Worksheet 18.2

Enthalpy changes of hydration

1 The table below gives the values of the enthalpy change of hydration for various ions.

Ion	Ionic radius / nm	Enthalpy change of hydration / kJ mol^{-1}
Li^+	0.068	–519
Na^+	0.098	–406
K^+	0.133	–322
Rb^+	0.148	–301
Cs^+	0.167	–276
Mg^{2+}	0.065	–1920
Ca^{2+}	0.094	–1650
Sr^{2+}	0.110	–1480
Ba^{2+}	0.134	–1360
Al^{3+}	0.045	–4690

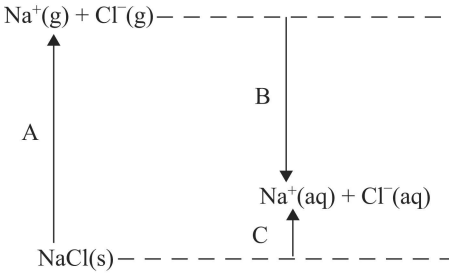
a Explain the trend in enthalpy change of hydration as a group is descended. [4]

b The ions Na^+, Mg^{2+} and Al^{3+} are isoelectronic.

i Explain the term **isoelectronic**. [2]

ii Explain the trend in enthalpy change of hydration as the charges on the ions increase. [3]

2 The diagram below shows the enthalpy changes when sodium chloride is dissolved in water.



a Define the following terms.

i enthalpy change of solution [2]

ii enthalpy change of hydration [2]

b Give ionic symbol equations to represent the processes associated with the following enthalpy changes.

i the enthalpy change of solution of NaCl [2]

ii the enthalpy change of hydration of the chloride ion [2]

c Name the enthalpy changes labelled A, B and C in the diagram above. [3]

d Draw the water molecules around the sodium and chloride ions in a solution of sodium chloride. [3]

3 The table below gives the values for various molar enthalpy changes for potassium chloride.

Enthalpy	**Value / kJ mol^{-1}**
lattice energy	–701
enthalpy change of solution	+17.2
enthalpy change of hydration of K^+	–322

a Construct an enthalpy cycle (Hess cycle) that can be formed using the lattice energy, the enthalpy of solution and the enthalpy change of hydration of KCl. [5]

b Give equations that represent the changes taking place for the three enthalpy changes shown in the table above. [6]

c Calculate the enthalpy change of hydration of the Cl^- ion. [4]

