

IB Biology SL Paper 2 Mock Paper (10 questions, 50 marks, 75 minutes, calculator allowed)

IB DP 第一年 (Grade 11) Biology | 時限 : 75 分鐘 | 總分 : 50 分 | 共 10 題

Section A (Questions 1 to 5, 25 marks)

Answer ALL questions. A calculator may be used. Show your working in calculations, give numerical answers to three significant figures unless told otherwise, and state units in every final answer. All data are examples and this is not a past paper of any examination board.

- Students took 8 random quadrats of 0.25 m² in a meadow. The numbers of wood sorrel plants recorded were: 12, 9, 15, 11, 14, 10, 13, 8. (a) Calculate the mean density in plants per square metre. (b) The meadow measures 40 m by 25 m. Estimate the total number of wood sorrel plants. (c) Explain why the quadrats must be placed at random, and why too few samples give a poor estimate.
- In a grassland ecosystem the gross primary production is 45,000 kJ m⁻² per year and producers lose 18,000 kJ m⁻² per year in respiration. Primary consumers ingest 5,400 kJ m⁻², of which 900 kJ m⁻² is egested in faeces; secondary consumers assimilate 450 kJ m⁻². (a) Calculate the net primary production (NPP). (b) Calculate the efficiency of energy transfer from producers (NPP) to primary consumers, and from primary consumer assimilation to secondary consumers, as percentages to one decimal place. (c) Give two reasons why so much energy is lost between trophic levels.
- Two pea plants were crossed. The 200 offspring were: 52 purple round, 48 purple wrinkled, 45 white round and 55 white wrinkled. (a) Write the genotypes of the two parents, using B/b for flower colour and R/r for seed shape. (b) Calculate the expected number of each phenotype for independent assortment (1:1:1:1). (c) Calculate chi-squared, where chi-squared = sum of (observed - expected) squared / expected, to two decimal places. (d) The critical value of chi-squared for df = 3 is 7.81. State your conclusion.
- Red-green colour blindness is X-linked recessive (X^c). A carrier mother (X^cX) and a father with normal colour vision (XY) have children. (a) List the possible genotypes of their children, stating the sex of each. (b) Calculate the probability that a son is colour-blind. (c) Calculate the probability that a daughter is a carrier. (d) If such couples had 320 children in total, how many would be expected to be colour-blind? Explain why far more males than females are affected.
- A student measured the initial rate of a hydrogen peroxide enzyme at different substrate concentrations (rate in arbitrary units, a.u.): 0.10 mmol dm⁻³: 14.0, 0.20 mmol dm⁻³: 21.0, 0.40 mmol dm⁻³: 28.0, 0.80 mmol dm⁻³: 33.6, 1.60 mmol dm⁻³: 37.3. (a) Describe how the initial rate changes with substrate concentration. (b) Estimate the maximum rate V_{max} and justify your estimate. (c) Estimate the Michaelis constant K_m, the substrate concentration at which the rate is half of V_{max}. (d) State how V_{max} and K_m change when a competitive inhibitor is added.

Section B (Questions 6 to 10, 25 marks)

Answer ALL questions. A calculator may be used. Show your working in calculations, give numerical answers to three significant figures unless told otherwise, and state units in every final answer. All data are examples and this is not a past paper of any examination board.

6. Five potato strips (initial mass 2.50 g each) were left for 30 minutes in sucrose solutions from 0.0 to 0.8 mol dm^{-3} . After blotting, their masses were 2.700、2.575、2.500、2.350、2.225 g. (a) Calculate the percentage change in mass for each strip, to one decimal place. (b) Estimate the sucrose concentration of the potato cell sap and justify your answer. (c) Explain why the 0.8 mol dm^{-3} strip lost mass. (d) Explain why the strips are blotted dry before weighing.
7. A 15-year-old student at rest has a tidal volume of 0.50 dm^3 and a breathing rate of 15 per minute. After vigorous exercise the tidal volume is 1.20 dm^3 and the rate is 32 per minute. Vital capacity is 4.2 dm^3 and residual volume is 1.2 dm^3 . (a) Calculate the minute ventilation at rest and after exercise, in dm^3 per minute. (b) Calculate how many times greater the ventilation is after exercise. (c) Calculate the total lung capacity. (d) Explain how the increase in ventilation helps muscles to keep contracting.
8. An athlete at rest has a heart rate of 70 beats per minute and a stroke volume of 70 cm^3 . During vigorous exercise the heart rate is 150 beats per minute and the stroke volume is 120 cm^3 . (a) Calculate the cardiac output at rest and during exercise, in dm^3 per minute. (b) Calculate how many times greater the cardiac output is during exercise, to three significant figures. (c) Calculate the percentage increase in stroke volume, to three significant figures. (d) Explain the benefit of the higher cardiac output to the tissues.
9. The polymerase chain reaction starts from a single double-stranded DNA molecule and doubles the number of molecules each cycle. Each cycle takes 1.5 minutes. (a) Calculate the number of DNA molecules after 30 cycles. (b) Calculate the total time needed for all the cycles, in minutes. (c) In a double-stranded DNA sample, adenine (A) makes up 28% of all bases. Calculate the percentage of guanine (G). (d) State the purpose of heating to about 95 degrees C in each PCR cycle.
10. A student counted the bubbles released per minute by the same water plant at 10, 20, 30 and 40 cm from a lamp: 10 cm: 48, 20 cm: 12, 30 cm: 5, 40 cm: 3. (a) State how light intensity depends on distance, and calculate the change in intensity when the distance is doubled. (b) Calculate the relative light intensity at 20 to 40 cm, taking the 10 cm value as 1.00 (three decimal places). (c) Predict the number of bubbles per minute at 5 cm. (d) Explain why the 30 cm and 40 cm results differ by only 2 bubbles.