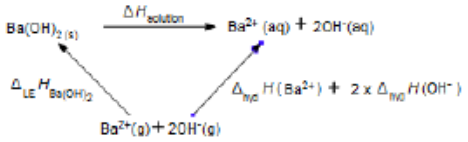
Lattice Energy - Mark Scheme

Q1.

Question number	Answer		Additional guidance	Mark
(a)(i)	• R = $O^{2-}(g)$	(1)		2
	• W = first electron affinity O(g)	(1)	Allow alternative ways to express electron affinity, e.g. EA State required Do not allow O_2/O^-	

Question number	Answer		Additional guidance	Mark
(a)(ii)			Example of calculation:	3
	• correct application of cycle	(1)	$\Delta_f H$ (BaO(s)) = $\Delta_{at}H$(Ba(s))+$\Delta_{at}H$(½O_2(g))+ I^{st} IE (Ba)(g) +2^{nd} IE (Ba(g))+2^{nd} EA (O(g))+1^{st} EA (O(g)) +$\Delta_{LE}H$ (BaO(s)) or Correct numbers = 180.0+249.2+503+965+798−141.1−3054	
	• correct value	(1)	(−)499.9/(−)500 (kJ mol^{-1})	
	• correct sign and units	(1)	Allow TE from incorrect application of cycle Allow TE for incorrect numbers Correct answer with no working scores 3	

Question number	Answer		Additional guidance	Mark
(a)(iii)	• ionic radius of Ba^{2+} >> ionic radius of Mg^{2+}/(have) lower charge density **and** Ba^{2+} (ions are) less polarising/(have) lower charge density	(1)	Allow reverse argument	3
	• iodide ions/I^- are large **and** their electron clouds are easily distorted/polarised (by Group 2 cations) or oxide ions/O^{2-} are small(er) **and** their electron clouds are less easily distorted/polarised	(1) (1)		
	• more distortion/covalency leads to greater difference between theoretical and experimental values			

Question number	Answer		Additional guidance	Mark
(b)(i)			Do not allow energy profile or energy level diagrams	4
	• all arrows in the correct direction	(1)	Species at each corner must be approximately correct	
	• correct formulae at each corner and enthalpies of hydration, and solution and LE correctly identified	(1)	Allow missing minor detail: brackets, position of subscripts, etc. but not absence of subscripts	
	• correct expression or correct substitution of values	(1)	Example of calculation: $\Delta_{sol}H = (\Delta_{hyd}H\ (Ba^{2+}) + 2\Delta_{hyd}H(OH^-)) -$ LE $(Ba(OH)_2)$ or $= (-1360 + (2 \times -460)) - (-2230)$	
	• correct evaluation	(1)	$= -50$ (kJ mol^{-1}) Allow TE from their cycle if $\Delta_{hyd}H(OH^-)$ is not doubled	

Question number	Answer		Additional guidance	Mark
b(ii)	• entropy (change) of system/ΔS_{system}/$\Delta S_{dissolving}$ is large and positive (and outweighs negative $\Delta S_{surroundings}$ ($-\Delta H/T$))	(1)		2
	• overall entropy change/ΔS_{total} is positive	(1)		
	or			
	• use of $\Delta S_{total} = \Delta S_{surroundings} + \Delta S_{system}$	(1)		
	• $\Delta S_{total} = \Delta S_{surroundings} + (-\Delta H/T)$	(1)	Allow use of ΔG	