Friday Worksheet **Name: ……………….**

Calorimetry worksheet 5

1) A bomb calorimeter containing 100.0 mL of water at 25.0°C was calibrated using 0.460 grams of ethanol. Upon the complete combustion of the ethanol in pure oxygen the temperature of the water rose to 60.0°C.
Calculate the calibration factor of the calorimeter.

Step 1 calculate the amount of energy input.
=> mol of ethanol = 0.460 /46.0 = 0.0100
=> energy released = 0.0100 X 1364 kJ (from data sheet) = 13.64 kJ
Step 2 Calculate the calibration factor
=> 13640 J/ 35 = 390 J /°C

2) 0.460 mL of liquid hexane was fully combusted in the same bomb calorimeter as in (1) above where the initial temperature for the water was 25.0°C.
a) Write a thermochemical equation for the combustion of hexane if the molar heat of combustion of hexane is 4158kJ/mol

$2C_6H_{14}(l) + 19O_2(g) \Rightarrow 19H_2O(g) + 12CO_2(g)$ ΔH = -8316 kJ mol^-

b) Given that the density of pure hexane is 0.659 g/mL at 25.0°C

c) How many mol of hexane were combusted?
Step 1 find the mass of hexane
=> m = d X V
=> 0.659 g/mL X 0.460 = 0.303g
Step 2 find the mol of hexane
=> 0.303 / 80 = 0.00352 mol = 3.52 X 10^{-3}

d) How much energy was released in the combustion process?

=> (8316 kJ mol^- / 2) X 3.52 X 10^{-3} = 14.64 kJ

e) What was the final temperature of the water in the bomb calorimeter?

=> Find the degree change in temperature =14640 J/ 390 J/°C = 37.54
=> final temperature 25.0 °C + 37.54°C = 62.5 °C

f) A student calibrated another calorimeter which contained 100.0 mL of water at 25.0°C. During calibration, it was found that 87.7% of the energy supplied to the calorimeter was used to heat the 100.0 mL of water within the calorimeter. The remaining energy heated other components of the equipment. In this calorimeter 0.460 grams of ethanol were fully combusted.

i. From the combustion process, how much energy was available to heat the water?

Step 1 Calculate the mol of ethanol
=> 0.460 / 46.0 = 0.0100 mol
Step 2 Find the amount of energy released
=> From the Data Sheet the molar enthalpy of combustion for ethanol is given as 1364 kJ/mol
=> Energy released = 0.0100 X 1364 kJ/mol = 13.64 kJ
Step 3 87.7% of this energy is available to heat the water.
=> 0.877 X 13.64 kJ = 12.00 kJ

ii. Determine what temperature rise the student would have measured.

12000 = 4.18 J/g/^{o}C X mass X ΔT
=> ΔT = 12000 / (4.18 X 100) = 28.7^{o}C