Thermodynamics

* First law of thermodynamics

$$\Delta U = q + W$$

$W_{isobaric} > W_{isotherm} > W_{adi} > W_{isochoric}$

Isothermal

* Reversible expansion

$$W = -P_{ext} \times dV$$

$$W = -2.303\, nRT \log \frac{V_2}{V_1}$$

$$W = -2.303\, nRT \log \frac{P_1}{P_2}$$

$$-|W_{exp}| = +|W_{compre}|$$

$$\Delta U = 0 \quad | \quad T = 0$$

Isothermal

* Irreversible expansion.

$$W = -P_{ex}(V_2 - V_1)$$

$$|W_{rev}| > |W_{irr}|$$

compression; $|W_{irr}| > |W_{rev}|$

expansion; $|W_{rev}| > |W_{irr}|$

Adiabatic process

$q = 0$

$$\therefore \Delta U = |W|$$

$$C_V \Delta T = -P_{ext} \cdot dV$$

$$C_V \ln \frac{T_2}{T_1} = -R \ln \frac{V_2}{V_1}$$

Clausius – clapeyron eqn

$$\frac{d \ln P}{dT} = \frac{\Delta H_V}{RT^2}$$

$$\ln \frac{K_2}{K_1} = \frac{\Delta H}{2.303\, R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

ΔT = changes

Heat capacity

$$C = \frac{q}{\Delta t}$$

Molar heat capacity

$$C_m = \frac{C}{n}$$

Specific heat capacity.

$$S = \frac{C}{m}$$

$$C_p - C_V = R$$

Enthalpy.

① $\Delta H = q_p$

② $\Delta H = U + PV$

③ $\Delta H = C_V \Delta T$

$\Delta H = C_p \Delta T$

④ $\Delta H = \Delta U + nR\Delta T$

$\Delta H = \Delta U + \Delta n_g RT$

$q_p = q_v + \Delta n_g RT$

$\Delta H = \Delta U + P(V_{gas})$

Thermochemistry

heat of formation सबै states matter लाहिमे करत

⇒ $\Delta_f H$ सबै ~~सदै~~ add गर्नुपर्दछ
$\Delta_{combustion} H$ also same

$\Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1)$

Bond enthalpy

$\Delta_{BE} H = \Sigma E_R - E_P$

Bomb calorimeter

$\Delta H = \Delta U + \Delta n_g RT$

$q_v = \dfrac{C_v \Delta T \times \text{molar mass}}{\text{given mass}}$

Entropy

① reversible

$\Delta S_{system} = \dfrac{q}{T}$ $\Delta S_{surr} = \dfrac{-q}{T}$

$\Delta S = \dfrac{\Delta H}{T}$

$\Delta S_{Total} > 0$ → spontaneous rxn

$\Delta S = C_v \ln \dfrac{T_2}{T_1} - nR \ln \dfrac{P_2}{P_1}$

② Irreversible

$\Delta S_{sys} = \dfrac{-q}{T}$ $\Delta S_{surr} = \dfrac{q}{T}$

Gibb's free energy

$\Delta G = \Delta H - T\Delta S$

→ spontaneous rxn ; $\Delta G < 0$
Non-spontaneous rxn ; $\Delta G > 0$

$\Delta G = -RT \ln K$

− भए rxn non-spontaneous
अथवा ~~यस~~ rxn backward अग्रसार

$\Delta S = S_{product} - S_{reactant}$