# S4 Chemistry Practice Paper: Moles and Molar Volume, Enthalpy of Combustion and Neutralisation, Reaction Rate and Catalysts, Electrolysis and Electroplating, Titration and pH, Redox and Chemical Cells

S4 | Chemistry | Time: 75 minutes | Total: 100 marks | 24 questions

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## Moles and Molar Volume

**Part A: Mole calculations and molar volume (16 marks)**

**1. How many moles are there in 8.8 g of carbon dioxide (molar mass 44 g/mol)?** [4]

**2. A gas has a molar volume of 24 dm^3/mol at room temperature and pressure. Find the volume of 0.20 mol of it.** [4]

**3. How many oxygen molecules are there in 3.2 g of oxygen (molar mass 32 g/mol)? (Avogadro constant 6.02 x 10^23)** [4]

**4. 0.25 mol of sodium chloride is dissolved in water to make 500 cm^3 of solution. Find the molarity.** [4]

## Enthalpy Changes

**Part B: Enthalpy of combustion and neutralisation (16 marks)**

**5. Burning 0.10 mol of methanol releases 72.6 kJ of energy. Find the enthalpy change of combustion of methanol in kJ/mol.** [4]

**6. Water of mass 4.2 g is heated through 10 degrees C (specific heat capacity of water 4.2 J g^-1 K^-1). Find the energy needed.** [4]

**7. Burning 1.0 g of a fuel raises 100 g of water from 25 degrees C to 35 degrees C. Find the energy released per gram of fuel.** [4]

**8. 50 cm^3 of 1.0 M hydrochloric acid is mixed with 50 cm^3 of 1.0 M sodium hydroxide and the temperature rises by 6.0 degrees C. Find the enthalpy change of neutralisation (assume the solution has the density and specific heat capacity of water).** [4]

## Reaction Rate

**Part C: Reaction rate and catalysts (17 marks)**

**9. In a reaction the amount of a reactant falls from 0.50 mol to 0.10 mol in 20 s. Find the average rate of reaction in mol/s.** [4]

**10. A reaction is first order with respect to reactant A. If the concentration of A is doubled, by what factor does the rate change?** [4]

**11. How does a catalyst affect the rate of a reaction and its enthalpy change?** [4]

**12. For a gas reaction the rate roughly doubles for every 10 degrees C rise in temperature. If the temperature rises from 300 K to 330 K, by what factor does the rate change?** [5]

## Electrolysis and Plating

**Part D: Electrolysis and electroplating (17 marks)**

**13. Copper(II) sulphate solution is electrolysed with a current of 2.0 A for 965 s. Find the mass of copper deposited at the cathode (molar mass of Cu = 63.5 g/mol, 1 F = 96500 C).** [5]

**14. Water acidified with dilute sulphuric acid is electrolysed using 4 F of charge. Find the amount in moles of the products at the anode and at the cathode.** [4]

**15. Silver plating deposits 1.08 g of silver (molar mass 108 g/mol). If the current is 1.0 A, find the time needed.** [4]

**16. When concentrated sodium chloride solution is electrolysed, what is formed at the anode and at the cathode, and is the remaining solution acidic, neutral or alkaline?** [4]

## Titration and pH

**Part E: Titration and pH (17 marks)**

**17. 25.0 cm^3 of sodium hydroxide solution is titrated with 0.100 M hydrochloric acid; 20.0 cm^3 of the acid is used. Find the concentration of the sodium hydroxide.** [4]

**18. A solution has a hydrogen ion concentration of 1.0 x 10^-3 M. Find its pH.** [4]

**19. 10 cm^3 of 0.10 M hydrochloric acid is diluted with water to 100 cm^3. Find the pH of the diluted solution.** [4]

**20. What volume of 0.20 M sulphuric acid is needed to neutralise 25 cm^3 of 0.10 M sodium hydroxide?** [5]

## Redox and Cells

**Part F: Redox and chemical cells (17 marks)**

**21. In a zinc-copper cell, in which direction do electrons flow, and which electrode is the negative terminal?** [4]

**22. Find the oxidation number of manganese in potassium manganate(VII), KMnO4.** [4]

**23. How many electrons are lost when an iron atom becomes Fe3+, and is the iron oxidised or reduced?** [4]

**24. A battery is rated at 3000 mAh. If it discharges at 3.0 A, how many coulombs does it supply?** [5]

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