

**HSSC-I ANNUAL EXAMINATION – 2026****PREDICTED PAPER****SUBJECT:** BIOLOGY (Pre-Medical) | NEW CURRICULUM  
(NCP 2022-23)**VARIANT:** HARDEST VARIANT**Time Allowed:** 3 Hours 10 Minutes**Total Marks:** 85**SECTION A:** MCQs (20 marks) **SECTION B:** Short Questions  
(40 marks) **SECTION C:** Long Questions (25 marks)**NOTE:** Attempt all MCQs. Answer as per instructions.**SECTION A – MULTIPLE CHOICE QUESTIONS (MCQs)**

Q.1 Choose the correct answer. Each question carries **ONE (1) mark**. Total: **20 marks**. Circle the correct option on the answer bubble sheet.

1. **[Ch.3]** Induced fit model was proposed by:  
(A) Emil Fischer (B) Koshland (C) Watson (D) Crick  
*Expected: 87% | Ans: (B)*
2. **[Ch.3]** Cofactors that are tightly bound to enzyme are called:  
(A) Coenzymes (B) Prosthetic groups (C) Activators (D) Inhibitors  
*Expected: 78% | Ans: (B)*
3. **[Ch.3]** Optimum pH of pepsin is:  
(A) 7 (B) 8 (C) 2 (D) 11  
*Expected: 85% | Ans: (C)*
4. **[Ch.3]** Enzyme activity is affected by:  
(A) Temperature only (B) pH only (C) Both temperature and pH (D) None of these  
*Expected: 92% | Ans: (C)*
5. **[Ch.4]** The site of light reactions in photosynthesis is:  
(A) Stroma (B) Thylakoid membrane (C) Cytoplasm (D) Mitochondrial matrix  
*Expected: 91% | Ans: (B)*
6. **[Ch.4]** ATP stands for:  
(A) Adenine Tri Phosphate (B) Adenosine Triphosphate (C) Adenyl Tri Protein (D) Adenosine Trisulfate  
*Expected: 96% | Ans: (B)*
7. **[Ch.4]** Net gain of ATP molecules in glycolysis is:  
(A) 2 (B) 4 (C) 36 (D) 38  
*Expected: 89% | Ans: (A)*
8. **[Ch.4]** Carbon dioxide is fixed in which cycle:  
(A) Calvin cycle (B) Krebs cycle (C) Urea cycle (D) Nitrogen cycle  
*Expected: 88% | Ans: (A)*
9. **[Ch.4]** Oxidative phosphorylation occurs in:  
(A) Cytoplasm (B) Nucleus (C) Inner mitochondrial membrane (D) Stroma  
*Expected: 84% | Ans: (C)*
10. **[Ch.4]** Chlorophyll a absorbs light maximally at:  
(A) Red and Blue wavelengths (B) Green wavelength (C) Yellow wavelength (D) UV wavelength  
*Expected: 82% | Ans: (A)*
1. **[Ch.4]** The electron acceptor in the electron transport chain is:  
(A) CO<sub>2</sub> (B) O<sub>2</sub> (C) H<sub>2</sub>O (D) NADH  
*Expected: 80% | Ans: (B)*

- 1 **[Ch.4]** Total ATP produced in aerobic respiration is approximately:  
 2. (A) 2 (B) 36-38 (C) 10 (D) 18  
*Expected: 93% | Ans: (B)*
- 1 **[Ch.5]** Viruses are:  
 3. (A) Prokaryotes (B) Eukaryotes (C) Acellular (D) Unicellular  
*Expected: 94% | Ans: (C)*
- 1 **[Ch.5]** The protein coat of a virus is called:  
 4. (A) Capsid (B) Envelope (C) Nucleoid (D) Capsomere  
*Expected: 93% | Ans: (A)*
- 1 **[Ch.5]** HIV is a:  
 5. (A) DNA virus (B) RNA virus (Retrovirus) (C) Both DNA and RNA virus (D) Neither  
*Expected: 91% | Ans: (B)*
- 1 **[Ch.5]** Bacteriophage attacks:  
 6. (A) Human cells (B) Plant cells (C) Bacterial cells (D) Fungal cells  
*Expected: 90% | Ans: (C)*
- 1 **[Ch.5]** In lytic cycle, the virus:  
 7. (A) Integrates with host DNA (B) Destroys host cell (C) Becomes dormant (D) Mutates  
*Expected: 88% | Ans: (B)*
- 1 **[Ch.5]** Reverse transcriptase enzyme is found in:  
 8. (A) All viruses (B) Retroviruses (C) Bacteriophages (D) Plant viruses  
*Expected: 86% | Ans: (B)*
- 1 **[Ch.6]** Bacteria that require oxygen are called:  
 9. (A) Anaerobes (B) Aerobes (C) Facultative anaerobes (D) Microaerophiles  
*Expected: 87% | Ans: (B)*
- 2 **[Ch.6]** The cell wall of bacteria is made of:  
 0. (A) Cellulose (B) Chitin (C) Peptidoglycan (D) Lignin  
*Expected: 92% | Ans: (C)*

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## SECTION B – SHORT QUESTIONS

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Q.2 – Q.7 Each question has **TWO parts** with internal choice. Each part carries **2 marks**. Total: **40 marks**. Answer in 3–5 lines.

**Q.2 Answer EITHER (a) OR (b):**

- (a) **[Ch.3]** What is the lock and key model vs. induced fit model?

■ **Expected: 88%**

*Answer: Lock and key (Fischer, 1894): enzyme active site has a rigid, complementary shape to the substrate. Induced fit (Koshland, 1958): active site is flexible and changes shape slightly when substrate binds to form a better fit.*

- (b) **[Ch.4]** What is photosynthesis? Write its overall equation.

■ **Expected: 95%**

*Answer: Photosynthesis is the process by which green plants, using sunlight energy, convert CO<sub>2</sub> and H<sub>2</sub>O into glucose and oxygen. Equation: 6CO<sub>2</sub> + 6H<sub>2</sub>O + light energy → C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6O<sub>2</sub>*

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**Q.3 Answer EITHER (a) OR (b):**

- (a) **[Ch.4]** Differentiate between light and dark reactions of photosynthesis.

■ **Expected: 91%**

*Answer: Light reactions occur in thylakoid membranes, use sunlight to split water, produce ATP and NADPH, and release O<sub>2</sub>. Dark reactions (Calvin cycle) occur in stroma, use ATP and NADPH to fix CO<sub>2</sub> into glucose (no direct light needed).*

- (b) **[Ch.4]** What is glycolysis? Where does it occur?

■ Expected: 89%

*Answer: Glycolysis is the breakdown of one glucose molecule (6C) into two pyruvate molecules (3C each), producing net 2 ATP and 2 NADH. It occurs in the cytoplasm and does not require oxygen.*

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**Q.4 Answer EITHER (a) OR (b):**

(a) [Ch.4] Define Krebs cycle (TCA cycle). Where does it occur?

■ Expected: 87%

*Answer: Krebs cycle (Citric Acid Cycle) is a series of reactions in the mitochondrial matrix where acetyl-CoA is completely oxidized, producing CO<sub>2</sub>, NADH, FADH<sub>2</sub>, and GTP. It occurs in the mitochondrial matrix.*

(b) [Ch.4] What is the role of NAD in respiration?

■ Expected: 83%

*Answer: NAD (Nicotinamide Adenine Dinucleotide) acts as an electron carrier in cellular respiration. It is reduced to NADH during glycolysis and Krebs cycle, then donates electrons to the electron transport chain for ATP synthesis.*

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**Q.5 Answer EITHER (a) OR (b):**

(a) [Ch.5] What are viruses? Are they living or non-living?

■ Expected: 94%

*Answer: Viruses are acellular, obligate intracellular parasites consisting of a nucleic acid (DNA or RNA) core surrounded by a protein coat (capsid). They are considered non-living outside a host but show living characteristics inside a host cell.*

(b) [Ch.5] Differentiate between lytic and lysogenic cycles.

■ Expected: 90%

*Answer: Lytic cycle: virus infects cell → replicates → lyses (destroys) host cell → new virions released. Lysogenic cycle: viral DNA integrates into host DNA (provirus) → replicates with host → may later enter lytic cycle.*

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**Q.6 Answer EITHER (a) OR (b):**

(a) [Ch.5] How does HIV cause AIDS?

■ Expected: 89%

*Answer: HIV (Human Immunodeficiency Virus) infects and destroys CD4+ T-helper cells, which are critical for immune response. As T-cell count drops below 200/μL, the immune system fails, leaving the body vulnerable to opportunistic infections — this stage is called AIDS.*

(b) [Ch.6] Describe the structure of a bacterial cell.

■ Expected: 88%

*Answer: Bacterial cell has: cell wall (peptidoglycan), cell membrane, circular DNA (nucleoid), ribosomes (70S), plasmids, and may have flagella, pili, and capsule. It lacks membrane-bound organelles and true nucleus.*

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**Q.7 Answer EITHER (a) OR (b):**

(a) [Ch.6] What is the significance of bacteria?

■ Expected: 82%

*Answer: Bacteria are important in: nitrogen fixation (e.g., Rhizobium), decomposition and nutrient cycling, production of antibiotics, fermentation (curd, vinegar), bioremediation, and as model organisms in genetic research.*

(b) [Ch.6] Differentiate between Gram positive and Gram negative bacteria.

■ Expected: 86%

*Answer: Gram positive bacteria have thick peptidoglycan layer, retain crystal violet stain (purple). Gram negative bacteria have thin peptidoglycan + outer lipopolysaccharide layer, do not retain crystal violet (stain pink with safranin).*

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**Q.8 Answer EITHER (a) OR (b):**

(a) [Ch.7] What are protists? Give examples.

■ Expected: 83%

**Answer:** Protists are eukaryotic, mostly unicellular organisms that don't fit in other kingdoms. Examples: Amoeba (animal-like), Euglena (plant-like), Plasmodium (parasitic), diatoms (algae). They can be autotrophic or heterotrophic.

(b) [Ch.7] What are the economic importance of fungi?

■ Expected: 85%

**Answer:** Fungi are important in: bread-making (*Saccharomyces*), antibiotic production (*Penicillium* → penicillin), food (mushrooms), decomposition/nutrient recycling. They also cause diseases (ringworm, athlete's foot, thrush).

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**Q.9 Answer EITHER (a) OR (b):**

(a) [Ch.7] How does Plasmodium cause malaria?

■ Expected: 88%

**Answer:** Plasmodium (a protist) is transmitted by female Anopheles mosquito. It infects liver cells first, then enters red blood cells, replicates, ruptures them (causing fever chills), and releases merozoites to infect more RBCs.

(b) [Ch.8] What are the main characteristics of bryophytes?

■ Expected: 84%

**Answer:** Bryophytes (mosses, liverworts, hornworts) are: non-vascular, live in moist habitats, have no true roots/stems/leaves, gametophyte generation is dominant, reproduce by spores, lack lignified tissue.

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## SECTION C – LONG QUESTIONS (DETAILED ANSWER)

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Q.8 – Q.12 Each question has internal choice. Each carries 5 marks. Total: 25 marks. Answer in detail with diagrams where required.

**Q.8 [Ch.2] Describe the structure of DNA and explain the concept of semi-conservative replication.**

■ Expected: 90%

**Answer:**

- DNA structure (Watson & Crick, 1953): double helix of two anti-parallel polynucleotide strands.
  - Each strand: deoxyribose sugar + phosphate + nitrogenous base (A, T, G, C).
  - Complementary base pairing: A-T (2 H-bonds), G-C (3 H-bonds).
  - Sugar-phosphate backbone on outside; bases on inside.
  - Semi-conservative replication (Meselson & Stahl, 1958): each strand serves as template.
  - Steps: (1) Helicase unwinds and separates strands (2) Primase adds RNA primer (3) DNA polymerase III adds nucleotides 5'→3' (4) Leading strand continuous; lagging strand discontinuous (Okazaki fragments) (5) Ligase joins fragments (6) Result: two identical daughter DNA molecules, each with one original + one new strand.
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**Q.9 [Ch.5] Describe the structure of a virus and explain the lytic and lysogenic cycles.**

■ Expected: 90%

**Answer:**

- Virus structure: acellular (no cells); nucleic acid core (DNA or RNA) + protein coat (capsid, made of capsomeres); some have a lipid envelope.
- Capsid shapes: icosahedral (e.g., adenovirus), helical (e.g., TMV), complex (e.g., bacteriophage).
- Bacteriophage structure: head (DNA + capsid), tail, base plate, tail fibers.
- LYTIC CYCLE: (1) Attachment — phage binds to specific receptor. (2) Penetration — DNA injected into host. (3) Biosynthesis — host machinery makes viral DNA + proteins. (4) Maturation — assembly of new virions. (5) Lysis — host cell bursts; ~200 new phages released.
- LYSOGENIC CYCLE: (1) Attachment & penetration (same). (2) Integration — viral DNA (prophage) integrates into host chromosome. (3) Replication — prophage replicates with host cell silently. (4) Induction — triggered by UV light or stress → lytic cycle begins.
- Retroviruses (e.g., HIV): RNA genome → reverse transcriptase → DNA → integrates as provirus.

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**Q.10 [Ch.2] Discuss the structure and functions of proteins, including levels of protein organization.**

■ Expected: 87%

**Answer:**

- Proteins: polymers of amino acids linked by peptide bonds.
- 20 amino acids; each has: amino group (-NH<sub>2</sub>), carboxyl group (-COOH), H, and variable R-group.
- PRIMARY STRUCTURE: sequence of amino acids in polypeptide chain; determined by DNA.
- SECONDARY STRUCTURE: local folding; α-helix (H-bonds within one chain) or β-pleated sheet (H-bonds between chains).
- TERTIARY STRUCTURE: overall 3D folding; stabilized by H-bonds, ionic bonds, disulfide bridges, hydrophobic interactions.
- QUATERNARY STRUCTURE: association of 2+ polypeptide subunits (e.g., hemoglobin: 4 subunits).
- Functions of proteins: enzymes (catalysis), structural (collagen, keratin), transport (hemoglobin), hormones (insulin), antibodies (immunity), contractile (actin, myosin), channel/carrier proteins (membrane transport).
- Denaturation: loss of 3D structure → loss of function; caused by heat, pH, chemicals.

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**Q.11 [Ch.12] Describe the structure and working of the human heart. Explain the cardiac cycle.**

■ Expected: 91%

**Answer:**

- Heart: 4-chambered (2 atria + 2 ventricles); pericardium surrounds it; myocardium (cardiac muscle).
- Right side: receives deoxygenated blood from body; sends to lungs (pulmonary circulation).
- Left side: receives oxygenated blood from lungs; pumps to body (systemic circulation).
- Valves: Atrioventricular (tricuspid: right; bicuspid/mitral: left), Semilunar (pulmonary, aortic).
- CARDIAC CYCLE (time for one heartbeat ~0.8 sec at 75 bpm):
  - - Diastole: relaxation; heart fills with blood; ~0.5 sec.
  - - Atrial systole: atria contract; blood pushed into ventricles; ~0.1 sec.
  - - Ventricular systole: ventricles contract; blood ejected into pulmonary artery and aorta; ~0.3 sec.
- Cardiac output = heart rate × stroke volume (normal: ~5 L/min).
- CONDUCTING SYSTEM: SA node (pacemaker) → AV node → Bundle of His → Purkinje fibers → ventricles contract.
- Blood pressure: systolic/diastolic (normal: 120/80 mmHg).

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**Q.12 [Ch.6] Discuss the diversity of prokaryotes. Describe beneficial and harmful roles of bacteria.**

■ Expected: 84%

**Answer:**

- Prokaryotes: no membrane-bound nucleus; DNA in nucleoid region; smaller (1-10 μm); 70S ribosomes.
- TWO DOMAINS: Bacteria and Archaea.
- CLASSIFICATION by shape: cocci (spherical), bacilli (rod-shaped), spirilla (spiral).
- GRAM STAINING: Gram+ (thick peptidoglycan, purple); Gram- (thin peptidoglycan + LPS outer layer, pink).
- BENEFICIAL BACTERIA: Rhizobium (nitrogen fixation), Lactobacillus (yogurt/curd), decomposers (recycle nutrients), E. coli (gut microbiome, vitamin K synthesis), Streptomyces (antibiotics), bioremediation.
- HARMFUL BACTERIA: Mycobacterium tuberculosis (TB), Vibrio cholerae (cholera), Salmonella (typhoid), Staphylococcus aureus (wound infections, food poisoning), Streptococcus (strep throat).
- Endospores: resistant resting structures formed by some bacteria in adverse conditions (e.g., Bacillus, Clostridium).