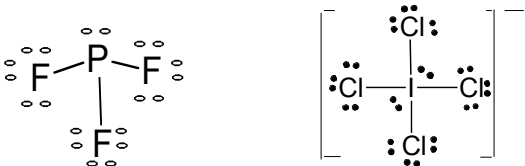


Assessment Schedule – 2006

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

Evidence Statement

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	Cl^- is larger or Ca^{+2} smaller. Both have same number of shells or electron arrangement. Ca^{2+} has more protons or nuclear charge is greater, so the electrostatic attraction between the valence electrons and the nucleus is stronger, making Ca^{2+} smaller.	Correct size.	Size and explanation correct.	
1(b)(i)	Energy required to remove the outermost electron from one mole of gaseous atoms OR $\text{Cl(g)} \rightarrow \text{Cl}^+(\text{g}) + \text{e}^-$	Either statement or equation correct. States are included.		
1(b)(ii)	$\text{Ca} < \text{Mg} < \text{Cl}$ Ionisation energies increase across the table or decrease down the group. <ul style="list-style-type: none"> Ca has the greatest number of electron shells, so its electrons are further from the nucleus, so less energy is required to remove a valence electron. Ca also has greater shielding effect of an additional shell between the valence shell and the nucleus, so less energy is required to remove the outermost electron. Mg and Cl have same number of shells, but Cl has greater nuclear charge or number of protons in the nucleus, so greater electrostatic attraction between nucleus and valence electrons. 	Correct order. OR Correct statement of trends across and down the table. OR One valid argument on order of ionisation energies.	Correct order and one valid argument presented.	Ionisation energies justified for all three using all three bullet points in a coherent logical argument.
2(a)(i)		Valence electrons correct for both molecules OR One Lewis diagram correct.	BOTH Lewis diagrams correct.	
2(a)(ii)	BF_3 trigonal planar (triangular) PF_3 trigonal pyramid (triangular) ICl_4^- square planar	Two valid shapes		

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
2 (b)	<p>BF₃ is non-polar. B and F have different electronegativities so the B–F bond is polar covalent. The shape of the molecule (trigonal pyramid) is symmetrical about the central B atom, so bond dipoles cancel/add to zero to give no net dipole or symmetric distribution of charge about the central atom.</p> <p>PF₃ is polar. P and F have different electronegativities so the P–F bond is polar covalent. The shape of the molecule (trigonal pyramid) so the molecule is asymmetrical about the central P atom, so the P–F bond dipoles add to give a net dipole or there is an asymmetric distribution of charge about the central atom.</p>	<p>Correct polarities for both stated. OR Correct polarity for one with explanation.</p>	<p>Correct polarities for both stated, with an explanation regarding symmetry or electronegativity.</p>	<p>Correct polarities stated, and differing electronegativities explained with a comprehensive justification of the polarities for each molecule.</p>
3(a)	<p>Cr $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$ OR [Ar] $4s^1 3d^5$ OR [Ar] $3d^5 4s^1$ Mn $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$ OR [Ar] $4s^2 3d^5$ OR [Ar] $3d^5 4s^2$ Mn²⁺ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ OR [Ar] $3d^5$</p>	Two correct.		
3(b) and (c)	<p>Mn and Cr have partially filled <i>d</i> sub-shell or sublevel.</p> <p>Mn and Cr can form stable compounds (species) with oxygen by losing or sharing various numbers of $4s^2$ and $3d^5$ electrons.</p> <p><i>d–d</i> electron transitions can occur/<i>d</i> electrons can be excited into a higher energy orbital by absorbing light in the visible region of the spectrum.</p>	<p>Mn and Cr have partially filled <i>d</i> subshell or sublevel. OR They can form stable compounds by losing or sharing various numbers of $4s$ and $3d$ electrons. OR <i>d–d</i> electron transitions can occur. OR Absorbs light in the visible region of the spectrum.</p>	<p>Correct explanation for both, with link to partially filled subshell. Eg, partially filled <i>d</i> subshell sublevel which can form stable compounds by losing or sharing various numbers of $4s$ and $3d$ electrons. AND <i>d–d</i> electron transitions which absorb light in the visible region.</p>	

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
4	<p>Ethanal, propanal and butanal are all aldehydes. They all have weak intermolecular or permanent dipole forces attracting molecules together. $\Delta_{\text{vap}}H^\circ$ increases from ethanal to butanal due to increasing M / electron numbers. The greater the M / electron numbers the greater the strength of intermolecular or temporary dipole forces.</p> <p>Ethanoic acid has an H atom bonded to an O atom so can form H-bonding between molecules.</p> <p>H bonding is a stronger intermolecular attraction compared to temporary and permanent dipole forces between the aldehydes.</p>	<p>Identifying H-bonding with ethanoic acid and any weak intermolecular attraction involved.</p> <p>OR</p> <p>Identifying of H-bonding in ethanoic acid and explaining that there is a difference in electronegativity between O and H.</p> <p>OR</p> <p>Relating increase in MW to increase in $\Delta_{\text{vap}}H^\circ$.</p>	<p>Identifying H-bonding with ethanoic acid and any weak intermolecular attraction involved.</p> <p>AND</p> <p>Explaining presence of H-bonding in ethanoic acid using a difference in electronegativity.</p> <p>AND ONE OF</p> <p>H-bond stronger than other intermolecular forces of attraction.</p> <p>OR</p> <p>Explaining trend in $\Delta_{\text{vap}}H^\circ$ of aldehydes by relating molecular mass to strength of intermolecular forces.</p>	<p>Comprehensive analysis and explanation of trends in the table.</p> <p>Explain temporary dipoles and the effect of increasing mass.</p> <p>Explain H bonding and how it occurs in ethanoic acid.</p> <p>Compare the strength H bonding weak intermolecular attractions.</p> <p>Explain how these attractions affect $\Delta_{\text{vap}}H^\circ$</p>
5(a)	$\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)$	Correct. States must be included.		
5(b)	$\Delta_f H^\circ (\text{H}_2\text{O}, \ell)$ value applies to $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)$ or stated in words. Same reaction as $\Delta_c H^\circ (\text{H}_2, \text{g})$ so same energy values for both.	Identifies reactions or equations as the same.	Answer clearly shows reactions or equations are same and that the species are in the same state for both reactions.	
(c)(i)(ii)	<ul style="list-style-type: none"> $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{s})$ $\text{H}-\text{H} + \frac{1}{2} \text{O}=\text{O} \rightarrow 2 \times \text{H}-\text{O}$ $\Delta_f H = 436 + \frac{1}{2} (498) - 2 (463)$ $\Delta_f H = -241 \text{ kJ mol}^{-1}$ $\Delta_{\text{vap}} H^\circ (\text{H}_2\text{O}) = \Delta_f H^\circ (\text{H}_2\text{O}, \text{g}) - \Delta_f H^\circ (\text{H}_2\text{O}, \ell) = -241 - (-286)$ $= 45 \text{ kJ mol}^{-1}$ $M(\text{H}_2\text{O}) = 18 \text{ g mol}^{-1}$ Heat required to vaporise 100 g water = $45/18 \times 100$ $= 250 \text{ kJ}$ 	<p>Correct equation for $\Delta_f H^\circ (\text{H}_2\text{O}, \text{g})$ and must include states.</p> <p>OR</p> <p>Correct application of $\Sigma_{\text{bonds broken}} - \Sigma_{\text{bonds formed}}$</p> <p>OR</p> <p>Correct deduction of $\Delta_{\text{vap}} H^\circ (\text{H}_2\text{O})$</p>	<p>Two of the processes correct.</p> <p>OR</p> <p>One correct answer and correct process for other two bulleted calculations.</p>	All correct and answers must include units and process.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
5(d)	$\text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(\text{g}) \rightarrow 3\text{H}_2\text{O}(\ell) + 2\text{CO}_2(\text{g})$ $3 \times \Delta_f H^\circ(\text{H}_2\text{O}, \ell) + 2 \times \Delta_f H^\circ(\text{CO}_2, \text{g}) - \Delta_f H^\circ(\text{C}_2\text{H}_5\text{OH}, \ell) = -1367 \text{ kJ}$ $\Delta_f H^\circ(\text{C}_2\text{H}_5\text{OH}, \ell) = -858 - 788 + 1367$ $= -279 \text{ kJ mol}^{-1}$ <p>Alternative Using Hess Law</p> $\text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(\text{g}) \rightarrow 3\text{H}_2\text{O}(\ell) + 2\text{CO}_2(\text{g}) \quad \Delta_c H^\circ = -1367 \text{ kJ mol}^{-1}$ <p>hence</p> $\text{x2 } \text{C} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta_f H^\circ = -788 \text{ kJ mol}^{-1}$ $\text{x3 } \text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell) \quad \Delta_f H^\circ = -858 \text{ kJ mol}^{-1}$ $\text{reverse } 3\text{H}_2\text{O}(\ell) + 2\text{CO}_2(\text{g}) \rightarrow \text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(\text{g}) \quad \Delta_c H^\circ = +1367 \text{ kJ mol}^{-1}$ <p>hence $\Delta_f H^\circ(\text{C}_2\text{H}_5\text{OH}, \ell) = -279 \text{ kJ mol}^{-1}$</p>	<p>Correct equation for combustion of $\text{C}_2\text{H}_5\text{OH}(\ell)$ OR Calculated using correct process but wrong balanced equation for combustion reaction, and no units in answer.</p>	<p>Clear method and correct equation. Calculation correct but has one mathematical error and /or no units.</p>	<p>Clear method and Calculation correct including units.</p>

Judgement Statement

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

Achievement	Achievement with Merit	Achievement with Excellence
SEVEN questions answered correctly. Minimum of $7 \times \text{A}$	EIGHT questions answered correctly, including at least FIVE at Merit level. Minimum of $5 \times \text{M} + 3 \times \text{A}$	TEN questions answered correctly, including at least FOUR at Merit level and at least THREE at Excellence level. Minimum of $3 \times \text{E} + 4 \times \text{M} + 3 \times \text{A}$