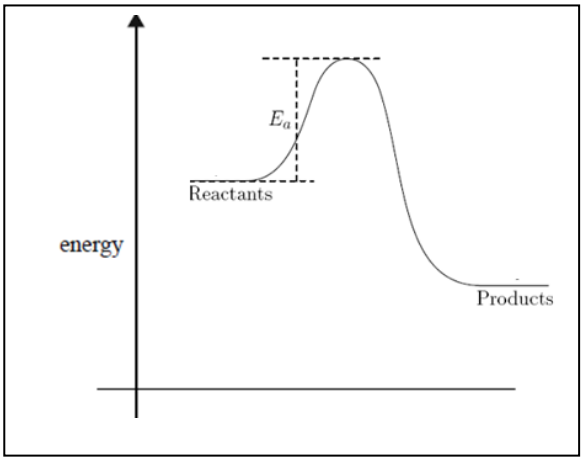
Friday Worksheet **Name: ……..**

Heat of reaction worksheet 1

1) Sketch the energy profile for the complete combustion of ethanol using the axis on the right, labelling the energy of the reactants, the products and the activation energy.



$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H = -393.5 \text{ kJ mol}^{-1}$$

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) \qquad \Delta H = -571.6 \text{ kJ mol}^{-1}$$

2) Consider the two equations above.

a) What is the ΔH of the following reactions?

i) $CO_2(g) \Rightarrow C(s) + O_2(g)$ ΔH =+393.5 kJ mol^{-}

ii) $H_2O(l) \Rightarrow H_2(g) + ½\ O_2(g)$ ΔH=+285.8 kJ mol^{-}

iii) $C(s) + 2H_2O(l) \Rightarrow CO_2(g) + 2H_2(g)$ ΔH=+178.1 kJ mol^{-}

b) 0.346 grams of dried coal (pure carbon) is used to heat 200.0 grams of water at 25.0 ^{o}C.

i. What is the amount of heat in kJ produced during the combustion of 34.56 g of coal?

Step 1 Obtain the equation for the combustion of carbon

⇨ $C(s) + O_2(g) \Rightarrow CO_2(g)$ ΔH =-393.5 kJ mol^{-}

Step 2 calculate the mol of carbon

⇨ 0.346/12.0 = 0.0288

Step 3 calculate the amount of energy released by 0.380 mol of carbon.

⇨ 0.0288 X 393.5 = 11.35 kJ

ii. Assuming no energy loss from the system and specific **heat capacity** of water is 4.18 joules/gram/°C, what is the final temperature of the water?

Energy = 4.18 X gram X ΔT

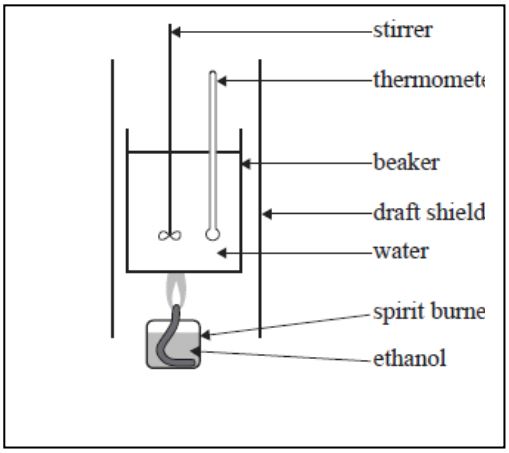
⇨ 11,350 = 4.18 X 200 X ΔT

⇨ 11,350/ 836 = ΔT

⇨ 13.58 = ΔT

⇨ Hence the final temperature is 25 + 13.58 = 38.58 °C

3) A student experimentally determined the molar enthalpy of combustion of ethanol (M = 46.0 g mol^{-}) using the equipment shown in the simplified diagram on the right. The student made the following experimental measurements



Mass of water in beaker = 100g
Amount of ethanol combusted = 0.960 grams
Temperature rise of the water = 40.0 °C

a) Write a balanced chemical equation for the combustion of ethanol.

$2C_2H_6O(l) + 7O_2(g) => 4CO_2(g) + 6H_2O(l)$

b) Calculate the molar enthalpy of combustion of ethanol according to the student's results is

Step 1 Calculate the mol of ethanol

⇨ *0.960 / 46.0 = 0.0209*

Step 2 Calculate the amount of energy released.

⇨ *Energy added to the water = 4.18J/g/°C X 100.0 X* ΔT

⇨ *= 4.18 X 100.0 X 40.0 = 16,700 J or 16.7 kJ*

Step 3 Calculate the energy released from one mol of ethanol.

⇨ *16.7 / 0.0209 = 799 kJ*

Step 4 Calculate the molar enthalpy of combustion of ethanol.

ΔH_c(ethanol) *= -799 kJ/mol*