Video worksheet – Using thermochemical equations

1. Hydrogen gas and nitrogen gas react to form ammonia according to the equation given below.

   $$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) \quad \Delta H = -92kJ/mol$$

   During the formation of ammonia, 184 kJ of energy is released. What is the mass, in grams, of NH_3 formed?

2. Below is the thermochemical equation for the combustion of glucose in oxygen gas.

   $$aC_6H_{12}O_6(aq) + bO_2(g) \Rightarrow xCO_2(g) + yH_2O(l) \quad \Delta H = -5606kJ/mol$$

   An amount of 1402 kJ of energy is released when 3 mol of carbon dioxide gas is formed from the complete combustion of glucose in excess oxygen.

   i. What is the value of the coefficient (x) in front of CO_2 in the equation above.

   ii.

   ii. What is the value of the coefficients a, b and y in the balanced thermochemical equation shown above?

3. Propane gas undergoes complete combustion in the presence of excess atmospheric oxygen at SLC.

   a. Write a balanced thermochemical equation for the reaction

   b. Calculate the volume of oxygen gas needed to burn just enough propane for the release of 1.83×10^4 kJ of heat energy.

4. The formation of phosphorus pentachloride (PCl_5) is shown below.

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g) \quad \Delta H = -88 kJmol^{-}$$

This reaction takes place in a bomb calorimeter, shown, filled with 200g of water at 25.0 °C. A mixture made of one mol of PCl_3 and one mol of Cl_2 gases was originally added to the 2.00 L reaction chamber and allowed to reach equilibrium, at which point the temperature of the water was measured at 77.63 °C.

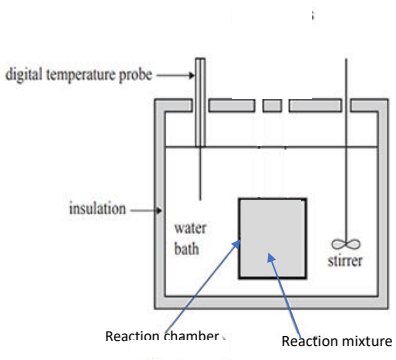

Diagram 1

a. Calculate the amount of energy, in kJ, produced by the reaction

b. What is assumed when calculating the amount of energy in a. above.

c. Calculate:

- the amount, in mol, of PCl_5 produced,

- the percentage yield.

d. Calculate the following concentrations at equilibrium
$[PCl_3]$, $[Cl_2]$ and $[PCl_5]$

e. Calculate the equilibrium constant for the reaction at these conditions.