

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.
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Question 2: Water and Organelles

(a) Water in Human Body

1. **Transportation:** Blood plasma (90% water) carries nutrients/O₂.
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 H₂O₂ 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).
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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.
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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).
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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

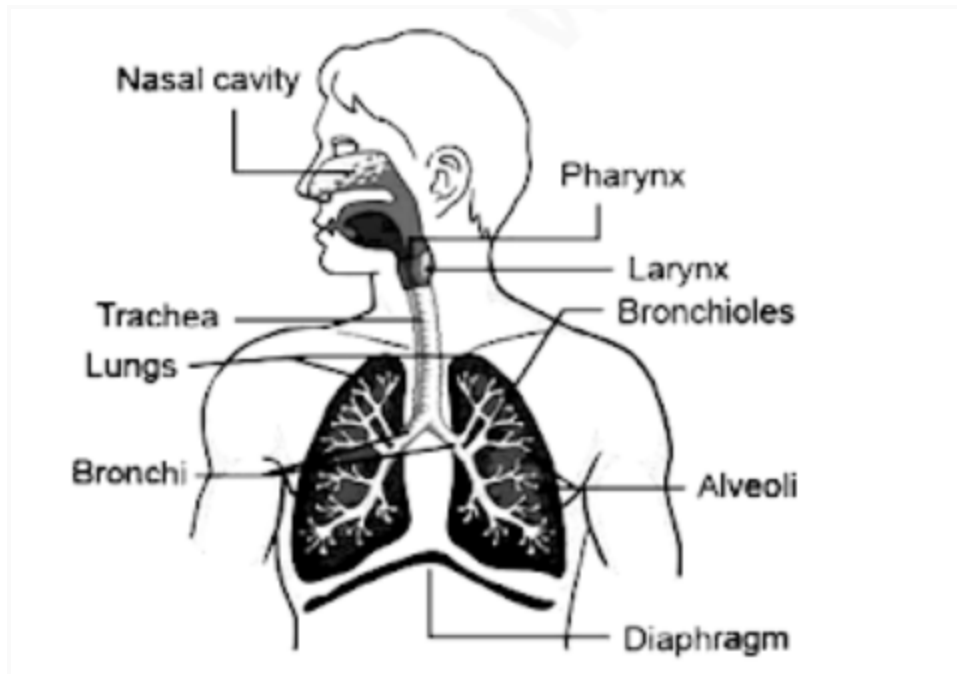
1. **Protects Epithelium:** Prevents autodigestion.
 2. **Lubrication:** Eases food passage.
 3. **pH Buffering:** Neutralizes surface acidity.
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Section B (30 Marks)

Question 8: Water Uptake (Root to Xylem)

1. **Osmosis:** Soil water (high Ψ) → 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:



Alveolar Adaptations:

1. **Thin Wall (1 cell):** Short diffusion distance ($0.5 \mu\text{m}$).
2. **Moist Surface:** Dissolves O_2/CO_2 for gas exchange.
3. **Large SA (70 m^2):** 300 million alveoli/lung.

Diagram:

