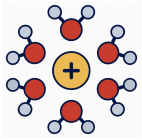
Solution and Hydration Map

Cambridge International AS & A Level Chemistry · Topic 23 Enthalpies of solution and hydration

1 Solution and hydration

23.2.1

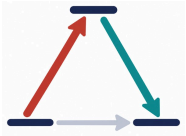
- ΔH_{sol}: **1 mol of solid** → infinitely dilute
- ΔH_{hyd}: **1 mol of gaseous ions** → aq
- Hydration always **exothermic**
- δ− O to cations, δ+ H to anions



2 The solution cycle

23.2.2, 23.2.3

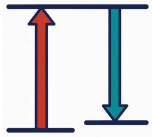
- **$\Delta H_{sol} = -\Delta H_{latt} + \Sigma\Delta H_{hyd}$**
- Break the lattice ($-\Delta H_{latt}$, up)
- Hydrate **every** ion (down)
- Small difference of large numbers

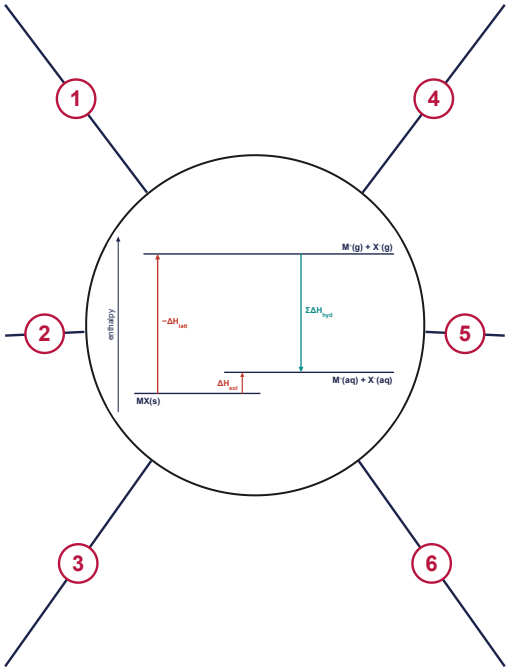


3 Energy level diagrams

23.2.2, 23.2.3

- Gaseous ions at the **top**
- Aqueous ions **above** solid: endothermic
- Aqueous ions **below** solid: exothermic
- Arrows to scale where possible

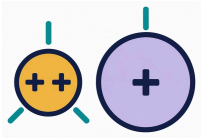




4 Charge and radius

23.1.5, 23.2.4

- **Smaller** ions: more exothermic
- **Higher charge**: much more exothermic
- Charge density = charge ÷ size
- Charge beats radius



5 Group 2: the balance

27.1.2

- Down the group **both** terms fall
- Larger cation: ions further apart (ΔH_{latt})
- and a weaker pull on water (ΔH_{hyd})
- The one that **falls faster** decides



6 Group 2 trends

27.1.2

- Hydroxides: **more soluble** down
- Sulfates: **less soluble** down
- Small OH^-: ΔH_{latt} falls faster
- Large SO_4^{2-}: hydration falls faster



Hydration enthalpies: charge and radius

data-book values; radii in pm

Ion	Charge	Radius / pm	ΔH_{hyd} / kJ mol^{-1}
Li^+	1+	76	−519
K^+	1+	138	−322
Ca^{2+}	2+	100	−1650
Ba^{2+}	2+	135	−1360
Al^{3+}	3+	54	−4690
I^-	1−	220	−293

Worked examples

ΔH_{sol} of KBr

- $-\Delta H_{latt}$ = +679
- $\Sigma\Delta H_{hyd}$ = −322 − 335 = −657
- ΔH_{sol} = **+22 kJ mol^{-1}**

$Ba(OH)_2$ against $Mg(OH)_2$

- ΔH_{latt} falls 614; $\Delta H_{hyd}(M^{2+})$ 560
- ΔH_{sol}: +2 → **−52**
- small OH^-: **more soluble** down

Why $BaSO_4$ is insoluble

- ΔH_{latt} falls 364; $\Delta H_{hyd}(M^{2+})$ 560
- ΔH_{sol}: −167 → **+29**
- large SO_4^{2-}: **less soluble** down

$BaSO_4$: barium meals and the sulfate test. Entropy and ΔG come next (23.3, 23.4).

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