

IGCSE Biology 0610 Paper 6 Alternative to Practical Mock Paper (10 questions, 40 marks, 60 minutes)

中四 – 中五 (Grade 9 – 10) Biology | 時限：60 分鐘 | 總分：40 分 | 共 10 題

Section A (Questions 1 to 5, 20 marks)

Answer ALL questions. This paper tests practical skills only; no microscope or apparatus is needed and all the data given are examples. Show your working in calculations, give numerical answers to three significant figures unless told otherwise, and state units in every final answer.

1. A drawing of an onion epidermis cell is 45 mm long; the actual cell is 150 μm long. (a) Calculate the magnification of the drawing. (b) The eyepiece is $\times 10$ and the objective lens is $\times 40$. Calculate the total magnification. (c) With the $\times 40$ objective the field of view is 0.45 mm in diameter. How many complete 150 μm cells would fit across the field of view?

答案：(a) magnification = image length / actual length = 45 mm / 0.150 mm = $\times 300$. (b) total magnification = eyepiece $\times$ objective = $10 \times 40 = \times 400$. (c) 0.45 mm / 0.150 mm = 3 complete cells. Marking notes: 1 mark each part; 1 further mark for converting 150 μm to 0.150 mm correctly.

2. Four test tubes each contain one food sample: A glucose solution, B starch solution, C protein solution, D vegetable oil emulsion. For each tube state the reagent to use and the positive result (colour change). Explain why a water bath is used when testing with Benedict's solution.

答案：A: Benedict's solution; on heating turns from blue to brick-red precipitate - reducing sugar present. B: iodine solution; turns from yellow-brown to blue-black - starch present. C: Biuret solution; turns from blue to purple - protein present. D: add ethanol then water (emulsion test); a cloudy white emulsion forms - lipid present. Water bath: the reaction between Benedict's solution and a reducing sugar needs heat energy to complete in a reasonable time; heating the tube directly over a flame can make it boil over, whereas a water bath heats it evenly and safely. Marking notes: 1 mark per sample (reagent plus colour); the water-bath reason is a method mark.

3. A student mixes 1 cm^3 of starch solution with 1 cm^3 of amylase solution buffered at different pH values. Every 10 seconds a sample is spotted on a spotting tile and tested with iodine solution. The time for the starch to disappear completely is: pH 5.0 - 40 s; pH 6.0 - 20 s; pH 7.0 - 10 s; pH 8.0 - 16 s. (a) Calculate the rate of reaction at each pH as $1 / \text{time}$ (in s^{-1} , to three decimal places). (b) State the most likely optimum pH of this enzyme. (c) Calculate how many times faster the reaction is at pH 7.0 than at pH 5.0. (d) Explain why samples are taken every 10 seconds instead of testing once after 60 seconds.

答案：(a) rate = $1 / t$: pH 5.0 = 0.025 s^{-1} , pH 6.0 = 0.050 s^{-1} , pH 7.0 = 0.100 s^{-1} , pH 8.0 = 0.063 s^{-1} . (b) optimum pH = 7.0, because the rate is highest. (c) $0.100 / 0.025 = 4$ times faster. (d) The starch is completely digested between 10 and 40 seconds, so a single test at 60 seconds would be negative in every tube and no comparison of rates would be possible; taking samples every 10 seconds allows the exact time of the colour change to be found. Marking notes: 0.5 mark per rate, 1 mark for optimum pH, 0.5 for the ratio, 0.5 for the sampling reason.

4. A pondweed is placed in sodium hydrogencarbonate solution and lit by a lamp. The distance from lamp to pondweed is changed and the bubbles released per minute are counted twice at each distance: 50 cm - 11 and 13; 40 cm - 17 and 19; 30 cm - 25 and 27; 20 cm - 31 and 33. (a) Calculate the mean number of bubbles per minute at each distance. (b) Calculate the overall mean of the four distances. (c) Light intensity is proportional to $1 / \text{distance squared}$. Calculate how many times greater the light intensity is at 20 cm than at 50 cm. (d) Explain why sodium hydrogencarbonate solution is used instead of pure water.

答案 : (a) means: 50 cm = 12, 40 cm = 18, 30 cm = 26, 20 cm = 32 bubbles per minute. (b) $(12 + 18 + 26 + 32) / 4 = 22$ bubbles per minute. (c) $(1 / 20 \text{ squared}) / (1 / 50 \text{ squared}) = 2500 / 400 = 6.25$ times greater. (d) The solution supplies dissolved carbon dioxide, the raw material for photosynthesis; in pure water the carbon dioxide is used up quickly and becomes a limiting factor. Marking notes: 0.5 mark per mean, 0.5 for overall mean, 1 for the ratio, 1 for the reason.

5. Five potato cylinders (each 4.0 cm long) are left for 30 minutes in 0.0, 0.2, 0.4 and 0.6 mol/dm³ sucrose solution and in a solution X of unknown concentration. Masses change as follows: 0.0 mol/dm³ from 2.40 g to 2.64 g; 0.2 from 2.50 g to 2.60 g; 0.4 from 2.60 g to 2.60 g; 0.6 from 2.80 g to 2.66 g; solution X from 2.20 g to 2.27 g. (a) Calculate the percentage change in mass for each treatment (one decimal place). (b) Use the result for X to deduce the range in which its concentration lies. (c) Explain why the mass falls in the 0.6 mol/dm³ solution.

答案 : (a) 0.0 mol/dm³: +10.0%; 0.2: +4.0%; 0.4: 0.0%; 0.6: -5.0%; X: +3.2%. (b) The change for X (+3.2%) lies between the values for 0.2 mol/dm³ (+4.0%) and 0.4 mol/dm³ (0.0%), so X is between 0.2 and 0.3 mol/dm³. (c) The external solution is more concentrated than the cell sap, so water leaves the cells by osmosis through the partially permeable cell membrane; the cells lose water and the mass falls. Marking notes: 0.5 mark per percentage, 1 mark for the range with evidence, 0.5 for the explanation.

Section B (Questions 6 to 10, 20 marks)

Answer ALL questions. This paper tests practical skills only; no microscope or apparatus is needed and all the data given are examples. Show your working in calculations, give numerical answers to three significant figures unless told otherwise, and state units in every final answer.

6. A potometer measures the water uptake of a leafy shoot: the air bubble moves 32 mm in 10 minutes. The capillary tube has a radius of 0.5 mm. (a) Calculate the rate of water uptake in mm/min and in mm/h. (b) Using volume of a cylinder = $\pi \times r \text{ squared} \times h$, calculate the volume of water taken up in 10 minutes (in mm³, one decimal place). (c) Explain why the shoot must be cut under water. (d) Predict and explain what happens to the bubble if all the leaves are removed.

答案 : (a) $32 / 10 = 3.2$ mm/min; $3.2 \times 60 = 192$ mm/h. (b) $V = \pi \times 0.5 \text{ squared} \times 32 = 3.14 \times 0.25 \times 32 = 25.1$ mm³. (c) Cutting under water stops air entering the xylem vessels; an air bubble would block the water column, so the readings would be too small or the flow would stop. (d) The bubble moves much more slowly or stops, because the leaves are the main transpiring organs (they carry the stomata), so removing them greatly reduces the transpiration pull. Marking notes: 1 mark each part.

7. Two vacuum flasks each contain 100 cm³ of water. Flask P has 20 g of germinating peas added, flask Q has 20 g of boiled, cooled peas. Over 20 minutes the temperature rises from 20.0 °C to 22.5 °C in P and to 20.2 °C in Q. The specific heat capacity of water is 4.2 J/(g °C). (a) Use $Q = mc(\Delta T)$ to calculate the energy absorbed by the water in each flask. (b) Calculate the difference and explain what it represents. (c) Calculate the average heat released per minute by flask P (J/min). (d) Explain why boiled peas are used in flask Q.

答案 : (a) P: $100 \times 4.2 \times 2.5 = 1050$ J; Q: $100 \times 4.2 \times 0.2 = 84$ J. (b) Difference = $1050 - 84 = 966$ J; this is the heat released by respiration in the living seeds (some heat is lost through the flask walls, so the value is a minimum estimate). (c) $1050 / 20 = 52.5$ J/min. (d) Boiling kills the seeds and denatures their enzymes, so respiration stops; this is the control that shows the temperature rise comes from respiration in living seeds rather than from other factors. Marking notes: 0.5 mark each in (a), 1.5 in (b), 0.5 in (c), 1 in (d).

8. A student uses 0.50 m x 0.50 m quadrats to count daisies in a meadow. The quadrats are placed at random 20 times and a total of 90 plants is counted. The meadow has an area of 800 m². (a) Calculate the area of one quadrat and the total area sampled. (b) Calculate the mean number of daisies per quadrat. (c) Calculate the density of daisies in plants per m². (d) Estimate the total number of daisies in the meadow and explain why the quadrats must be placed at random rather than where the flowers are densest.

答案 : (a) one quadrat = $0.50 \times 0.50 = 0.25$ m²; twenty quadrats = $0.25 \times 20 = 5.0$ m². (b) $90 / 20 = 4.5$ daisies per quadrat. (c) $4.5 / 0.25 = 18$ daisies per m². (d) $18 \times 800 = 14,400$ daisies. Random placement avoids bias (for example choosing only flowery or bare patches), so that the sample represents the whole meadow and the estimate is reliable. Marking notes: 0.5 mark each in (a), 1 in (b), 1 in (c), 0.5 for the number and 0.5 for the reason in (d).

9. A pigment extract from green leaves is spotted on chromatography paper at the origin and run in a solvent. The solvent front travels 70 mm from the origin and two pigment spots travel 42 mm and 21 mm. (a) Write the equation for R_f. (b) Calculate R_f for both spots. (c) A known pigment has an R_f of 0.60 in the same solvent. What can you conclude? (d) Explain why the origin must be above the level of the solvent.

答案 : (a) $R_f = \text{distance moved by the pigment} / \text{distance moved by the solvent front}$. (b) $42 / 70 = 0.60$ and $21 / 70 = 0.30$. (c) The spot with R_f 0.60 matches the known pigment under the same conditions, so it is probably the same pigment; R_f is a characteristic value but is only reliable when compared using the same solvent and temperature. (d) If the origin were below the solvent surface the pigments would simply dissolve into the liquid instead of travelling up the paper, so no separation would occur. Marking notes: 1 mark (a), 0.5 each in (b), 1 in (c), 1 in (d).

10. Two purple-flowered pea plants are crossed. Of 240 offspring, 178 have purple flowers and 62 have white flowers. (a) Write the genotypes of the parents, using B and b. (b) Calculate the observed ratio of purple to white. (c) Calculate the expected numbers on a 3:1 ratio and the chi-squared value, $\chi^2 = \text{sum of (observed - expected)}^2 / \text{expected}$ (two decimal places). (d) The critical value of chi-squared is 3.84. State your conclusion.

答案 : (a) Both parents are Bb (heterozygous), because both are purple but white (bb) offspring appear. (b) $178 / 62 = 2.87$, i.e. about 2.87 : 1. (c) Expected purple = $240 \times 0.75 = 180$; expected white = $240 \times 0.25 = 60$. $\chi^2 = (178 - 180)^2 / 180 + (62 - 60)^2 / 60 = 0.022 + 0.067 = 0.09$. (d) $\chi^2 = 0.09$ is less than 3.84, so the deviation from a 3:1 ratio is not significant; the data support single-gene inheritance with purple dominant. Marking notes: 1 mark (a) with explanation, 0.5 (b), 1.5 (c), 1 (d).

