THERMAL PROPERTIES OF MATTER

Temperature and State Change :→

→ Temperature: Degree of hotness or coldness.

100°C	212°F	373K	B.P. of Water.
0°C	32°F	273K	M.P. of Water.

$$\boxed{\frac{C-0}{100-0} = \frac{F-32}{212-32} = \frac{x - M.P.}{B.P.-M.P.}}$$

x = temperature at general scale

$$\boxed{F = \frac{9}{5}C + 32}$$

→ Heat Capacity: $\boxed{\frac{Q}{\Delta T} = S}$

→ Specific Heat Capacity: $\boxed{s = \frac{S}{m} = \frac{Q}{m\Delta T}}$

$s_{water} = 1\ cal/gm\text{-}°C = 4186\ J/Kg\text{-}K$

$s_{ice} = 0.5\ cal/gm\text{-}°C$

→ Principle of Calorimetry:→

$$\boxed{Q_1 + Q_2 + Q_3 + \dots = 0}$$

Heat given by one System = Heat taken by other system.

→ Water Equivalent:→ $\boxed{S_c = W m_w}$

where W is water equivalent (in g/Kg)

Thermal Expansion→

• Linear Expansion: $\boxed{\Delta l = l\alpha\Delta T}$

$\boxed{l_f = l(1+\alpha\Delta T)}$ α = coeff. of linear expansion.

• Areal Expansion: $\boxed{\Delta A = A\beta\Delta T}$

$\boxed{A_f = A(1+\beta\Delta T)}$ β = coeff. of aeriel expansion.

• Volume Expansion: $\boxed{\Delta V = V\gamma\Delta T}$

$\boxed{V_f = V(1+\gamma\Delta T)}$ γ = coeff. of volume expansion.

$\boxed{\gamma = 3\alpha}$; $\boxed{\beta = 2\alpha}$

• Thermal Stress: $\boxed{Y\alpha\Delta T}$

Heat Transfer→

• Conduction: heat is transferred due to vibrations b/w the molecules.

• Rate of flow of Heat: $\boxed{H = -\frac{KA\Delta T}{l}}$

K = coeff. of thermal conductivity.

• Analogy B/w Electric Current and Heat Current→

$\boxed{I = \frac{\Delta V}{R}} \equiv \boxed{H = \frac{\Delta T}{R}}$ For heat current $\boxed{R = \frac{l}{KA}}$

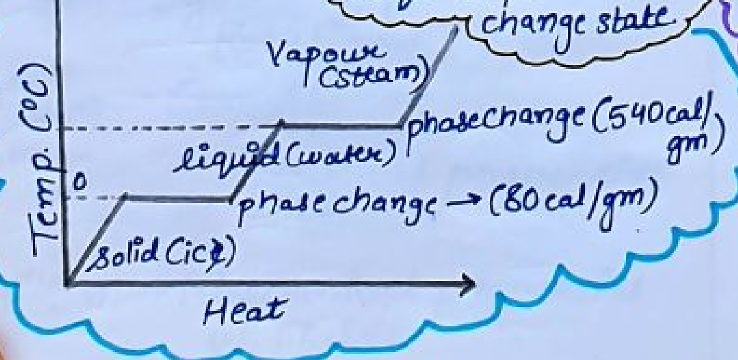
→ Convection: Heat is transferred due to transfer of mass.

→ Radiation: Heat is transferred due to electro-magnetic waves.

→ Change Of State:→

* Solid to liquid → melting.
* Liquid to Solid → fusion.
* Liquid to Vapour → Vapourisation
* Solid to vapour w/o passing through the liquid state → Sublimation

Latent Heat → Heat required/unit mass to change state.



Newton's Law Of Cooling:

Rate Of Cooling, $\boxed{-\frac{dT}{dt} = K(T - T_0)}$

T = temperature of body.

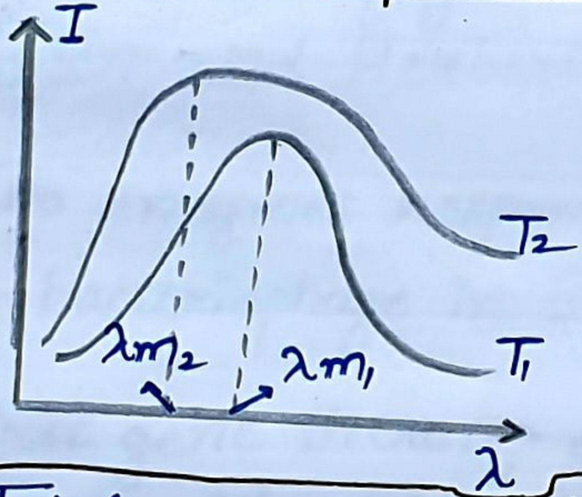
T_0 = temperature of surrounding.

* When temp. drops from T_1 to T_2:

$$\boxed{-\frac{(T_2 - T_1)}{t} = K\left[\frac{T_1 + T_2}{2} - T_s\right]}$$

Heat Radiation →

- **Wien's Displacement Law**: $\boxed{\lambda_m T = b}$



$b =$ Wien's Constant
$= 2.9 \times 10^{-3}$ m-K

$\boxed{\text{Total energy carried by all radiation} = \text{Total area of } I\text{-}\lambda \text{ graph}}$

- **Stefan's Boltzman law**:

Total power radiated by black body : $\boxed{P = \sigma A T^4}$

For a body of emissivity e, $P = e\sigma A T^4$

If temp. of surrounding $= T_s$,

Power Loss → $\boxed{P = e.\sigma A(T^4 - T_s^4)}$