MARK SCHEME

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

Higher Tier — Combined Science · Total: 60 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■ to diffuse to palisade cells [1]

• Stomata in lower epidermis — allow gas exchange (CO■ in, O■ 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■ 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■ and CO■ [1]

• Moist lining — gases dissolve before diffusing across the membrane [1]

• Dense capillary network — maintains steep concentration gradient by continuously removing O■ and delivering CO■ [1]

(b) [3 marks]

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

• 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 cm³. Calculate the cardiac output in…

• Cardiac output = 68 × 80 = 5440 cm³/min [1]

• = 5.44 dm³/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

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