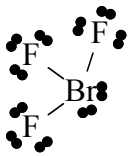
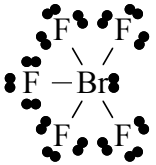
Assessment Schedule – 2007

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

Evidence Statement

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	K $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ **OR** [Ar]$4s^1$ ($1s^2 2s^2 p^6 3s^2 p^6 4s^1$ format OK) P^{3-} $1s^2 2s^2 2p^6 3s^2 3p^6$ **OR** [Ne]$3s^2 3p^6$ **OR** [Ar] Zn^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ **OR** [Ne]$3s^2 3p^6 3d^{10}$ **OR** [Ar]$3d^{10}(4s^0)$	THREE correct		
(b)	Cu^{2+} has partially filled d orbitals/subshell, Zn^{2+} d orbitals/subshell are full. Absorption of: visible light / light of certain colours: excites e- (Colour is due to d e^- being excited to higher energy d orbital on absorption of certain frequencies of visible light. The colour seen is the colour not absorbed.)	Either statement **OR** ONE ion accounted for	BOTH statements covered *(Difference fully explained)*	
(c)	$r(K^+) < r(K)$, K^+ has: 1 fewer shell/subshell/energy level $r(P^{3-}) > r(P)$ P^{3-} has: more valence e^- – causing greater e^- – e^- repulsion	TWO radius comparisons correct **OR** ONE comparison correct and accounted for.	TWO radius comparisons correct **AND** full explanations	

(d)	^{TP} – Electronegativity increases across a period ^{TG} – Electronegativity increases up a group From K to As: ^{P1} – Electronegativity increases because ^{P2} – nuclear charge increases (while shielding remains same) ^{P3} – causing increasing attraction to the nucleus From N to As: ^{G1} – Electronegativity decreases Because ^{G2} – (whilst nuchear charge and shielding increase at the same rate, electron shells are added and so) radii increase ^{G3} – causing decreasing attraction to the nucleus.	Statement of trends across period AND up or down group **ie TP + TG / P1 + G1** **OR** Partial explanation of one trend. **P1 + P2** **OR** **G1 + G2**	Statement of **TRENDS** across period AND up or down group **ie TP + TG / P1 + G1** **AND** Explanation of one trend **P2 + P3 / G2 + G3** **OR** Partial explanation of both trends ie element pairs, **P2 + G2** **TRENDS +** **P2 + P3 / G2 + G3** **OR** **TRENDS + P2+G2**	Full discussion of trends **P1 + P2 + P3** **AND** **G1 + G2 + G3**
TWO (a)(i) (a)(ii)	 T  (distorted) Square Pyramid	TWO correct structures OR ONE correct structure and its correct name	BOTH structures correct and their names correct	

TWO (b) S	[S1]AsF_3 is <u>trigonal pyramid</u> Shape [S2]Repulsion of four charge clouds around As: three bonding (or similar) [S3]AsF_5 is <u>trigonal bipyramid</u> Shape [S4]Repulsion of 5 charge clouds around As: all are bonding (or similar)	TWO shapes stated **OR** ONE shape accounted for **S1 + S3** or **S1 + S2** or **S3 + S4**	TWO molecule shapes **AND** explanation in terms of repulsion of regions of electron density around the central atom. **S1 + S2 + S3 + S4**	
(b) P	[P1]F different electronegativity than As: AsF bond polar. [P2]AsF_3 is Polar [P3] (Trigonal pyramid) molecule asymmetrical; <u>Polarities</u> of AsF bonds reinforce **OR** Centres of +ve and –ve charge do not coincide OR Asymetric/uneven distribution of charge about central atom. [P4]AsF_5 is Non - Polar [P5](Trigonal bipyramid) molecule symmetrical; <u>Polarities</u> of AsF bonds cancel. **OR** centres of +ve and –ve charge coincide OR Symmetric/even distribution of charge about central atom.	BOTH polarities stated. **OR** Bond polarity attributed to different electronegativities. **OR** Account relates symmetry and bond polarity to molecule polarity. **P1** or **P2 + P4** or **P2 + P3** or **P4 + P5**	Bond polarity attributed to different electronegativities. **AND** Account that relates symmetry and bond polarity to molecule polarity. **P1 + P2 + P3** or **P1 + P4 + P5**	Comprehensive discussion. **P1 + P2 + P3+P4 + P5**

THREE (a)	– HF has hydrogen bonding, – the strongest intermolecular force, – so has the highest BP – F_2 and HCl have (similar) temporary dipole (or similar) forces (as they have same number of electrons) – However HCl also has, permanent dipole forces (or similar) –- giving it a higher BP than F_2.	TWO of the following relationships identified HF ➔ H bonding HCl ➔ PD F_2 ➔ TD (and no incorrect relationships Incorrect: F_2: PD or HB etc HCl: HB or ionic or covalent).	Each molecule identified with an appropriate inter-molecular force. (and no incorrect ones) **AND** ONE comparison made.	Comprehensive discussion relating relative BPs to intermolecular forces for all THREE molecules.
(b)(c)(i)	$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$ $\Delta_r H^o = \sum BE\ (reactants) - \sum BE\ (products)$ $= \frac{1}{2} BE\ (H_2) + \frac{1}{2} BE(Cl_2) - BE(HCl)$ $= \frac{1}{2} 436 + \frac{1}{2} 242 - 431$ $= -92\ kJ\ mol^{-1}$	Equation correct (states required) **OR** Using incorrect equation, correct process with one minor error.	Equation Correct Correct process with one minor error. *(units not required.)* **OR** Using incorrect equation, correct process.	Equation correct $-92\ kJ\ mol^{-1}$ *(Correct value of $\Delta_r H°$ with units.*
(c)(ii)	$Mr(HBr) = 80.9$ $n(HBr) = \frac{m}{M} = \frac{50.0\ g}{80.9\ g\ mol^{-1}} = 0.618\ mol$ heat(50.0 g HBr) = $n\Delta_f H°$ (HBr) $= 0.618\ mol \times 36.2\ kJ\ mol^{-1}$ $= 22.4\ kJ$	0.617 – 0.618 mol Correct numerical value for heat.	22.3 to 22.4 kJ (**OR** –22.3 to –22.4 kJ) *(Correct value with unit.)*	

FOUR	Desired Equation: $C_2H_2(g) + 2\frac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$ $\Delta_cH^o = \sum\Delta_fH°\ (products) - \sum\Delta_fH°(reactants)$ $= 2\Delta_fH°\ (CO_2)+\Delta_fH°\ (H_2O)\ -\Delta_fH°\ (C_2H_2)-\Delta_fH^o(O_2)$ $= 2 \times (-393) + (-285) - (+229) - 0$ $= -1300\ kJ\ mol^{-1}$ OR Desired Equation: $C_2H_2(g) + 2\frac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l) \quad \Delta_cH^o = ?$ I: $2C(s) + H_2(g) \rightarrow C_2H_2(g) \quad \Delta_rH°(I) = 229\ kJ\ mol^{-1}$ II: $H_2(g) + -O_2(g) \rightarrow H_2O(l) \quad \Delta_rH°\ (II) = -285\ kJ\ mol^{-1}$ III: $C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta_rH°(III) = -393\ kJ\ mol^{-1}$ -I: $C_2H_2(g) \rightarrow \cancel{2C(s)} + \cancel{H_2(g)} \quad -\Delta_rH°(I) = -229\ kJ\ mol^{-1}$ II: $\cancel{H_2(g)} + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta_rH°(II) = -285\ kJ\ mol^{-1}$ 2III: $\cancel{2C(s)} + 2O_2(g) \rightarrow 2CO_2(g) \quad 2\Delta_rH°\ (III) = -786\ kJ\ mol^{-1}$ $C_2H_2(g) + 2\frac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)\ \Delta_cH° = -1300\ kJ\ mol^{-1}$	Combustion eq. correct (states not required). **OR** Error in combustion equation and follow on calculation has one minor error.	Combustion eq. correct (states not required). **AND** Applies Hess' Law with one minor error AND OR no units. **OR** Error in combustion equation and correct follow on calculation. **OR** Unit error in value.	$-1300\ kJ\ mol^{-1}$ *(Correct value of $\Delta_cH°$ with units. 2 – 4 SF)*

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
SIX opportunities answered at Achievement level (or higher). Minimum of $6 \times A$	EIGHT opportunities answered including at least FIVE at Merit level (or higher) and THREE at Achievement level (or higher). Minimum $5 \times M + 3 \times A$	NINE opportunities answered including at least THREE at Excellence level plus THREE at Merit level (or higher) and THREE at Achievement level (or higher). Minimum $3 \times E + 3 \times M + 3 \times A$