2.1 EXERCISE 1 – measuring enthalpy changes

In all the following questions, assume that the densities and specific heat capacities of the solutions are the same as pure water
i.e. $\rho = 1.0\ gcm^{-3}$ and $c = 4.18\ Jg^{-1}K^{-1}$

1. Zinc will displace copper from copper (II) sulphate solution according to the following equation:
   $CuSO_4(aq) + Zn(s) \rightarrow Cu(s) + ZnSO_4(aq)$
   If an excess of zinc powder is added to 50 cm^3 of 1.0 $moldm^{-3}$ copper(II) sulphate, the temperature increases by 6.3 ^oC. Calculate the enthalpy change for the reaction.

2. Magnesium will also displace copper from copper (II) sulphate solution. If an excess of magnesium is added to 100 cm^3 of 1.0 $moldm^{-3}$ copper(II) sulphate, the temperature increases by 46.3 ^oC.
   a) Calculate the molar enthalpy change for the reaction
   b) Calculate the minimum quantity of magnesium required to ensure it is in excess.
   c) Calculate the temperature change if only 0.8 g of magnesium is added.

3. When 5.73 g of sodium chloride (NaCl) dissolves in 100 cm^3 of water, the temperature of the water fell from 22.4 ^oC to 19.8 ^oC. Calculate the enthalpy change of the reaction.

4. When 2.3 g of magnesium chloride dissolves in 200 cm^3 of water, the temperature rose by 3.4 ^oC. Calculate the enthalpy change for the reaction.

5. If 50 cm^3 of 0.1 $moldm^{-3}$ HCl and 50 cm^3 of 0.1 $moldm^{-3}$ NaOH are mixed, the temperature of the solution rises by 0.68 ^oC. Calculate the enthalpy change of the reaction in $kJmol^{-1}$.

6. If 50 cm^3 of 1.0 $moldm^{-3}$ NaOH is added to 25 cm^3 of 2.0 $moldm^{-3}$ CH_3COOH, the temperature rose by 8.3 ^oC. Calculate the molar enthalpy change for the reaction.

Answers to 2.1 exercises

1. -26.3 $kJmol^{-1}$
2. a) -193.5 $kJmol^{-1}$ b) 2.43 g c) 15.2 ^oC
3. +11.1 $kJmol^{-1}$
4. -118 $kJmol^{-1}$
5. -56.8 $kJmol^{-1}$
6. -52.0 $kJmol^{-1}$