



Biology

Higher Level

Paper 1A — Mock Examination

Mock Exam 1

Calculator required

Time allowed: **1 hour 5 minutes**

Maximum mark: **40 marks**

Candidate information

Candidate name:

Session number:

Date:

Topic emphasis: unity and diversity of living organisms, form and function at the molecular, cellular and organism level, interaction and interdependence within organisms and ecosystems, and continuity and change through inheritance, evolution and ecological succession.

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told 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 this examination paper is **[40 marks]**.

The mark allocation is shown in square brackets at the end of each question; every question in this paper is worth one mark **[1]**. There is no penalty for an incorrect answer, so you should attempt every question. Where a numerical answer is required, show no working on the answer sheet — record only the letter of the option you have chosen.

Assume standard conditions of temperature and pressure unless the question states otherwise. Where a formula is needed, it is given in the question.

Mark allocation

Questions 1–20	[20 marks]
Questions 21–40	[20 marks]
Total	[40 marks]

Section A

Answer all questions. The maximum mark for each question is given in square brackets.

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1. Which property of water explains its effectiveness as a coolant when a mammal sweats? [1]
- A. High latent heat of vaporization
 - B. High specific heat capacity
 - C. Cohesion between water molecules
 - D. Its ability to act as a solvent for polar solutes
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2. Which structural feature makes cellulose suitable as a component of the plant cell wall? [1]
- A. Branched chains of α -glucose that pack closely together
 - B. Helical chains of α -glucose held in a coil by hydrogen bonds
 - C. Unbranched chains of β -glucose that hydrogen bond to form microfibrils
 - D. Chains of β -glucose joined by 1,6 glycosidic bonds
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3. Which level of protein structure is determined only by hydrogen bonding between atoms of the polypeptide backbone? [1]
- A. Primary
 - B. Secondary
 - C. Tertiary
 - D. Quaternary

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- 4.** Which process requires an integral membrane protein but no adenosine triphosphate (ATP)? **[1]**
- A.** Diffusion of oxygen across the phospholipid bilayer
 - B.** Exchange of sodium and potassium ions across an axon membrane
 - C.** Uptake of a large protein droplet by endocytosis
 - D.** Movement of glucose into a red blood cell down its concentration gradient
-
- 5.** What is the function of cholesterol in the plasma membrane of an animal cell at 37 °C? **[1]**
- A.** It acts as a receptor for peptide hormones.
 - B.** It increases the permeability of the membrane to sodium ions.
 - C.** It restricts the movement of phospholipids, reducing permeability to hydrophilic particles.
 - D.** It forms pores through which water molecules cross the membrane.
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- 6.** The rate of an enzyme-catalysed reaction increases as substrate concentration increases, then reaches a plateau. What explains the plateau? **[1]**
- A.** The enzyme molecules have become denatured.
 - B.** All of the substrate has been converted into product.
 - C.** The pH of the reaction mixture has fallen.
 - D.** Almost all active sites are occupied at any given moment.

-
- 7.** Where does the link reaction take place, and what are its products? **[1]**
- A.** In the cytoplasm, producing lactate and NAD
 - B.** In the mitochondrial matrix, producing acetyl-CoA, carbon dioxide and reduced NAD
 - C.** On the inner mitochondrial membrane, producing ATP and water
 - D.** In the intermembrane space, producing pyruvate and reduced FAD
-
- 8.** What is the immediate source of energy for the synthesis of ATP by ATP synthase in a mitochondrion? **[1]**
- A.** The oxidation of reduced NAD by the first carrier of the electron transport chain
 - B.** Substrate-level phosphorylation during the Krebs cycle
 - C.** The reduction of oxygen to water at the end of the electron transport chain
 - D.** The movement of protons down their concentration gradient into the matrix
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- 9.** What supplies the electrons that replace those lost from photosystem II? **[1]**
- A.** Photolysis of water
 - B.** Reduced NADP
 - C.** Photosystem I
 - D.** ATP synthase

- 10.** The supply of carbon dioxide to an illuminated plant is suddenly reduced. What happens to the concentrations of ribulose biphosphate (RuBP) and glycerate-3-phosphate (GP)? **[1]**

	Concentration of RuBP	Concentration of GP
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

- 11.** What is the role of DNA primase during DNA replication? **[1]**

- A. It unwinds the double helix and separates the two strands.
- B. It joins Okazaki fragments together on the lagging strand.
- C. It synthesizes a short RNA sequence so that DNA polymerase III can begin.
- D. It removes RNA nucleotides and replaces them with DNA nucleotides.

- 12.** What is a consequence of alternative splicing of a primary messenger RNA (mRNA) transcript? **[1]**

- A. A single gene can give rise to more than one polypeptide.
- B. The number of genes in the genome increases.
- C. Introns are translated into amino acid sequences.
- D. Transcription of the gene is prevented.

13. A substitution of the third base of a codon frequently has no effect on the polypeptide produced. What is the reason for this? **[1]**

- A. The mutation is always repaired before translation begins.
- B. Ribosomes read only the first two bases of each codon.
- C. A transfer RNA (tRNA) molecule can carry more than one type of amino acid.
- D. More than one codon can code for the same amino acid.

14. Two DNA sequences from the same gene in different individuals are shown.

Sequence 1 TACGGACTTAGC

Sequence 2 TACGGACTAGC

What type of mutation has occurred? **[1]**

- A. Substitution
- B. Insertion
- C. Deletion
- D. Duplication

15. Why is the DNA polymerase obtained from *Thermus aquaticus* (Taq polymerase) used in the polymerase chain reaction (PCR)? **[1]**

- A. It can synthesize DNA without the need for primers.
- B. It is not denatured at the high temperatures used to separate the DNA strands.
- C. It separates the two strands of the DNA molecule.
- D. It adds RNA nucleotides to the growing strand at high temperatures.

16. Four DNA fragments of 400, 1200, 2500 and 6000 base pairs were separated by gel electrophoresis. Which fragment will have moved the furthest towards the positive electrode? **[1]**

- A.** 6000 base pairs
 - B.** 2500 base pairs
 - C.** 1200 base pairs
 - D.** 400 base pairs
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17. What distinguishes the lysogenic cycle from the lytic cycle of a bacteriophage? **[1]**

- A.** Viral nucleic acid is integrated into the host chromosome and replicated with it.
 - B.** The host cell is broken open immediately after the virus attaches to it.
 - C.** The virus uses its own ribosomes to synthesize capsid proteins.
 - D.** The virus enters the host cell without binding to a receptor.
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18. A gland cell secretes large quantities of a protein hormone. Which two structures would be especially well developed in this cell? **[1]**

- A.** Smooth endoplasmic reticulum and lysosomes
- B.** Chloroplasts and vacuoles
- C.** Nucleolus and centrioles
- D.** Rough endoplasmic reticulum and Golgi apparatus

19. Which structure is present in a prokaryotic cell but never in an animal cell? **[1]**

- A. Plasma membrane
- B. Ribosome
- C. Cell wall containing peptidoglycan
- D. Deoxyribonucleic acid (DNA)

20. A mitochondrion measures 40 mm in length on an electron micrograph taken at a magnification of $\times 20\,000$. What is the actual length of the mitochondrion? **[1]**

- A. $0.2\ \mu\text{m}$
- B. $2\ \mu\text{m}$
- C. $20\ \mu\text{m}$
- D. $200\ \mu\text{m}$

21. How is the cytoplasm divided at the end of mitosis in a plant cell? **[1]**

- A. Vesicles from the Golgi apparatus fuse to form a cell plate.
- B. A ring of actin and myosin contracts to form a cleavage furrow.
- C. The nuclear envelope pinches the cell into two halves.
- D. Spindle microtubules cut through the cytoplasm.

22. Which events increase the genetic variation of the gametes produced by meiosis? **[1]**

- I. Crossing over between non-sister chromatids during prophase I
 - II. Random orientation of bivalents at the equator during metaphase I
 - III. Separation of sister chromatids during anaphase II
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

23. Which property of stem cells makes them suitable for use in therapeutic treatments? **[1]**

- A. They divide by meiosis and so generate genetic variation.
- B. They have a shorter cell cycle than any other cell in the body.
- C. They can divide repeatedly and differentiate into specialized cell types.
- D. They have no nucleus and therefore cannot be rejected by the patient.

24. A plant cell has a solute potential of -850 kPa and a pressure potential of $+300$ kPa. What is the water potential of this cell?

$$\Psi_w = \Psi_s + \Psi_p \quad \text{[1]}$$

- A. -1150 kPa
- B. $+550$ kPa
- C. $+1150$ kPa
- D. -550 kPa

25. What generates the tension that draws water upwards through the xylem of a tall tree? **[1]**

- A.** Active transport of water molecules by cells of the root cortex
- B.** Positive pressure generated in the phloem at a source
- C.** Evaporation of water from the cell walls of leaf mesophyll cells
- D.** Contraction of the lignified walls of the xylem vessels

26. According to the pressure-flow hypothesis, what happens in the phloem at a sink? **[1]**

- A.** Sucrose is unloaded and water leaves the sieve tubes, lowering the hydrostatic pressure.
- B.** Sucrose is loaded by active transport, raising the hydrostatic pressure.
- C.** Water enters the sieve tubes by osmosis, raising the hydrostatic pressure.
- D.** Sucrose diffuses into the sieve tubes through plasmodesmata.

27. What causes the atrioventricular valves to close during the cardiac cycle? **[1]**

- A.** Contraction of the muscle in the walls of the atria
- B.** Pressure in the ventricles rising above the pressure in the atria
- C.** Elastic recoil of the wall of the aorta
- D.** Arrival of the impulse from the sinoatrial node at the atrioventricular node

28. The oxygen dissociation curve of fetal haemoglobin lies to the left of the curve for adult haemoglobin. What is the advantage of this difference?
[1]

- A.** It allows the fetus to release oxygen more readily to its own tissues.
- B.** It increases the quantity of carbon dioxide that fetal blood can carry.
- C.** It prevents the Bohr shift from occurring in fetal blood.
- D.** It allows fetal blood to take up oxygen from maternal blood in the placenta.

29. What is the role of memory cells in the secondary immune response?
[1]

- A.** They engulf and digest pathogens by phagocytosis.
- B.** They secrete histamine to increase blood flow to infected tissue.
- C.** They allow rapid production of large numbers of plasma cells and antibodies.
- D.** They present antigens to helper T-cells for the first time.

30. What causes the depolarization phase of an action potential in a neuron? **[1]**

- A.** Opening of voltage-gated sodium channels and diffusion of sodium ions into the axon
- B.** Opening of voltage-gated potassium channels and diffusion of potassium ions out of the axon
- C.** Active transport of sodium ions out of the axon by the sodium–potassium pump
- D.** Binding of acetylcholine to receptors on the axon membrane

31. What happens to the bands of a sarcomere when a skeletal muscle fibre contracts? **[1]**

- A.** The A band shortens while the I band remains the same length.
 - B.** Both the actin and the myosin filaments shorten.
 - C.** The Z discs move further apart and the H zone becomes wider.
 - D.** The I band and the H zone shorten while the A band stays the same length.
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32. The concentration of glucose in the blood rises after a meal. What is the response? **[1]**

- A.** Alpha cells secrete glucagon and glycogen is hydrolysed in the liver.
- B.** Beta cells secrete insulin and liver and muscle cells absorb glucose.
- C.** Alpha cells secrete insulin and the kidney excretes glucose in the urine.
- D.** Beta cells secrete glucagon and glucose is converted into lipid in the liver.

- 33.** A fruit fly heterozygous for two genes was crossed with a homozygous recessive fly. The phenotypes of the 400 offspring are shown in the table.

Offspring phenotype	Number of offspring
parental type 1	168
parental type 2	172
recombinant type 1	32
recombinant type 2	28

What is the recombination frequency for these two genes?

[1]

- A. 7.5 %
- B. 15 %
- C. 30 %
- D. 85 %

- 34.** In a large population that is in genetic equilibrium, 16 % of the individuals show the recessive phenotype for a gene with two alleles. What percentage of the population is heterozygous?

$$p^2 + 2pq + q^2 = 1$$

[1]

- A. 24 %
- B. 40 %
- C. 48 %
- D. 60 %

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- 35.** On an island where the size of the available seeds has not changed for many generations, birds with an intermediate beak depth have the highest survival rate. What type of selection is occurring? **[1]**
- A.** Directional
 - B.** Disruptive
 - C.** Sexual
 - D.** Stabilizing
-
- 36.** A population of flowering plants produces a fertile tetraploid individual that can reproduce only with other tetraploids, although it grows in the same area as the original diploid population. What does this illustrate? **[1]**
- A.** Allopatric speciation
 - B.** Sympatric speciation
 - C.** Adaptive radiation
 - D.** Convergent evolution
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- 37.** Which evidence is used to estimate the time at which two clades diverged from a common ancestor? **[1]**
- A.** The number of differences in the base sequence of a gene shared by the two groups
 - B.** The number of analogous structures found in the two groups
 - C.** The similarity of the habitats occupied by the two groups
 - D.** The number of species currently living in each group

38. The producers of a grassland ecosystem convert $12\,000\text{ kJ m}^{-2}\text{ year}^{-1}$ of light energy into carbon compounds. If 10 % of the energy in each trophic level is passed on to the next, how much energy is available to the secondary consumers? **[1]**

- A. $12\,000\text{ kJ m}^{-2}\text{ year}^{-1}$
- B. $1200\text{ kJ m}^{-2}\text{ year}^{-1}$
- C. $120\text{ kJ m}^{-2}\text{ year}^{-1}$
- D. $12\text{ kJ m}^{-2}\text{ year}^{-1}$

39. Bare rock produced by a lava flow is first colonized by lichens and mosses. What changes are expected in this ecosystem over the following centuries? **[1]**

	Depth of soil	Species diversity
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	no change	increases

40. What is a direct consequence of an increase in the concentration of dissolved carbon dioxide in the oceans? **[1]**

- A. An increase in biochemical oxygen demand (BOD)
- B. Eutrophication of coastal waters
- C. A fall in pH and reduced availability of carbonate ions for shell formation
- D. An increase in the concentration of dissolved oxygen

End of examination.

Total: 40 marks

Answer sheet

Write the letter of your chosen answer in the box next to each question number.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

Candidate name:

Session number:

Total mark: / 40