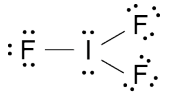
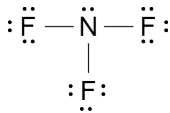


**Assessment Schedule – 2011****Chemistry: Describe properties of particles and thermochemical principles (90780)****Evidence Statement**

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	Fe [Ar] 3d <sup>6</sup> 4s <sup>2</sup> Al [Ne] 3s <sup>2</sup> 3p <sup>1</sup> Al <sup>3+</sup> [Ne] Na [Ne] 3s <sup>1</sup>	TWO of:  THREE correct from (a).	TWO of:  FOUR correct from (a).	
(b)	Al has the larger radius. • Al <sup>3+</sup> has lost 3 electrons / valence shell. • This means that there is one less energy level than in Al. • The remaining electrons are drawn closer by nuclear charge / nuclear attraction greater causing smaller size.	OR  Correct radii identified to be largest. With one of first two bullet points.	AND/OR  Correct radii identified to be largest. With fully correct explanation.	
(c)(i)	Li(g) → Li <sup>+</sup> (g) + e <sup>-</sup>	OR Li(g) → Li <sup>+</sup> (g) + e <sup>-</sup> (states needed)		

(c)(i)(ii)	<ul style="list-style-type: none"> <li>• As you move across a period from Li to Ne, the ionisation energies increase. Electrons are added to the same valence shell / the same distance from the nucleus. Extra protons in the nucleus increase the nuclear charge, so the electrons in the valence shell are held more tightly and ionisation energy is greater.</li> <li>• As you go down a group, ionisation energy decreases. This is due to a new energy level being added, which is further from the nucleus. Electrons can be removed more easily and the ionisation energy is less/shielding increase explained</li> <li>• The drop Be and B is due to B having 1 electron in the p subshell (<math>2p^1</math>) and Be being <math>2s^2</math>. Although B has a greater nuclear charge, the electron in the p-subshell is further from the nucleus/has less stability. Thus the p-electron in B's valence shell is not held so tightly/is more easily removed.</li> <li>• Drop N – O N has 1/2 full subshell (<math>2p^3</math>) and O 1 more electron giving it a partly full subshell (<math>2p^4</math>). added electron going into suborbital already occupied by an electron – increased electron electron repulsion so makes electron more easily removed / partly full subshell less stable so electron more easily removed</li> </ul>	<p>OR</p> <p>Recognises that ionisation energy increases across a period AND decreases down a group. (Mentioned or implied.)</p> <p>OR</p> <p><b>Links</b> increasing OR decreasing ionisation energy <b>to</b> increase in protons / energy levels / shielding (explained) down group.</p>	<p>AND</p> <p>Increase across period OR decrease down group fully explained</p> <p>OR</p> <p>Increase AND decrease partly explained</p> <p>OR</p> <p>Correctly links dip between Be and B or N and O to s and p sub-energy (sub-shell) level.</p>	<p>Links increase <b>and</b> decrease of ionisation energies to correct explanation.</p> <p>AND</p> <p>Acceptable explanation of dip between Be and B. (must refer to electron arrangements of both)</p> <p>OR</p> <p>Acceptable explanation of the dip between N and O. (Must refer to electron arrangements of both.)</p> <p>*if electron arrangement penalised in (a) not penalised again in (c)</p>
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<p>TWO (a)</p>	<p>IF<sub>3</sub> = T-shape</p>  <p>NF<sub>3</sub> = Trigonal pyramid</p> 	<p>TWO of</p> <p>ONE correct Lewis diagram and a correct shape name. OR TWO correct diagrams. OR TWO correct shape names.</p>	<p>TWO correct Lewis diagrams and at least ONE shape name.</p>	<p>TWO correct Lewis diagrams AND at least ONE shape name.</p>
<p>(b)</p>	<p><b>IF<sub>5</sub></b></p> <ul style="list-style-type: none"> <li>• polar IF bond due to difference in electronegativity between I and F</li> <li>• molecule asymmetrical</li> <li>• bond dipoles do not cancel/centre of +ve and -ve charges correspond</li> <li>• molecule is polar.</li> </ul> <p><b>PCl<sub>5</sub></b></p> <ul style="list-style-type: none"> <li>• polar PCl bond due difference in electronegativity between P and Cl</li> <li>• molecule symmetrical</li> <li>• bond dipoles cancel / centre of +ve and -ve charges correspond</li> <li>• molecule is non-polar.</li> </ul> <p>• <b>**note shapes not needed</b></p>	<p>OR</p> <p>Both polarities correct.</p> <p>OR</p> <p>Recognises polarity of bonds and relationship of polarity to shape / symmetry.</p> <p>OR</p> <p>Partial explanation of ONE with correct polarity and symmetry.</p>	<p>AND</p> <p>Both polarities correct. AND full discussion of ONE molecule (all bullet points). OR partial discussion of TWO (one bullet point missed – same for both).</p>	<p>AND</p> <p>Correct discussion for both molecules (all bullet points correct for both).</p>

THREE (a)	The energy required to change (energy change) when 1 mole of a substance in its liquid phase changes into a gas (not molecules or compounds)	TWO of  Correct definition.		
(b)	<p><b>H<sub>2</sub>O</b></p> <ul style="list-style-type: none"> <li>• has hydrogen bonding because it has H joined to atom of high electronegativity, causing attraction of H to O on another molecule</li> <li>• strongest of the <b>intermolecular forces</b></li> <li>• <b>more energy</b> needed to break these bonds than other intermolecular forces, therefore higher boiling point.</li> </ul> <p><b>H<sub>2</sub>S to H<sub>2</sub>Te</b></p> <ul style="list-style-type: none"> <li>• going down a group molecules have greater molar mass/ more electrons</li> <li>• stronger temporary dipoles / instantaneous dipoles / London's forces</li> <li>• <b>more energy</b> required to break bonds, therefore higher boiling point.</li> <li>• As the electronegativities of S &gt; Se &gt; Te decrease down the group, the permanent dipole-dipole interactions will decrease, so boiling points would be expected to decrease. However, as the mass increases, the temporary dipole interactions play a greater role and thus the boiling points increase.</li> </ul>	<p>Recognises that hydrogen bonding is involved with water (must imply between molecules).</p> <p>OR</p> <p>Recognises that increased molar mass/more electrons = stronger temporary dipoles.</p>	<p><b>Complete explanation for either</b></p> <p>high value for H<sub>2</sub>O because of H bonding (3 H<sub>2</sub>O bullet points) and must compare with other molecules</p> <p>OR</p> <p>change from H<sub>2</sub>S to H<sub>2</sub>Te because of temporary dipole changes (3 H<sub>2</sub>S – H<sub>2</sub>Te bullet points) –must have comparison</p> <p>OR</p> <p>TWO partial explanations. (2 bullet points for each)</p>	<p><b>Comprehensive</b> discussion of <b>both</b> H bonding comparison <b>and</b> temporary dipole comparison (3 bullet points for each)</p>
(c)	$\Delta_r H = \sum \Delta_f H^\circ (\text{products}) - \sum \Delta_f H^\circ (\text{reactants})$ $= [(2 \times -394) + (3 \times -286)] - [-277]$ $= -1646 + 277$ $= -1\ 369 \text{ kJ mol}^{-1}$	Process that could lead to a correct answer, ie. ONE line of calculation correct.	Correct calculation, with units.	

FOUR (a)	$\Delta_f H^\circ(\text{CO}_2(\text{g}))$ is equal to the enthalpy change for the reaction in which one mole of $\text{CO}_2(\text{g})$ is formed from its elements in their standard state. $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ This is also the equation for $\Delta_c H^\circ(\text{C}(\text{s}))$ , the combustion of one mole of carbon under standard conditions.	TWO of:  ONE correct answer with limited reasoning.  Eg. Process / reactions the same.	TWO of:  Same because both involve the same reaction. Reaction given as words or equation.													
(b)	Enthalpy change = $\sum$ bonds broken – $\sum$ bonds formed  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Bonds broken</th> <th style="text-align: left; border-bottom: 1px solid black;">Bonds formed</th> </tr> </thead> <tbody> <tr> <td>C – H <math>413 \times 6 = 2478</math></td> <td>C=O <math>745 \times 4 = 2980</math></td> </tr> <tr> <td>C – O <math>358 \times 2 = 716</math></td> <td>O–H <math>463 \times 8 = 3704</math></td> </tr> <tr> <td>O – H <math>463 \times 2 = 926</math></td> <td></td> </tr> <tr> <td>O = O <math>498 \times 3 = 1494</math></td> <td></td> </tr> <tr> <td style="text-align: right;"><u>+5614</u></td> <td style="text-align: right;"><u>– 6684</u></td> </tr> </tbody> </table> $\Delta_r H = -1070 \text{ kJ mol}^{-1}$  OR  Bonds broken = 4688      Bonds formed = 5758	Bonds broken	Bonds formed	C – H $413 \times 6 = 2478$	C=O $745 \times 4 = 2980$	C – O $358 \times 2 = 716$	O–H $463 \times 8 = 3704$	O – H $463 \times 2 = 926$		O = O $498 \times 3 = 1494$		<u>+5614</u>	<u>– 6684</u>	Ie, equation – needs to have $\sum$ if has equation only  OR  Correct answer but wrong sign.  OR  EITHER bonds broken OR bonds formed identified or calculated correctly.	Correct answer with no working  OR Correct method with minor number transcription error (ie some calculator error with correct numbers).  OR Correct answer with wrong / no unit.	Answer correct with some calculation done. With correct units.
Bonds broken	Bonds formed															
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(c)(i)	<b>(a) <math>\text{C}_3\text{H}_6 + 4.5 \text{O}_2 \rightarrow 3\text{CO}_2 + 3\text{H}_2\text{O}</math></b>  <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="padding-right: 20px;"><math>\text{C}_3\text{H}_6 + \text{H}_2 \rightarrow \text{C}_3\text{H}_8</math></td> <td style="text-align: right;">–124</td> </tr> <tr> <td>(b) <math>\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}</math></td> <td style="text-align: right;">–2220</td> </tr> <tr> <td>(c) <math>\text{H}_2\text{O} \rightarrow \frac{1}{2} \text{O}_2 + \text{H}_2</math></td> <td style="text-align: right;">+286</td> </tr> <tr> <td style="border-top: 1px solid black;"><math>\text{C}_3\text{H}_6 + 4.5\text{O}_2 \rightarrow 3\text{CO}_2 + 3\text{H}_2\text{O}</math></td> <td style="text-align: right; border-top: 1px solid black;">–2058 <math>\text{kJ mol}^{-1}</math></td> </tr> </tbody> </table>	$\text{C}_3\text{H}_6 + \text{H}_2 \rightarrow \text{C}_3\text{H}_8$	–124	(b) $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$	–2220	(c) $\text{H}_2\text{O} \rightarrow \frac{1}{2} \text{O}_2 + \text{H}_2$	+286	$\text{C}_3\text{H}_6 + 4.5\text{O}_2 \rightarrow 3\text{CO}_2 + 3\text{H}_2\text{O}$	–2058 $\text{kJ mol}^{-1}$	Combustion equation (a) correct          Provides a valid reason for the discrepancy in the results. AND Suggests an improvement.	OR All three equations (a, b, c) written with numbers. (Equation (c) may be reversed.)   Units not required as given in question.	AND Calculation correct, must have equations correct and correct working (not just worked out way numbers add up correctly). Units not required as given in question.				
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(ii)	Conditions were not standard. Carry out under standard conditions. Heat lost to atmosphere / beaker / by evaporation. Insulate equipment, ensure all / as much as possible, of the energy produced is collected and measured. Not complete combustion – make sure $\text{O}_2$ supply sufficient for complete combustion.															

**Judgement Statement**

<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
<b>3 A</b>	<b>3 M</b> <i>OR</i> <b>1 E + 1 M + 2 A</b>	<b>3 E</b> <i>OR</i> <b>2 E + 2 M</b>

