

SECTION B

Question			Answer	Marks	Guidance
16	(a)	(i)	(enthalpy change when) 1 mole of gaseous ions react OR 1 mole of hydrated/aqueous ions are formed ✓ gaseous ions dissolve in water OR gaseous ions form aqueous/hydrated ions ✓	2	IGNORE 'energy released' OR 'energy required'
	(a)	(ii)	<p> $\text{Ca}^{2+}(\text{g}) + 2\text{F}^{-}(\text{g})$ ✓ $\text{Ca}^{2+}(\text{aq}) + 2\text{F}^{-}(\text{g})$ ✓ $\text{Ca}^{2+}(\text{aq}) + 2\text{F}^{-}(\text{aq})$ ✓ $\text{CaF}_2(\text{s})$ ✓ </p>	4	<p>Correct species AND state symbols required for each mark. (mark independently)</p> <p>On 2nd line, ALLOW $\text{Ca}^{2+}(\text{g}) + 2\text{F}^{-}(\text{aq})$ (i.e. F^{-} hydrated before Ca^{2+})</p> <p>On 3rd line, ALLOW $\text{CaF}_2(\text{aq})$</p> <p>DO NOT ALLOW when first seen but ALLOW ECF for '2' missing and for use of the following ions Fl^{-} F_2^{-} Ca^{+3+}</p>

Question		Answer	Marks	Guidance
(a)	(iii)	<p>FIRST, CHECK THE ANSWER ON ANSWER LINE IF answer = $-504 \text{ (kJ mol}^{-1}\text{)}$ award 2 marks IF answer = $-1008 \text{ (kJ mol}^{-1}\text{)}$ award 1 mark -----</p> <p>$2 \times \Delta_{\text{hyd}}H(\text{F}^-)$ $= [-2630 + 13] - (-1609)$ OR $-2617 + 1609$ OR $-1008 \text{ (kJ mol}^{-1}\text{)}$ ✓</p> <p>$\Delta_{\text{hyd}}H(\text{F}^-) = \frac{-1008}{2} = -504 \text{ ✓ (kJ mol}^{-1}\text{)}$</p>	2	<p>IF alternative answer, check to see if there is any ECF credit possible using working below.</p> <p>'-' sign is needed.</p> <p>COMMON ERRORS for 1 mark: $(+)$2694: <i>signs all reversed</i> -2113: <i>sign wrong for -1609</i> -2126: <i>sign wrong for 2630</i> -517: <i>sign wrong for 13</i> $+504$: <i>sign wrong</i></p> <p>IF ALL 3 relevant values from the information at the start of Q16a(iii) have NOT been used, award zero marks unless one number has a transcription error, where 1 mark can be awarded ECF</p>
(a)	(iv)	<p>Correct comparison of Δ_{hyd} linked to sizes $\Delta_{\text{hyd}}H(\text{F}^-)$ more negative/exothermic (than $\Delta_{\text{hyd}}H(\text{Cl}^-)$) AND F^- has smaller size (than Cl^-) ✓</p> <p>Comparison of attraction between ions and water F^- OR smaller sized ion linked to greater attraction to H_2O ✓</p>	2	<p>ORA IGNORE 'atomic' before radius when comparing size of ions IGNORE charge density</p> <p>IGNORE electronegativity IGNORE nuclear attraction DO NOT ALLOW 'forms stronger hydrogen bonds with water' OR 'forms stronger van der Waals' forces with water' ALLOW 'forms bonds' for attraction' DO NOT ALLOW F^- greater attraction to H_2O if given as larger ion Assume 'F' / 'Fluorine' means 'ions' but DO NOT ALLOW 'F molecules'</p>

Question		Answer	Marks	Guidance
	(b) (i)	<p>Average bond enthalpy</p> <p>Breaking of one mole of bonds ✓</p> <p>In gaseous molecules ✓</p>	2	<p>IGNORE energy required OR energy released IGNORE heterolytic / homolytic</p> <p>DO NOT ALLOW bonds formed</p> <p>DO NOT ALLOW ionic bonds</p> <p>IGNORE species for molecules</p>
	(b) (ii)	<p>FIRST, CHECK ANSWER ON ANSWER LINE</p> <p>IF answer = (+) 158 award 3 marks</p> <p>-----</p> <p>Bond enthalpy of F–F</p> <p>(ΔH for (O–H) bonds broken =) 1856 OR 4×464 (kJ mol⁻¹) ✓</p> <p>(ΔH for bonds made =) 2770 (kJ mol⁻¹) OR 498 AND 2272 (kJ mol⁻¹) OR 498 AND 4×568 (kJ mol⁻¹) ✓</p> <p>(bond enthalpy) F–F = $\frac{2770 - 1856 - 598}{2}$ = (+)158 (kJ mol⁻¹) ✓</p>	3	<p>ANNOTATE ANSWER WITH TICKS AND CROSSES</p> <p>IGNORE sign</p> <p>IGNORE sign</p> <p>ALLOW ECF</p> <p>Common errors</p> <p>Award 2 marks for; –158 (Wrong sign) (±)316 (No ÷ 2) (+) 622 (use of 2 x 464) (+) 457 (omitting – 598) (+) 756 (use of +598)</p> <p>Award 1 mark for; (+) 970 (use of 2 x 464 and +598)</p>
		Total	15	