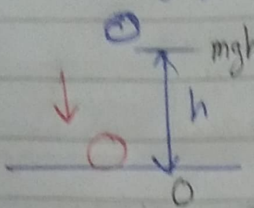
Spontaneity of Chemical Reactions :

① 

Energy is more stable at ground
High Energy → Low Energy

② $HCl + NaOH \rightarrow NaCl + H_2O$

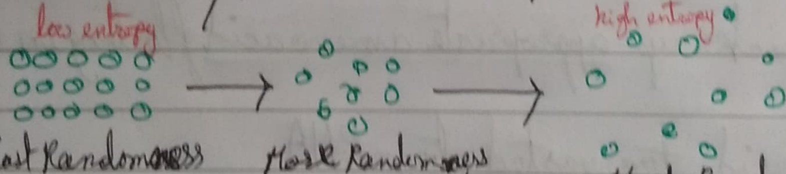
This reaction occurs because :-
Stability of :-
Products > Reactants

Therefore, stability of any chemical reaction will point towards low energy

Both endo & exothermic reactions can be spontaneous

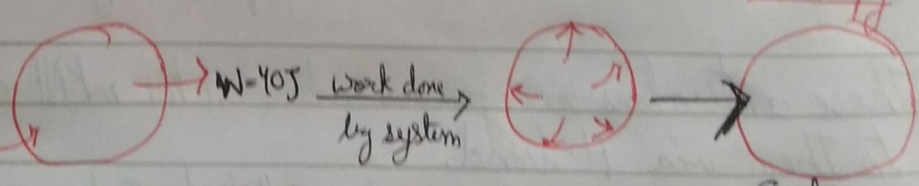
For spontaneous reactions :-

1) High → Low Energy Stability
2) Points towards More Randomness



Least Randomness movement → More Randomness movement → Most Randomness movement

This Randomness movement is called Entropy

Eg:- 

* At high temperature (600°C) Entropy is low
* At low temperature (100°C) Entropy is high

$40J \rightarrow 100°C$
$xJ \rightarrow 1°C$
$\therefore x = \frac{40}{100} \frac{(q_{rev})}{(T)} = 0.4\ J/°C$

$x = 0.06\ J/°C$

$$\boxed{\Delta S = \frac{q_{rev}}{T}}$$

We cannot calculate absolute entropy

Entropy :-

It is the quantity that tells weather a chemical reaction or physical change can occurs spontaneously in an isolated system or not.

Entropy of system is difficult to express.
Hence, Change of entropy during change of state can be expressed

$\therefore \Delta S$ is the integral of all terms involving $\frac{q_{rev}}{T}$

$$\therefore \boxed{\Delta S = \frac{q_{rev}}{T}}$$

$$\Delta S_{Total} = \Delta S_{(system)} + \Delta S_{(surroundings)}$$

Conditions:- 1) If $\Delta S_{Total} = 0$:- Equilibrium & Reversible process

2) If $\Delta S_{Total} > 0$:- Spontaneous & Irreversible process

3) If $\Delta S_{Total} < 0$:- Non-Spontaneous

$\therefore$ Entropy is a state function → depends on initial & final state
→ does not depend on path

For Reversible process, $\Delta S = \Delta S_{sys} + \Delta S_{surrounding}$

$$= +\frac{q}{t} + \left(-\frac{q}{t}\right)$$ (same temperature (t))

$$\Rightarrow \Delta S = 0$$

for Irreversible process, $\Delta S = \frac{+q}{T_1} + \left(-\frac{q}{T_2}\right)$ (different temperature $T_1 \rightarrow T_2$)

$$= q\left(\frac{1}{T_2} - \frac{1}{T_1}\right) = q\left(\frac{T_1 - T_2}{T_1 T_2}\right)$$

But $T_1 > T_2 \therefore T_1 - T_2 \rightarrow +ve \quad \therefore \Delta S > 0$