WS 3 – Communicating Energy Changes

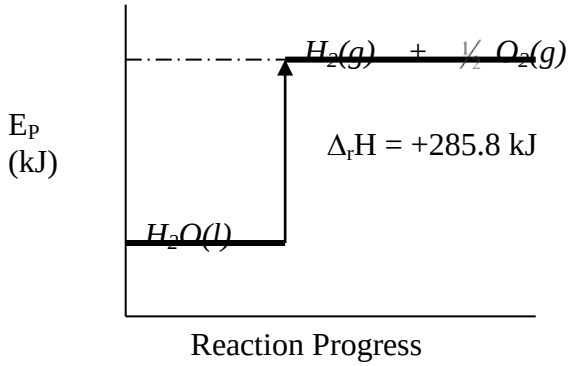
Part I

Rewrite the following equations expressing the balanced equation with one mole of the substance underlined and using the $\Delta_r H$ notation. Sketch a labelled potential energy diagram for each question.

Example

$$\underline{2\ H_2O(l)} + 571.6\ kJ \rightarrow 2\ H_2(g) + O_2(g)$$

Answer: $H_2O(l) \rightarrow H_2(g) + \frac{1}{2}\ O_2(g) \quad \Delta_r H = +285.8\ kJ$



1. $N_2(g) + O_2(g) + 180.8\ kJ \rightarrow \underline{2\ NO(g)}$

2. $\underline{2\ C_2H_6(g)} + 7\ O_2(g) \rightarrow 4\ CO_2(g) + 6\ H_2O(g) + 2857\ kJ$

3. $\underline{2\ Na(s)} + 218\ kJ \rightarrow 2\ Na(g)$

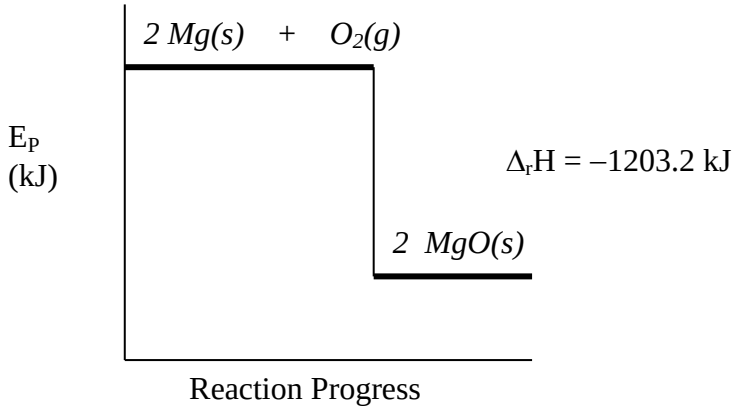
Part II

Rewrite the following equations to have the simplest whole number coefficients and by expressing the energy change as a term in the equation. Sketch a labelled potential energy diagram for each question.

Example

$Mg(s) + \frac{1}{2} O_2(g) \rightarrow MgO(s)$ $\Delta_r H = -601.6$ kJ

Answer: *$2\ Mg(s) + O_2(g) \rightarrow 2\ MgO(s) + 1203.2$ kJ*



1. $2\ Al(s) + \frac{3}{2} O_2(g) \rightarrow Al_2O_3(s)$ $\Delta_r H = -1680.0$ kJ

2. $H_2SO_{4(l)} \rightarrow SO_{2(g)} + H_2O_{(g)} + \frac{1}{2} O_{2(g)}$ $\Delta_r H = +273.0$ kJ

3. $NH_3(g) \rightarrow \frac{1}{2} N_2(g) + 3/2\ H_2(g)$ $\Delta_r H = +46.1$ kJ

Part III

1. Given the reaction $3\ NO_2(g) + H_2O(l) \rightarrow 2\ HNO_3(l) + NO(g)$ $\Delta_rH = -72.0$ kJ, calculate the molar enthalpy of reaction, $_rH$ for:
   a) $NO_2(g)$ b) $H_2O(l)$
   c) $HNO_3(l)$ d) $NO(g)$

2. The molar enthalpy of combustion of butane is −2657.3 kJ/mol. Write the balanced reaction for the combustion of butane, including energy in the reaction.

3. Calculate the heat released (enthalpy change) when 100 g of methane is burned in a water heater. $\Delta_cH_m = -802.5$ kJ/mol $CH_4(g)$.

4. Calculate the enthalpy change when 5.00 g of glucose is burned during cellular respiration. The molar enthalpy of reaction for glucose is −2802.5 kJ/mol.

5. What mass of ethane is required to produce 1500 kJ of energy during a combustion reaction? The molar enthalpy of combustion of ethane is −1251.0 kJ/mol.