# CALORIMETRY 2

1) In an experiment, 1.00 g of propanone ($CH_3COCH_3$) was completely burned in air. The heat evolved raised the temperature of 150 g of water from 18.8°C to 64.3°C. Use this data to calculate the enthalpy of combustion of propanone (the specific heat capacity of water is 4.18 J $g^{-1}$ $K^{-1}$).

2) In an experiment, 1.00 g of hexane ($C_6H_{14}$) was completely burned in air. The heat evolved raised the temperature of 200 g of water from 293.5 K to 345.1 K. Use this data to calculate the enthalpy of combustion of hexane (the specific heat capacity of water is 4.18 J $g^{-1}$ $K^{-1}$).

3) In an experiment, 1.56 g of propan-1-ol ($CH_3CH_2CH_2OH$) was completely burned in air. The heat evolved raised the temperature of 0.250 $dm^3$ of water from 292.1 K to 339.4 K. Use this data to calculate the enthalpy of combustion of propan-1-ol (the specific heat capacity of water is 4.18 J $g^{-1}$ $K^{-1}$).

4) 25 $cm^3$ of 2.0 mol $dm^{-3}$ nitric acid was added to 25 $cm^3$ of 2.0 mol $dm^{-3}$ potassium hydroxide solution. The temperature rose by 13.7°C. Calculate the enthalpy of neutralisation for this reaction. Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$.

5) 50 $cm^3$ of 2.0 mol $dm^{-3}$ hydrochloric acid was added to 50 $cm^3$ of 2.0 mol $dm^{-3}$ ammonia solution. The temperature rose by 12.4°C. Calculate the enthalpy of neutralisation for this reaction. Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$.

6) 50 $cm^3$ of 1.0 mol $dm^{-3}$ nitric acid was added to 20 $cm^3$ of 1.0 mol $dm^{-3}$ barium hydroxide solution. The temperature rose by 7.9°C. Calculate the enthalpy of neutralisation for this reaction (per mole of nitric acid reacting). Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$.

7) 25 $cm^3$ of 1.00 mol $dm^{-3}$ copper sulphate solution was put in a calorimeter and 6.0 g of zinc powder added. The temperature of the solution rose by 50.6°C. Work out which reagent was in excess and then calculate the enthalpy change for the reaction. Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$. Ignore the heat capacity of the metals.

$$CuSO_4(aq) + Zn(s) \rightarrow Cu(s) + ZnSO_4(aq)$$

8) 50 $cm^3$ of 0.10 mol $dm^{-3}$ silver nitrate solution was put in a calorimeter and 0.2 g of zinc powder added. The temperature of the solution rose by 4.3°C. Work out which reagent was in excess and then calculate the enthalpy change for the reaction (per mole of zinc that reacts). Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$. Ignore the heat capacity of the metals.

$$2\ AgNO_3(aq) + Zn(s) \rightarrow 2\ Ag(s) + Zn(NO_3)_2(aq)$$

9) 3.53 g of sodium hydrogencarbonate was added to 30.0 $cm^3$ of 2.0 mol $dm^{-3}$ hydrochloric acid. The temperature fell by 10.3 K. Work out which reagent was in excess and then calculate the enthalpy change for the reaction. Assume that the density of the solution is 1.00 g $cm^{-3}$, the specific heat capacity of the solution is 4.18 J $g^{-1}$ $K^{-1}$.

$$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

10) A calorimeter was calibrated by burning 2.00 g of methanol ($CH_3OH$) whose enthalpy of combustion is -715 kJ $mol^{-1}$. The temperature of the calorimeter rose from 19.6°C to 52.4°C. The same calorimeter was used to measure the enthalpy of combustion of propan-2-ol. 1.50 g of propan-2-ol $CH_3CH(OH)CH_3$ raised the temperature by from 19.8°C to 56.2°C. Calculate the heat capacity of the calorimeter and then the enthalpy of combustion of propan-2-ol.