CIE A-Level Biology 9700 Paper 2 Practice Paper (AS structured questions)

Total: 40 marks · 2 h · 2 questions · 11 parts

Data and formulae

Quantity	Value
Magnification	magnification = image size / actual size
Length conversion	1 mm = 1000 micrometres; 1 micrometre = 1000 nm
Percentage change in mass	(final mass - initial mass) / initial mass x 100
Cardiac output	cardiac output = stroke volume x heart rate
Mitotic index	mitotic index = number of dividing cells / total number of cells
Mean relative molecular mass of one amino acid	110

Q 1 · Enzymes: catalase kinetics, active sites and denaturation [10]

(a) In an investigation 2.0 g of potato tissue (a source of catalase) was added to 20 cm3 of hydrogen peroxide solution at five different concentrations at a constant 25 degrees C. The volume of oxygen collected in 60 seconds was 12 cm3 at 0.10 mol dm-3, 24 cm3 at 0.20, 36 cm3 at 0.30, 42 cm3 at 0.40 and 44 cm3 at 0.50. State the independent variable. [1]

(b) Use the data to calculate the rate of oxygen production, in cm3 s-1, at 0.10 and at 0.20 mol dm-3. [2]

(c) Describe the trend in the rate as the concentration of hydrogen peroxide increases, using the data. [2]

(d) Explain why the rate does not increase much above 0.40 mol dm-3. [2]

(e) Predict and explain the effect on the rate of oxygen production if the potato tissue is boiled for five minutes before the investigation. [3]

Q 2 · Cell structure and microscopy: magnification, actual size and organelle function [10]

(a) A mitochondrion measures 48 mm in an electron micrograph; its actual length is 0.75 micrometres. Calculate the magnification and state the formula you used. [2]

(b) On another micrograph taken at x5,000, a chloroplast measures 30 mm across. Calculate its actual diameter in micrometres. [2]

(c) With a light microscope at x400 the field of view is 0.20 mm across and 40 cells of average size lie along that diameter. Calculate the mean diameter of one cell in micrometres. [2]

(d) Explain why an electron microscope is needed to see the internal structure of a mitochondrion clearly. [2]

(e) State one function of a mitochondrion and explain how its structure helps it carry out that function. [2]

Q 3 · Cell membranes and transport: osmosis in potato cylinders, water potential and plasmolysis [10]

(a) Five potato cylinders of initial mass 2.00 g were placed in 0.0, 0.2, 0.4, 0.6 and 0.8 mol dm-3 sucrose solution for 40 minutes. Their masses afterwards were 2.36, 2.20, 2.02, 1.86 and 1.70 g. Explain why the cylinders are blotted dry before weighing. [1]

(b) Calculate the percentage change in mass for the cylinder in 0.80 mol dm-3 sucrose. [2]

(c) Describe and explain the trend in the change in mass as sucrose concentration increases, using the data. [2]

(d) Use the data to estimate the sucrose concentration at which the potato tissue has the same water potential as the solution, and explain your reasoning. [2]

(e) Explain, in terms of the cell, why the mass falls in 0.80 mol dm-3 sucrose and name the phenomenon. [3]

Q 4 · The cell cycle and mitosis: root tip squash, mitotic index and stage durations [10]

(a) A student made a squash of an onion root tip and counted 200 cells: 150 in interphase, 18 in prophase, 12 in metaphase, 8 in anaphase and 12 in telophase; the cell cycle lasts 24 hours. Explain why a root tip is used rather than a mature leaf. [2]

(b) Calculate the mitotic index of the root tip cells and express it as a percentage. [2]

(c) State one feature of metaphase that can be seen under the microscope. [2]

(d) Use the data to calculate how long anaphase lasts, in minutes, in a 24-hour cell cycle. [2]

(e) Explain why cells should not be chosen only because they are darkly stained or large when counting. [2]

Q 5 · Gas exchange and transport: cardiac output, the response to exercise and the Bohr shift [10]

(a) An athlete has a stroke volume of 70 cm3 and a heart rate of 75 beats per minute at rest, and 110 cm3 and 150 beats per minute during vigorous exercise. Define cardiac output. [1]

(b) Calculate the cardiac output at rest in both cm3 per minute and dm3 per minute. [2]

(c) Calculate the cardiac output during exercise and the percentage increase compared with rest. [2]

(d) Explain how exercising muscle obtains more oxygen, referring to the shift of the oxygen dissociation curve. [3]

(e) Explain why both the rate and the depth of breathing increase during exercise. [2]

Q 6 · Nucleic acids and protein synthesis: base composition, codons and translation [10]

(a) In a sample of double-stranded DNA, adenine makes up 28 per cent of all bases. Calculate the percentage of thymine, guanine and cytosine, and state the basis of your answer. [2]

(b) Explain how the two polynucleotide chains of DNA are held together and why the pairing rule matters. [2]

(c) The coding region of a gene contains 1215 nucleotides. Calculate the number of codons and the number of amino acids in the polypeptide produced. [2]

(d) State two roles of the ribosome in translation. [2]

(e) If one nucleotide is replaced by a different purine (a substitution mutation), explain the possible effects on the structure of the protein. [2]