ADVANCED CERTIFICATE OF SECONDARY EDUCATION
BIOLOGY 1 (133/1) — HOLIDAY REVISION PACKAGE
70 Practice Questions Aligned with NECTA

Topic 1: Biochemistry

1. Compare and contrast fibrous proteins and globular proteins in terms of their structure, solubility, and biological functions.
2. Explain the four levels of protein structure (primary, secondary, tertiary, and quaternary), naming the specific chemical bonds that stabilize each level.
3. Describe the mechanism of peptide bond formation between two amino acids, and explain how a polypeptide chain is broken down.
4. Explain how extreme changes in pH disrupt the tertiary structure of an enzyme, leading to loss of catalytic activity.
5. Account for the role of heavy metal ions (such as mercury and lead) and organic solvents in causing protein denaturation.
6. Give five biological roles of proteins in living organisms, providing a specific named example for each role.
7. Explain the zwitterionic nature of amino acids and describe how this property enables proteins to act as buffers in body fluids.
8. Explain how the dipolar nature of water molecules enables water to act as a universal solvent in biological systems.
9. Describe five thermal properties of water and explain the biological significance of each property to living organisms.
10. Explain the role of water in seed germination, photosynthesis, and hydrolytic digestion in mammals.
11. How do cohesive and adhesive properties of water facilitate the upward movement of water in tall trees?
12. Explain why ice floats on liquid water and discuss the ecological importance of this phenomenon to aquatic life during winter.
13. Account for the role of water in osmoregulation and thermoregulation in the human body.
14. Explain how water acts as a lubricant and a protective shock absorber in various parts of the human body.

Topic 2: Cytology

15. Draw a well-labelled diagram of an animal cell as seen under an electron microscope, and state the function of six labelled organelles.
16. Compare the structure and functions of rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER).

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17. Explain why liver cells and kidney cells contain a remarkably high number of peroxisomes compared to skin cells.
18. Describe the role of lysosomes in phagocytosis, autophagy, and autolysis.
19. Explain the structural and functional relationship between the rough endoplasmic reticulum, Golgi apparatus, and secretory vesicles.
20. Describe the fluid mosaic model of the plasma membrane, highlighting the roles of phospholipids, cholesterol, and membrane proteins.
21. Explain four specific functions of the glycocalyx (cell coat) in eukaryotic animal cells.
22. Justify the presence of numerous mitochondria in cardiac muscle cells, sperm cells, and active transport epithelial cells.
23. Describe the structure of a chloroplast and explain how its internal membranes are adapted for photosynthesis.
24. State five structural differences between a prokaryotic cell and a eukaryotic animal cell.
25. Explain the structure and functions of the cytoskeleton (microtubules, microfilaments, and intermediate filaments) in animal cells.
26. Describe the structure of the nucleus and explain how the nuclear envelope regulates communication between the nucleoplasm and cytoplasm.
27. Explain why red blood cells lack a nucleus and mitochondria at maturity, and state how they obtain energy.
28. Describe the structural adaptations of ribosomes for protein synthesis, and differentiate between 70S and 80S ribosomes.

Topic 3: Respiration

29. Define cellular respiration and explain why ATP is referred to as the universal energy currency of the cell.
30. Outline the main steps of glycolysis, indicating the sites of ATP consumption, ATP synthesis, and NADH production.
31. Explain the link reaction (oxidative decarboxylation of pyruvate) and state its significance in aerobic respiration.
32. Describe the sequence of reactions in the Krebs cycle (citric acid cycle), accounting for all reduced coenzymes and ATP produced per glucose molecule.
33. Explain the mechanism of oxidative phosphorylation along the electron transport chain (ETC) in the inner mitochondrial membrane.
34. Describe the chemiosmotic theory of ATP synthesis as proposed by Peter Mitchell.
35. Compare alcoholic fermentation in yeast with lactic acid fermentation in mammalian skeletal muscles.
36. Explain the fate of lactic acid produced in skeletal muscles during vigorous exercise once oxygen becomes available again (the Cori cycle).

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37. Account for the difference in ATP yield between aerobic respiration (36–38 ATP) and anaerobic respiration (2 ATP) per molecule of glucose.

38. Explain what is meant by Respiratory Quotient (RQ) and calculate the RQ for carbohydrates, lipids, and proteins.

39. Explain why fats yield more energy per gram than carbohydrates during aerobic respiration.

40. Describe how proteins and lipids enter the aerobic respiratory pathway when carbohydrate reserves are depleted.

41. State five structural adaptations of a mitochondrion to its function in aerobic respiration.

42. Explain the effect of cyanide and carbon monoxide on the electron transport chain and cellular ATP production.

Topic 4: Principles of Classification

43. Define taxonomy and distinguish between taxonomy, systematics, and nomenclature.

44. Explain five rules governing the binomial system of nomenclature as established by Carolus Linnaeus.

45. Differentiate between artificial, natural, and phylogenetic systems of classification, giving advantages and disadvantages of each.

46. Explain why modern taxonomists use homologous structures rather than analogous structures when classifying organisms.

47. Describe how molecular biology (DNA sequencing and protein analysis) has improved the accuracy of modern classification.

48. State the taxonomic hierarchy from the highest rank to the lowest rank, using humans (*Homo sapiens*) and maize (*Zea mays*) as examples.

49. Explain the concept of a species according to the biological species concept, and state three limitations of this concept.

50. Construct a simple numbered dichotomous key to identify five common arthropods: a housefly, a spider, a centipede, a crab, and a grasshopper.

51. Outline five general rules to follow when constructing an effective dichotomous key.

52. State the five kingdoms of living organisms and give two distinguishing features for each kingdom.

53. Explain why viruses are difficult to classify under the five-kingdom system of classification.

54. Compare Kingdom Protoctista and Kingdom Fungi in terms of cell wall composition, mode of nutrition, and cellular organization.

55. Explain the economic importance of members of Kingdom Monera (bacteria) in agriculture, medicine, and industry.

56. Discuss the challenges faced by taxonomists when classifying organisms that reproduce exclusively asexually.

Topic 5: Gaseous Exchange and Respiration

57. State five general characteristics of an efficient respiratory surface in living organisms.

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58. Describe the pathway of atmospheric oxygen from the external nostrils to the red blood cells in the pulmonary capillaries.

59. Explain the role of the nasal cavity, ciliated epithelium, and goblet cells in conditioning inhaled air before it reaches the lungs.

60. Describe the structural features of the trachea and bronchi that prevent them from collapsing during inspiration.

61. Explain the mechanism of inspiration and expiration in humans, detailing the roles of the diaphragm and intercostal muscles.

62. Describe the role of pulmonary surfactant in the alveoli and explain the condition known as Infant Respiratory Distress Syndrome (IRDS).

63. Explain how oxygen is transported in the blood from the alveoli to respiring body tissues.

64. Describe the three ways in which carbon dioxide is transported from respiring tissues to the lungs.

65. Explain the Bohr effect and draw an oxygen dissociation curve to show how increased partial pressure of carbon dioxide affects haemoglobin affinity for oxygen.

66. Compare the oxygen dissociation curves of adult haemoglobin, foetal haemoglobin, and myoglobin, explaining the physiological significance of each.

67. Explain the chloride shift (Hamburger phenomenon) and its importance in maintaining ionic balance in red blood cells.

68. Describe the nervous and chemical control of breathing rate in humans during vigorous physical exercise.

69. Explain how mammals living at high altitudes adapt physiologically to low partial pressures of oxygen.

70. Compare the mechanism of gaseous exchange in mammals (lungs) with that of bony fish (gills) and insects (tracheal system).

END

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