Energy changes and rates of reactions

Assignment-1

According to Hess law

$\Delta H_f = [\sum \Delta H_f \text{ (products)}] - [\sum \Delta H_f \text{ (reactants)}]$

ΔH_f of individual products or reactants can be found from standard enthalpy of formation.

1. A) $H_2SO_4 \longrightarrow H_2O + SO_2 + O_2$

Considering individual reactions in the product side

$H_2 + 1/2O_2 \longrightarrow H_2O$

$\Delta H_{H2O} = -242.76$ KJ/mol

$S + O_2 \longrightarrow SO_2$

$\Delta H_{SO2} = -297.19$KJ/mol

$\Delta H_{O2} = 0$ KJ/mol

Considering individual reactions in the reactant side

$\Delta H_{H2SO4} = -814.8$KJ/mol

$\Delta H_f = [\sum \Delta H_f \text{ (products)}] - [\sum \Delta H_f \text{ (reactants)}]$

$\Delta H_f = [\Delta H_{H2O} + \Delta H_{SO2} + \Delta H_{O2}] - [\Delta H_{H2SO4}]$

$\Delta H_f = [-539.95] - [-814.8]$

$\Delta H_f = 274.85$ KJ/mol.

H_2SO_4 ⟶ $H_2O + SO_2 + O_2$ ΔH_f = 274.85 KJ/mol.

B) $NH_3 + O_2$ ⟶ $N_2 + H_2O$

Considering individual reactions in the product side

$\Delta H_{N2} = 0$ KJ/mol

$H_2 + 1/2O_2$ ⟶ H_2O

$\Delta H_{H2O} = -242.76$ KJ/mol

Considering individual reactions in the reactant side

$\Delta H_{O2} = 0$ KJ/mol

$\Delta H_{NH3\ (g)} = -46.29$ KJ/mol

$\Delta Hf = [\sum \Delta Hf\ (products)] - [\sum \Delta Hf\ (reactants)]$

$\Delta Hf = [\Delta H_{N2} + \Delta H_{H2O}] - [\Delta H_{O2} + \Delta H_{NH3\ (g)}]$

$\Delta Hf = [0 - 242.76] - [0 - 46.29]$

ΔHf = -196.47 KJ/mol.

$NH_3 + O_2$ ⟶ $N_2 + H_2O$ ΔH_f = - 196.47KJ/mol.

C) $F_2(g)+H_2O(l) \longrightarrow HF(g) + O_2(g)$

Considering individual reactions in the product side

$\Delta H_{O2} = 0$

KJ/mol $H+F \rightarrow HF$

ΔH_{HF} (g) = -541.8/mol.

Considering individual reactions in the reactant side

$\Delta H_{F2} = 0$ KJ/mol.

$H_2 + 1/2O_2 \longrightarrow H_2O$

$\Delta H_{H2O} = -283.46$ KJ/mol.

$\Delta Hf = [\sum \Delta Hf \text{ (products)}] - [\sum \Delta Hf \text{ (reactants)}]$

$\Delta Hf = [\Delta H_{HF} (g) + \Delta H_{O2}] - [\Delta H_{F2}+\Delta H_{H2O}]$

$\Delta Hf = [-541.8+0] – [-283.46+0]$

ΔH_f = -258.34 KJ/mol.

$F_{2\,(g)} + H_2O_{\,(l)} \longrightarrow HF_{(g)} + O_{2(g)}$ $\quad \Delta H_f = -258.34$ KJ/mol