



Biology

Higher Level

Paper 1A — Mock Examination

Mock Exam 3

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.** Glucose is transported dissolved in blood plasma, but cholesterol is carried inside lipoproteins. What explains this difference? **[1]**
- A.** Glucose molecules are much larger than cholesterol molecules.
 - B.** Cholesterol is broken down by enzymes in the plasma.
 - C.** Glucose is polar and soluble in water, whereas cholesterol is hydrophobic.
 - D.** Cholesterol carries a negative charge and would react with plasma proteins.
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- 2.** Glycogen has many more branch points than amylose. What is the advantage of this to an animal? **[1]**
- A.** Glucose can be released rapidly because there are many ends for enzymes to act on.
 - B.** Glycogen dissolves completely, so it can be transported in the blood.
 - C.** Glycogen can be used directly in respiration without hydrolysis.
 - D.** Branching allows glycogen to be converted into cellulose when needed.

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- 3.** What happens when a globular protein is denatured by heating? **[1]**
- A.** The peptide bonds of the primary structure are hydrolysed.
 - B.** The bonds holding the tertiary structure break and the three-dimensional shape is lost.
 - C.** The amino acid sequence is rearranged into a different order.
 - D.** The protein is converted into a mixture of lipids and carbohydrates.
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- 4.** Lactase can be immobilized on beads and used to produce lactose-free milk. What is an advantage of immobilizing the enzyme? **[1]**
- A.** The enzyme works at a much lower temperature than in solution.
 - B.** The enzyme no longer needs a substrate to be present.
 - C.** The enzyme is not denatured at any pH.
 - D.** The enzyme can be recovered and reused, and the product is not contaminated with it.
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- 5.** Which evidence led to the replacement of the Davson–Danielli model of the membrane by the fluid mosaic model? **[1]**
- A.** Electron micrographs showing two dark lines either side of a lighter band
 - B.** Freeze-fracture images showing globular proteins within the interior of the bilayer
 - C.** The discovery that membranes contain both lipid and protein
 - D.** The measurement of the thickness of the membrane at about 10 nm

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- 6.** A human red blood cell and a plant palisade cell are both placed in distilled water. Why does only the red blood cell burst? **[1]**
- A.** The red blood cell has no cell wall to resist the increase in pressure.
 - B.** The red blood cell has a much lower water potential than the plant cell.
 - C.** Water enters the red blood cell by active transport rather than osmosis.
 - D.** The plant cell actively pumps the excess water back out.
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- 7.** Why does the electron transport chain stop working in the absence of oxygen? **[1]**
- A.** Oxygen is needed to oxidize pyruvate during glycolysis.
 - B.** Oxygen is the substrate for ATP synthase.
 - C.** Without a final electron acceptor the carriers remain reduced and cannot accept more electrons.
 - D.** Oxygen is needed to pump protons into the intermembrane space.
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- 8.** What is produced from one turn of the Krebs cycle? **[1]**
- A.** One carbon dioxide, one reduced NAD and two ATP
 - B.** Two carbon dioxide, three reduced NAD, one reduced FAD and one ATP
 - C.** Three carbon dioxide, two reduced NAD and no ATP
 - D.** Two carbon dioxide, one reduced NAD and two reduced FAD

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- 9.** The rate of photosynthesis of a plant increases with light intensity and then levels off at high light intensities on a warm day. Which factor is most likely to be limiting at this point? **[1]**
- A.** The concentration of carbon dioxide
 - B.** The intensity of the light
 - C.** The concentration of oxygen in the air
 - D.** The wavelength of the light
-
- 10.** How is the thylakoid membrane system adapted for the light-dependent reactions? **[1]**
- A.** It encloses a large volume so that carbon dioxide can be stored.
 - B.** It contains the enzymes of the Calvin cycle in a concentrated form.
 - C.** It is freely permeable to protons, allowing them to reach the stroma quickly.
 - D.** It has a large surface area for photosystems and encloses a small space in which protons accumulate.
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- 11.** The experiment of Meselson and Stahl used DNA labelled with heavy nitrogen. What did the results show about DNA replication? **[1]**
- A.** Each new molecule contains one original strand and one newly synthesized strand.
 - B.** Both strands of each new molecule are newly synthesized.
 - C.** The original molecule is broken into fragments that are randomly reassembled.
 - D.** Replication begins at only one point in a eukaryotic chromosome.
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12. What is the role of DNA ligase during replication? **[1]**

- A.** It unwinds the double helix by breaking hydrogen bonds.
- B.** It adds free nucleotides to the leading strand.
- C.** It proofreads the new strand and removes incorrect bases.
- D.** It joins Okazaki fragments by forming phosphodiester bonds.

13. The genetic code is a triplet code based on four different bases. How many different codons are possible? **[1]**

- A.** 12
- B.** 20
- C.** 64
- D.** 81

14. Sickle cell anaemia is caused by a change in the gene for the beta chain of haemoglobin. What is this change? **[1]**

- A.** The deletion of three bases, removing one amino acid from the chain
- B.** A substitution that replaces glutamic acid with valine in the polypeptide
- C.** The insertion of a base that shifts the reading frame of the whole gene
- D.** The duplication of the whole gene on chromosome 11

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- 15.** What happens to the *lac* operon of *Escherichia coli* when lactose is present in the growth medium? **[1]**
- A.** The repressor protein binds to the operator and transcription stops.
 - B.** The structural genes are deleted from the bacterial chromosome.
 - C.** Lactose binds to the repressor so that it can no longer bind to the operator, and transcription occurs.
 - D.** RNA polymerase is broken down, so no enzymes are produced.
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- 16.** Down syndrome is usually caused by the presence of three copies of chromosome 21. What is the cause of this condition? **[1]**
- A.** A substitution mutation in a gene on chromosome 21
 - B.** Crossing over between non-homologous chromosomes
 - C.** The fusion of two sperm cells with one egg cell
 - D.** The failure of a pair of chromosomes to separate during meiosis
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- 17.** Which is an example of natural cloning in flowering plants? **[1]**
- A.** The production of seeds after cross-pollination
 - B.** The dispersal of fruits by animals
 - C.** The fusion of pollen nuclei with the nuclei of the ovule
 - D.** The formation of new plants from runners produced by a parent plant
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18. Which pair of organelles contains its own DNA and 70S ribosomes? **[1]**

- A.** Nucleus and nucleolus
 - B.** Golgi apparatus and lysosomes
 - C.** Rough and smooth endoplasmic reticulum
 - D.** Mitochondria and chloroplasts
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19. A cell that is $20\text{ }\mu\text{m}$ in diameter is shown in a drawing in which it measures 60 mm across. What is the magnification of the drawing? **[1]**

- A.** $\times 300$
 - B.** $\times 3000$
 - C.** $\times 30\,000$
 - D.** $\times 300\,000$
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20. All the cells of a multicellular organism contain the same genome, yet they differ in structure and function. What is the reason for this? **[1]**

- A.** Different cells lose the genes that they do not require.
- B.** Different genes are expressed in different cell types.
- C.** Each cell type gains extra chromosomes as it specializes.
- D.** Mutations occur in every cell as the organism grows.

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- 21.** A section of a root tip contains 60 cells, of which 12 are in a stage of mitosis. What is the mitotic index of this tissue? **[1]**
- A.** 0.12
 - B.** 0.20
 - C.** 0.48
 - D.** 5.00
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- 22.** What is the chromosome number of a human secondary oocyte, and how has it been produced? **[1]**
- A.** 46, produced by mitosis of a primary oocyte
 - B.** 46, produced by the first division of meiosis
 - C.** 23, produced by the first division of meiosis
 - D.** 23, produced by the second division of meiosis
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- 23.** Which adaptation of a xerophyte reduces the rate of transpiration? **[1]**
- A.** A thin waxy cuticle on the upper surface of the leaf
 - B.** Broad, flat leaves with a large surface area
 - C.** A large number of stomata on the upper surface of the leaf
 - D.** Stomata sunk in pits, which trap humid air close to the leaf

24. How are mineral ions absorbed into the root hair cells of a plant when their concentration in the soil is very low? **[1]**

- A.** By osmosis through aquaporins
- B.** By simple diffusion through the phospholipid bilayer
- C.** By active transport using protein pumps and ATP
- D.** By mass flow through the plasmodesmata

25. What causes tissue fluid to be forced out of a capillary at the arteriole end? **[1]**

- A.** The hydrostatic pressure of the blood is greater than the osmotic effect of plasma proteins.
- B.** The plasma proteins move out of the capillary and draw water with them.
- C.** The capillary wall actively pumps fluid into the surrounding tissue.
- D.** The pressure in the surrounding tissue is greater than the pressure in the capillary.

26. What is the main cause of coronary heart disease? **[1]**

- A.** A build-up of fatty plaques that narrows the coronary arteries
- B.** An increase in the number of red blood cells in the coronary arteries
- C.** The failure of the semilunar valves to open fully
- D.** A reduction in the diameter of the pulmonary vein

27. How does a phagocyte destroy a pathogen that it has engulfed? **[1]**

- A.** It secretes antibodies that bind to the surface of the pathogen.
- B.** It surrounds the pathogen with fibrin so that it cannot divide.
- C.** It transfers the pathogen to a B-cell for destruction.
- D.** Lysosomes fuse with the vesicle and their enzymes digest the pathogen.

28. Which sequence of events occurs when blood clots? **[1]**

- A.** Fibrin → fibrinogen → thrombin → prothrombin
- B.** Thrombin → platelets → fibrin → fibrinogen
- C.** Platelets release clotting factors → prothrombin is converted to thrombin → fibrinogen is converted to fibrin
- D.** Platelets release clotting factors → thrombin is converted to prothrombin → fibrin is converted to fibrinogen

29. Which region of the brain controls the rate of the heartbeat and of ventilation? **[1]**

- A.** The cerebral cortex
- B.** The cerebellum
- C.** The pituitary gland
- D.** The medulla oblongata

30. What is the correct pathway of a nerve impulse in a reflex arc? **[1]**

- A.** Receptor → sensory neuron → interneuron → motor neuron → effector
- B.** Receptor → motor neuron → interneuron → sensory neuron → effector
- C.** Effector → sensory neuron → brain → motor neuron → receptor
- D.** Receptor → sensory neuron → brain → effector → motor neuron

31. The elbow joint is moved by an antagonistic pair of muscles. What happens when the arm is bent at the elbow? **[1]**

- A.** Both the biceps and the triceps contract at the same time.
- B.** The triceps contracts and the biceps relaxes.
- C.** The biceps contracts and the triceps relaxes.
- D.** The biceps contracts and pushes on the radius.

32. What is the response of the human body to a fall in core temperature? **[1]**

- A.** Vasodilation of skin arterioles and increased sweating
- B.** Vasoconstriction of skin arterioles and shivering of skeletal muscle
- C.** A reduction in the metabolic rate of the liver
- D.** An increase in the volume of blood flowing through the skin capillaries

33. A man with blood group AB has children with a woman of blood group O. Which blood groups are possible in their children? **[1]**

- A. A and B only
- B. AB only
- C. AB and O only
- D. A, B, AB and O

34. Two plants heterozygous for two unlinked genes are crossed. What phenotypic ratio is expected in the offspring? **[1]**

- A. 1 : 1 : 1 : 1
- B. 3 : 1
- C. 9 : 3 : 3 : 1
- D. 1 : 2 : 1

35. What does a chi-squared test allow a biologist to decide? **[1]**

- A. Whether the difference between observed and expected results is likely to be due to chance
- B. Whether two variables are causally related to one another
- C. The mean and the standard deviation of a set of measurements
- D. The proportion of the variation in a population that is inherited

36. The pelvic girdle of a whale is a reduced structure with no function in locomotion. What does the presence of such vestigial structures provide evidence for? **[1]**

- A.** That whales are adapting to life on land
- B.** That whales evolved from ancestors that had functional hind limbs
- C.** That structures used frequently by an organism are passed on to its offspring
- D.** That whales and fish share a recent common ancestor

37. What does a node on a cladogram represent? **[1]**

- A.** A species that is now extinct
- B.** The point at which a mutation first appeared in a gene
- C.** A hypothetical common ancestor from which two clades diverged
- D.** The habitat occupied by the members of a clade

38. Why do food chains rarely contain more than four or five trophic levels? **[1]**

- A.** Most of the energy entering a trophic level is lost, mainly as heat from respiration.
- B.** Producers are unable to trap enough light energy to support more levels.
- C.** Top predators are always larger than the organisms below them.
- D.** Energy is destroyed each time it is passed from one organism to the next.

39. Fertilizer containing nitrates is washed from farmland into a lake. What is the expected sequence of events? **[1]**

- A.** Algal bloom → death of algae → increased decomposition → fall in dissolved oxygen
- B.** Fall in dissolved oxygen → algal bloom → increased decomposition → death of algae
- C.** Increased decomposition → rise in dissolved oxygen → algal bloom → death of fish
- D.** Algal bloom → rise in dissolved oxygen → increase in fish populations

40. Which is an example of *in situ* conservation? **[1]**

- A.** Storing seeds of endangered plants in a refrigerated seed bank
- B.** Breeding an endangered mammal in a zoo
- C.** Keeping tissue cultures of rare species in a laboratory
- D.** Establishing a protected nature reserve that includes the habitat of a rare species

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