CBSE EXAMINATION PAPER-2026

BIOLOGY

(Solved)

Time allowed : 3 hours | Maximum Marks : 82

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **38 questions.** All questions are **compulsory.**

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

iii. **Section A** – questions number **1 to 2** are case based questions

iv. **Section B** – questions number **3 to 18** are multiple choice questions

v. **Section C** – questions number **19 to 24** are very short answer

vi. **Section D** – questions number **25 to 32** are short answer

vii. **Section E** – questions number **33 to 38** 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.

Read the following passage and answer the questions that follow :

Gene expresses itself in a cell system as a protein/enzyme. How an expression of gene occurs in a cell system, when it needs to occur and how the gene expression is regulated in prokaryotic cell system was studied by the combined efforts of Francois Jacob, a geneticist and Jacques Monod, a biochemist. For their work on lactose metabolism in E. coli and introducing the concept of 'lac operon', they were awarded the Nobel Prize in 1965.

(1) It is said that 'lac operon' has to be operational at a very low level in the bacterial cell all the time. Justify.

[1 Marks]

Answer:

The lac operon is kept operational at a very low level in bacterial cells to allow immediate response when lactose becomes available. This ensures that the enzymes needed for lactose metabolism can be synthesized quickly, helping the bacteria adapt efficiently to changes in the environment as described in the passage.

Key Points: lac operon active at low level - allows quick response to lactose - helps bacteria adapt efficiently

(2) How are the structural genes activated in the lac operon in E. coli ?

[1 Marks]

Answer:

In E. coli, the structural genes of lac operon are activated when lactose is present in the medium.
The lactose acts as an inducer and binds to the repressor protein, inactivating it.
This allows RNA polymerase to bind to the promoter and transcribe the structural genes.
Thus, gene expression occurs only when needed, as explained by Jacob and Monod in the lac operon model.

Key Points: Lactose presence activates lac operon - Lactose binds and inactivates repressor protein - RNA polymerase transcribes structural genes leading to gene expression

(3) Why is lac operon said to be a transcriptionally regulated system ?

[2 Marks]

Answer: Lac operon is called a transcriptionally regulated system because the control occurs at the transcription stage, which is the primary step of gene expression regulation.
In bacteria like E. coli, genes needed for lactose metabolism are organized in an operon and are transcribed together as one polycistronic mRNA from a common promoter.
The lac operon is regulated based on the presence of lactose in the medium; when lactose is present, transcription of structural genes occurs to produce enzymes that metabolize lactose.
This regulation by the lac operon was the first example of gene regulation at the transcriptional level discovered by Jacob and Monod, as mentioned in the case passage.

Key Points: Regulation at transcription level - Genes arranged in operon under common promoter - Operon induced by lactose presence leading to transcription

Question 2.

Read the following passage and answer the questions that follow:

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. Acquired immunity is characterised by memory. Antibodies are specific to antigens and there are four types of antibodies produced in our body — IgA, IgE, IgG and IgM. It shows primary response where it encounters the pathogen for the first time and secondary response during the subsequent encounters with the same antigen/pathogen. These immune responses are carried out with the help of two special types of lymphocytes present in the blood

(1) Name the two types of specialised cells which carry out the primary and secondary responses.

[1 Marks]

Answer:

The two specialised lymphocytes that carry out the primary and secondary immune responses are B-lymphocytes and T-lymphocytes. B-lymphocytes produce specific antibodies against pathogens, while T-lymphocytes help in destroying infected cells. These cells are responsible for the acquired immunity which has memory as described in the passage.

Key Points: B-lymphocytes - T-lymphocytes - Carry out primary and secondary immune responses

(2) Name any two barriers present in our body that provide innate immunity.

[1 Marks]

Answer: Two barriers that provide innate immunity are skin and mucous membranes. Skin acts as a physical barrier to prevent the entry of microorganisms, while mucous membranes trap pathogens to protect our body from infections. These barriers provide a non-specific defence, as explained in the case passage.

Key Points: Skin acts as a physical barrier - Mucous membranes trap pathogens - Both provide non-specific defence as part of innate immunity

(3) How is active immunity different from passive immunity ? Write any two differences.

[2 Marks]

Answer: Active immunity involves the production of antibodies by the body's own immune system when exposed to antigens either by infection or vaccination. It is slow to develop but provides long-lasting protection with memory.
Passive immunity is when ready-made antibodies are directly given to the body, providing immediate but short-term protection without memory. Thus, active immunity is slow and long-lasting, whereas passive immunity is fast-acting but temporary.

Key Points: Active immunity involves antibody production by host - Passive immunity involves transfer of ready-made antibodies - Active immunity provides long-lasting protection with memory - Passive immunity provides immediate but short-term protection

Section B

Question 3.

Choose the option that gives the correct number of pollen grains that will be formed after 325 microspore mother cells undergo microsporogenesis.

[1 Marks]

(A) 650

(B) 325

(C) 1300

(D) 975

Explanation:

Each microspore mother cell undergoes meiosis during microsporogenesis to produce 4 microspores. Each microspore develops into a pollen grain. Therefore, from 325 microspore mother cells, the total number of pollen grains formed will be 325 × 4 = 1300.

Question 4. Select the phase of menstrual cycle in which the remaining parts of Graafian follicle transform into the corpus luteum.

[1 Marks]

(A) Secretory phase

(B) Proliferative phase

(C) Menstrual phase

(D) Ovulatory phase

Explanation: The transformation of the remaining parts of Graafian follicle into the corpus luteum occurs after ovulation and during the luteal phase, which is also called the secretory phase. During this phase, the corpus luteum secretes progesterone essential for maintaining the endometrium. This is clearly described in the context that after ovulation (ovulatory phase), the luteal (secretory) phase begins when the follicle becomes corpus luteum.

Question 5.

A female undergoing IVF treatment has blocked fallopian tube. The technique by which the embryo with more than 8 blastomeres will be transferred into the female for further development is :

[1 Marks]

(A) ZIFT

(B) GIFT

(C) IUT

(D) AI

Explanation:

According to the context, embryos with more than 8 blastomeres are transferred into the uterus by the technique called Intra Uterine Transfer (IUT). Since the female has a blocked fallopian tube, transfer into the fallopian tube (as in ZIFT or GIFT) is not possible. Therefore, the correct technique for transferring embryos with more than 8 blastomeres in IVF treatment is IUT.

Question 6.

Select the correct statement.

All genes located on the same chromosome

[1 Marks]

(A) form one linkage group.

(B) form interactive groups that affect the phenotype

(C) form different groups depending upon their relative distance

(D) will not form linkage groups

Explanation:

Genes located on the same chromosome tend to be inherited together as a single linkage group because they do not assort independently. However, the strength of linkage depends on the distance between the genes — genes that are very close are tightly linked with low recombination, while those farther apart show higher recombination but still belong to the same linkage group. Therefore, all genes on the same chromosome form one linkage group.

Question 7.

Choose the correct statements:

(i) Polycistronic mRNA is generally found in eukaryotes.

(ii) The RNA polymerase II transcribes precursor of mRNA, the hn RNA.

(iii) The process of translation of mRNA begins when the mRNA encounters the large subunit of ribosomes.

(iv) Stop codons do not have any tRNAs

[1 Marks]

(A) (ii) and (iii)

(B) (i), (ii) and (iv)

(C) (i) and (ii)

(D) (ii) and (iv)

Explanation:

Statement (ii) is correct because RNA polymerase II transcribes the precursor of mRNA known as heterogeneous nuclear RNA (hnRNA). This is clearly mentioned in the context. Statement (iv) is also correct because stop codons do not code for any amino acid and therefore do not have any corresponding tRNAs; they signal termination of translation. Statement (i) is incorrect because polycistronic mRNA is generally found in prokaryotes, not eukaryotes. Statement (iii) is incorrect because translation begins when mRNA encounters the small subunit of the ribosome, not the large subunit.

Question 8.

Name the extinct ancestor of humans who ate only fruits and hunted with stone weapons.

[1 Marks]

(A) Australopithecus

(B) Ramapithecus

(C) Homo erectus

(D) Dryopithecus

Explanation:

Australopithecus lived about 2 million years ago in East African grasslands. Evidence shows they hunted with stone weapons but essentially ate fruits, making them the extinct ancestor described. Ramapithecus and Dryopithecus were earlier primates more ape-like or man-like but did not have the described behavior. Homo erectus likely ate meat and had a larger brain, differing from the characteristics given.

Question 9.

Nicotine affects blood pressure and heart rate due to release of certain adrenal hormones. Following are some of the adrenal hormones :

(i) Adrenaline

(ii) Cortisol

(iii) Noradrenaline

(iv) Aldosterone Select the correct option :

[1 Marks]

(A) (i) and (ii)

(B) (i) and (iv)

(C) (ii) and (iii)

(D) (i) and (iii)

Explanation:

Adrenaline and noradrenaline are catecholamines secreted by the adrenal medulla. They are responsible for the 'fight or flight' response and increase heart rate and blood pressure. Cortisol and

aldosterone are secreted by the adrenal cortex and do not directly affect heart rate and blood pressure in the way adrenaline and noradrenaline do. Therefore, the correct hormones affecting blood pressure and heart rate due to nicotine are adrenaline (i) and noradrenaline (iii).

Question 10.

Microbes used for biocontrol of pest butterfly caterpillars is :

[1 Marks]

(A) Trichoderma

(B) Streptococcus sp.

(C) Saccharomyces cerevisiae

(D) Bacillus thuringiensis

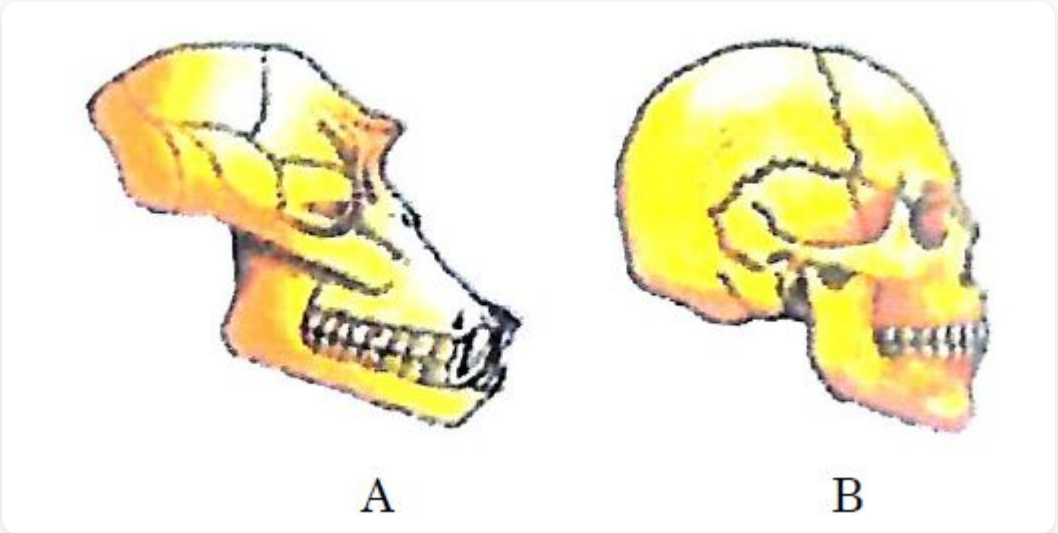
Explanation:

Bacillus thuringiensis (Bt) is a bacterium used for the biocontrol of pest butterfly caterpillars. Bt produces toxins that are harmful to insect larvae but safe for other insects and humans. These toxins are released in the gut of the caterpillars when they ingest the bacteria, killing them effectively. Bt is commonly used in agriculture, for example Bt-cotton is a crop genetically engineered to contain Bt toxin genes, providing resistance against insect pests. Other options like Trichoderma are used against plant pathogens, and Streptococcus sp. and Saccharomyces cerevisiae are not used for this purpose.

Question 11.

The given diagram shows the skulls of two different mammals. Which of the following options accurately describes the differences between these skulls ?

[1 Marks]



(A) Skull A is of a human and skull B is of an adult chimpanzee

(B) Skull A has more brain capacity than skull B.

(C) Skull A is of an adult chimpanzee and skull B is of a human.

(D) Skull B is the ancestor of skull A.

Explanation:

Based on the provided context, Skull A has a larger braincase, smaller jaw, and a flat face with a prominent chin, which are characteristics of a human skull. Skull B has a smaller braincase and a larger, projecting jaw, typical of an adult chimpanzee. Therefore, Skull A corresponds to a human and Skull B corresponds to an adult chimpanzee.

Question 12.

In RNAi, genes are silenced using which of the following biomolecules ?

[1 Marks]

(A) ssDNA

(B) dsDNA

(C) ssRNA

(D) dsRNA

Explanation:

RNA interference (RNAi) involves the silencing of specific mRNA molecules by complementary double-stranded RNA (dsRNA). The dsRNA binds to the target mRNA and prevents its translation, effectively silencing the gene. This method is used as a cellular defense mechanism in eukaryotic organisms. The context explains that dsRNA triggers RNAi by forming through complementary sense and anti-sense RNA strands, which then silence the expression of the target gene.

Question 13.

Connell's elegant field experiments on the rocky seacoast of Scotland, found that larger barnacles Balanus dominated the intertidal area and removed the smaller barnacles Chathamalus. This happened due to :

[1 Marks]

(A) Parasitism

(B) Competition

(C) Mutualism

(D) Predation

Explanation:

Connell's field experiments showed that the larger barnacle Balanus, which is competitively superior, dominates the intertidal zone and excludes the smaller barnacle Chathamalus. This exclusion happens because both species compete for the same space and resources, and the superior competitor outcompetes the other species. This is an example of competition, where species struggle to gain limited resources, and one species excludes the other.

Question 14.

Protein encoded by gene Cry-I Ab controls the infestation of which of the following ?

[1 Marks]

(A) Agrobacterium

(B) Cotton bollworms

(C) Mosquitoes

(D) Corn borer

Explanation:

According to the provided context, the protein encoded by gene cryIAb controls corn borer infestation. The context specifies that different cry genes from Bacillus thuringiensis target specific pests, and cryIAb specifically controls corn borer, whereas cryIAc and cryIIAb control cotton bollworms. Thus, the correct answer is Corn borer.

Question 15.

Assertion (A) : Cleistogamous flowers have assured seed set.

Reason (R) : Cleistogamous flowers are invariably autogamous and do not depend on any pollinating agents

[1 Marks]

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

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

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

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

Explanation:

Cleistogamous flowers are closed flowers that do not open and self-pollinate internally. This means they are invariably autogamous, ensuring pollination without the need for external pollinating agents. As a result, cleistogamous flowers have assured seed set since self-pollination occurs even in the absence of pollinators. Thus, both the assertion and reason are true, and the reason correctly explains the assertion.

Question 16.

Assertion (A) : The human blood group ‘AB’ exemplifies co-dominance.

Reason (R) : The gene for human blood group trait exists in three allelic forms IA, IB and i.

[1 Marks]

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

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

(C) Assertion (A) is true, but Reason (R) is false

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

Explanation:

The human blood group 'AB' is an example of co-dominance because both IA and IB alleles are expressed equally when present together, resulting in the AB blood group. The gene controlling the ABO blood group has three allelic forms: IA, IB, and i. The presence of both IA and IB alleles leads to co-dominance, as both phenotypes appear simultaneously without one being dominant over the other. Thus, both the assertion and reason are true, and the reason correctly explains the assertion.

Question 17.

Assertion (A) : Nucleopolyhedrovirus are useful as they are good biocontrol agents.

Reason (R) : They are species-specific, narrow spectrum bioinsecticide

[1 Marks]

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

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

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true

Explanation:

Nucleopolyhedroviruses belong to the genus Nucleopolyhedroviral, a group of baculoviruses that specifically infect certain insect species. These viruses are considered good biocontrol agents because they act as species-specific, narrow spectrum bioinsecticides. This specificity ensures that they target only the pest insects without harming plants, mammals, birds, fish, or beneficial non-target insects, making them environmentally friendly and effective for pest management.

Question 18.

Assertion (A) : The pyramid of biomass in a pond aquatic ecosystem is always inverted.

Reason (R) : The biomass of consumers like fishes far exceeds that of the producers like phytoplanktons

[1 Marks]

(A) Assertion (A) is true, but Reason (R) is false

(B) Assertion (A) is false, but Reason (R) is true

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

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

Explanation:

The pyramid of biomass in a pond aquatic ecosystem is often inverted because the biomass of producers (phytoplankton) at any given time is small due to their rapid reproduction and turnover, even though they support a larger biomass of consumers (like zooplankton and fishes). While it is true that the biomass of consumers like fishes can be greater than that of producers like phytoplankton, this fact alone does not fully explain why the pyramid is inverted. The key reason for the inversion is the high turnover rate of phytoplankton, not just the relative biomasses of fishes and phytoplankton.

Section C

Question 19.

How do ‘implants’ act as an effective method of contraception in human females ? Mention one advantage of implants over contraceptive pills

[2 Marks]

Answer: (a) Implants act as an effective contraceptive method in human females by releasing hormones slowly into the bloodstream, which prevent ovulation and make the uterus unsuitable for implantation of a fertilized egg.
(b) One advantage of implants over contraceptive pills is that implants provide long-term protection against pregnancy without the need for daily intake, thus ensuring better convenience and compliance.

Key Points: Implants release hormones slowly to prevent ovulation - Implants make uterus unsuitable for implantation - Advantage: long-term protection without daily intake

Question 20.

(a) Write one way by which apomictic seeds can be developed.

(b) Why do farmers prefer apomictic seeds over hybrid seeds ?

[2 Marks]

Answer: (a) Apomictic seeds can be developed by producing seeds without fertilisation, a process called apomixis, where embryos form from the diploid cells of the ovule.
(b) Farmers prefer apomictic seeds over hybrid seeds because apomictic seeds produce offspring identical to the parent plant, maintaining desired traits without segregation. This saves farmers from buying hybrid seeds every year as the quality remains stable in subsequent generations, reducing cost and effort.

Key Points: Apomictic seeds develop without fertilisation - Apomixis produces genetically identical embryos - Farmers save cost and maintain quality by using apomictic seeds

Question 21.

A laboratory assistant collected three water samples, namely river water, untreated sewage water and secondary effluent discharged from a sewage treatment plant. But the laboratory attendant did not note which was which. The samples were labelled A, B and C and subjected to a BOD test. The BOD values of the three samples A, B and C were recorded as 30 mg/L, 8 mg/L and 400 mg/L respectively.

(a) Which sample of the water is most polluted ?

(b) Can you assign the correct label to each, assuming the river water is relatively clean ?

[2 Marks]

Answer: (a) The most polluted water sample is the one with the highest BOD value, which is sample C with a BOD of 400 mg/L. This means it has the highest organic matter and pollution.
(b) Since river water is relatively clean, it will have the lowest BOD value. Therefore, sample B with BOD 8 mg/L is river water. Untreated sewage water has the highest pollution and BOD, so sample C (400 mg/L) is untreated sewage. The remaining sample A with BOD 30 mg/L is the secondary effluent from the sewage treatment plant, which is partially treated water with reduced pollution.

> **Key Points: Higher BOD means more pollution - Sample with highest BOD is untreated sewage - River water has lowest BOD and pollution - Secondary effluent has intermediate BOD**

Question 22.

Write the role of ‘ori’ and ‘restriction’ site in a cloning vector pBR322.

[2 Marks]

Answer: ori (origin of replication): It is the site where DNA replication starts in the plasmid. It allows the plasmid pBR322 to replicate independently inside the bacterial cell.
Restriction site: These are specific sequences recognized by restriction enzymes which cut the plasmid at precise points. They allow insertion of foreign DNA into the plasmid at desired locations during cloning.

> **Key Points: origin of replication allows plasmid replication independently - restriction sites are specific enzyme recognition sequences - restriction sites enable insertion of foreign DNA**

Question 23.

Biodiversity must be conserved as it plays an important role in many ecosystem services that nature provides. Explain any two ecosystem services.

[2 Marks]

Answer: Pollination: Many plants depend on animals like bees and butterflies for pollination, which helps in the production of fruits and seeds.
Purification of air and water: Forests and plants act as natural filters, cleaning the air by absorbing harmful gases and purifying water by filtering pollutants, thus maintaining a healthy environment.

> **Key Points: Pollination helps in plant reproduction - Forests purify air and water - Ecosystem services support life and environment**

Question 24.

(i) State, what does 'standing crop' of a trophic level represent.

(ii) List any two ways of measuring the standing crop of a trophic level.

[2 Marks]

Answer: (i) The standing crop of a trophic level represents the total mass of living organisms present in that trophic level at a particular time. It indicates the biomass or number of organisms available at that level.
(ii) Two ways to measure the standing crop of a trophic level are:
1. By measuring the biomass, either fresh weight or dry weight of the organisms.
2. By counting the number of individuals present per unit area.

> **Key Points: Standing crop is total mass of living organisms at a trophic level - Measured as biomass or number of individuals - Biomass expressed as fresh weight or dry weight**

Section D

Question 25.

Differentiate between wind-pollinated and insect-pollinated flowers. Give an example of each type.

[3 Marks]

Answer: Difference between wind-pollinated and insect-pollinated flowers:
1. Pollination Agent: Wind-pollinated flowers use wind to carry pollen from one flower to another, while insect-pollinated flowers rely on insects like bees to transfer pollen.
2. Pollen Characteristics: Wind-pollinated flowers produce large quantities of light and dry pollen to be easily carried by wind. Insect-pollinated flowers produce sticky and heavy pollen that sticks to insects.
3. Flower Structure: Wind-pollinated flowers usually have small, dull petals and exposed stamens and stigmas to catch pollen from the air. Insect-pollinated flowers have bright colored petals, scent, and nectar to attract insects.

4. Examples: An example of a wind-pollinated flower is grass or maize, and an example of an insect-pollinated flower is a rose or an orchid.

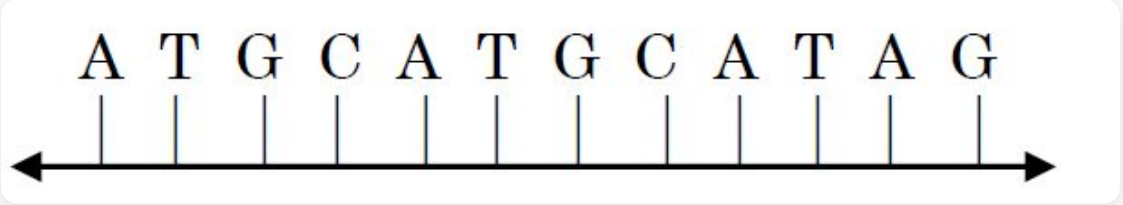
Key Points: Wind-pollinated flowers use wind for pollination - Produce large amounts of light pollen - Have small, inconspicuous flowers - Example: grass or maize - Insect-pollinated flowers use insects for pollination - Produce sticky pollen - Have colorful, fragrant flowers - Example: rose or orchid

Question 26.

(a) Construct a complete transcription unit with promoter and terminator on the basis of the hypothetical coding strand given below:

(b) Write the RNA strand transcribed from the above transcription unit along with its polarity

[3 Marks]



Answer: (a) A complete transcription unit consists of the promoter, structural gene, and terminator arranged sequentially on the coding strand. Given a hypothetical coding strand sequence 5'-ATGCATGCATGCATGCATGCATGC-3', the promoter is located upstream (towards the 5' end) directing RNA polymerase to start transcription. The terminator sequence is located downstream (towards the 3' end) signaling RNA polymerase to stop transcription. Thus, the transcription unit can be represented as:
Promoter - 5'-ATGCATGCATGCATGCATGCATGC-3' (coding strand) - **Terminator**
(b) The RNA strand is synthesized using the template strand which is complementary and antiparallel to the coding strand. Since the coding strand is 5'-ATGCATGCATGCATGCATGCATGC-3', the template strand is 3'-TACGTACGTACGTACGTACGTACG-5'. RNA polymerase reads the template strand from 3' to 5' and synthesizes RNA in 5' to 3' direction. The transcribed RNA sequence is complementary to the template strand and identical in sequence to the coding strand except that thymine (T) is replaced by uracil (U). Hence, the RNA strand is 5'-AUGCAUGCAUGCAUGCAUGCAUGC-3'. The polarity of the RNA strand is from 5' to 3'.

Key Points: Transcription unit components - Promoter directs RNA polymerase binding - Terminator signals end of transcription - Coding strand sequence given - Template strand is complementary to coding strand - RNA strand is complementary to template strand and identical to coding strand replacing T with U - RNA synthesized in 5' to 3' direction

Question 27.

Explain the three different ways in which natural selection operates. Explain with the help of graphs.

[3 Marks]

Answer: Natural selection is the process where organisms better adapted to their environment tend to survive and produce more offspring.

(a) Stabilising Selection: In stabilising selection, natural selection favors the individuals with average traits. This makes the peak of the curve higher and narrower, meaning most individuals have traits closer to the average. Extremes are less common. For example, medium-sized babies have a higher survival rate than very small or very large babies.

(b) Directional Selection: Directional selection occurs when natural selection favors one extreme trait over the other. This causes the entire population curve to shift towards that extreme, either to the left or right on the graph. For instance, if larger size helps animals survive better, over time more bigger animals will be present.

(c) Disruptive Selection: Disruptive selection favors individuals at both extremes rather than average traits. This results in two peaks in the graph, showing two groups with extreme traits are more common, and the average becomes less common. An example is when both very small and very large seeds exist and birds with either very small or very large beaks survive better but not birds with medium-sized beaks.

> **Key Points: Stabilising selection favors average traits - Directional selection favors one extreme trait - Disruptive selection favors both extreme traits causing two groups**

Question 28.

(a) How do some viruses cause cancer in humans ?

(b) How do benign tumours turn malignant ? How do malignant tumours harm the human body ?

[3 Marks]

Answer: (a) Some viruses cause cancer in humans by carrying genes called viral oncogenes that can transform normal cells into cancerous cells. These oncogenic viruses insert their genetic material into the host cell's DNA, causing uncontrolled cell division and tumor formation.
(b) Benign tumours turn malignant when they lose the property of being confined to their original location and begin to invade nearby tissues. Malignant tumours spread rapidly through the body by invading other organs or through the bloodstream and lymphatic system. Malignant tumours harm the human body by damaging tissues, interfering with normal organ functions, and spreading cancerous cells to other parts of the body, which can be life-threatening.

Key Points: Oncogenic viruses carry viral oncogenes - Benign tumours remain localized - Malignant tumours invade tissues and spread - Malignant tumours disrupt organ function and are harmful

Question 29.

(a) How is insulin different from proinsulin ?

(b) Explain all the stages of how human insulin is produced through rDNA technology.

[3 Marks]

Answer: (a) Insulin is the active hormone consisting of A and B chains linked by disulfide bonds, while proinsulin is its inactive precursor containing A chain, B chain, and an additional C peptide which connects A and B chains. The C peptide is removed enzymatically to form mature insulin.
(b) Human insulin is produced through rDNA technology by the following steps:
1. The genes coding for A and B chains of human insulin are separately inserted into plasmids of E coli bacteria.
2. These recombinant plasmids are introduced into E coli which then expresses A and B chains separately.
3. The A and B chains are extracted and purified from bacterial cultures.
4. Chemically, the two chains are combined by forming disulfide bonds to produce active human insulin.
This method allows large scale insulin production identical to natural human insulin without immune reactions.

Key Points: Proinsulin is inactive precursor with C peptide - Insulin is active hormone without C peptide - A and B chains form insulin with disulfide bonds - Genes for A and B chains inserted into plasmids - E coli produces A and B chains separately - Chains combined chemically to form insulin

Question 30.

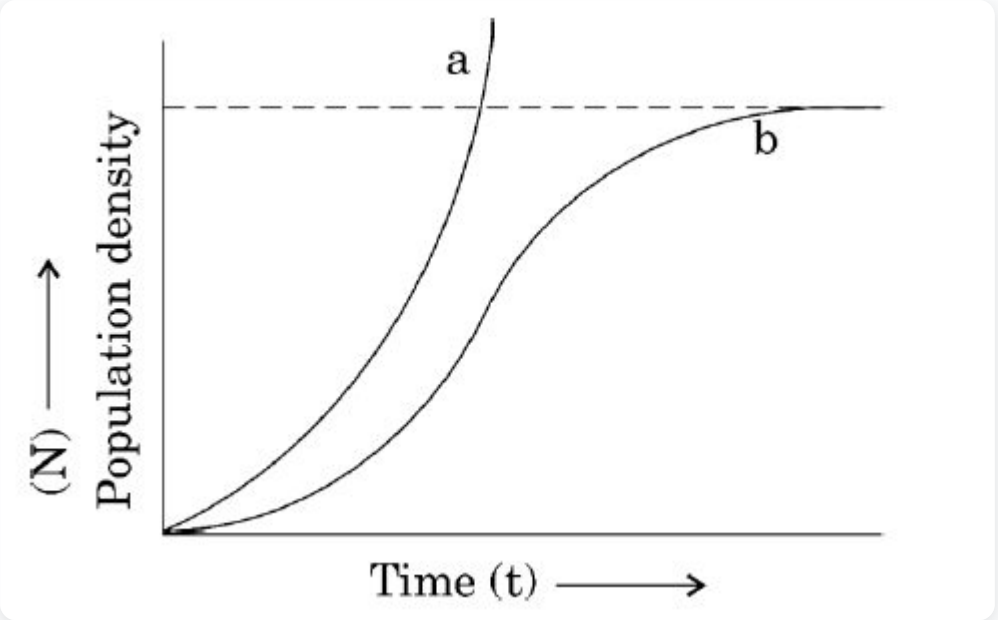
Study the graph given below and answer the questions that follow :

(i) Write the status of food and space in the curves a and b.

(ii) In the absence of predators, which one of the two curves would appropriately depict the prey population ?

(iii) 'Time' has been shown on x-axis and there is a parallel dotted line above it. Give the significance of this dotted line.

[3 Marks]



Answer: (a) Curve a represents exponential growth where food and space are unlimited, allowing the population to grow rapidly without any restrictions. Curve b represents logistic growth where food and space are limited, causing the population to increase initially and then level off as it approaches the carrying capacity.
(b) In the absence of predators, curve a (exponential growth curve) would depict the prey population because without predators, the prey population can grow without limitation assuming food and space are sufficient.
(c) The parallel dotted line above the x-axis (time) indicates the carrying capacity or maximum population size that the environment can sustain due to limited resources like food and space. This line shows the level at which the population stabilizes in logistic growth.

Key Points: Curve a shows unlimited food and space leading to exponential growth - Curve b shows limited food and space leading to logistic growth - Dotted line indicates carrying capacity (maximum sustainable population)

Question 31.

Answer the following questions :

(i) Define ‘predation’.

(ii) Why is predation required in a community of different organisms ? Give any two points.

(iii) Why are predators ‘prudent’ in nature ?

[3 Marks]

Answer: (a) **Predation** is a biological interaction where one organism, called the predator, hunts, kills and feeds on another organism, called the prey. It is an important process through which energy is transferred between trophic levels in an ecosystem.
(b) Predation is required in a community because: 1. It helps in controlling the population of prey

species, preventing them from overpopulating and causing imbalance in the ecosystem. 2. It facilitates the transfer of energy from one trophic level to another, which is essential for the survival of higher organisms.
(c) Predators are 'prudent' in nature because if they consume their prey too efficiently, it could lead to the extinction of the prey species. This would result in the predator losing its source of food and eventually becoming extinct as well. Therefore, predators maintain a balance by not overexploiting their prey, ensuring the survival of both species in the ecosystem.

Key Points: Definition of predation - Importance of predation for population control - Predators are prudent to avoid prey extinction

Question 32.

There are many animals, which have become extinct in the wild, but continue to be maintained in zoological parks. Answer the questions that follow:

(a) What type of bio-diversity conservation is observed in this case ?

(b) Explain any other two ways which help in this type of conservation.

(c) Besides zoological parks, mention one place that serves this purpose.

[3 Marks]

Answer: (a) The type of bio-diversity conservation observed here is **ex situ conservation**. It involves protecting endangered animals by removing them from their natural habitat and maintaining them in a controlled environment like zoological parks.
(b) Two other ways that help in ex situ conservation are:
1. **Botanical gardens**: These are special places where rare and endangered plants are grown and protected.
2. **Cryopreservation**: This technique involves preserving gametes or tissues at very low temperatures so that they can be used later for breeding or research.
(c) Besides zoological parks, **botanical gardens** also serve the purpose of ex situ conservation by protecting endangered plant species in a controlled environment.

Key Points: Ex situ conservation - Botanical gardens protect endangered plants - Cryopreservation preserves genetic material - Zoological parks maintain endangered animals

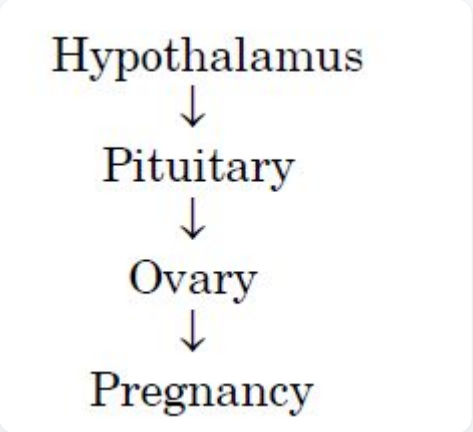
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Section E

Question 33.

Study the flow chart given below. Name the hormones involved at each stage and explain their functions.

[5 Marks]



Answer: Answer:

The flow chart represents the hormonal control involving the hypothalamus, pituitary gland, and target glands.

1. Hypothalamus:

The hypothalamus produces releasing hormones. For example, Gonadotropin Releasing Hormone (GnRH).

Function : GnRH stimulates the anterior pituitary gland to release specific hormones.

2. Anterior Pituitary Gland:

It secretes trophic hormones such as Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH).

Function : FSH promotes the growth of ovarian follicles in females and sperm production in males. LH triggers ovulation and stimulates production of estrogen and progesterone from ovaries or testosterone from testes.

3. Target Glands (Ovaries/Testes):

They produce sex hormones like estrogen, progesterone, and testosterone.

Function : These hormones regulate secondary sexual characteristics, reproductive cycles, and fertility.

Summary:

The hypothalamus releases GnRH which acts on the anterior pituitary to secrete FSH and LH. These pituitary hormones act on the gonads to release sex hormones that control reproduction and secondary sexual characteristics. This is a classical example of hormonal regulation through feedback mechanisms to maintain balance in the body.

Key Points: Hypothalamus produces releasing hormones GnRH - Anterior pituitary secretes FSH and LH - Target glands produce sex hormones controlling reproduction

Question 34.

(i) Draw a diagram of L.S. of maize grain and label its any six parts.

(ii) Differentiate between perisperm and endosperm giving one example of each.

[5 Marks]

Answer: (i) The longitudinal section (L.S.) of a maize grain shows the following six parts:
1. Pericarp: The outermost protective layer of the maize grain.
2. Seed coat: A thin layer present just inside the pericarp that protects the seed.
3. Endosperm: The large food-storing tissue that provides nutrients to the developing embryo.
4. Embryo: The young plant inside the seed which will grow into a new maize plant.
5. Scutellum: Part of the embryo that absorbs food from the endosperm during germination.
6. Coleoptile: A protective sheath that covers the young shoot of the embryo.

(ii) Difference between Perisperm and Endosperm:
Perisperm: It is the nutritive tissue derived from the nucellus of the ovule. It is usually found surrounding the endosperm or embryo and stores food. An example of a seed having perisperm is black pepper.
Endosperm: It is the nutritive tissue formed as a result of fertilization and is triploid in nature. It provides food to the developing embryo. An example of a seed rich in endosperm is maize.

Key Points: Diagram of maize grain L.S. showing six parts - Perisperm is nucellus derived food tissue present in some seeds like black pepper - Endosperm is fertilization product and triploid nutritive tissue present in seeds like maize - Functions of each part briefly explained - Embryo and its parts identified - Protective layers such as pericarp and seed coat noted

Question 35.

Write the types and locations of the genes causing thalassemia in humans. State the cause and symptoms of the disease. How is sickle-cell anemia different from this disease ?

[5 Marks]

Answer:

(a) Types and locations of genes causing thalassemia in humans: Thalassemia is classified into two main types based on the affected globin chain: alpha (\u03b1) thalassemia and beta (\u03b2) thalassemia. \u03b1 Thalassemia is caused by mutations or deletions in the HBA1 and HBA2 genes

located on chromosome 16. \u03b2 Thalassemia is due to mutations in the HBB gene on chromosome 11.

(b) Cause and symptoms of thalassemia: Thalassemia occurs due to defective or deficient synthesis of either the \u03b1 or \u03b2 globin chains of hemoglobin, leading to an imbalance in globin chain production. This results in anemia, fatigue, weakness, pale skin, slow growth, and enlargement of spleen and liver.

(c) Difference between sickle-cell anemia and thalassemia: Sickle-cell anemia is a qualitative disorder caused by a mutation in the HBB gene resulting in abnormal hemoglobin (HbS) which distorts red blood cells into a sickle shape. In contrast, thalassemia is a quantitative disorder characterized by reduced or absent production of one type of globin chain. Thus, thalassemia results from producing too few globin molecules, while sickle-cell anemia results from producing a structurally abnormal globin molecule.

> **Key Points: Types of thalassemia - Gene locations on chromosomes 16 and 11 - Cause: defective globin synthesis - Symptoms: anemia, fatigue, pale skin - Difference from sickle-cell anemia: quantitative vs qualitative defect**

Question 36.

(i) Enlist any four prime goals of the Human Genome Project (HGP).

(ii) List the two methodologies which were involved in the human genome project. Mention how they were used.

(iii) Expand 'YAC' and mention what it was used for

[5 Marks]

Answer: (i) Four prime goals of the Human Genome Project (HGP) were:
1. Identify all the approximately 20,000-25,000 genes in human DNA.
2. Determine the sequences of the 3 billion chemical base pairs that make up human DNA.
3. Store this information in databases accessible to researchers worldwide.
4. Develop tools for data analysis and address ethical, legal, and social issues arising from genome research.

(ii) The two main methodologies used in the Human Genome Project were:
1. Genetic Mapping: This involved locating genes on chromosomes by discovering their relative positions using markers.
2. Physical Mapping and DNA Sequencing: Physical maps determined the exact physical locations of genes, and DNA sequencing was used to read the order of nitrogen bases A, T, C, and G in the DNA. Both methodologies together helped in identifying gene locations and reading their sequences.

(iii) YAC stands for Yeast Artificial Chromosome. It was used as a cloning vector to carry very large

fragments of human DNA during the genome sequencing. This helped in organizing and analyzing large segments of DNA effectively.

Key Points: Prime goals of HGP - Genetic mapping and physical mapping methodologies - YAC stands for Yeast Artificial Chromosome used as a cloning vector

Question 37.

(i) EcoR I has played a very important role in rDNA technology.

(a) Explain the convention for naming EcoR I.

(b) Write the recognition site of this endonuclease restriction enzyme.

(ii) Name the overhanging stretches of DNA produced by these restriction enzymes. Describe their role in the formation of rDNA.

[5 Marks]

Answer: (i)(a) The naming convention of restriction enzymes is based on the bacterium they are isolated from. The first letter represents the genus of the bacterium, the next two letters represent the species, and the following letter represents the strain. In EcoRI, 'Eco' comes from Escherichia coli and 'R' is the strain RY13 from which it was isolated. The Roman numeral I indicates that it was the first enzyme isolated from this strain.
(b) EcoRI recognizes the specific palindromic DNA sequence GAATTC and cuts between G and A on each strand.
(ii) EcoRI produces sticky ends which are single-stranded overhanging stretches of DNA after cutting. These sticky ends are complementary and can anneal with other DNA fragments cut by the same enzyme. This property is crucial in recombinant DNA technology as it allows foreign DNA to join easily with vector DNA to form rDNA, facilitating gene cloning and other molecular biology techniques.

Key Points: Naming based on genus, species, and strain - Recognition sequence GAATTC - Sticky ends help join DNA fragments in rDNA formation

Question 38.

(i) Insertional inactivation is a method to detect the recombinant DNA. Explain this method.

(ii) Name the commonly used vector for transferring genes in plants from bacteria.

(iii) How is this able to transform a normal plant cell into a tumour ?

[5 Marks]

Answer: (a) **Insertional inactivation** is a technique used to detect recombinant DNA by inserting a DNA fragment into the coding sequence of an enzyme gene, commonly the gene for β-galactosidase.

When foreign DNA is inserted into this gene, the gene gets inactivated and the enzyme is not produced. This allows identification of recombinant bacteria by screening for the absence of enzyme activity.

(b) The commonly used vector for transferring genes in plants is the **Ti plasmid** of the bacterium *Agrobacterium tumefaciens*.

(c) The Ti plasmid of *Agrobacterium tumefaciens* has a segment called T-DNA, which integrates into the plant cell genome and causes production of plant hormones leading to uncontrolled cell division, forming a tumour or gall. This ability to induce tumours allows the plasmid to transfer genes into plant cells and modify them genetically.

Key Points: Insertional inactivation involves disruption of β-galactosidase gene - Ti plasmid of Agrobacterium tumefaciens is commonly used vector - Ti plasmid transforms normal plant cells into tumours by inserting T-DNA causing hormone induced cell division