Worksheet 18.3

Lattice energy

1 Using calcium, bromine and calcium bromide as examples, define the following terms. You should illustrate each answer with an equation, including all state symbols.

a first ionisation energy [4]

b second ionisation energy [4]

c enthalpy change of atomisation [3]

d first electron affinity [4]

e lattice energy [3]

2 Use the data in the table below to draw and label a Born–Haber cycle and to calculate the lattice energy of:

a sodium chloride [4]

b magnesium chloride. [5]

Enthalpy change	Atom or molecule	Value / kJ mol^{-1}
atomisation energy	Na	+109
atomisation energy	Mg	+150
atomisation energy	Cl	+121
first ionisation energy	Na	+494
first ionisation energy	Mg	+736
second ionisation energy	Mg	+1450
first electron affinity	Cl	–364
enthalpy change of formation	NaCl	–411
enthalpy change of formation	$MgCl_2$	–642

3 **a** Draw an enthalpy cycle (Hess cycle) to show the dissolving of magnesium chloride ($MgCl_2$) in water. [5]

b The table below shows the values of all but one of the enthalpy changes relevant to this cycle.

Enthalpy change	Value / kJ mol^{-1}
enthalpy change of solution	–155
lattice energy	–2493
enthalpy change of hydration of Cl^- ion	–364

i Define the enthalpy change of hydration for the magnesium ion. [3]

ii Use the values given to calculate the value of the enthalpy change of hydration for magnesium ions. [5]

c Draw a diagram to show how water molecules are arranged around a magnesium ion in a solution of magnesium chloride. [2]

d Explain why the enthalpy change of hydration for a magnesium ion is more exothermic than for a sodium ion. [3]

e The enthalpy change of solution of magnesium chloride is exothermic whilst that of potassium chloride is endothermic. Explain this difference. [4]

4 For each of the following pairs of compounds, state which one you would expect to have the higher lattice energy. Explain your answers.

a NaF and MgO [2]

b MgO and SrS [2]

