat loss and fragmentation, Over-exploitation, Biological invasions, Ex situ conservation, Botanical gardens, Seed banks