

Enthalpy of Solution part 2

[Click here for enthalpy of solution part 1](#)

Definitions

Enthalpy of hydration: *the enthalpy change that occurs when 1 mole of gaseous ions forms aqueous/hydrated ions.*



Hydration and lattice enthalpies

Both of these enthalpy changes are exothermic and both are affected in the same way by the same factors. It's back to **size** and **charge** again as discussed in the Born-Haber cycles tutorials.

a **high charge** on the ions: **both** hydration and lattice enthalpies become more **exothermic**.

small size of the ions: **both** hydration and lattice enthalpies become more **exothermic**.

- ✓ as lattice and hydration enthalpies are on different sides of the subtraction they will have opposite effects on the ΔH_{sol} value.

$$\Delta H_{\text{sol}} = \Delta H_{\text{hyd}} - \Delta H_{\text{latt}}$$

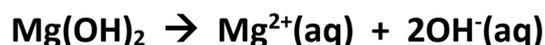
- as ΔH_{latt} becomes more exothermic, ΔH_{sol} becomes more positive i.e. harder to dissolve.
 - as ΔH_{hyd} becomes more exothermic, ΔH_{sol} becomes more negative i.e. easier to dissolve.
- ✓ as was mentioned in part 1, you can think of ΔH_{sol} as a "fight" between hydration and lattice. Whichever is **more** negative "wins".

Calculations

You just have to remember that: $\Delta H_{\text{sol}} = \Delta H_{\text{hyd}} - \Delta H_{\text{latt}}$

Example

Calculate the enthalpy of solution of $\text{Mg}(\text{OH})_2$ given that $\Delta H_{\text{latt}} = -2694 \text{ kJ mol}^{-1}$, $\Delta H_{\text{hyd}}(\text{OH}^-) = -460 \text{ kJ mol}^{-1}$ and $\Delta H_{\text{hyd}}(\text{Mg}^{2+}) = -1926 \text{ kJ mol}^{-1}$.



ΔH_{hyd} : you need the ΔH_{hyd} values for OH^- and Mg^{2+} , which are given in the question. Just make sure that you multiply the OH^- value by 2:

$$\Delta H_{\text{hyd}} = (2 \times -460) + (-1926) = \mathbf{-2846 \text{ kJ mol}^{-1}}$$

ΔH_{sol} : we have the lattice enthalpy and the hydration enthalpies so we now just use $\Delta H_{\text{sol}} = \Delta H_{\text{hyd}} - \Delta H_{\text{latt}}$

$$\Delta H_{\text{sol}} = -2846 - (-2694) = \mathbf{-152 \text{ kJ mol}^{-1}}$$

They could also ask you to calculate a lattice enthalpy or a hydration enthalpy, it just depends on the question.

- ✓ if they ask you to calculate ΔH_{hyd} , you may have to **divide by 2** at the end. For example, $\text{MgCl}_2 \rightarrow \text{Mg}^{2+} + 2\text{Cl}^-$. The ΔH_{hyd} value calculated would be for 2 x Cl^- .

[Click here for enthalpy
of solution part 1](#)