

2025 SUPER MOCK 1 - BIOLOGY 2 SOLUTION

PAPER 2

SECTION A

Question 1

- a)
 - **i) Proximal:** Refers to a part of the body that is closer to the center of the body or to the point of attachment.
 - **ii) Lateral:** Refers to a part of the body that is farther away from the middle or center of the body.
- b)
 - A pigment is a chemical substance that absorbs specific wavelengths of visible light and reflects others, which produces color.
 - **Two major plant pigments:** Chlorophylls and Carotenoids.
- c)

Meiosis in the ovaries begins with a diploid cell (oogonium) which grows into a primary oocyte.

 - **Meiosis I:** The primary oocyte undergoes the first meiotic division. Homologous chromosomes pair up and exchange genetic material (crossing over). The division is unequal, producing one large haploid secondary oocyte and one small polar body.
 - **Meiosis II:** The secondary oocyte begins the second meiotic division but pauses at metaphase II. This division only completes if fertilization occurs. Upon completion, it divides unequally again to form a large ovum (egg cell) and a second polar body. The first polar body may also divide. The final result is one viable ovum and two or three non-viable polar bodies.
- d) Floral Formula:
 $\oplus \text{ } \text{♀} \text{ } K_{(5)} \text{ } C_5 \text{ } A_{(8)+2} \text{ } \underline{G}_1$
- e) Placentation:
Placentation is the arrangement and attachment of ovules within the ovary of a flower.

Question 2

- a) **Social Insects:** Insects that live together in large, organized colonies or groups. They exhibit a division of labor into castes (e.g., queens, workers, drones), cooperative care for the young, and have overlapping generations living together.

- **b) Characteristics of Hemiptera (True Bugs):**
 1. They possess piercing and sucking mouthparts (a rostrum or beak).
 2. They undergo incomplete metamorphosis (egg → nymph → adult).
 3. Their forewings are often hardened at the base and membranous at the tips, known as hemelytra.
- **c) Structure of a Quill Feather:** A quill feather consists of a central shaft. The hollow, bare base of the shaft is the **calamus** (quill), which anchors in the skin. The rest of the shaft is the **rachis**, which supports the **vane**.

The vane is made of many parallel branches called **barbs**, which in turn have smaller **barbules** that interlock with hooks, creating a smooth, continuous surface.
- **d) Examples of Incomplete Metamorphosis:** Grasshopper, Cockroach, Dragonfly.
- **e) Economic Importance of Bees:**
 1. **Pollination:** They pollinate crops, which is essential for food production.
 2. **Honey Production:** They produce honey, a valuable food source.
 3. **Beeswax Production:** They produce beeswax, used in candles, cosmetics, and polishes.
- **f) Phytohormones:** These are plant hormones; chemical substances produced by plants that regulate their growth, development, and responses to environmental stimuli.
- **g) Phytohormone Responsibility:**
 - **Promotes dormancy in seeds:** Abscisic acid (ABA)
 - **Promotes ripening in fruits:** Ethylene
- **h) Hormones from the Pancreas:** Insulin and Glucagon.

Question 3

- **a) Irritability:** The fundamental property of living organisms to respond to an external or internal stimulus.
- **b)**
 - **i) Examples of neurotransmitters:** Acetylcholine, Dopamine, Noradrenaline.
 - **ii) Action Potential:** A rapid, short-lasting change in the electrical membrane potential of a nerve or muscle cell that occurs when it is stimulated, allowing for the transmission of signals.

- **c) Protective Membrane of Brain/Spinal Cord:** The meninges.
- **d) Components of Blood & Endocrine Organs:**
 - **i) Five components of blood:** Plasma, Red Blood Cells (Erythrocytes), White Blood Cells (Leukocytes), Platelets (Thrombocytes), Water.
 - **ii) Location of Endocrine Organs:**
 - **a. Adrenal gland:** On top of the kidneys.
 - **b. Parathyroid gland:** On the posterior side of the thyroid gland in the neck.
 - **c. Pituitary gland:** At the base of the brain.
- **e) Independent Assortment:** A principle stating that when two or more characteristics are inherited, individual hereditary factors (alleles) assort independently during gamete formation, giving different traits an equal opportunity of occurring together.

Question 4

- **a) Necessity of Cell Cycle Checkpoints:** To ensure that all processes at each stage of the cell cycle are completed accurately before the cell proceeds to the next stage. This prevents errors in DNA replication and chromosome distribution, which could cause mutations or cell death.
- **b) Phototropism & Photoperiodism:**
 - **i) Importance of Positive Phototropism:** It enables plant shoots and leaves to grow towards a light source, maximizing the absorption of light for photosynthesis, which is crucial for the plant's energy production and survival.
 - **ii) Photoperiodism:** The physiological reaction of organisms, particularly plants, to the length of day or night. It influences processes like flowering.
- **c) Digestion & Osmoregulation:**
 - **i) Condition for Gastric Juice:** A highly acidic environment (low pH), created by hydrochloric acid (HCl), is necessary to activate pepsinogen into its active form, pepsin, which digests proteins.
 - **ii) Osmoregulation:** The process by which a living organism controls the water balance and solute concentration of its body fluids to maintain a stable internal environment.

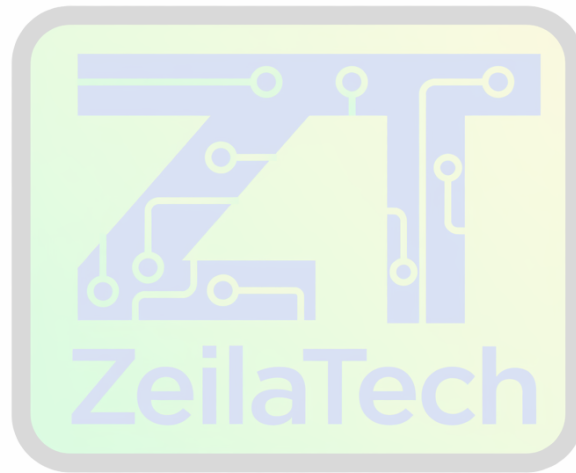
- **d) Photosynthesis & Starch Digestion:**
 - **i) Two conditions for photosynthesis:** Presence of light, Presence of chlorophyll, Availability of carbon dioxide.
 - **ii) Starch Digestion without Saliva:** If salivary glands malfunction, the chemical digestion of starch would begin in the **small intestine** (duodenum), where pancreatic amylase breaks it down.

SECTION B

Question 5

- a) mRNA Sequence:
The mRNA sequence is transcribed from the template strand, but since the coding strand is given, the mRNA sequence will be the same, with Uracil (U) replacing Thymine (T).
mRNA: 5' AUUGCCAAAUUCGAGAAUUACCGAUAUGCAACGA 3'
- **b) Genetic Terms:**
 - **i) Gene:** A specific segment of DNA that codes for a functional product (like a protein or RNA molecule) and is the basic unit of heredity.
 - **ii) Pure breed (Homozygous):** An organism that has two identical alleles for a particular trait.
 - **iii) Allele:** An alternative form of a gene that is located at a specific position on a specific chromosome.
- **c) Genotypes:**
 - **i) Homozygous dominant:** TT
 - **ii) Homozygous recessive:** tt
 - **iii) Heterozygous:** Tt
- **d) Knee Joint:** The knee is a **synovial hinge joint**. It primarily allows movement in one plane (flexion and extension). It is formed by the femur, tibia, and patella, and contains synovial fluid for lubrication, articular cartilage to reduce friction, and is stabilized by ligaments and menisci.
- **e) Mango Genetics:**
 - **i) F₁ Phenotypes:**
 - **Parents:** Fleshy (FF) × Juicy (ff)
 - **Gametes:** (F) from fleshy, (f) from juicy
 - **F₁ Generation:** All offspring have the genotype **Ff**.

- **F₁ Phenotype:** Since F is dominant, **all F₁ mangoes are fleshy.**
- **ii) F₂ Ratio:**
 - **Cross:** Ff × Ff
 - **Resulting Phenotypes:** Fleshy, Fleshy, Fleshy, Juicy
 - **Expected Ratio: 3 Fleshy : 1 Juicy**
- **iii) Number of Juicy Mangoes:**
 - The proportion of juicy mangoes is 1/4.
 - Number = (1/4) * 8460 = **2115 juicy mangoes.**



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