COMMON PRE-BOARD EXAMINATION 2024-25

Subject: BIOLOGY (044)

Date: 12/12/2024

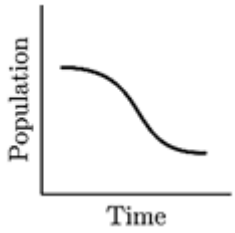
Max. Marks: 70 Time: 3 Hours

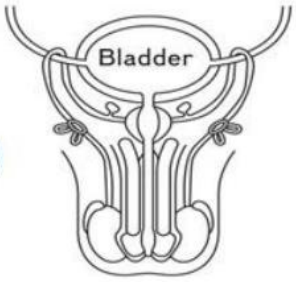
General Instructions:

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

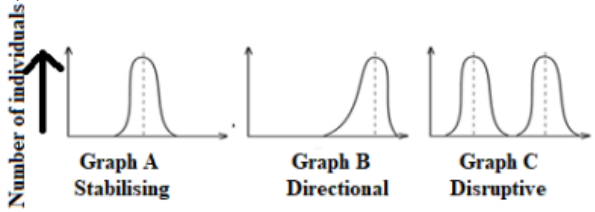
Section – A

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

S. No	Questions	Marks
1	D. only i, ii and iii.	1
2	C. 3	1
3	C. only i, ii, iv	1
4	A. only Y	1
5	**A.** 	1
6	A. 24	1
7	B. Region X is less diverse than region Y even though both regions have the same species richness.	1
8	C. a-(ii), b-(iv), c-(iii), d-(i)	1
9	B. 23.5° N to 23.5° S	1
10	D. Soil Sample C	1

11	(A) 	1
12	A. The sum total of the frequency of C and C' is equal to 1.	1
13	D. A is False but R is true	1
14	B. Both A and R are true and R is not the correct explanation of A.	1
15	A. Both A and R are true and R is the correct explanation of A.	1
16	A. Both A and R are true and R is the correct explanation of A.	1
	Section - B	
17	Attempt either option A or B. A. (i) Sample 1: EcoRI Sample 2: BamHI Sample 3: Hind III **(1mark)** (ii) She can grow the culture on a media plate containing ampicillin and tetracycline. - Since cutting with HindIII will disrupt the ampicillin resistance gene and not the tetracycline resistance gene, only cells containing the plasmid ligated with the target DNA will grow. **(1mark)** **OR** B. (i) The cell membrane is an amphipathic structure whose outer ends are hydrophobic or non-polar in nature. - Oxygen being a non-polar molecule can enter the cell easily but DNA is highly polar/hydrophilic in nature which is repelled by the cell membrane. [Accept any other valid answer. **1 Mark**] (ii) DNA is a negatively charged molecule and this makes it highly polar in nature. - Calcium are divalent cations which bind to DNA making it non-polar and so easier to cross the cell membrane. [Accept any other valid answer**.]** **½ mark** (c) An increase in temperature results in greater kinetic energy of molecules making the membrane more fluid/porous. [Accept any other valid answer.] **½ mark**	2
18	Attempt either option A or B. A. i. " Flocs reduce the pollution in water by adding its BOD" is false. Flocs are millions of bacteria and other microorganisms that form in wastewater treatment plants. They help to reduce pollution in water by dwindling its BOD (biochemical oxygen demand). **1mark.** ii. Mycorrhizal fungi establish a mild form of parasitism that is mutualistic, meaning both the plant and the fungus benefit from the association. About 90 percent of land plants rely on mycorrhizal fungi, especially for mineral nutrients (i.e., phosphorus), and in return the fungus receives nutrients formed by the plant. **1mark.**	2

	B (i) Streptokinase ½ **mark** (ii) Streptococcus spp. ½ **mark** (iii) Textiles made from plant sources, such as cotton, will contain plant material such as pectin which will need to be degraded. Waste water will also contain pectinaceous material where pectinase can act to clarify water reducing plant wastes. **½ + ½mark**	
19	(a) disulfide bonds **½mark** (b) The prohormone undergoes cleavage to remove specific C-peptide chain resulting in two active chains (A and B) that are linked by disulfide bonds, transforming it into a mature, functional hormone. 1**mark** (c) The hormone produced via recombinant DNA technology is considered better for diabetic patients because: It is identical to human insulin, reducing the risk of immune reactions. It has consistent quality and purity, unlike animal-derived insulin. It is more efficient to produce in large quantities, ensuring better availability. (any one **½mark)**	2
20	A) The air inlet/sparger should be absent. - Since lactobacillus is anaerobic, it may not thrive well if oxygen is present. 1**mark** B) A sensor should monitor temperature as bacteria are likely to die if the temperature fluctuates. - Dissolved oxygen should be measured to ensure anaerobic conditions are maintained. [Accept any other valid answer.] **½ + ½mark**	2
21	**<u>Attempt either option A or B.</u>** **A.** (i) Plasmodium falciparum. **½mark** (ii) By attacking human red blood cells, Plasmodium benefits in several ways: • It avoids detection by the immune system. • It gains access to nutrients and the oxygen-carrying hemoglobin in red blood cells. • The sexual-stage parasites (gametocytes) develop within red blood cells, allowing the parasite to continue its life cycle when a mosquito bites the host. • The periodic release of merozoites causes regular cycles of fever, increasing the chance of mosquito feeding while gametocytes are present, which helps in transmission. (Any 3) **1.5 mark** B. (i) Immune system may recognize the kidney as foreign and a cell-mediated immune response develops that can lead to inflammation, tissue damage, and rejection of the transplanted organ. **1 mark** (ii) Anti-A antibodies in the recipient's plasma will react with A antigens on the transfused red blood cells, causing agglutination, hemolytic reaction, and possible tissue damage. **1 mark**	2
	Section – C	
22	(i) The experimental setup does not have a source of electric sparks/energy, that could provide the energy necessary to initiate chemical reactions among the gases and form various organic molecules. **1 mark**	3

	(ii) - CH4, H2O, H2, NH3 **1 mark** (iii) Haldane and Oparin proposed the chemical theory of origin of life in which he stated that formation of organic materials take place from abiogenic material in presence of an external source of energy. They also stated that the first form of life could have come from prebiotic life. **1 mark**	
23	• To produce human erythropoietin in culture, follow these steps: • Gene Preparation-Use the known sequence of the erythropoietin gene, which has eight exons and seven introns, to create a DNA construct. • Vector Insertion-Insert the constructed DNA into a suitable vector (like a plasmid). • Transformation-Introduce the recombinant vector into Namalwa cells (a type of human cell culture). • Selection-Select the cells that have successfully taken up the recombinant vector. • Cultivation- Grow the selected cells in a bioreactor under optimal conditions to produce erythropoietin. • Protein Extraction - Once the cells have produced sufficient erythropoietin, harvest the culture medium. The EPO will typically be secreted into the medium. • Purification of Erythropoietin • Quality Control - Perform tests to ensure the purity and activity of the purified erythropoietin, confirming that it is functional and safe for use. • This process allows for the production of recombinant human erythropoietin, • which can be used in medical treatments, particularly for patients with anemia due to chronic kidney disease. [Award marks if the answer is presented as a flowchart or diagram.]	3
24	A) Genes y and w are tightly linked as they show only 1.3 % recombination so chances of crossing over/ independent assortment are low. **(1mark)** B) Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and 'mapped' their position on the chromosome. **(1mark)** C) Genetic maps are used as a starting point in the sequencing of whole genomes as in the case of Human Genome Sequencing Project. **(1mark)**	3
25	A) A -stabilising; B - directional; C - disruptive; **1.5 marks** B) **1.5 marks**  	3
26	A) Bacillus thuringiensis (Bt). **(1/2 mark)**	3

B) GM cotton crops are able to resist insect attacks through the incorporation of **cry gene** from Bacillus thuringiensis that produces **a protein toxic** to certain insects, including bollworms. This protein, known as Bt toxin, is **activated in the alkaline environment** of the insect's gut. When bollworms consume the cotton plant, they ingest **the Bt toxin, which binds to specific receptors in their gut, causing cell damage, gut paralysis, and ultimately leading to the insect's death.** This natural insecticidal property reduces the need for chemical insecticides and provides an effective means of pest control, enhancing the crop's resilience against bollworm attacks. **(2.5 marks)**

27 (A) The regulatory gene in this operon is i gene. The operon is switched off in the absence of the inducer, lactose. In the absence of lactose, the repressor gene is constitutively synthesized from the repressor gene. This active repressor protein binds to the operator gene of the operon and prevents the RNA polymerase to initiate the process of transcription. — 3

(B) The regulation of lac operon is controlled by a repressor that is responsible for switching on and off the operon. When repressor binds to the operator, the operon is switched off and transcription is stopped, the reason why it is called negative regulation.

(C) Lactose is called the inducer molecule. Gene 'z' codes for beta-galactosidase, which is responsible for the hydrolysis of lactose into galactose and glucose. Gene 'y' codes for permease which increases the permeability of the cell to lactose.

28 — ½ x6 =3

Sl no.	Type of units involved	No. of these units involved	Provide explanation for each of your answer
1.	Pollen grains	160	Each pollen grain has one male gamete that fuses with the egg to form the zygote/ one pollen grain is required for formation of a seed.
2.	Ovules	160	Each ovule has one egg to form the seed.
3.	Microspore mother cells	640	MMC's undergo meiosis to form 4 microspores, each needs to fuse with the egg.

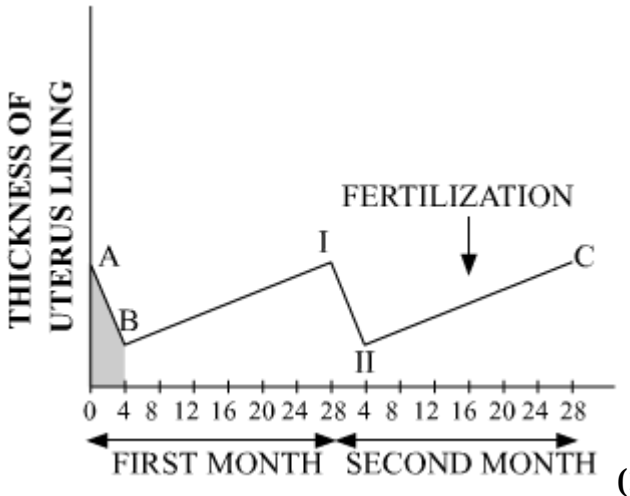
Section – D

29 — 4

A. Since prey X is the primary food for prey Y, as the prey population increases, so does the predator population. - More predators consume the prey causing the prey population to drop. - As the prey population drops, predators do not have enough prey and so their population also drops. - When this happens, the prey population increases again. **1 mark**

B. The vegetation will also slowly disappear. **1 mark**

Attempt either subpart C or D.

	C. The two species will compete for the same prey and the inferior one is likely to be eliminated over time. - Since they both feed on the same prey, resources are limited causing the elimination of the inferior predator. [Accept any other valid answer.] **2 mark** **OR** D. Amensalism - The black walnut is neither harmed nor benefitted while the plants surrounding it are harmed. **1+1 mark**	
30	A. The period between A and B represents the menstrual flow. During this phase the uterus lining is shed along with blood and moves out of the body in the form of bleeding. **1 mark** B. The points I and II correspond to the period when bleeding/menstrual flow will occur.  **(1 mark)** **<u>Attempt either subpart C or D</u>** C. Since fertilisation occurs on day 16, the graph after point C will be straight lined. It is because, once fertilisation occurs, the uterus lining is retained and no bleeding/menstrual flow occurs during that period. **(2 marks)** D. After the 28th day of the menstrual cycle, if fertilization does not occur, the levels of progesterone drop significantly, triggering the shedding of the uterine lining. This drop in hormone levels leads to the onset of menstruation, marking the start of a new cycle. The hormonal changes are primarily due to a decrease in progesterone, which is produced by the corpus luteum in the ovary after ovulation. If fertilization and implantation do not take place, the corpus luteum degenerates, leading to a decrease in progesterone. This hormonal shift happens to reset the cycle, allowing for the possibility of another ovulation and potential fertilization in the following cycle. (**Any Related Answer 2marks)**	4
	Section – E	
31	**<u>Attempt either option A or B.</u>** (a) The type of evolution exhibited by these organs is **divergent evolution**. Divergent evolution occurs when a common ancestral structure evolves into different forms in different species, adapted to different functions due to varying environmental pressures. **1 mark**	5

(b) Such organs are called homologous organs. These organs indicate common ancestry, meaning that the organisms possessing these organs likely share a common ancestor, even though they have adapted to perform different functions over time. **1 mark**

(c) (i) Organs that are not anatomically similar but perform similar functions in different groups are **called analogous organs**. These organs exhibit convergent evolution, where different species evolve similar traits independently, often because they face similar environmental challenges. **1 mark**

(ii) Examples:

Plant: The thorns of cacti and the tendrils of cucumbers (both help in protection and support but arise from different origins). **1 mark**

Animal: The wings of a butterfly and the wings of a bird (both used for flying but have different anatomical structures and evolutionary origins). **1 mark**

OR

B.1. i) **1 mark for 2 points**

Feature	Alpha Thalassemia	Beta Thalassemia
Affected Hemoglobin Chain	Alpha-globin chains	Beta-globin chains
Genetic Cause	Mutations in the HBA1 and HBA2 genes on chromosome 16	Mutations in the HBB gene on chromosome 11

ii) The child is said to be born with thalassemia, a genetic disorder. The child would have received the genes with a defect either from the mother or the father or some mutation might have happened in the embryonic stage. So, the mother should not be blamed and the family needs counseling. **1 mark**

2. Cross (a)-The F_1 progeny display a 9:3:3:1 ratio (6:2:6:2 simplified), which is indicative of a dihybrid cross where both parents are heterozygous for both traits.

- **Parental Genotypes**: **VvAa×vvAa (1 mark)**

Cross (b) -The F_1 progeny show a 1:1:1:1 ratio, which is typical of a test cross. This suggests that one parent is heterozygous for both traits, and the other is homozygous recessive for both.

- **Parental Genotypes**: **VvAa×vvaa (1 mark)**

Cross (c)-The F_1 progeny display a 3:1 ratio, which is typical of a monohybrid cross. This suggests both parents are heterozygous for flower color but homozygous for flower position.

- **Parental Genotypes: VvAA×VvAA (1 mark)**

32	Attempt either option A or B. 1) 1. Autogamy 2. Geitonogamy 3. Xenogamy **(1.5 mark)** 2) i. Water lily: achieve successfully pollination by insects/wind. ii. Vallisneria: Female flowers on long stalks reach water surface male flowers or pollen released on water and carried by water current to female flowers to achieve pollination. **(1+1mark)** 3) **Genetic**: Self-incompatibility/prevents self-pollen (same flower or other flowers of same plant) from fertilizing the ovules by inhibiting pollen germination, pollen tube growth in pistil. **(1mark)** **Physiological**: Pollen release and stigma receptivity are not synchronized, either pollen matures earlier and stigma later or pollen matures later than stigma **(any one) (0.5 mark)** **OR** B. 1. Pregnancy Tests. Pregnancy tests look for a special hormone —human chorionic gonadotropin (HCG) — that only develops in a person's body during pregnancy. **(1 mark)** 2. i) a: Primary Follicle b: Secondary Follicle c: Tertiary Follicle d: Graafian Follicle **(1/2 x 4)** ii) c is **Corpus Luteum**, the corpus luteum secretes progesterone to maintain the uterine lining for potential pregnancy. If fertilization doesn't occur, it degenerates, triggering menstruation. **(1 mark)** iii) After ovulation, a **secondary oocyte** is released from the Graafian follicle. This oocyte is in the metaphase stage of the second meiotic division. If it encounters a sperm and fertilization occurs, it will complete meiosis II to form a mature ovum and a polar body. If fertilization does not occur, the secondary oocyte will degenerate. **(1/2 + 1/2 mark)**	5
33	**Attempt either option A or B.** A i. Oncogenic viruses are cancer-causing viruses external cancer-causing factor. proto-oncogenes -identified in normal cells which when activated under certain **1 mark** condition could lead to ocogenic transformation of cells/ internal cancer-causing factor. ii. Mucosa-associated lymphoid tissue. gastrointestinal tract, nasopharynx, thyroid, breast, lung, salivary glands, eye, and skin. **(1/2 + 1/2 + 1/2 mark)**	5

iii. (Any 2 points 1 marks)

Feature	Pneumonia	Common Cold
Cause	Primarily caused by bacteria, viruses, or fungi that infect the lungs.	Caused mainly by viruses, such as rhinoviruses.
Transmission	Spread through respiratory droplets, close contact, or aspiration of secretions.	Spread through respiratory droplets, direct contact, or surfaces contaminated with viruses.
Symptoms	Severe symptoms include cough (often with mucus), fever, chills, shortness of breath, chest pain, and fatigue.	Milder symptoms like runny or stuffy nose, sore throat, sneezing, coughing, and mild fever.
Severity	Can be severe and potentially life-threatening, especially in vulnerable populations.	Generally mild and self-limiting, usually resolving within a week or two.

iv.a) Allergy is an immune system response to a typically harmless substance, causing symptoms that can range from mild to severe. Allergens are the specific substances that trigger these allergic reactions. **(1 mark)**

b) Pollen, dust, certain foods, and insect stings**. (any related answer ½ mark)**

OR

Give reasons for the following:

i) **Lipase enzymes** attack stains containing fats and oils by cutting lipid molecules into smaller pieces. **(1mark)**

ii) The bottled fruit juices that are brought are tested by treating them with enzymes - **pectinases and proteases**.so, they are clearer as compare to those made at home. **(1mark)**

iii) **Streptokinase is the product produced by the bacterium Streptococcus.** This is known as clot buster. This chemical helps in removing clots from the blood vessels of patients who have undergone myocardial infarction. **(1mark)**

iv) **Cyclosporin A**- An immunosuppressant drug utilized in the transplantation of the liver, heart, and kidney. It is procured from the fungi **Trichoderma polysporum**. **(1mark)**

v) **Statins produced by Monascus purpureus have** been used as blood-cholesterol lowering agents. **(1mark)**