S5 Chemistry Practice Paper: Reaction Rates and Collision Theory, Chemical Equilibrium and Le Chatelier's Principle, Electrolysis and Redox, Organic Compounds and Polymers, Energetics and Enthalpy (100 marks)

S5 | Chemistry | Time: 75 minutes | Total: 100 marks | 24 questions

---

Section A Reaction Rates and Collision Theory

Part A: 4 marks each, 16 marks in total.

1. The initial concentration of a reactant is 0.80 mol dm⁻³ and it falls to 0.32 mol dm⁻³ after 30 s. Calculate the average rate of reaction (mol dm⁻³ s⁻¹) over this period. [4]

2. Raising the temperature by 10 K roughly doubles the rate of most reactions. Explain two reasons for this using collision theory. [4]

3. How does a catalyst increase the rate of a reaction? Does adding a catalyst change the ΔH of the reaction? [4]

4. For the reaction 2A + B -> C, A is consumed at 0.024 mol dm⁻³ s⁻¹. Find the rate of consumption of B and the rate of formation of C. [4]

Section B Chemical Equilibrium and Le Chatelier's Principle

Part B: 4 marks each, 16 marks in total.

5. For N2(g) + 3H2(g) <=> 2NH3(g), at equilibrium [N2] = 0.40, [H2] = 0.50 and [NH3] = 0.60 mol dm⁻³. Calculate the equilibrium constant Kc. [4]

6. At constant temperature the volume of the equilibrium vessel is halved. Explain the direction in which the equilibrium shifts. [4]

7. The forward reaction is exothermic (ΔH < 0). What effect does raising the temperature have on Kc and on the yield of ammonia? [4]

8. Iron catalyst is added to the equilibrium mixture. What is the effect on the position of equilibrium and on Kc? [4]

Section C Electrolysis and Redox

Part C: 4 marks each, 16 marks in total.

9. A current of 2.0 A is passed through CuSO4(aq) for 965 s (F = 96500 C mol⁻¹, Ar(Cu) = 63.5). Calculate the mass of copper deposited at the cathode. [4]

10. Find the oxidation number of manganese in $KMnO_4$ and of chromium in $K_2Cr_2O_7$. [4]

11. Write the anode reaction of a hydrogen-oxygen fuel cell with an acidic electrolyte, and explain why it is regarded as a cleaner energy source. [4]

12. 0.243 g of magnesium reacts completely with excess dilute hydrochloric acid (Ar(Mg) = 24.3, molar volume = 24 $dm^3\ mol^{-1}$). Calculate the volume of hydrogen formed at room conditions. [4]

Section D Organic Compounds

Part D: 4 marks each, 16 marks in total.

13. State the general formulae of alkanes and alkenes, and hence give the molecular formula of the alkane with 5 carbon atoms and the alkene with 4 carbon atoms. [4]

14. State the conditions, the type of reaction and the equation for the dehydration of ethanol to ethene. [4]

15. Ethanol and ethanoic acid are warmed with concentrated sulphuric acid. Name the compound formed and give its molecular formula and functional group. [4]

16. Ethene is bubbled through bromine water. Does the orange-yellow colour decolourise? Write the equation and state the mole ratio of the reactants. [4]

Section E Polymers and Materials

Part E: 4 marks each, 16 marks in total.

17. Poly(ethene) is made by addition polymerisation of ethene; the repeating unit C_2H_4 has relative mass 28. If the average degree of polymerisation is 2000, find the relative molecular mass. [4]

18. Nylon-6,6 is made from hexane-1,6-diamine and hexanedioic acid. State the type of reaction, the small molecule released for each bond formed, and the characteristic bond in the repeating unit. [4]

19. Give the name and the structure (in words if preferred) of the monomer of poly(chloroethene), PVC. [4]

20. Describe how thermosoftening and thermosetting plastics behave when heated, giving one example of each. [4]

Section F Energetics and Enthalpy Change

Part F: 5 marks each, 20 marks in total.

21. Complete combustion of 0.50 mol of methanol releases 363 kJ of energy. Find the enthalpy change of combustion of methanol. [5]

22. 50 cm^3 of 1.0 M hydrochloric acid is mixed with 50 cm^3 of 1.0 M sodium hydroxide solution and the temperature rises by 6.7 °C. Taking the density as 1.0 g cm^{-3} and the specific heat capacity as 4.2 J g^{-1} K^{-1}, find the enthalpy change of neutralisation. [5]

23. For a reaction, ΔH of the forward reaction is -92 kJ mol^{-1} and the activation energy of the reverse reaction is 200 kJ mol^{-1}. Find the activation energy of the forward reaction. [5]

24. Given bond enthalpies H-H = 436, Cl-Cl = 243 and H-Cl = 431 kJ mol^{-1}, calculate ΔH for H2(g) + Cl2(g) -> 2HCl(g). [5]
