

CIE A-Level Chemistry 9701 Paper 2 Practice

Paper (AS) - ANSWERS

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

Part	Answer	Marking points	marks
1(a)	The weighted mean mass of the atoms of an element compared with 1/12 of the mass of an atom of carbon-12.	1 mark: weighted mean mass of the atoms (allowance for isotopic abundances) 1 mark: compared with 1/12 of the mass of an atom of ^{12}C	2
1(b)	$A_r(\text{Cu}) = 63 \times 0.692 + 65 \times 0.308 = 43.60 + 20.02 = 63.6$	1 mark: $63 \times 0.692 + 65 \times 0.308$ 1 mark: 63.6	2
1(c)	$M_r(\text{CO}_2) = 12.0 + 2(16.0) = 44.0$; $n = 4.40/44.0 = 0.100 \text{ mol}$; molecules = $0.100 \times 6.02 \times 10^{23} = 6.02 \times 10^{22}$	1 mark: $M_r = 44.0$ 1 mark: $n = 0.100 \text{ mol}$ 1 mark: 6.02×10^{22}	3
1(d)	$n = 0.200 \times 25.0/1000 = 5.00 \times 10^{-3} \text{ mol}$; $m = 5.00 \times 10^{-3} \times 40.0 = 0.200 \text{ g}$	1 mark: volume converted to dm^3 1 mark: $n = 5.00 \times 10^{-3} \text{ mol}$ 1 mark: $m = 0.200 \text{ g}$	3
2(a)	Mg^{2+} : $1s^2 2s^2 2p^6$, 10 electrons; Cl^- : $1s^2 2s^2 2p^6 3s^2 3p^6$, 18 electrons.	1 mark: Mg^{2+} configuration / 10 electrons 1 mark: Cl^- configuration / 18 electrons 1 mark: both configurations fully correct	3
2(b)	Both are giant ionic lattices; the ions in MgO carry higher charges ($2+$ and $2-$) than in NaCl ($1+$ and $1-$), so the electrostatic attraction is stronger and more energy is needed to break the lattice.	1 mark: both giant ionic lattices 1 mark: higher ionic charges in MgO 1 mark: stronger electrostatic attraction / more energy needed	3
2(c)	Tetrahedral; bond angle 109.5° .	1 mark: tetrahedral 1 mark: 109.5°	2
2(d)	Boron has three bonding pairs and no lone pairs; the three pairs repel to maximum separation, giving a planar arrangement with 120°	1 mark: three bonding pairs, no lone pairs	2

	degree angles.	1 mark: maximum separation of pairs gives 120 degrees in one plane	
3(a)	Bonds broken: $612 + 4 \times 410 + 436 = 2,688$ kJ/mol; bonds formed: $348 + 6 \times 410 = 2,808$ kJ/mol; $\Delta H = 2,688 - 2,808 = -120$ kJ/mol	1 mark: broken = 2,688 1 mark: formed = 2,808 1 mark: $\Delta H = -120$ kJ/mol (sign required)	3
3(b)	The energy released when new bonds form (2,808 kJ/mol) is greater than the energy absorbed when bonds break (2,688 kJ/mol), so energy is released overall.	1 mark: more energy released than absorbed 1 mark: supported by the values in (a)	2
3(c)	$q = mc \Delta T = 50.0 \times 4.18 \times 6.8 = 1,421$ J = 1.42 kJ; $\Delta H = -1.421/0.0250 = -56.8$ kJ/mol	1 mark: $q = 1,421$ J 1 mark: divided by 0.0250 mol 1 mark: -56.8 kJ/mol	3
3(d)	Heat loss to the surroundings; incomplete combustion or non-standard conditions.	1 mark: heat loss to surroundings 1 mark: incomplete combustion / non-standard conditions	2
4(a)	$\text{rate} = (0.060 - 0.015)/45 = 1.0 \times 10^{-3}$ mol dm ⁻³ s ⁻¹	1 mark: change = 0.045 mol dm ⁻³ 1 mark: 1.0×10^{-3} mol dm ⁻³ s ⁻¹ with units	2
4(b)	The concentration of reactants falls, so there are fewer collisions per unit time and fewer successful collisions with energy above the activation energy.	1 mark: concentration falls so collision frequency drops 1 mark: fewer collisions with $E \geq E_a$	2
4(c)	$72/24 = 3$ half-lives; $0.80 \rightarrow 0.40 \rightarrow 0.20 \rightarrow 0.10$ mol/dm ³	1 mark: three half-lives 1 mark: successive halving shown 1 mark: 0.10 mol dm ⁻³	3
4(d)	HI formed 0.780 mol, so 0.390 mol of each reactant reacted; at equilibrium $[H_2] = [I_2] = 0.500 - 0.390 = 0.110$ mol/dm ³ ; $K_c = 0.780^2/(0.110 \times 0.110) = 0.6084/0.0121 = 50.3$ (no units)	1 mark: 0.390 mol reacted 1 mark: equilibrium conc 0.110 mol dm ⁻³ 1 mark: correct K_c expression 1 mark: $K_c = 50.3$	4
4(e)	K_c decreases (equilibrium shifts in the endothermic direction).	1 mark: K_c decreases	1
5(a)	General formula C_nH_{2n} ; they contain a C=C double bond so the carbon atoms are not bonded to the maximum number of hydrogen atoms.	1 mark: C_nH_{2n} 1 mark: C=C present / not maximum number of hydrogens	2

5(b)	Major product: 2-bromobutane; reaction type: electrophilic addition.	1 mark: 2-bromobutane 1 mark: electrophilic addition	2
5(c)	C: $85.7/12.0 = 7.14$; H: $14.3/1.0 = 14.3$; ratio $7.14:14.3 = 1:2$, so empirical formula CH_2 (M_r 14.0); $56/14 = 4$, so molecular formula C_4H_8	1 mark: mol C = 7.14 1 mark: mol H = 14.3, ratio 1:2 1 mark: empirical formula CH_2 1 mark: molecular formula C_4H_8	4
5(d)	Add bromine water and shake: the alkene decolourises the orange bromine water, hexane does not.	1 mark: bromine water decolourised by alkene only	1
5(e)	The repeat unit is C_3H_6 , $M_r = 3 \times 12.0 + 6 \times 1.0 = 42.0$	1 mark: 42.0	1
6(a)	Each element down the group has one more occupied shell; increased shielding outweighs the greater nuclear charge, so the outer electrons are less strongly attracted and the radius increases.	1 mark: extra shell / more shielding 1 mark: weaker attraction from nucleus, radius increases	2
6(b)	Reactivity increases down the group; the first and second ionisation energies decrease, so less energy is needed to lose the two outer electrons.	1 mark: reactivity increases down the group 1 mark: lower ionisation energies / electrons lost more easily	2
6(c)	$\text{Mg(s)} + \text{H}_2\text{O(g)} \rightarrow \text{MgO(s)} + \text{H}_2\text{(g)}$	1 mark: correct equation with state symbols	1
6(d)	$n(\text{Mg}) = 0.240/24.3 = 9.88 \times 10^{-3} \text{ mol}$; $V(\text{H}_2) = 9.88 \times 10^{-3} \times 24.0 = 0.237 \text{ dm}^3 = 237 \text{ cm}^3$	1 mark: $n = 9.88 \times 10^{-3} \text{ mol}$ 1 mark: $0.237 \text{ dm}^3 / 237 \text{ cm}^3$	2
6(e)	Thermal stability increases down the group.	1 mark: thermal stability increases	1