MARK SCHEME

Pearson Edexcel GCSE (9-1) Biology · Paper 1: Key Concepts, Cells & Control, Genetics, Natural Selection, Health & Disease (Topics 1–5)

Higher Tier — Combined Science · Total: 60 marks

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 correctly describes the induced fit model of enzyme action?

• B. The active site changes shape slightly when the substrate binds [1]

(b) [1 mark]

A patient has HIV. Which cells does HIV specifically infect?

• C. CD4+ T helper lymphocytes [1]

(c) [1 mark]

In clinical trials, what is the purpose of a placebo?

• B. An inactive treatment used to compare with the real drug [1]

(d) [1 mark]

Which of the following represents the correct hierarchy of organisation?

• B. Cell → Tissue → Organ → Organ system → Organism [1]

Total for question 1: 4

Question 2 [7 marks]

A student investigated the effect of pH on the activity of the enzyme pepsin. She measured the time taken to digest a fi…

(a) [2 marks]

Describe the relationship between pH and pepsin activity shown in the graph.

• Pepsin activity is highest (shortest digestion time) at around pH 2 — this is its optimum [1]

• Activity decreases on either side of the optimum — at higher pH the enzyme is denatured [1]

(b) [3 marks]

Explain, using the term "active site," why pepsin does not function efficiently in the small intesti…

• At pH 7 (far above the optimum of pH 2), the ionic bonds maintaining the tertiary structure of pepsin break [1]

• The active site permanently changes shape (denaturation) [1]

• Substrate (protein) can no longer fit the active site — enzyme cannot catalyse digestion [1]

(c) ★ [2 marks]

★ Explain the difference between the lock and key model and the induced fit model of enzyme action.

• Lock and key: active site is rigid and has a fixed shape — substrate fits exactly like a key into a lock [1]

• Induced fit: active site is flexible and changes shape slightly when the substrate binds, forming a tighter fit to catalyse the reaction more efficiently [1]

Total for question 2: 7

Question 3 [9 marks]

This question is about cell division and stem cells.

(a) [3 marks]

Describe the differences between mitosis and meiosis.

- Mitosis: 2 genetically identical diploid daughter cells; used for growth and repair [1]
- Meiosis: 4 genetically different haploid cells; used to produce gametes for sexual reproduction [1]
- Meiosis creates variation through crossing over and independent assortment [1]

(b) [4 marks]

Embryonic stem cells are described as totipotent. Explain what this means and evaluate the use of em…

- Totipotent: embryonic stem cells can differentiate into any type of cell in the body [1]
- Benefit: could be used to replace damaged cells in conditions such as Parkinson's disease, spinal cord injury or diabetes [1]
- Concern: obtaining embryonic stem cells requires destroying a human embryo — raises ethical questions [1]
- Risk: potential for tumour formation / immune rejection unless therapeutic cloning used [1]

(c) ★ [2 marks]

★ Explain how cancer results from abnormal control of the cell cycle.

- Mutations in genes controlling cell cycle checkpoints prevent cells from responding to stop signals [1]
- Cells divide uncontrollably → formation of a tumour; if malignant, cells may metastasise (spread) to other parts of the body [1]

Total for question 3: 9

Question 4 [9 marks]

This question is about genetic inheritance.

(a) [4 marks]

Huntington's disease is caused by a dominant allele (H). A person with Huntington's disease is heter…

- Gametes of Hh: H and h; gametes of hh: h and h [1]
- Punnett square: Hh, Hh, hh, hh [1]
- 50% / 1 in 2 probability of Huntington's disease [1]
- 50% probability of unaffected (hh) [1]

(b) [3 marks]

Explain the difference between continuous variation and discontinuous variation. Give ONE example of…

- Continuous: a range of values with no distinct categories — influenced by many genes and environment — forms a normal distribution; e.g. height, mass [1]
- Discontinuous: distinct categories with no intermediates — usually controlled by one gene; e.g. blood group, attached or detached earlobes [1]
- State one example of each correctly [1]

(c) ★ [2 marks]

★ Explain what is meant by co-dominance. Give one example.

- Co-dominance: both alleles are expressed in the phenotype of a heterozygous individual — neither is dominant over the other [1]
- Example: I■ and I■ alleles of the ABO blood group gene — heterozygote (I■ I■) has blood group AB [1]

Total for question 4: 9

Question 5 [10 marks]

This question is about the immune system and communicable diseases.

(a) [4 marks]

Describe the specific immune response that occurs when a pathogen enters the body for the first time…

• Pathogen has specific antigens on its surface [1]

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

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

• Memory cells formed → rapid and large-scale response on future exposure → immunity [1]

(b) [4 marks]

Describe the process of developing a new drug from initial discovery to being available for patients…

• Preclinical testing on cells/animals: tests for toxicity, mode of action, effective dose — many drugs fail at this stage [1]

• Phase 1 clinical trial (healthy volunteers): tests for safety in humans — identifies side effects [1]

• Phase 2 (patients): tests for effectiveness against the disease [1]

• Phase 3 (large-scale, double-blind, placebo-controlled): confirms safety and effectiveness against existing treatments [1]

(c) ★ [2 marks]

★ Describe how monoclonal antibodies are produced and explain why they are particularly useful in t…

• B lymphocyte fused with tumour cell → hybridoma cell → cloned → large quantities of identical antibodies [1]

• Antibodies specific to cancer cell antigens — can carry toxic drug directly to cancer cells (magic bullet) — reduces damage to healthy cells compared to chemotherapy [1]

Total for question 5: 10

Question 6 [6 marks]

(a) [6 marks]

★ Quality of written communication. Evaluate the evidence that smoking causes lung cancer and other…

• Epidemiological evidence: strong positive correlation between smoking rates and lung cancer rates in different populations [1]

• Controlled studies: smokers have significantly higher rates of lung cancer, cardiovascular disease and COPD than non-smokers [1]

• Biological mechanism: carcinogens in tobacco smoke cause mutations in lung cell DNA → increase risk of uncontrolled division [1]

• Dose-response relationship: higher number of cigarettes smoked correlates with higher cancer risk — strengthens causal link [1]

• Limitations: correlation ≠ causation — some heavy smokers never develop cancer; confounding variables (e.g. air pollution, diet) may contribute [1]

• Conclusion: weight of evidence (epidemiological + biological mechanism + dose-response) strongly supports causation — sufficient for public health action [1]

Note: QWC: 5-6 marks requires well-organised answer using scientific vocabulary correctly throughout, with clear evaluation and conclusion.

Total for question 6: 6
