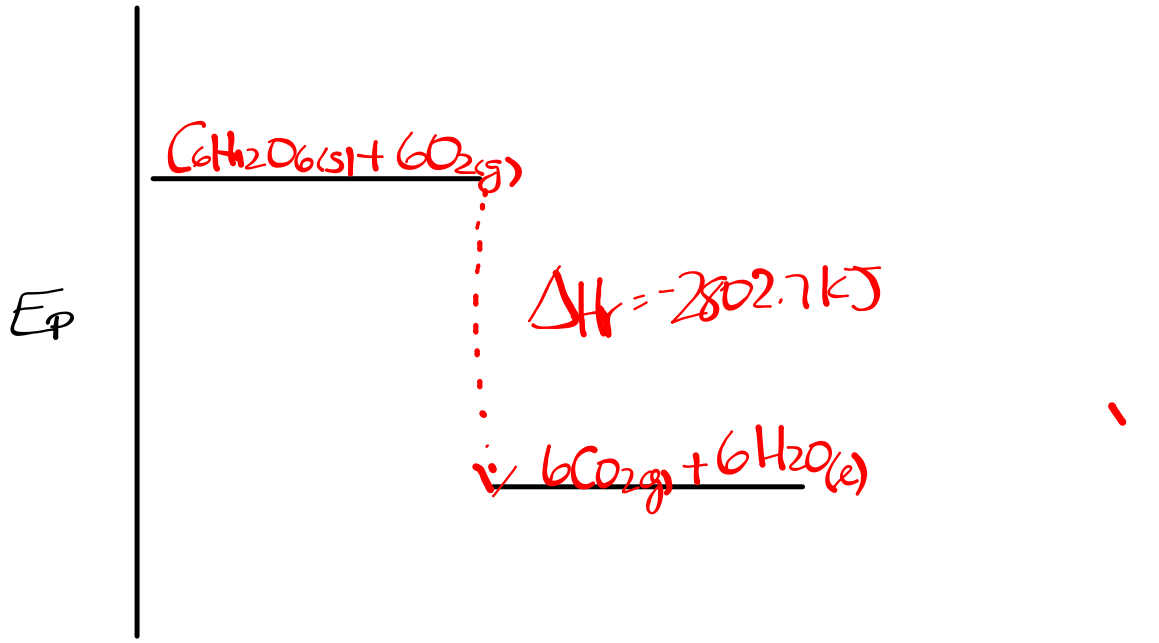
For each of the following reactions:
(a) rewrite the equation including the enthalpy change as a term
(b) draw a potential energy diagram

(i) $C_6H_{12}O_{6(s)} + 6O_{2(g)} \longrightarrow 6CO_{2(g)} + 6H_2O_{(l)} \quad \Delta H^o = -2802.7kJ$

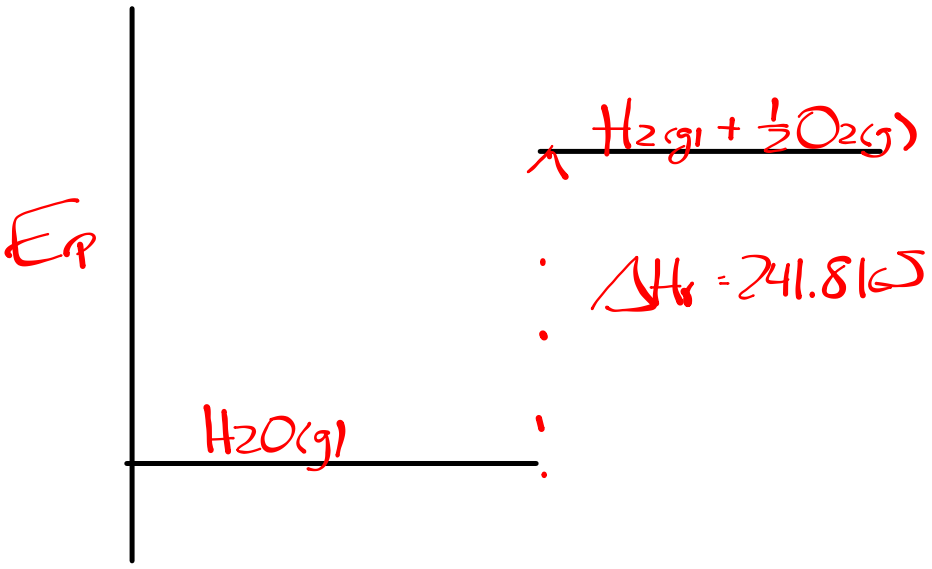
$C_6H_{12}O_{6(s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)} + 2802.7kJ$



For the following reactions:
(a) rewrite the equation including the enthalpy change as a term
(b) draw a potential energy diagram

(ii) $H_2O_{(g)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ $\Delta H^o = 241.8$ kJ

$H_2O_{(g)} + 241.8\ kJ \rightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$



Predicting Energy Changes using Hess's Law

Hess' Law - (Heat of Summation)
- allows for the determination of the enthalpy change of a reaction with direct use of calorimetry.

Rules:
- if a chemical equation is reversed, then the sign of the ΔH_r changes
- if the coefficients of a chemical equation are altered by multiplying or dividing by a constant factor, then the ΔH_r is altered in the same way

Ex. $C_{(s)} + O_{2(g)} \Rightarrow CO_{2(g)}$ $\Delta H = -393.5$ kJ

Rev.

$CO_{2(g)} \rightarrow C_{(s)} + O_{2(g)}$ $\Delta H = 393.5$ kJ

x 2

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ $\Delta H = -787.0$ kJ

$H_2O_{(s)} \rightarrow H_2O_{(\ell)} \quad \Delta H_{fus} = 6.03\,kJ$

$H_2O_{(\ell)} \rightarrow H_2O_{(s)} \quad \Delta H_{solid} = -6.03\,kJ$

Example

$H_2O\,(g) + C\,(s) \rightarrow CO\,(g) + H_2\,(g)$

$\Delta H = ?$

Steps (found using calorimetry):

1. $H_2\,(g) + 1/2\,O_2\,(g) \rightarrow H_2O\,(g) \quad \Delta H = -242.0\ kJ$
2. $2CO\,(g) \rightarrow 2\,C\,(s) + O_2\,(g) \quad \Delta H = +221.0\ kJ$

Rev ①

③ $H_2O_{(g)} \rightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ $\Delta H_r = 242.0\ kJ$

Rev ② ÷ 2

④ $C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$ $\Delta H_r = -110.5\ kJ$

③ + ④

$H_2O_{(g)} + C_{(s)} \longrightarrow H_{2(g)} + CO_{(g)}$ $\Delta H_r = 131.5\ kJ$

Calculate the heat released by the burning of sulfur in oxygen given the following steps:

$$2S(s) + 3O_2(g) \rightarrow 2SO_3(g) \qquad \Delta H = ?$$

Evidence:

~~Step 1~~	~~$S(s)$~~	~~+~~	~~$O_2(g)$~~	~~$\rightarrow$ $SO_2(g)$~~	~~$\Delta H = -297$ kJ~~
Step 2	~~$2SO_2(g)$~~	+	$O_2(g)$	$\rightarrow 2SO_3(g)$	$\Delta H = -198$ kJ

① x 2

③ $2S_{(s)} + 2O_{2(g)} \rightarrow 2SO_{2(g)}$ $\Delta H = -594$ kJ

② + ③

$2S_{(s)} + 3O_{2(g)} \rightarrow 2SO_{3(g)}$ $\Delta H_r = -792$ kJ

Worksheet