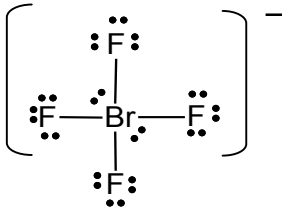
AS 90780 Assessment Schedule – 2008

Chemistry: Describe properties of particles and thermochemical principles (90780)

Evidence Statement

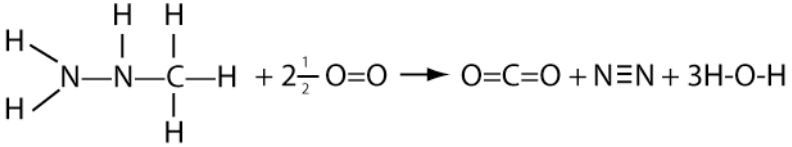
Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)(i)	$H^+ < H < H^-$	Correct order AND ONE reason.	Correct order AND BOTH reasons.	
(ii)	• because H^+ has no electron / has lost a shell / has lost an electron / is a bare proton • because H^- has more electrons: causing electron repulsions.			
(b)	• Sc $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$ / [Ar] $3d^1 4s^2$ • Br^- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$ / [Ar] $3d^{10} 4s^2 4p^6$ / [Kr] • Mn^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ / [Ar] $3d^5$	TWO correct.	THREE correct	

(c)(i)	• Br has greater nuclear charge / no. of protons • But same number of shells / energy levels OR • Br has greater effective nuclear charge (ENC) AND • Causing stronger attraction to the electrons.	• Nuclear charge / effective nuclear charge (ENC) is greater.	• ONE explanation is complete.	• BOTH explanations complete.
(ii)	• Br electrons closer to the nucleus / smaller radius / bromine is smaller OR • Br has greater nuclear charge / number of protons • But same number of shells / energy levels OR • Br has greater ENC than Sc, AND • causing stronger attraction to the electrons OR Same answer as above.			
TWO (a)	(i) tetrahedral (ii) square planar (iii) distorted tetrahedral / seesaw	• TWO correct.		

(b)	• A and B: symmetric • Polarities / dipoles / the effect of the polar bonds: cancel OR Centres of positive and negative charge coincide OR Symmetric / even distribution of charge about central atom. AND • C: asymmetric • Polarities reinforce OR centres of positive and negative don't coincide OR Asymmetric/uneven distribution of charge about central atom. OR • C: asymmetric arrangement of polar bonds • causes charge separation.	• Recognises different symmetries of molecules. OR • One type explained	• Explanation complete.	
(c)		• Diagram correct.		

(d) (i)(ii)	• Square planar or B (or follow on) • electron pairs repel • 6 electron clouds / pairs • 2 non-bonding / 4 bonding	• Correct choice of shape (i) OR atom (iii) • linked to number of electron clouds / pairs on central atom. Ie square planar – 6 charge clouds Se – 5 charge clouds Note: **follow on**: can be from TWO (a) if structure (b) has been incorrectly named OR from an incorrect structure for TWO (c).	Correct choice of shape AND atom linked to number of electron clouds / pairs on central atoms. OR (d)(i)(ii) correct OR (d)(iii) correct	All Correct
(iii)	• Se • Shape requires, 5 electron pairs / 4 bonding pairs … and 1 non-bonding pair • 4 Se electrons shared with F's / 4 F electrons shared with Se (may include structure as part of evidence for these) • 6 valence electrons on Z OR • Se • Need 5 electron pairs / clouds on central atom so total valence electrons must be 34. Total electrons from 4 F atoms is 28, (may include structure as part of evidence for these) • so central atom must have 6 valence electrons OR • Se • by elimination of other possibilities OR correct structure (but relevant supporting text must be correct)			
(e) (i)	• A has hydrogen bonding AND permanent dipole (PD) / temporary dipole (TD) : attractions • B has PD / TD : attractions • Hydrogen bonding is a stronger attraction	• Identifies two of the following inter-molecular relationships. A → H bonding B → TD or PD C → PD D → TD	• All of A → H bonding B → TD or PD attractions C → PD attractions D → TD attractions AND discussion of relative bond strengths OR • One pair as above plus a third relevant force (from evidence column).	• All of A → H bonding B → TD or PD attractions C → PD attractions D → TD attractions AND discussion of relative bond strengths AND a fifth relevant force (from evidence column).
(ii)	• C has PD / TD attractions : stronger • D has TD attractions (attractions = force = bond)			

THREE (a)	(i) $\frac{1}{2}\ O_2(g) + 2H_2(g)\ + N_2(g)\ + C(s)\ \rightarrow\ (NH_2)_2CO(s)$ (ii) $(NH_2)_2CO(s) \rightarrow\ (NH_2)_2CO(\ell)$	• (i) OR (ii) correct (including states)	• Both correct (including states)	
(b)	Desired Equation = EqA – $\frac{1}{2}$ EqB – 2EqC + 3EqD $(NH_2)_2CO(s) + 3\ \frac{1}{2}\ O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell) + 2NO_2(g)$ $\quad \Delta_rH = -632$ $2NO(g)\ +\ 3H_2O(g) \rightarrow\ 2NH_3(g)\ +\ 2\ \frac{1}{2}\ O_2(g) \quad \Delta_rH = +453$ $2NO_2(g) \rightarrow\ 2NO(g)\ +\ O_2(g) \quad \Delta_rH = +114$ $3H_2O(\ell) \rightarrow\ 3H_2O(g) \quad \Delta_{vap}H\ = +123$ $(NH_2)_2CO(s)\ +\ H_2O(l) \rightarrow\ CO_2(g)\ +\ 2NH_3(g)$ $\Delta_rH = \Delta_rH\ (\text{EqA}) - \frac{1}{2}\ \Delta_rH\ (\text{EqB}) - 2\Delta_rH\ (\text{EqC}) + 3\Delta_{vap}H(\text{EqD})$ $= -632 + \frac{1}{2}\ 906 + 2 \times 57 + 3 \times 41$ $= -632 + 453 + 114 + 123 = 58\ \text{kJ mol}^{-1}$	• Reactants and products correctly identified for all FOUR equations with states for H_2O OR • Calculation correct with one error.	• Numerical value correct	• Numerical value correct with sign and unit(s).

(c) (i), (ii)	(i) The energy required to break a bond (ii)  $\Delta_c H^O = \Sigma E_B(\text{reactants}) - \Sigma E_B(\text{products})$ $= 3E_B(N–H) + E_B(N–N) + E_B(N–C) + 3E_B(C–H) + 2.5\ E_B(O=O) - 2E_B(C=O) - E_B(N\equiv N) - 6E_B(O–H)$ $= 3\times391 + 163 + 286 + 3\times414 + 2.5\times498 - 2\times804 - 941 - 6\times463$ $= -1218$ kJ mol^{-1} (or heat released = 1218 kJ / kJ mol^{-1}) **Bonds broken** / **Bonds formed** 3N–H 391 × 3 = 1173 / 2C=O 804 × 2 = 1608 N–N 163 = 163 / N ≡ N 941 = 941 C–N 286 = 286 / 6O–H 463 × 6 = 2778 3C–H 414 × 3 = 1242 2 ½ O=O 498 × 2 ½ = 1245 Adds to = 4109 / Adds to = 5327	• Definition correct OR • Value for either bonds broken (4109) or bonds formed (5327).	• Definition correct AND Value of energy released = 1218 (ignore sign and units)	• Definition correct AND • calculation correct i.e. either $\Delta_c H°$ $= -1218$ kJ mol^{-1} OR heat released = 1218 kJ / kJ mol^{-1}

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Total of SIX opportunities answered at Achievement level or higher. 6 × A	Total of at least EIGHT opportunities answered with FOUR at Merit level or higher. 4 × M + 4 × A	Total of at least NINE opportunities answered with TWO at Excellence level and FOUR at Merit level or higher. 2 × E + 4 × M + 3 × A