

# MARK SCHEME

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

Higher Tier — Separate Science · Total: 100 marks

Higher Tier — Separate Science

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<sub>2</sub> 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 =  $48 \div 0.008 = \times 6000$  [1] (accept  $\times 6000$  working in  $\mu\text{m}$ :  $48,000 \div 8 = 6000$ )

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  $\text{CO}_2$  produced...

#### (a) [2 marks]

Write the word equation for anaerobic respiration in yeast.

- Glucose  $\rightarrow$  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 respiration...

- Rate increases as temperature rises from 0 to  $\sim 35^\circ\text{C}$  [1]
- Higher temperature gives more kinetic energy  $\rightarrow$  more frequent enzyme-substrate collisions  $\rightarrow$  faster reaction [1]
- Above optimum ( $\sim 35\text{--}40^\circ\text{C}$ ) 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 function...

- 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<sup>3</sup>.

- Cardiac output =  $65 \times 85$  [1]
- = 5525 cm<sup>3</sup>/min [1] (accept dm<sup>3</sup>/min if correctly converted to 5.525 dm<sup>3</sup>/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 explain...

- 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**

---