

IGCSE Biology 0610 Paper 4 Mock Paper (second set, 10 questions, 80 marks, 1 hour 15 minutes)

中五 (IGCSE Year 11) Chemistry | 時限 : 75 分鐘 | 總分 : 80 分 | 共 10 題

Section A (Questions 1 to 5, 40 marks)

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

1. A shoot of an aquatic plant is placed at different distances from a white lamp and oxygen bubbles are collected in a capillary tube. Bubbles counted over 2 minutes: 10 cm = 48, 20 cm = 27, 30 cm = 12, 40 cm = 6.
(a) Calculate the number of bubbles per minute at 10 cm and at 30 cm. (b) Calculate the ratio of the rate at 10 cm to the rate at 30 cm. (c) Predict the number of bubbles if counting continued for 7.5 minutes at 30 cm. (d) Explain why bubbles are still released at 40 cm. (e) State the limiting factor between 10 cm and 20 cm.

答案 : (a) At 10 cm: $48 / 2 = 24.0$ bubbles per minute; at 30 cm: $12 / 2 = 6.0$ bubbles per minute. (b) $24.0 / 6.0 = 4.0$ times. (c) $6.0 \times 7.5 = 45$ bubbles. (d) Light still reaches the leaf at 40 cm, so the light-dependent stage still occurs, but the light intensity is lower and the rate falls to 3.0 bubbles per minute. (e) Light intensity. Marking notes: (a) 2 marks, (b) 2 marks, (c) 1 mark, (d) 2 marks, (e) 1 mark; total 8 marks.

2. Amylase is mixed with starch solution and the time taken for the starch to be completely digested is measured at different temperatures: 20 C = 180 s, 30 C = 72 s, 40 C = 45 s, 50 C = 60 s, and at 60 C digestion is still incomplete after 600 s. (a) Calculate the rate of reaction at each temperature as $1000 / \text{time in seconds}$. (b) State the optimum temperature. (c) Explain the result at 60 C. (d) Calculate how many times faster the reaction is at 50 C than at 30 C.

答案 : (a) 20 C: $1000 / 180 = 5.56$; 30 C: 13.89 ; 40 C: 22.22 ; 50 C: 16.67 (arbitrary units). (b) 40 C. (c) 60 C is above the optimum, so hydrogen and ionic bonds in the enzyme are broken, the active site changes shape and the enzyme is permanently denatured, so the substrate can no longer bind and digestion is incomplete after 600 s. (d) $16.67 / 13.89 = 1.2$ times. Marking notes: (a) 3 marks, (b) 1 mark, (c) 3 marks, (d) 1 mark; total 8 marks.

3. Body colour in an insect is controlled by one pair of alleles, dark (D) dominant to pale (d). Two dark insects are crossed and produce 720 offspring: 552 dark and 168 pale. (a) Write the genotypes of the parents. (b) Calculate the expected numbers on a 3:1 ratio. (c) Calculate chi-squared. (d) Using a critical value of 3.841 at 1 degree of freedom, decide whether the results fit 3:1. (e) State how the conclusion would differ if chi-squared were 5.2.

答案 : (a) Dd x Dd. (b) Dark: $720 \times 3/4 = 540$; pale: $720 \times 1/4 = 180$. (c) $\chi^2 = (552 - 540)^2 / 540 + (168 - 180)^2 / 180 = 0.267 + 0.800 = 1.07$. (d) 1.07 is less than 3.841, so the difference is not significant and the results fit a 3:1 ratio. (e) 5.2 is greater than 3.841, so the difference is significant, the 3:1 hypothesis is rejected and other modes of inheritance or experimental error must be considered. Marking notes: (a) 1 mark, (b) 2 marks, (c) 2 marks, (d) 2 marks, (e) 1 mark; total 8 marks.

4. Yeast is added to glucose, sucrose and lactose solutions for 10 minutes with a layer of paraffin oil on top. The volumes of carbon dioxide released are 12.0 cm³, 6.4 cm³ and 0.8 cm³. (a) Calculate the rate of gas production per minute for each sugar. (b) Calculate how many times faster glucose is than lactose. (c) Write the equation for anaerobic respiration in yeast. (d) Explain why the layer of paraffin oil is needed.

答案 : (a) Glucose: $12.0 / 10 = 1.20$ cm³ per minute; sucrose: 0.64 cm³ per minute; lactose: 0.08 cm³ per minute. (b) $12.0 / 0.8 = 15$ times. (c) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ (+ small amount of energy). (d) The paraffin oil excludes air so that the yeast respires anaerobically, ensuring the carbon dioxide measured comes from fermentation rather than aerobic respiration, and preventing oxygen dissolving in the solution from affecting the readings. Marking notes: (a) 3 marks, (b) 1 mark, (c) 2 marks, (d) 2 marks; total 8 marks.

5. A potometer is used to measure water uptake: the air bubble moves 42 mm in 7 minutes and the total leaf area is 12 cm². (a) Calculate the distance moved per minute. (b) Calculate the distance moved per minute per cm² of leaf. (c) Predict the distance moved in 20 minutes. (d) Explain the effect of increasing wind speed on the reading.

答案 : (a) $42 / 7 = 6.0$ mm per minute. (b) $6.0 / 12 = 0.5$ mm per minute per cm². (c) $6.0 \times 20 = 120$ mm. (d) A higher wind speed removes water vapour from the leaf surface, increasing the water vapour gradient between the air spaces and the outside air, so transpiration and the bubble movement increase; very strong wind may close the stomata and reduce the rate. Marking notes: (a) 2 marks, (b) 2 marks, (c) 1 mark, (d) 3 marks; total 8 marks.

Section B (Questions 6 to 10, 40 marks)

Answer ALL questions. A calculator may not be used. Show your working in calculations, give numerical answers to an appropriate number of significant figures, 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 each of mass 2.50 g are placed in 0.0, 0.2, 0.4, 0.6 and 0.8 mol dm⁻³ sucrose solution for 30 minutes. After blotting, their masses are 2.78 g, 2.60 g, 2.50 g, 2.38 g and 2.26 g. (a) Calculate the percentage change in mass for each solution. (b) State the concentration that is isotonic to the potato cells. (c) Explain why the strip becomes soft in 0.8 mol dm⁻³ sucrose. (d) Explain why the strips are blotted before weighing.

答案 : (a) $(2.78 - 2.50) / 2.50 \times 100\% = +11.2\%$; $+4.0\%$; 0.0% ; -4.8% ; -9.6% . (b) 0.4 mol dm⁻³, where the change in mass is zero. (c) The external solution has a higher concentration and lower water potential, so water leaves the cells by osmosis, the vacuole shrinks and the cell membrane pulls away from the cell wall (plasmolysis), the cells lose turgor and the strip becomes soft and shorter. (d) To remove solution from the surface so that it does not affect the mass reading and distort the percentage change. Marking notes: (a) 3 marks, (b) 1 mark, (c) 3 marks, (d) 1 mark; total 8 marks.

7. Producers in a grassland fix 48 000 kJ per square metre per year and the transfer efficiency between trophic levels is 10%. (a) Calculate the energy available to the primary, secondary and tertiary consumers. (b) State what happens to the other 90% of the energy. (c) Explain why food chains usually have only four or five trophic levels. (d) Calculate the energy available to the primary consumer if the transfer efficiency were 15%.

答案：(a) Primary consumer: $48\,000 \times 10\% = 4\,800$ kJ; secondary: 480 kJ; tertiary: 48 kJ. (b) Most is lost as heat during respiration; the rest is in excretory products, undigested material and dead bodies, and is broken down by decomposers. (c) Only about one tenth of the energy passes to the next level, so after four or five levels too little energy remains to support another trophic level. (d) $48\,000 \times 15\% = 7\,200$ kJ. Marking notes: (a) 3 marks, (b) 2 marks, (c) 2 marks, (d) 1 mark; total 8 marks.

8. A bacterial population grows from 20 to 1 280 cells in 6 hours under ideal conditions. (a) Calculate the number of divisions. (b) Calculate the generation time in minutes. (c) Calculate the population after 3 hours. (d) Explain why the real population after 24 hours is far below the theoretical value.

答案：(a) $1\,280 / 20 = 64 = 2^6$, so there are 6 divisions. (b) 6 hours = 360 minutes; $360 / 6 = 60$ minutes. (c) $20 \times 2^3 = 160$ cells. (d) The theoretical number is $20 \times 2^{24} = 335\,544\,320$, but in practice nutrients run out, metabolic waste accumulates, space is limited, oxygen supply falls and cells are eaten by other organisms, so growth slows and the population enters a stationary and then a death phase. Marking notes: (a) 2 marks, (b) 2 marks, (c) 1 mark, (d) 3 marks; total 8 marks.

9. A recessive condition is caused by allele t. Two unaffected carriers (Tt) plan to have children. (a) State the gametes each parent can produce. (b) Calculate the probability that a child is affected. (c) If they had 400 children, how many would be expected to be affected? (d) Calculate the probability that all three children are affected. (e) Calculate the probability that at least one of three children is affected.

答案：(a) T and t, each with a probability of 1/2. (b) 1/4. (c) $400 \times 1/4 = 100$ children. (d) $(1/4)^3 = 1/64$, about 1.56%. (e) $1 - (3/4)^3 = 37/64$, about 57.8%. Marking notes: (a) 1 mark, (b) 1 mark, (c) 1 mark, (d) 2 marks, (e) 3 marks; total 8 marks.

10. The same batch of bacteria is plated on media containing different concentrations of an antibiotic. After 24 hours the colony counts are 500 at 0 micrograms per cm³, 120 at 2, 30 at 4 and 4 at 8. (a) Calculate the percentage survival at each concentration relative to the control. (b) Explain why a few colonies still grow at the highest concentration. (c) Explain how the antibiotic increases the proportion of resistant bacteria. (d) Suggest two ways to slow the development of resistance.

答案：(a) $120 / 500 \times 100\% = 24.0\%$; 6.0%; 0.8%. (b) Random mutation already exists in the population, so a few individuals carry resistance alleles and can survive and reproduce in the presence of the antibiotic. (c) The antibiotic kills susceptible individuals and reduces competition, so resistant individuals obtain more resources and reproduce, raising the proportion of resistance alleles in the population; this is natural selection. (d) Complete the full course of treatment as prescribed, prescribe antibiotics only when necessary, avoid overuse in agriculture, and rotate different antibiotics. Marking notes: (a) 3 marks, (b) 2 marks, (c) 2 marks, (d) 1 mark; total 8 marks.