

Chemguide – answers

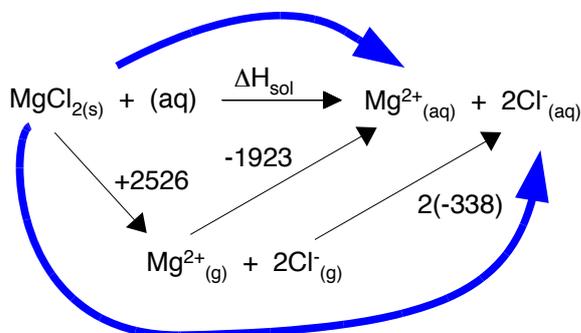
ENTHALPIES OF SOLUTION

- The enthalpy change of solution is the enthalpy change when 1 mole of an ionic substance dissolves in water to give a solution of infinite dilution.
 - The hydration enthalpy is the enthalpy change when 1 mole of gaseous ions dissolve in sufficient water to give an infinitely dilute solution.
- Hydration enthalpy is a measure of the attractions between the ion and the surrounding water molecules. (That applies to the next two questions as well.) As you go from lithium to potassium, the ions are getting bigger, and so the attractions are operating over a longer distance. That makes them weaker.
 - The magnesium ions have two positive charges rather than the one on sodium ions, and that makes the attractions between the ion and water molecules stronger. Magnesium ions are also smaller than sodium ions, and that also increases the strength of the attractions.

(In case you have forgotten, magnesium ions and sodium ions are isoelectronic (have the same electronic structure). But magnesium ions have 12 protons in the nucleus rather than sodium's 11, and so the electrons are pulled more tightly in towards the nucleus.)

c) The calcium value would be less negative than the magnesium one. Calcium ions are bigger than magnesium ions, and so the water molecules aren't so close to the centre of the calcium ions, and so the attractions are less strong.

d)



$$\begin{aligned}\Delta H_{\text{sol}} &= +2526 - 1923 - 2(338) \\ &= -73 \text{ kJ mol}^{-1}\end{aligned}$$

Don't take this figure too literally! If you take data from another source, you can get an entirely different answer. For example, taking data from the Chemistry Data Book by Stark and Wallace gives an answer of -155 kJ mol^{-1} . So which is right? Almost certainly neither!

When I was trying to find a real experimental value for this enthalpy change of solution, the number -155 came up several times on the internet. So does that mean that that is the right value? No! It just means that people quoting it probably calculated it from Stark and Wallace figures.