Biology 1 (F6) 2024 Examination

Below are **detailed**, **step-by-step solutions** for **Section A and Section B** of the **Biology 1 (F6) 2024** paper. Each question is broken down systematically with clear explanations and diagrams where applicable.

Section A (70 Marks)

Question 1: Protein Structure and Denaturation

(a) Features of Globular Proteins

- 1. **Spherical Shape:** Compact, water-soluble structure.
- 2. **Functional Diversity:** Enzymes (e.g., amylase), hormones (e.g., insulin), antibodies.
- 3. **Tertiary Structure:** 3D folding stabilized by hydrogen bonds, ionic bonds, and disulfide bridges.
- 4. Hydrophilic Surface: Polar amino acids face outward for solubility in water.
- 5. **Active Sites:** Specific binding pockets for substrates (e.g., hemoglobin's heme group).

(b) Preventing Denaturation

- 1. Optimal Temperature: Avoid extremes (e.g., boiling) to prevent bond breakage.
- 2. **pH Regulation:** Maintain physiological pH (e.g., 7.4 for enzymes).
- 3. Avoid Heavy Metals: Hg^{2+} or Pb^{2+} disrupt disulfide bonds.
- 4. **Hydration:** Prevent dehydration to maintain hydrogen bonds.
- 5. Chemical Stabilizers: Use glycerol or sucrose in lab storage.

Question 2: Water and Organelles

(a) Water in Human Body

- 1. **Transportation**: Blood plasma (90% water) carries nutrients/ O_2 .
- 2. **Waste Removal:** Urine (95% water) excretes urea via kidneys.
- 3. **Secretion:** Digestive juices (e.g., saliva) dissolve enzymes.
- 4. **Hearing/Balance:** Endolymph in cochlea transmits sound waves.

(b) Organelle Functions

- 1. **Peroxisomes:** Detoxify H_2O_2 into water and oxygen.
- 2. Lysosomes: Digest pathogens via hydrolytic enzymes.
- 3. **RER:** Synthesize/secrete proteins (e.g., insulin).
- 4. **Glycocalyx:** Cell recognition (e.g., ABO blood groups).

Question 3: Synapse Structure and Function

(a) Synapse Diagram

Labels:

- 1. Presynaptic Neuron: Contains synaptic vesicles.
- 2. **Synaptic Cleft:** 20–30 nm gap for neurotransmitter diffusion.
- 3. **Postsynaptic Membrane:** Receptor proteins (e.g., Na⁺ channels).
- 4. **Neurotransmitters:** Acetylcholine (ACh) or dopamine.

(b) Adaptations for Impulse Transmission

- 1. Vesicle Clustering: Rapid ACh release via exocytosis.
- 2. **Enzymes (e.g., AChE):** Terminate signals to prevent overstimulation.
- 3. Receptor Specificity: Ensures one-way transmission.
- 4. **Mitochondria:** Provide ATP for neurotransmitter recycling.

Question 4: Respiration

(a) Preventing Anaerobic Respiration

• Increase O₂ Supply: Aerobic respiration yields 38 ATP/glucose vs. 2 ATP (anaerobic).

(b) ATP Production

Stage	ATP Yield
Glycolysis	2 (net)
Krebs Cycle	2
Electron Transport Chain	34
Total	38

Question 5: Reproduction

(a) Triplets Explanation

- 1. Identical Twins: One zygote splits into two embryos (monozygotic).
- 2. Fraternal Sibling: Third baby from a separate fertilized egg (dizygotic).

(b) Birth Process Importance

- 1. **Cervix Dilation:** Allows fetal passage (10 cm diameter).
- 2. **Head-First Expulsion:** Prevents umbilical cord compression.
- 3. **Placenta Expulsion:** Prevents hemorrhage (uterine contraction seals vessels).

Question 6: Classification

(a) Importance of Classification

- 1. **Biodiversity Study:** Identifies 8.7 million species.
- 2. Evolutionary Links: Shows common ancestry (e.g., homologous structures).
- 3. Medical Research: Pathogen tracking (e.g., SARS-CoV-2 variants).

(b) Limitations of Artificial System

- 1. **Ignores Phylogeny:** Groups bats/birds based on wings, not ancestry.
- 2. Static Criteria: Doesn't adapt to genetic discoveries (e.g., DNA sequencing).

Question 7: Digestion

(a) HCl in Gastric Juice

- 1. Activates Pepsinogen → Pepsin (pH 2).
- 2. **Denatures Proteins:** Unfolds tertiary structure.
- 3. Kills Pathogens: Low pH sterilizes food.

(b) Mucus Functions

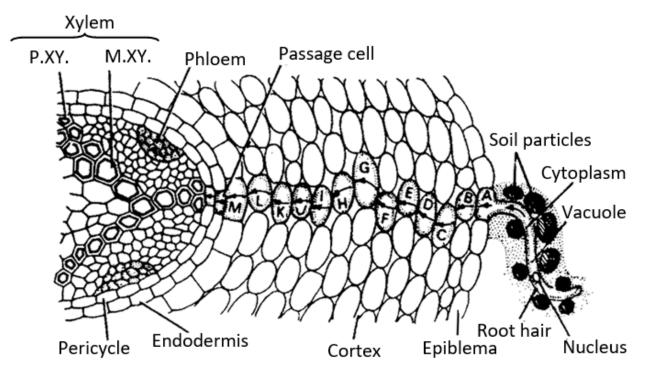
- 1. Protects Epithelium: Prevents autodigestion.
- 2. **Lubrication:** Eases food passage.
- 3. **pH Buffering:** Neutralizes surface acidity.

Section B (30 Marks)

Question 8: Water Uptake (Root to Xylem)

- 1. **Osmosis:** Soil water (high Ψ) \rightarrow root hair (low Ψ).
- 2. Apoplast Pathway: Water moves through cell walls.
- 3. Symplast Pathway: Via plasmodesmata.
- 4. Casparian Strip: Endodermis forces water into xylem (blocks apoplast).
- 5. Root Pressure: Active ion pumping creates Ψ gradient.

Diagram:



Passive absorption of water through root hair

Question 9: Infertility Causes

Male Factors:

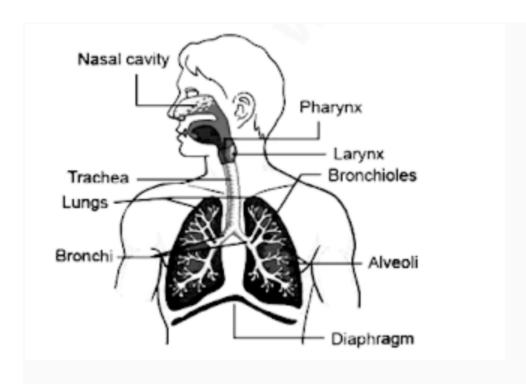
- Low Sperm Count: <15 million/mL (WHO standard).
- Varicocele: Enlarged veins raise testicular temperature.

Female Factors:

- Endometriosis: Tissue blocks fallopian tubes.
- PCOS: Hormonal imbalance prevents ovulation.

Question 10: Respiratory Pathway & Alveoli Adaptations

Pathway:



Alveolar Adaptations:

- 1. Thin Wall (1 cell): Short diffusion distance (0.5 μ m).
- 2. Moist Surface: Dissolves O₂/CO₂ for gas exchange.
- 3. Large SA (70 m²): 300 million alveoli/lung.

Diagram:

