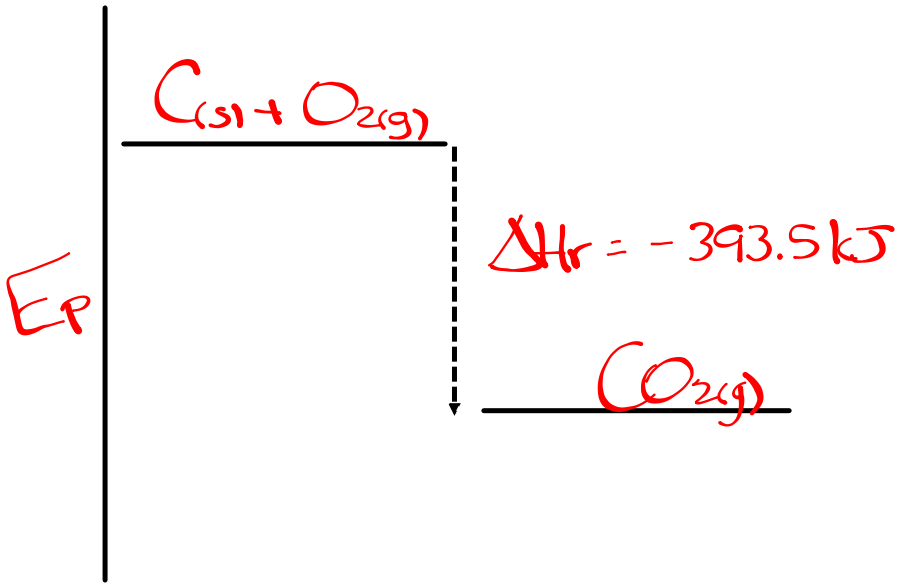
(ii) $H_2O_{(g)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ $\Delta H^o_r = 241.8$ kJ

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

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

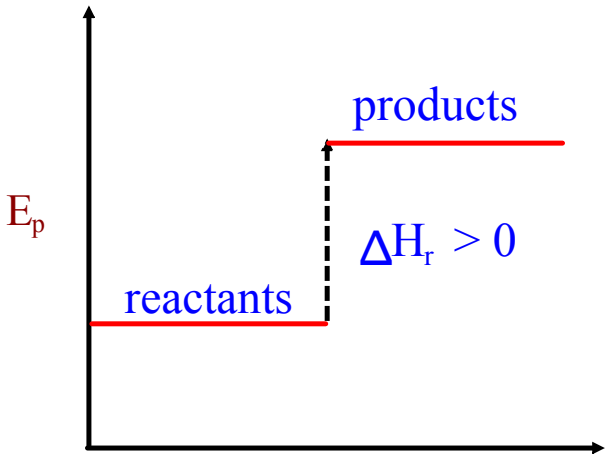
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} + 393.5\,kJ$


$C_{(s)} + O_{2(g)}$
$\Delta H_r = -393.5\ kJ$
$CO_{2(g)}$
EP

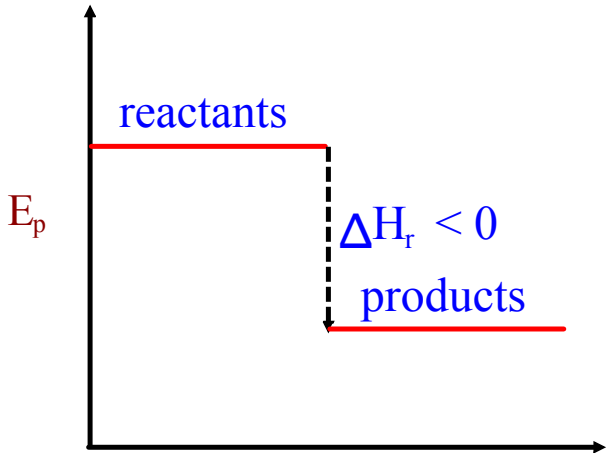
POTENTIAL ENERGY DIAGRAMS

- may be used to express enthalpy change (ΔH_r)
- shows the potential energy of the reactants and products of a chemical reaction.
- shows the difference between the initial and final energies as the enthalpy change. (ΔH_r)

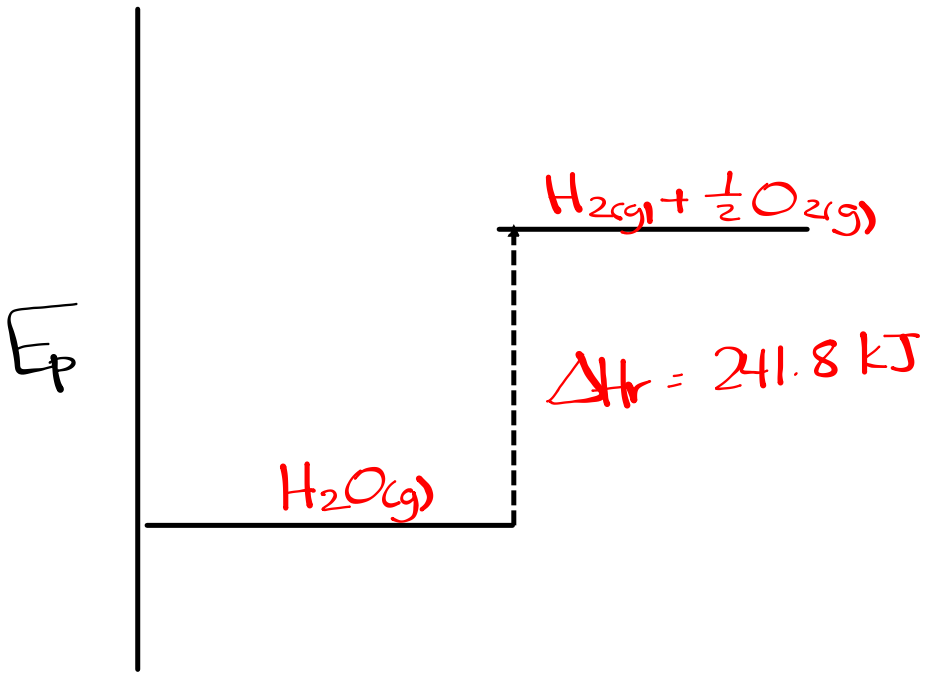
Endothermic Rxn



Exothermic Rxn



see Fig 11-8 p 373 (also 11-15,16,17)


E_p
$H_2(g) + \frac{1}{2}O_2(g)$
$\Delta H_r = 241.8$ kJ
$H_2O(g)$

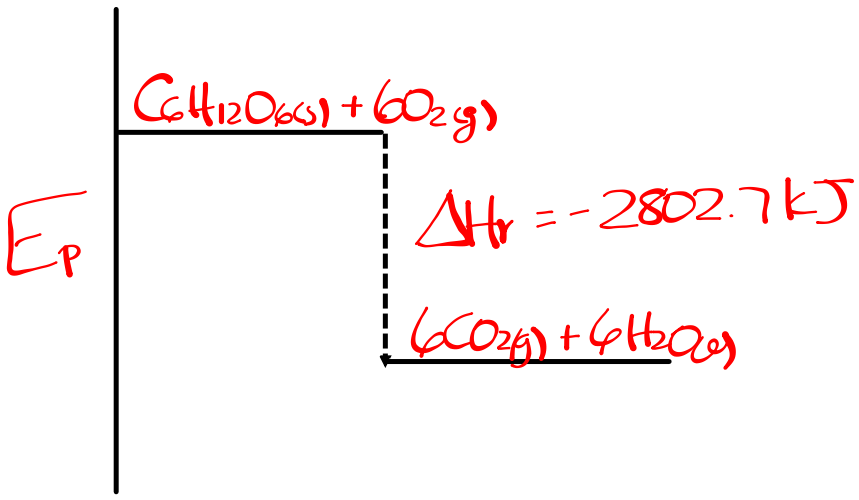
For the following reactions:
(a) rewrite the equation including the enthalpy change as a term
(b) draw a potential energy diagram

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

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

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

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



Predicting Energy Changes using Hess's Law

Hess's 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

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

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ $\Delta H_r = -787.0$ 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 $H_2O_{(g)} \rightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$ $\Delta Hr = 242.0\ kJ$

Rev ② ÷ 2

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

③ + ④

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