

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

IB DP 第一年 (Grade 11) Chemistry | 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. (a) Write the equation for the reaction between magnesium and dilute hydrochloric acid. (b) Calculate the number of moles in 2.40 g of magnesium (Ar: Mg = 24.3). (c) Calculate the volume of hydrogen collected at room temperature and pressure (molar volume $24.0 \text{ dm}^3 \text{ mol}^{-1}$). (d) State and explain whether the measured volume would be larger or smaller if the gas were not cooled to room temperature.
2. 0.500 g of ethanol ($M_r = 46.0$) burns completely in oxygen and raises the temperature of 150 g of water from 21.0°C to 33.0°C (specific heat capacity of water $4.18 \text{ J g}^{-1} \text{ K}^{-1}$). (a) Calculate the heat absorbed by the water in J. (b) Calculate the number of moles of ethanol burnt. (c) Calculate the enthalpy change of combustion of ethanol in kJ mol^{-1} . (d) Explain why the experimental value differs greatly from the literature value of $-1367 \text{ kJ mol}^{-1}$.
3. In a 1.00 dm^3 vessel, 0.500 mol of H_2 and 0.500 mol of I_2 react at constant temperature until equilibrium is reached, when the concentration of HI is $0.760 \text{ mol dm}^{-3}$. $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$ (a) Calculate the number of moles of H_2 used. (b) State the equilibrium concentrations of H_2 and I_2 . (c) Write the K_c expression and calculate K_c . (d) Explain whether K_c changes when the vessel is compressed to half its volume.
4. A current of 2.50 A is passed through copper(II) sulphate solution for 40.0 minutes using inert electrodes ($F = 96\,500 \text{ C mol}^{-1}$, molar volume $24.0 \text{ dm}^3 \text{ mol}^{-1}$, Ar: Cu = 63.5). (a) Calculate the charge passed in C. (b) Calculate the number of moles of electrons. (c) Calculate the mass of copper deposited at the cathode. (d) Calculate the volume of oxygen formed at the anode.
5. A first order reaction has a rate constant $k = 4.62 \times 10^{-3} \text{ s}^{-1}$ at 298 K. (a) Calculate the half-life. (b) Starting from $0.800 \text{ mol dm}^{-3}$, calculate the concentration remaining after 450 s. (c) Calculate the percentage remaining after 450 s. (d) State how rate depends on concentration for a first order reaction and describe the shape of the concentration against time graph.

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. At 25°C a weak acid HA has $K_{\text{a}} = 1.80 \times 10^{-5}$. (a) Write the K_{a} expression and calculate $[\text{H}^{+}]$ in $0.0200\text{ mol dm}^{-3}$ HA, assuming the degree of ionisation is small. (b) Calculate the pH of this solution. (c) Calculate the pH after the solution is diluted ten times. (d) Explain why the pH rises by less than one unit on dilution.
7. A compound contains 40.0 per cent carbon, 6.7 per cent hydrogen and 53.3 per cent oxygen by mass, and has a relative molecular mass of 180 (Ar: C = 12.01, H = 1.008, O = 16.00). (a) Calculate the mole ratio and deduce the empirical formula. (b) Calculate the empirical formula mass. (c) Deduce the molecular formula. (d) The compound reduces ammoniacal silver nitrate; name the compound.
8. 25.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid is mixed with 25.0 cm^3 of 0.500 mol dm^{-3} sodium hydroxide in a polystyrene cup and the temperature rises by 3.5°C . Assume the mixture has density 1.00 g cm^{-3} and specific heat capacity $4.18\text{ J g}^{-1}\text{ K}^{-1}$, and that heat loss is negligible. (a) Calculate the mass of the mixture. (b) Calculate the heat released. (c) Calculate the number of moles of water formed. (d) Calculate the enthalpy change of neutralisation and compare it with the literature value of -57.3 kJ mol^{-1} .
9. 25.0 cm^3 of iron(II) sulphate solution of unknown concentration is titrated in acidic conditions with $0.0200\text{ mol dm}^{-3}$ potassium permanganate solution; 18.5 cm^3 is required to reach the end point. (a) Write the half-equation for the reduction of MnO_4^{-} to Mn^{2+} . (b) Calculate the number of moles of MnO_4^{-} used. (c) Using electron balance, calculate the number of moles of Fe^{2+} . (d) Calculate the concentration of the Fe^{2+} solution.
10. 12.0 g of ethanol is heated with 18.0 g of ethanoic acid and a concentrated sulphuric acid catalyst to form ethyl ethanoate (Mr: ethanol 46.0, ethanoic acid 60.05, ethyl ethanoate 88.1). (a) Calculate the moles of each reactant and identify the limiting reagent. (b) Calculate the theoretical yield of ethyl ethanoate in g. (c) The actual yield is 16.5 g ; calculate the percentage yield. (d) Suggest two ways of increasing the yield.