KEY

WS 2 - Calorimetry

1. Calculate the heat lost (ΔrH) in a chemical reaction which causes 250 g of water to increase in temperature by 12.0°C.

$\Delta_r H = Q$ (expand) $= mc\Delta t$

$\Delta_r H = (250\,g)(4.19\,J/g\cdot°C)(12.0°C)$

$\Delta_r H = 12570\,J$

$\Delta_r H = -12.6\,kJ$

↑ negative because chemical reaction (lost) gave energy to water

2. The combustion of 0.500 g of carbon causes the temperature of 100 mL of water in a bomb calorimeter to rise from 20.10°C to 59.20°C. Calculate the molar enthalpy of combustion of carbon in kJ/mol.

$n = \frac{m}{M}$

$\Delta_c H = Q$

$(n)(\Delta_c H_m) = mc\Delta t$

$\left(\frac{0.500\,g}{12.01\,g/mol}\right)\Delta_c H_m = (100\,g)(4.19\,J/g\cdot°C)(39.10°C)$

$\Delta_c H_m = -393517.258\,J/mol$

$\Delta_c H_m = -394\,kJ/mol$

3. A 12.7 g sample of sulphur, $S_{8(s)}$, is placed in a bomb which is then filled with oxygen under pressure. The bomb is placed in the calorimeter which is filled with 2.20 kg of water at 21.08°C. The reaction mixture is ignited and the temperature rises to 33.88°C. Calculate the molar heat of combustion of sulphur in kJ/mol.

$\Delta_c H = Q$

$(n)(\Delta_c H_m) = mc\Delta t$

$\left(\frac{12.7\,g}{256.56\,g/mol}\right)\Delta_c H_m = (2.20\,kg)(4.19\,J/g\cdot°C)(12.80°C)$

$\Delta_c H_m = -2383.591..\,kJ/mol = -2.38 \times 10^3\,kJ/mol$

4. A student mixed 100.0 mL of 1.50 mol/L sulphuric acid with 200.0 mL of 1.50 mol/L sodium hydroxide. Both solutions were at 19.67°C initially and the highest temperature reached by the reaction mixture was 34.06°C. Calculate the molar enthalpy of neutralization for sulphuric acid in kJ/mol.

$\Delta_n H = Q$

$(n)(\Delta_n H_m) = mc\Delta t$

$[(0.1000\,L)(1.50\,mol/L)]\,\Delta_n H_m = (300.0\,g)(4.19\,J/g\cdot°C)(14.39°C)$

200.0 mL + 100.0 mL

$n = cV$

$\Delta_n H_m = -120588.2\,J/mol$

$\Delta_n H_m = -121\,kJ/mol$