MARK SCHEME

OCR Gateway GCSE Biology A · Paper 1: Cell-Level Systems, Scaling Up and Organism-Level Systems (B1–B3)

Higher Tier — Combined Science · Total: 70 marks

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This mark scheme is designed for use by examiners. Alternative correct answers should be accepted. Marks in brackets [1] indicate one mark. Points separated by / indicate alternatives. Underlined words are essential. ★ indicates Higher Tier only marks.

Question 1 [4 marks]

(a) [1 mark]

Which of the following is a difference between a eukaryotic and a prokaryotic cell?

• C. Eukaryotic cells have a membrane-bound nucleus; prokaryotic cells do not [1]

(b) [1 mark]

Osmosis is defined as the net movement of water from a region of:

• B. High water potential to low water potential through a partially permeable membrane [1]

(c) [1 mark]

Which blood vessel has valves to prevent backflow of blood?

• D. Vein [1]

(d) [1 mark]

Anaerobic respiration in yeast produces:

• C. Ethanol and carbon dioxide [1]

Total for question 1: 4

Question 2 [8 marks]

Scientists use microscopes to study cells. The photograph below was taken using an electron microscope and shows the int…

(a) [2 marks]

State TWO reasons why an electron microscope was used rather than a light microscope to take this ph…

• Higher resolution — can see finer detail at nanometre scale [1]

• Higher magnification — allows larger enlargement of small structures [1]

(b) [1 mark]

The cell in the photograph has a nucleus and mitochondria but no chloroplasts. State the type of cel…

• Animal cell [1]

(c) [3 marks]

Explain how cells become specialised. Give ONE example of a specialised cell and describe how its st…

• Cells differentiate — specific genes are switched on or off during development [1]

• Named specialised cell: e.g. red blood cell [1]

• Adaptation linked to function: biconcave shape increases surface area for O■ diffusion / no nucleus gives more space for haemoglobin [1] — accept any valid specialised cell with linked adaptation

(d) ★ [2 marks]

★ A cell is 8 µm in diameter. A student draws the cell with a diameter of 48 mm. Calculate the magn…

• Convert: 8 µm = 0.008 mm / or 48 mm = 48,000 µm [1]

• Magnification = 48 ÷ 0.008 = ×6000 [1] (accept ×6000 working in µm: 48,000 ÷ 8 = 6000)

Total for question 2: 8

Question 3 [7 marks]

A student investigates the effect of temperature on the rate of respiration in yeast. She measures the volume of CO■ pro…

(a) [2 marks]

Write the word equation for anaerobic respiration in yeast.

• Glucose → ethanol + carbon dioxide [1]

• (+ small amount of energy) [1] — do not penalise if energy not mentioned

(b) [3 marks]

Using the graph, describe and explain the relationship between temperature and the rate of respirati…

• Rate increases as temperature rises from 0 to ~35°C [1]

• Higher temperature gives more kinetic energy → more frequent enzyme-substrate collisions → faster reaction [1]

• Above optimum (~35-40°C) rate falls sharply as enzymes begin to denature — active sites permanently change shape [1]

(c) [2 marks]

State TWO variables the student must control to make this a fair investigation.

• Any two of: concentration of yeast / glucose solution; volume of yeast/glucose; pH; same apparatus/volume of solution [1 each]

Total for question 3: 7

Question 4 [8 marks]

The diagram shows the human circulatory system.

(a) [2 marks]

Explain why the mammalian circulatory system is described as a "double" circulatory system.

• There are two separate circuits: the pulmonary circulation (heart to lungs) and the systemic circulation (heart to body) [1]

• This keeps oxygenated blood from the lungs separate from deoxygenated blood from the body [1]

(b) [4 marks]

Compare the structure of arteries, veins and capillaries. Relate each structural feature to its func…

• Arteries: thick muscular elastic walls — to withstand high pressure blood from heart / smooth out pulsatile flow [1]

• Veins: valves — prevent backflow of low-pressure blood [1]

• Capillaries: walls one cell thick — minimises diffusion distance for exchange of substances [1]

• Capillaries: large total surface area — maximises rate of exchange [1]

(c) ★ [2 marks]

★ Calculate the cardiac output for a patient with a heart rate of 65 bpm and stroke volume of 85 cm…

• Cardiac output = 65 × 85 [1]

• = 5525 cm^3/min [1] (accept dm^3/min if correctly converted to 5.525 dm^3/min)

Total for question 4: 8

Question 5 [10 marks]

This question is about the immune system and vaccination.

(a) [5 marks]

Describe the specific immune response when a pathogen enters the body for the first time, and explai…

• Pathogen has antigens (proteins) on its surface [1]

• Lymphocytes detect the antigens and produce specific complementary antibodies [1]

• Antibodies bind to antigens → pathogen marked for destruction / agglutination [1]

• Memory (lymphocyte) cells are formed and remain in the body long-term [1]

• On re-exposure: memory cells respond rapidly → large antibody production → infection destroyed before symptoms develop [1]

(b) [3 marks]

Explain why some viral diseases, such as influenza, are difficult to vaccinate against effectively i…

• Influenza virus mutates rapidly — antigens on its surface change (antigenic variation) [1]

• Memory cells from previous vaccination no longer recognise the new strain [1]

• New vaccine must be developed and administered each year [1]

(c) ★ [2 marks]

★ Describe how monoclonal antibodies are produced.

• B lymphocyte (producing desired antibody) fused with a tumour cell → hybridoma cell [1]

• Hybridoma cells are cloned to produce large quantities of identical monoclonal antibodies [1]

Total for question 5: 10

Question 6 [10 marks]

(a) [4 marks]

Describe the role of the small intestine in the digestion and absorption of lipids (fats).

• Bile from the liver emulsifies fats — breaks large fat droplets into smaller droplets, increasing surface area [1]

• Lipase (from pancreas) chemically digests fats → fatty acids and glycerol [1]

• Fatty acids and glycerol absorbed across the epithelial cells of the villi [1]

• Absorbed into lacteals (lymph vessels) in the villi and eventually enter the bloodstream [1]

(b) [2 marks]

Explain why bile is NOT classified as an enzyme.

• Bile does not catalyse a chemical reaction [1]

• It physically breaks fat into small droplets (emulsification) but does not break chemical bonds — only lipase breaks the chemical bonds in fat [1]

(c) ★ [4 marks]

★ Explain how the structure of the small intestine is adapted for efficient absorption. Include ref…

• Villi: greatly increase surface area of small intestine for absorption [1]

• Microvilli (on epithelial cells): further increase surface area [1]

• Walls one cell thick (thin epithelium): short diffusion distance [1]

• Dense capillary network: maintains steep concentration gradient / rapidly removes absorbed nutrients [1]

Total for question 6: 10

Question 7 [6 marks]

(a) [6 marks]

A scientist claims: "Natural selection acting on genetic variation is the only mechanism responsible…

• Natural selection acts on existing variation: better-adapted individuals survive and reproduce more, passing on advantageous alleles [1]

• Evidence supporting natural selection: fossil record, DNA evidence, directly observed examples (antibiotic resistance, peppered moth) [1]

• Mutations are the source of NEW variation — without mutation, no new alleles, limiting natural selection [1]

• Sexual reproduction also generates variation through crossing over and independent assortment — increases raw material for selection [1]

• The claim may be too strong — genetic drift (random allele frequency changes in small populations) can cause evolution without natural selection [1]

• Overall: natural selection acting on variation is the primary mechanism, but mutations, genetic drift and sexual reproduction all play roles [1]

Note: For 6/6: all major points addressed in a balanced way, clear scientific vocabulary, well-organised argument.

Total for question 7: 6