

CIE A-Level Chemistry 9701 Paper 2 Practice

Paper (AS)

Total: 60 marks · 1 hour 15 minutes · 6 questions · 27 parts

Q 1 · Atomic structure and the mole [10]

- (a) Define the term relative atomic mass. [2]
- (b) Copper has two natural isotopes: ^{63}Cu (69.2%) and ^{65}Cu (30.8%). Calculate the relative atomic mass of copper to 3 significant figures. [2]
- (c) How many moles and how many molecules are there in 4.40 g of carbon dioxide? (Ar: C=12.0, O=16.0; $L=6.02 \times 10^{23}$) [3]
- (d) 25.0 cm³ of 0.200 mol/dm³ sodium hydroxide solution: calculate the amount, in mol, and the mass of NaOH present. (Mr: NaOH = 40.0) [3]

Q 2 · Chemical bonding and structure [10]

- (a) Write the electron configuration of Mg^{2+} and Cl^{-} (in the form 1s² 2s² ...) and state the total number of electrons in each ion. [3]
- (b) The melting point of magnesium oxide (2,852 C) is much higher than that of sodium chloride (801 C). Explain why. [3]
- (c) State the shape of the ammonium ion, NH_4^{+} , and its bond angle. [2]
- (d) Explain why boron trifluoride, BF_3 , is trigonal planar with bond angles of 120 degrees. [2]

Q 3 · Energetics [10]

- (a) Use bond enthalpies to calculate the enthalpy change of hydrogenation: $\text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{C}_2\text{H}_6$.
C=C 612, C-C 348, C-H 410, H-H 436 kJ/mol. [3]
- (b) In terms of bond breaking and bond making, explain why the reaction above is exothermic. [2]
- (c) Burning 0.0250 mol of a fuel raises the temperature of 50.0 g of water by 6.8 C. Specific heat capacity of water = 4.18 J g⁻¹ K⁻¹. Calculate the heat released, q, and the enthalpy change per mole of fuel. [3]

(d) The experimental value is usually less exothermic than the standard value in the Data Booklet. Give two reasons. [2]

Q 4 · Reaction rates and equilibrium [12]

(a) The concentration of a reactant falls from 0.060 to 0.015 mol/dm³ in 45 s. Calculate the average rate of reaction, with units. [2]

(b) Using collision theory, explain why the rate of reaction decreases as the reaction proceeds. [2]

(c) A reaction is first order with respect to a reactant and has a half-life of 24 s. Starting from 0.80 mol/dm³, what is the concentration after 72 s? [3]

(d) 0.500 mol each of H₂ and I₂ are mixed in a 1.00 dm³ vessel. At equilibrium [HI] = 0.780 mol/dm³. Calculate K_c for H₂ + I₂ ⇌ 2HI. [4]

(e) If the forward reaction is exothermic, state the effect of raising the temperature on the value of K_c. [1]

Q 5 · Organic chemistry: alkenes [10]

(a) State the general formula of the alkenes and explain why alkenes are described as unsaturated. [2]

(b) But-1-ene reacts with hydrogen bromide. Name the major product and state the type of reaction. [2]

(c) An alkene contains 85.7% carbon and 14.3% hydrogen by mass and has M_r = 56. Determine its empirical and molecular formulae. (Ar: C=12.0, H=1.0) [4]

(d) Describe one laboratory test to distinguish the alkene from hexane. [1]

(e) Propene undergoes addition polymerisation to form poly(propene). State the relative molecular mass of the repeat unit. [1]

Q 6 · Group 2 and periodicity [8]

(a) Explain the trend in atomic radius down Group 2. [2]

(b) State and explain the trend in reactivity of Group 2 elements with water. [2]

(c) Write the equation for the reaction of magnesium with steam, including state symbols. [1]

(d) 0.240 g of magnesium reacts with excess steam. Calculate the volume of hydrogen formed at room temperature and pressure (molar volume 24.0 dm³/mol; Ar: Mg = 24.3). [2]

(e) State how the thermal stability of Group 2 nitrates changes down the group. **[1]**