

IB Biology SL Paper 2 Mock Paper (second set, 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.

1. At 25 ° C, 2.0 cm³ of 0.50% hydrogen peroxide solution is mixed with 2.0 cm³ of potato extract and 24.0 cm³ of oxygen is collected in 60 seconds. (a) Calculate the mean rate of oxygen production at 25 ° C, in cm³ s⁻¹. (b) The same apparatus is warmed to 40 ° C and 40.8 cm³ of oxygen is collected in 60 seconds. Calculate the rate at 40 ° C, in cm³ s⁻¹. (c) Calculate the percentage increase in rate from 25 ° C to 40 ° C. (d) Explain why the rate is close to zero at 80 ° C. (e) Explain how the rate of oxygen production represents enzyme activity in this experiment.

2. The rate of oxygen production of an aquatic plant is measured at different light intensities: 3.0 cm³ per hour at 20 units, 5.5 at 40 units, 6.4 at 60 units and 6.4 at 80 units. Temperature is kept at 25 ° C and carbon dioxide is sufficient. (a) Calculate the percentage increase in the rate when light intensity rises from 20 to 40 units. (b) Describe the change beyond 60 units and explain it. (c) Describe one change in the experimental design that would show carbon dioxide becomes the limiting factor above 60 units. (d) Explain why oxygen production per unit time is a better measure than leaf colour. (e) Predict the effect on the rate at 35 ° C and 80 units, and explain it.

3. Yeast breaks down glucose into ethanol and carbon dioxide in anaerobic conditions. 5.0 g of glucose is fully fermented at 25 ° C and 1 atm (molar mass of glucose 180.16 g mol⁻¹, molar gas volume 24.0 dm³ mol⁻¹). (a) Calculate the number of moles of glucose in 5.0 g. (b) Write the balanced equation for anaerobic respiration and calculate the moles of carbon dioxide produced. (c) Calculate the volume of carbon dioxide produced at 25 ° C and 1 atm, in dm³. (d) Explain why aerobic respiration yields far more ATP per mole of glucose than anaerobic respiration. (e) State one industrial use of this fermentation and explain why anaerobic conditions are needed.

4. A cross between two fruit flies gives 240 offspring: 168 show the dominant phenotype and 72 show the recessive phenotype. The expected ratio is 3 to 1. (a) Calculate the expected numbers of dominant and recessive offspring. (b) Calculate the chi-squared value. (c) With one degree of freedom the 5 per cent critical value is 3.841. Decide whether the result deviates significantly from 3 to 1 and explain. (d) Suggest one biological reason that could make an observed ratio depart from 3 to 1. (e) Explain why a chi-squared test is used instead of simply comparing percentages.

5. Energy data for a grassland ecosystem in kJ per square metre per year: producers 45,000; primary consumers 4,500; secondary consumers 405; tertiary consumers 32.4. (a) Calculate the efficiency of energy transfer from producers to primary consumers. (b) Calculate the efficiencies from primary to secondary and from secondary to tertiary consumers. (c) Calculate the energy of the tertiary consumers as a percentage of the producers. (d) Explain why the number of trophic levels is usually limited to four or five. (e) State two main fates of the remaining energy at each level.

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. A length of mRNA has a coding region of 900 nucleotides and a stop codon of 3 nucleotides. (a) Calculate the number of amino acids in the protein. (b) Calculate the total number of nucleotides in this mRNA. (c) State where transcription and translation take place in the cell. (d) A substitution of A by G at nucleotide 300 of the coding region causes a missense mutation. Explain the possible effect on the protein. (e) Explain why a stop codon does not code for an amino acid but is still essential.

7. A potometer records that the water column moves 2.4 cm³ in 20 minutes on a leafy shoot. The total leaf area is 0.0150 m². (a) Calculate the rate of water uptake per minute, in cm³ min⁻¹. (b) Calculate the rate of water uptake per hour, in cm³ h⁻¹. (c) Calculate the transpiration rate per unit leaf area, in dm³ m⁻² h⁻¹. (d) Explain why transpiration is expressed per unit leaf area rather than per leaf. (e) Predict how the rate changes in windier conditions and explain.

8. An adult produces 180 dm³ of glomerular filtrate per day and excretes 1.5 dm³ of urine. Plasma glucose concentration is 1.0 g dm⁻³ and the urine contains no glucose. (a) Calculate the volume of water reabsorbed per day, in dm³. (b) Calculate the percentage of water reabsorbed. (c) Calculate the mass of glucose filtered per day, in grams, and explain why none appears in the urine. (d) State where most reabsorption occurs in the nephron and describe the mechanism. (e) Predict the effect on urine volume and concentration if ADH secretion increases.

9. The basic reproduction number R_0 of an infectious disease is 4.0, meaning one infected person infects 4 others on average in a fully susceptible population. (a) Calculate the percentage of the population that must be vaccinated to reach herd immunity. (b) Recalculate the required coverage if R_0 rises to 5.0 and compare the two values. (c) Explain why herd immunity cannot protect every individual. (d) Describe the roles of memory B cells and memory T cells in vaccine-induced immunological memory. (e) Explain why other public health measures are still needed when R_0 is very high.

10. A recessive genetic disease affects 4 per cent of a closed population of 5,000 people that is in Hardy-Weinberg equilibrium. (a) Calculate the recessive allele frequency q . (b) Calculate the dominant allele frequency p . (c) Calculate the carrier, heterozygous, genotype frequency and convert it to a number of people. (d) Calculate the number of affected people. (e) State two conditions required for Hardy-Weinberg equilibrium and explain how inbreeding changes the proportion of carriers.