

# MARK SCHEME

## Pearson Edexcel GCSE (9-1) Biology · Paper 2: Plant Structures, Animal Coordination, Exchange & Transport, Ecosystems (Topics 6–9)

Higher Tier — Separate Science · Total: 100 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 process drives water movement from the roots to the leaves of a plant?*

- C. Transpiration [1]

**(b) [1 mark]**

*Which hormone is released by the pituitary gland when blood water content is low?*

- D. ADH [1]

**(c) [1 mark]**

*At which trophic level are producers found?*

- C. Level 1 [1]

**(d) [1 mark]**

*Which of the following correctly describes eutrophication?*

- B. Oxygen depletion in water due to algal bloom and bacterial decomposition [1]

**Total for question 1: 4**

### Question 2 [10 marks]

*Figure 1 shows a cross-section through a leaf.*

**(a) [3 marks]**

*Identify THREE adaptations of a leaf for efficient photosynthesis and explain how each adaptation he...*

- Palisade cells near top of leaf, packed with chloroplasts — maximise light absorption [1]
- Spongy mesophyll with air spaces — allow CO<sub>2</sub> to diffuse to palisade cells [1]
- Stomata in lower epidermis — allow gas exchange (CO<sub>2</sub> in, O<sub>2</sub> and water vapour out) [1] — accept other valid adaptations with explanation

**(b) [3 marks]**

*Explain how guard cells control the opening and closing of stomata.*

- In light/water-sufficient conditions: guard cells absorb water by osmosis → become turgid → bow outward → stomata open [1]
- In darkness/drought: guard cells lose water → become flaccid → stomata close [1]
- This balances the need for CO<sub>2</sub> entry (photosynthesis) against the need to prevent excess water loss [1]

**(c) ★ [4 marks]**

*★ Explain how auxin causes a plant shoot to show positive phototropism.*

- Auxin is produced at the tip of the shoot [1]
- Unilateral light causes auxin to migrate to the shaded side of the shoot [1]

- Higher auxin concentration on the shaded side causes those cells to elongate more than cells on the lit side [1]
- Differential cell elongation causes the shoot to curve towards the light source [1]

Total for question 2: 10

### Question 3 [10 marks]

This question is about blood glucose homeostasis and kidney function.

#### (a) [4 marks]

Describe how blood glucose concentration is regulated after a meal. Use the terms insulin, glycogen ...

- Pancreatic beta cells detect rise in blood glucose → secrete insulin into blood [1]
- Insulin causes cells to take up glucose; liver converts glucose to glycogen (glycogenesis) [1]
- Blood glucose returns to set point — insulin secretion decreases [1]
- This is negative feedback: the response (insulin release and glycogen storage) opposes the original change (rise in blood glucose) [1]

#### (b) ★ [4 marks]

★ Describe the processes of ultrafiltration and selective reabsorption in the kidney. Explain what ...

- Ultrafiltration: blood filtered at high pressure in the glomerulus → small molecules (water, glucose, urea, mineral ions) enter Bowman's capsule; proteins and blood cells remain in blood [1]
- Selective reabsorption: ALL glucose is reabsorbed by active transport in the proximal convoluted tubule [1]
- Most water is reabsorbed; the amount depends on ADH levels [1]
- Urea is not reabsorbed — it remains in the filtrate and is excreted in urine [1]

#### (c) ★ [2 marks]

★ Explain the role of ADH in regulating urine concentration.

- When blood water content is low, the pituitary gland releases more ADH [1]
- ADH increases the permeability of the collecting duct to water → more water reabsorbed → small volume of concentrated urine [1]

Total for question 3: 10

### Question 4 [9 marks]

This question is about exchange surfaces in animals.

#### (a) [4 marks]

Explain how the alveoli of the lungs are adapted for efficient gas exchange.

- Large total surface area (millions of alveoli) — maximises the area available for diffusion [1]
- Thin walls (one cell thick) — minimises the diffusion distance for O<sub>2</sub> and CO<sub>2</sub> [1]
- Moist lining — gases dissolve before diffusing across the membrane [1]
- Dense capillary network — maintains steep concentration gradient by continuously removing O<sub>2</sub> and delivering CO<sub>2</sub> [1]

#### (b) [3 marks]

Describe the pathway of blood from the right atrium to the aorta. Name all four chambers of the heart...

- Deoxygenated blood enters right atrium → right ventricle → pulmonary artery → lungs [1]
- Oxygenated blood returns via pulmonary vein → left atrium → left ventricle [1]
- Left ventricle pumps blood into aorta → body [1]

#### (c) ★ [2 marks]

★ A patient has a heart rate of 68 bpm and stroke volume of 80 cm<sup>3</sup>. Calculate the cardiac output in...

- Cardiac output = 68 × 80 = 5440 cm<sup>3</sup>/min [1]
- = 5.44 dm<sup>3</sup>/min [1]

Total for question 4: 9

## Question 5 [10 marks]

*This question is about ecosystems and biodiversity.*

### (a) [4 marks]

*Explain why only approximately 10% of energy transfers from one trophic level to the next. Describe ...*

- Most energy does not reach the next level because it is used by organisms at each level [1]
- Heat released through respiration — energy used for metabolic processes [1]
- Energy used in movement [1]
- Energy lost in undigested material — faeces and urine that are not eaten by the next consumer [1]

### (b) [4 marks]

*Describe the full chain of events that leads to eutrophication of a lake. Start with the application...*

- Fertilisers (nitrates, phosphates) applied to farmland; excess washes into lake in rainfall/runoff [1]
- Algae use the extra nutrients to grow rapidly — forming an algal bloom that covers the surface [1]
- Algal bloom blocks sunlight reaching aquatic plants below → plants die [1]
- Bacteria decompose dead plants, consuming dissolved oxygen → oxygen levels fall → fish and other aquatic organisms suffocate [1]

### (c) ★ [2 marks]

*★ Evaluate international agreements as a strategy for reducing threats to biodiversity.*

- Benefit: coordinate action across countries (e.g. Paris Agreement limits emissions; CITES regulates trade in endangered species) [1]
- Limitation: agreements may not be legally binding / economic interests may override conservation / not all countries participate / enforcement is difficult [1]

**Total for question 5: 10**

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## Question 6 [6 marks]

### (a) [6 marks]

*★ Quality of written communication. Selective breeding and genetic engineering are both methods of ...*

- Selective breeding: choosing organisms with desired traits and breeding them over generations — natural alleles only, no cross-species transfer [1]
- Genetic engineering: directly inserts specific genes from any organism using restriction enzymes and ligase — can cross species barriers, faster result [1]
- Advantage of GM: can produce traits not found in existing gene pool (e.g. human insulin in bacteria, golden rice) [1]
- Advantage: faster than selective breeding — desired trait appears in first generation [1]
- Concern: potential for GM genes to transfer to wild species through cross-pollination — unknown ecological consequences [1]
- Concern: ethical issues about "unnaturalness"; corporate control of food supply; reduced seed biodiversity [1]

*Note: QWC: for 5-6 marks must be well-organised, use scientific vocabulary throughout, clear comparison and balanced evaluation.*

**Total for question 6: 6**

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