Biology

Standard level

Paper 1A

1 hour 30 minutes [Paper 1A and 1B]

Instructions to candidates

- Do not open the examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- The maximum mark for paper 1A is **[30 marks]**.
- The maximum mark for paper 1A and paper 1B is **[55 marks]**.

1. The following image shows a water strider insect standing on water. What property of water enables this insect to stay on the surface?

A. High viscosity

B. Low specific heat capacity

C. Cohesion

D. Low density compared to air

2. Which characteristic of DNA allows it to store an almost limitless amount of genetic information?

A. The ability of DNA to form triple helices

B. The enormous number of possible base sequences

C. The presence of different types of pentose sugars

D. The fixed number of base pairs in each gene

3. The table below shows the differences between cell types. Which row correctly distinguishes prokaryotic and eukaryotic cells?

	Prokaryotic Cells	**Eukaryotic Cells**
A	DNA enclosed in a nucleus	DNA free in the cytoplasm
B	80S ribosomes	70S ribosomes
C	Contains mitochondria	Lacks mitochondria
D	Lacks membrane-bound organelles	Contains membrane-bound organelles

4. A scientist observes an unknown cell under a microscope and identifies the presence of a large central vacuole, a cellulose cell wall, and chloroplasts. What type of cell is this?

   A. Bacterial cell

   B. Animal cell

   C. Fungal cell

   D. Plant cell

5. The table below compares the genome sizes of different organisms. What conclusion can be drawn?

Organism	**Genome Size (Mb)**
E. coli	4.6
Drosophila melanogaster	175
Homo sapiens	3,200
Paris japonica (plant)	150,000

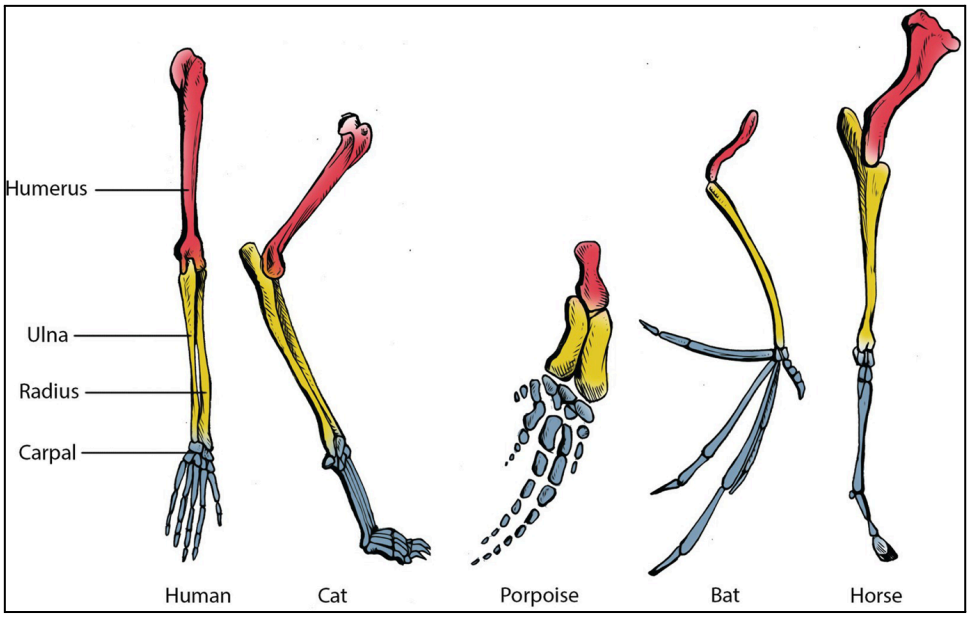
   A. More complex organisms always have larger genomes

   B. Genome size varies independently of organism complexity

   C. Prokaryotes always have larger genomes than eukaryotes

   D. Genome size is directly proportional to the number of genes

6. The diagram below shows the forelimbs of different vertebrates. What evolutionary concept does this illustrate?



A. Convergent evolution

B. Analogous structures

C. Homologous structures

D. Genetic drift

7. Which of the following best explains why Lamarck's theory of evolution is not accepted?

A. It suggests that organisms acquire characteristics that are then passed to offspring

B. It is based on natural selection, which has been disproven

C. It does not account for genetic variation in populations

D. It does not explain the role of environmental pressures in evolution

8. The table below shows reproductive behaviors in different species. Which species is most likely to undergo speciation due to reproductive isolation?

Species	Mating Behavior	Geographic Range
A	Seasonal breeding	Widespread
B	Nocturnal breeding	Isolated island
C	Open mating system	Global
D	Shared breeding sites	Overlapping habitats

A. Species A

B. Species B

C. Species C

D. Species D

9. Which of the following is a major anthropogenic cause of the sixth mass extinction?

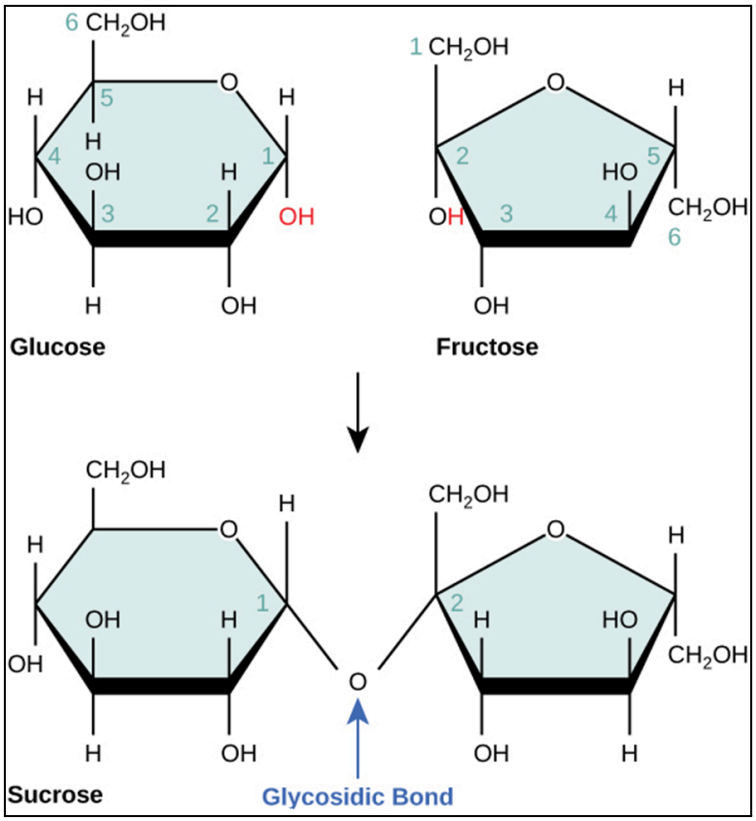
A. Volcanic activity leading to habitat destruction

B. Urbanization and habitat fragmentation

C. Large asteroid impacts similar to the one that killed the dinosaurs

D. Natural selection leading to species decline

10. The diagram below represents a polymer of glucose molecules. What type of reaction forms this polymer?



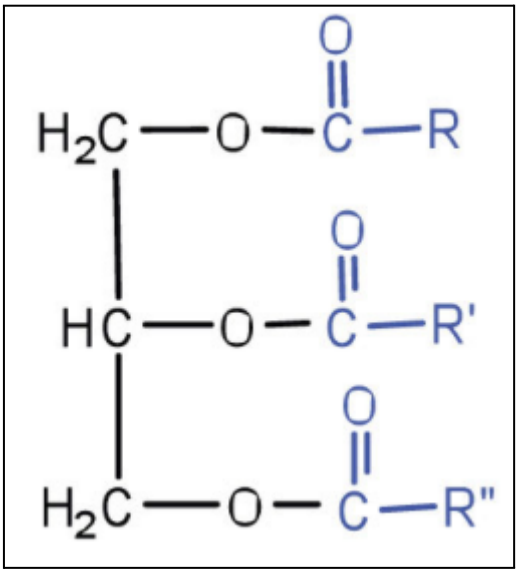
A. Hydrolysis

B. Condensation

C. Redox reaction

D. Neutralization

11. The diagram below represents a molecular structure. What is the function of this molecule in animals?



A. It provides short-term energy storage for rapid use

B. It is a component of plasma membranes and regulates fluidity

C. It serves as long-term energy storage and thermal insulation

D. It is used as a quick source of ATP during exercise

12. Which of the following best describes how polypeptides form from amino acids?

A. Hydrolysis reactions break peptide bonds, linking amino acids into a polypeptide

B. Condensation reactions remove water molecules to form peptide bonds

C. Amino acids are linked by ionic bonds to form long peptide chains

D. Phosphodiester bonds hold amino acids together in a growing polypeptide chain

13. A protein functions at a pH of 7.4 but becomes inactive at pH 5.0. What is the most likely explanation?

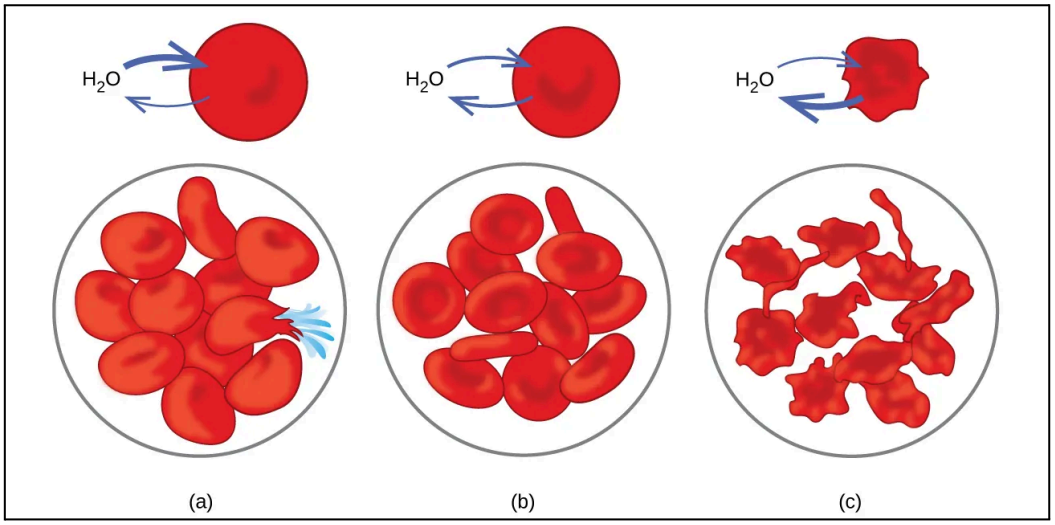
    A. The peptide bonds are broken at low pH

    B. The protein undergoes hydrolysis at low pH

    C. The lower pH disrupts ionic interactions in the structure

    D. The R-groups of hydrophobic amino acids become charged

14. The diagram below represents a red blood cell placed in a solution. What best explains observation in (c)?



    A. The solution is hypotonic, causing water to leave the cell

    B. The cell is actively transporting water out using ATP

    C. The solution is hypertonic, causing water to leave by osmosis

    D. The membrane is impermeable to water, preventing balance

15. Which feature distinguishes mitochondria from most other organelles?

    A. A single membrane composed of phospholipids

    B. The ability to synthesize their own ribosomes and proteins

    C. The presence of a nucleus for genetic storage

    D. The lack of a defined function in energy production

16. Stem cells in the bone marrow can differentiate into multiple blood cell types but not into neurons or muscle cells. How should these stem cells be classified?

A. Totipotent

B. Pluripotent

C. Multipotent

D. Unipotent

17. The diagram below shows a cell with an unusually large cytoplasm and multiple nuclei. What is the most likely explanation?

A. The cell has undergone multiple rounds of mitosis without cytokinesis

B. The cell lacks compartmentalization and relies on direct diffusion

C. The cell is in early embryonic development before differentiation

D. The cell is undergoing apoptosis and breaking down into smaller units

18. How do fish gills maintain an efficient concentration gradient for oxygen uptake?

A. They use countercurrent exchange to maximize diffusion efficiency

B. They prevent water from flowing past the gills to trap oxygen

C. They store oxygen in specialized cells for later use

D. They release carbon dioxide into the bloodstream to attract more oxygen

19. The table below shows the stomatal density of two plant species grown in different environmental conditions. Which conclusion is best supported by the data?

Plant Species	Stomatal Density (stomata per mm^2)	Growing Condition
A	120	Arid (dry)
B	280	Humid (wet)

A. Plant A has a higher stomatal density to maximize water retention in dry conditions

B. Plant B has a higher stomatal density because it reduces transpiration in humid conditions

C. Plant A has fewer stomata to limit water loss in dry environments

D. Both plants have equal transpiration rates despite differences in stomatal density

20. Which structural difference explains why blood flow in veins is slower?

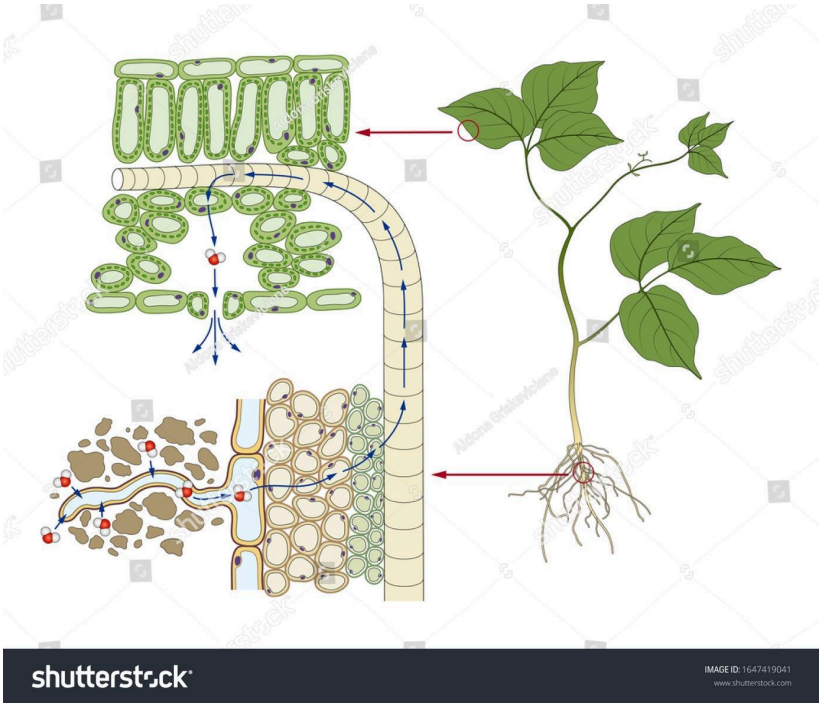
A. Veins have more smooth muscle, reducing flow speed

B. Veins have a wider lumen and lower pressure than arteries

C. Veins have a higher oxygen concentration, slowing diffusion

D. Veins have no endothelial lining, causing turbulence

21. The diagram below shows the movement of water through a plant. What is the main force driving water uptake from the roots to the leaves?



A. Root pressure actively pushes water upwards

B. Water molecules form hydrogen bonds, creating cohesion and tension

C. ATP is used to pump water up the xylem

D. Capillary action moves water through the phloem to the leaves

22. A biologist compares the range of tolerance of two fish species to water temperature. Which conclusion is best supported by the data?

Species	Lower Temperature Limit (°C)	Optimal Range (°C)	Upper Temperature Limit (°C)
A	5	15–25	30
B	10	20–30	35

A. Species A is better adapted to warm environments than Species B

B. Both species require the same optimal temperature for survival

C. Species A will always outcompete Species B in all environments

D. Species B has a wider range of tolerance to temperature changes

23. In a coastal mangrove forest, the soil is frequently waterlogged and has low oxygen levels. Which root adaptation is most beneficial for plants in this environment?

    A. Deep taproots that extend into anaerobic soil layers

    B. Pneumatophores that allow oxygen uptake from the air

    C. Root hairs that actively pump water into plant cells

    D. Symbiotic relationships with fungi for nitrogen fixation

24. The table below shows the oxygen tolerance of different microorganisms found in a polluted water sample. Which microorganism is most likely an obligate anaerobe?

Microorganism	Growth in O_2 (High)	Growth in O_2 (Low)	Growth in Anoxic Conditions
A	-	+	+
B	+	+	-
C	+	-	-
D	+	+	+

    A. Microorganism A, because it grows in low oxygen and anoxic conditions but not high oxygen

    B. Microorganism B, because it survives in high oxygen but not in anoxic conditions

    C. Microorganism C, because it cannot grow in anoxic conditions

    D. Microorganism D, because it can tolerate all oxygen levels

25. A plant species is observed to grow well in both sunny and shaded conditions, but it produces more flowers in direct sunlight. How would this plant's realized niche compare to its fundamental niche?

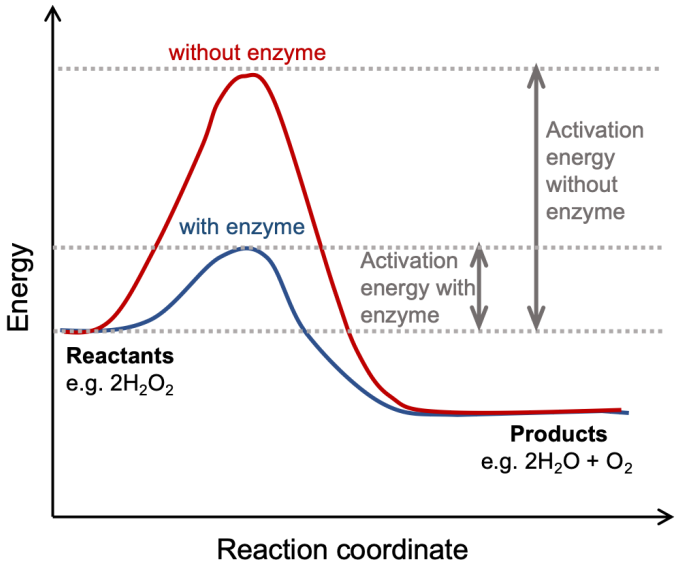
A. The realized niche is larger because it thrives in multiple conditions

B. The fundamental niche is smaller due to competition from other plants

C. The realized niche is equal to the fundamental niche because the plant survives in both conditions

D. The realized niche is smaller because competition limits its reproductive success

26. The diagram below shows an energy profile for a reaction with and without an enzyme. What can be inferred from the diagram?



A. The enzyme decreases the energy released by the reaction

B. The enzyme changes the equilibrium constant of the reaction

C. The enzyme lowers activation energy but does not change overall energy change

D. The enzyme converts an endergonic reaction into an exergonic one

27. What would happen if a metabolic poison inhibited ATP synthase in mitochondria?

    A. The proton gradient would dissipate, but ATP synthesis would continue

    B. Electron transport would stop, preventing oxygen consumption

    C. Protons would accumulate in the intermembrane space, but ATP would not be generated

    D. Glycolysis would immediately stop due to the lack of ATP

28. A plant is placed in a sealed chamber containing water and exposed to light. After several hours, oxygen levels inside the chamber have increased. What can be concluded about the plant's activity?

    A. Photosynthesis occurs because oxygen is a by-product of water-splitting

    B. Respiration has stopped, allowing oxygen to accumulate

    C. Carbon dioxide levels inside the chamber have increased, causing oxygen release

    D. The light-dependent reactions have stopped, leading to oxygen production

29. A biologist compares the conduction velocity of nerve impulses in two axons: one from a squid's giant axon and another from a small mammalian unmyelinated axon. What is the expected result?

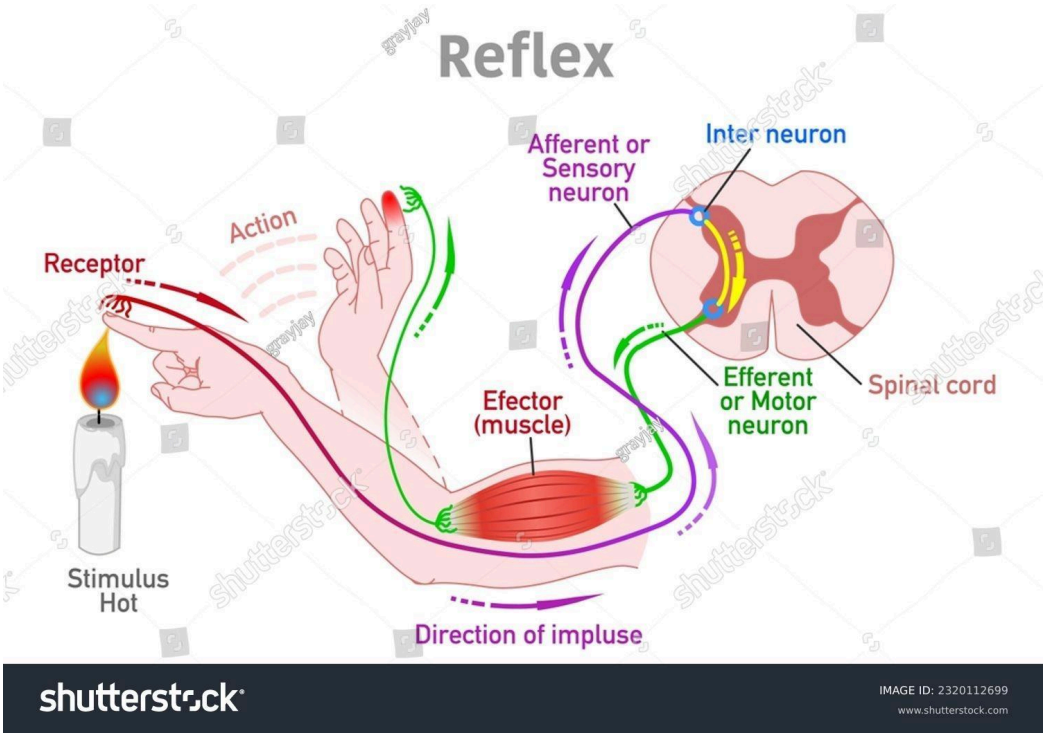
    A. The mammalian axon will conduct impulses faster due to its higher body temperature

    B. The squid axon will conduct impulses faster due to its larger diameter

    C. Both axons will have the same conduction velocity due to similar ion distributions

    D. The mammalian axon will conduct impulses faster due to its higher metabolic rate

30. The diagram below shows a simplified neural pathway involved in a pain reflex arc. What would happen if the interneuron in this pathway were inhibited?



A. The motor neuron would fail to activate the effector muscle

B. The sensory neuron would no longer detect stimuli

C. The sensory neuron would send signals directly to the muscle

D. The brain would take over the function of the spinal cord in processing reflexes