{ Temp. Conversion } Heat & Thermodynamics

THERMODYNAMICS

- The branch dealing with measurement of temperature is called thermometry and the devices used to measure temperature are called thermometers.
- तापमान की माप करने वाली शाखा को थर्मोमेट्री कहा जाता है और तापमान को
- मापने के लिए उपयोग किए जाने वाले उपकरणों को थर्मामीटर कहा जाता है।

Heat (ऊष्मा)

- Heat is a form of energy called thermal energy which flows from a higher temperature body to a lower temperature body when they are placed in contact.

- ऊष्मा ऊर्जा का एक रूप है जिसे तापीय ऊर्जा कहा जाता है जो उच्च तापमान वाले

पिंड से निम्न तापमान पिंड तक बहती है जब उन्हें संपर्क में रखा जाता है।

⇒ Heat → ऊर्जा (Energy) ✓

⇒ Temp :- Measuring unit ✓

SI unit - joule (J).

- The practical unit of heat energy is calorie.
- ऊष्मा ऊर्जा की व्यावहारिक इकाई कैलोरी है।
- 1 cal = 4.18 J
- W = JQ
- J is a conversion factor (not a physical quantity) and its value is 4.186 J/cal.
- J एक रूपांतरण कारक है (भौतिक मात्रा नहीं) और इसका मान 4.186 J / cal है।

Temperature (तापमान)

SI unit → K ✓.

- Temperature of a body is the degree of hotness or coldness of the body. A device which is used to measure the temperature, is called a thermometer.
- निकाय का तापमान निकाय की गर्माहट या ठंडक का डिग्री है। एक उपकरण जो

तापमान को मापने के लिए उपयोग किया जाता है, उसे थर्मामीटर कहा जाता है।

- NTP or STP implies 273.15 K (0°C = 32°F).

Standard " " "

°C
°F
K

Differences between heat and temperature

Heat	Temperature
It is a form of energy	It is the degree of hotness or coldness of a body
It is measured in joules	It is measured in Kelvin
it is not determined directly by an instrument	it is directly determined by a thermometer
it is a derived quantity	It is a fundamental quantity

Different Type of Thermometer

① Liquid Thermometer :- Alchohol + Mercury

Range :- $-30^{\circ}C \longrightarrow 357^{\circ}C$

② Gas Thermometer :- Hydrogen

Range :- $-200^{\circ}C \longrightarrow 500^{\circ}C$

Ranges → Nitrogen → -200°C → 1000°C

→ Less than -200°C → Helium (He) ✓

(3) Clinical Thermometer:- Mercury (Hg)

Range:- 96°F → 110°F

⇒ clearly visible.

⇒ High Density.

⇒ Non-sticky.

⇒ expand on heating.

⇒ Specific Heat Capacity Low.
विशिष्ट ऊष्मा कम।

NTP → Normal Temp & Pressure

STP → Standard " " "

↳ IUPAC

0°C → 100 KPa

20°C 101.3 KPa

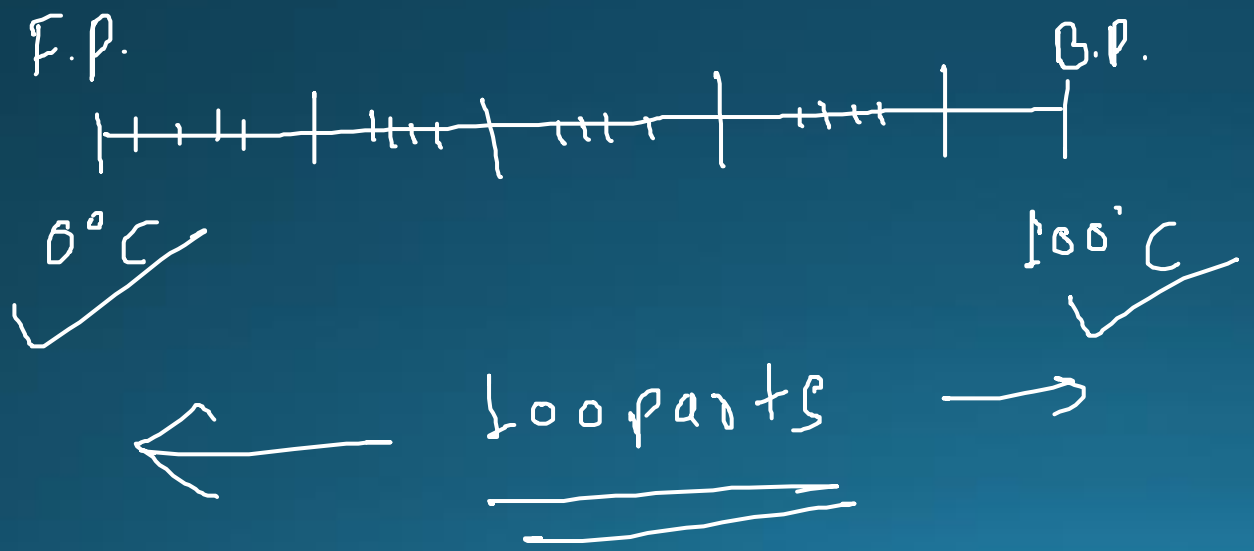
Different Scale of Temperature

* (1) Centigrade Scale (Celsius):-

Water

Boiling point → 100 °C

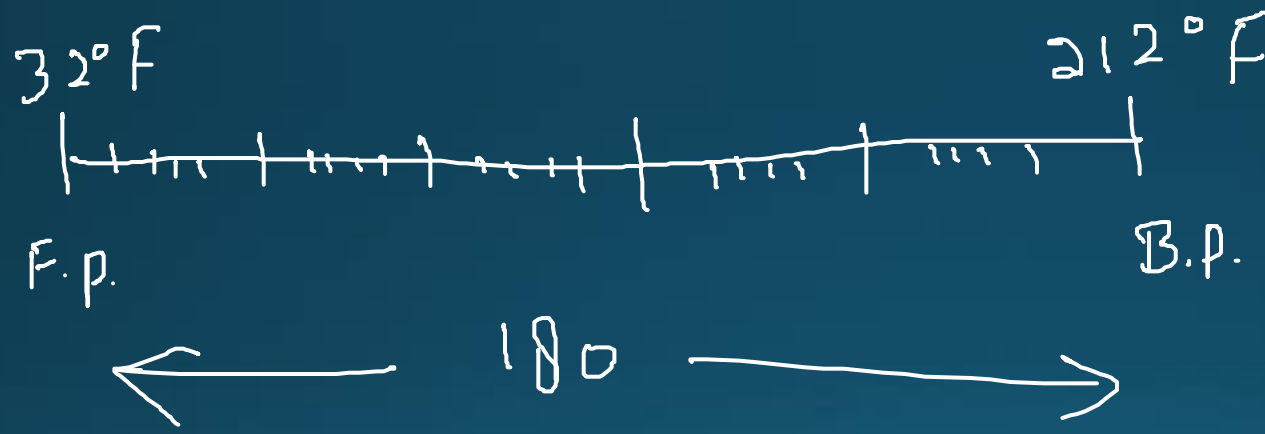
Freezing point → 0° C



② Fahrenheit Scale:- water

B.P. ⇒ 212° F

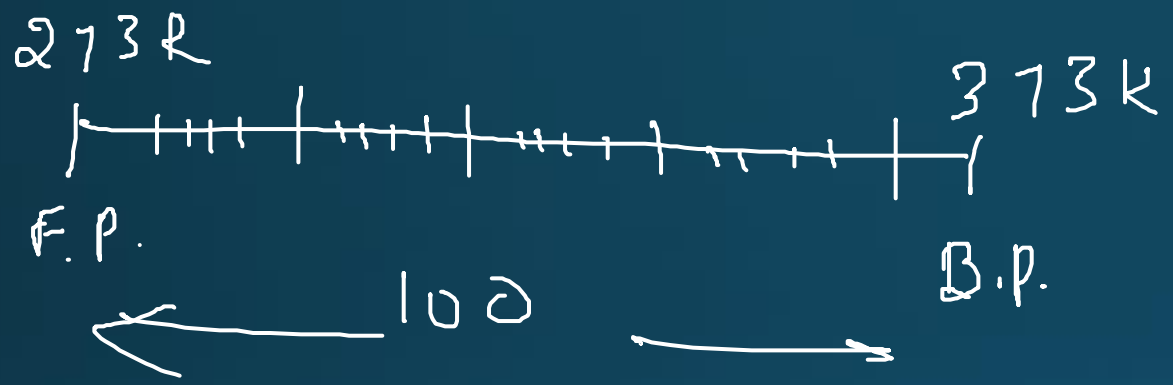
F.P. = 32° F



③ Kelvin Scale:- water

B.P. = 373 K

F.P. = 273 K



Relation between Different Scales of Temperatures

$$\left\{ \frac{C}{100} = \frac{F-32}{180} = \frac{K-273}{100} \right\}$$

⇒ Watery: (Ranjal's Scale)

B.P. ⇒ 80°P

F.P. ⇒ 2°P

$$\frac{\text{Name} - \text{FP}}{\text{BP} - \text{FP}}$$

$$= \frac{P-2}{80-2} = \frac{P-2}{78}$$

$\Rightarrow$ °C & °F :-

$$\frac{C}{100} = \frac{F-32}{180} \Rightarrow \boxed{(F-32) = \frac{9}{5}C}$$

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

$\ast$ $-40^\circ C \longrightarrow {}^\circ F = ? = -40^\circ C$

$$F = \frac{9}{5}(-40^\circ C) + 32$$

$$= -72 + 32$$

$$\Rightarrow \boxed{F = -40^\circ F}$$

* °F & K :- 574.25 °F = 574.25 K

⇒ Note :- 27°C → °F = ? °F > °C

(i) 25°F ✗

(ii) 20°F ✗

(iii) 24°F ✗

(iv) 39°F ✓

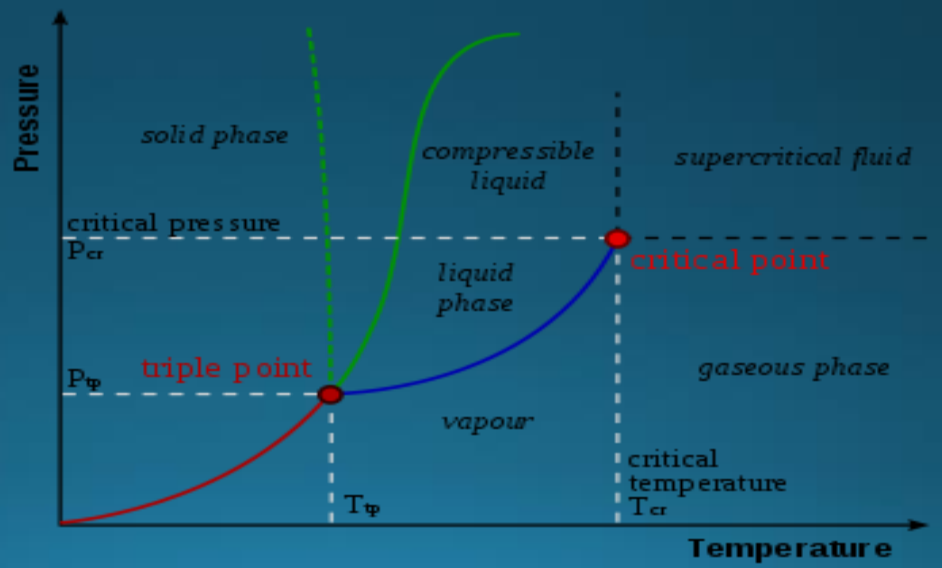
Triple Point of Water (पानी का ट्रिपल प्वाइंट)

liquid + Gas + Solid

- The values of pressure and temperature at which water coexists in equilibrium in all three states of matter, i.e., ice, water and vapor called triple point of water.

273.16 K or 0.01 °C / 0.46 cm of Hg

- Triple point of water is 273 K temperature and 0.46 cm of mere pressure.



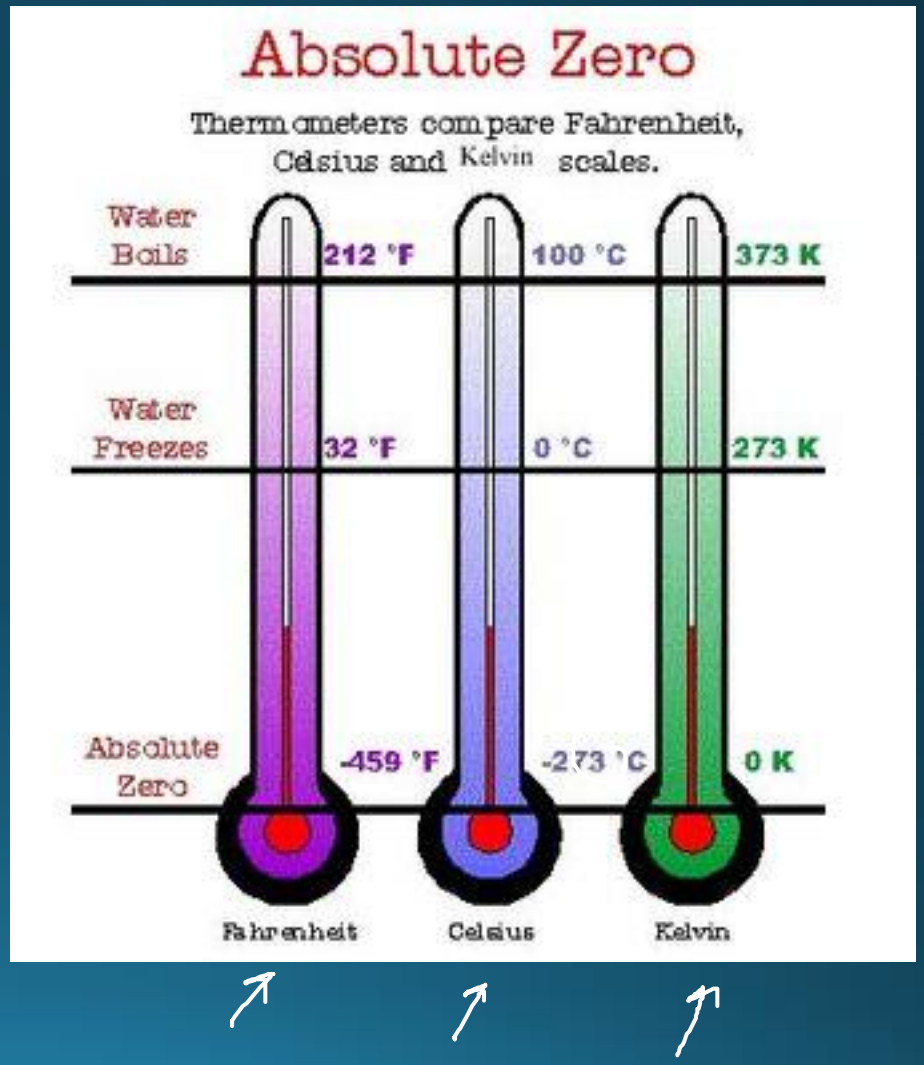
Absolute Zero Temperature

⇒ Lowest Temp ✓

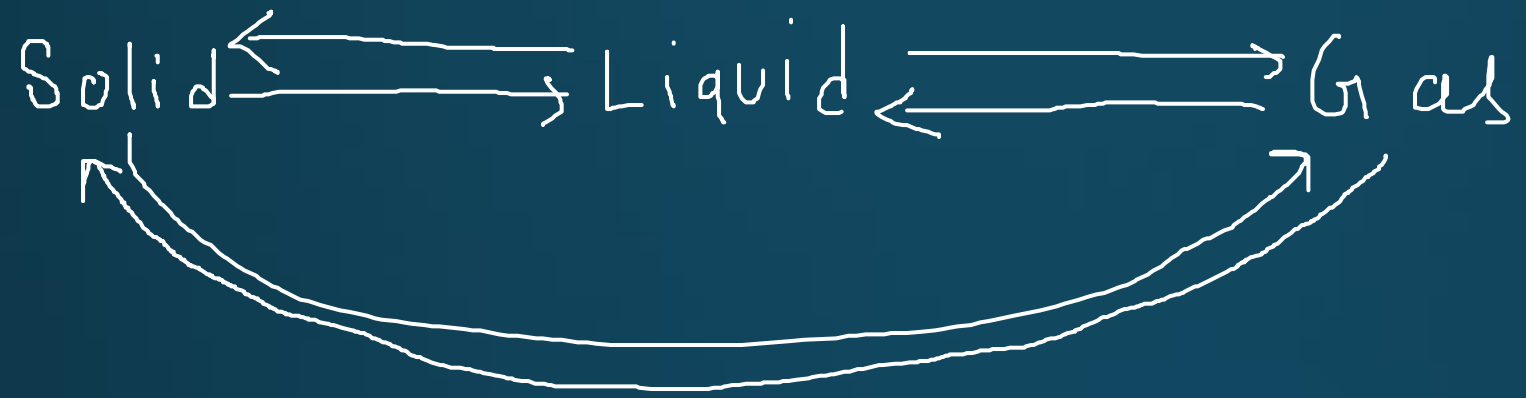
⇒ Atomic Energy ↓ Lowest

⇒ -273°C or 0K

परम शून्य ताप



Change of State (अवस्था परिवर्तन)



* Liquid to Solid:- Liquid $\xrightarrow{\text{cold}}$ Solid

↳ Freezing.

* Solid to Gas:- अर्थपान (Sublimation)

धुर,

* Solid to liquid:- (by giving Heat)

This process is called → Melting.

* Liquid to Gas:- (by giving Heat)

↳ vapourization (वाष्पीकरण)

* Gas to Liquid:- (Gas $\xrightarrow{\text{cold}}$ Liquid)

↳ Condensation

Gas to Solid:-

Hoar frost

Dry ice

⇒ VAPORIZATION (वाष्पीकरण)

- **BOILING POINT** :→ NTP or STP

① Liquid → Pressure ↑ → Boiling Point ↑

② Water can boil at → 0 °C when
Surrounding Pressure → 4.6 mm of Hg.

③ By adding Impurities → Boiling Point ↑

& (Boiling point) ↓ because Pressure Decreases

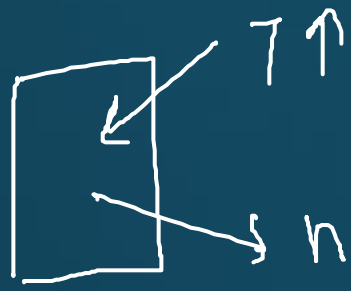
EVAPORATION (वाष्पन)

[liquid to Gas!]

* Factors affecting:

① Surface Area: S.A. ↑ → Rate of evaporation ↑

② Temp :-



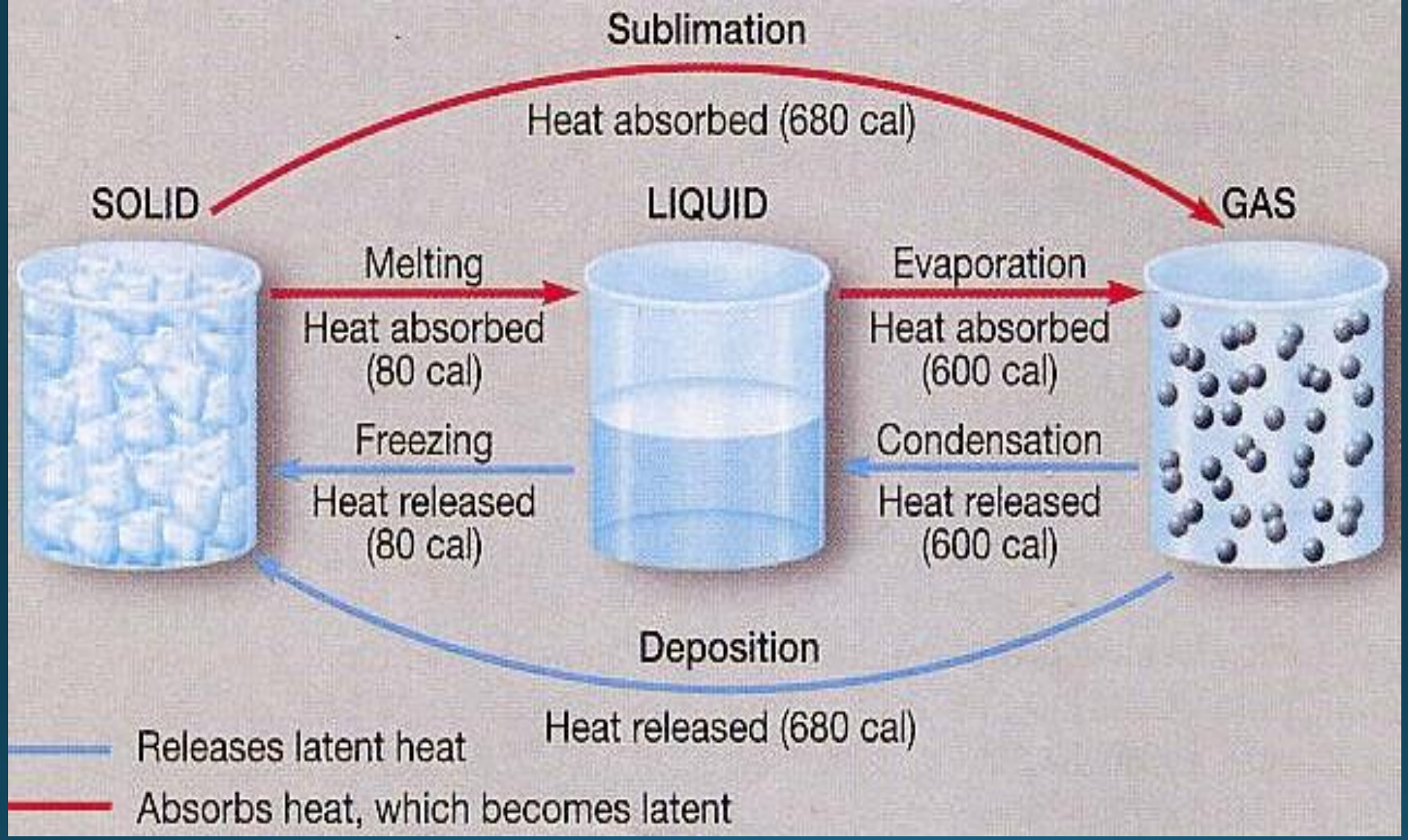
③ Humidity :- Humidity ↓ Rate of evap = ↓

④ Speed of wind :- v_s ↑ $R_{evap.}$ → ↑

- **Melting:** Conversion of solid into liquid state at constant temperature is melting.

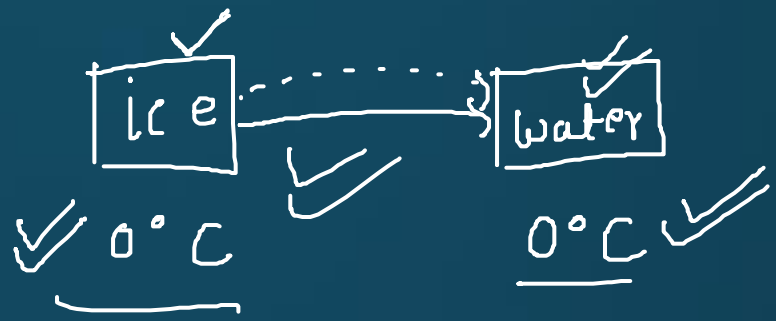
- **Sublimation** The conversion of a solid into vapour state is called sublimation.

- **Hoar Frost** The conversion of vapours into solid state is called hoar fr..


Sublimation
Heat absorbed (680 cal)
SOLID
LIQUID
GAS
Melting
Heat absorbed
(80 cal)
Evaporation
Heat absorbed
(600 cal)
Freezing
Heat released
(80 cal)
Condensation
Heat released
(600 cal)
Deposition
Heat released (680 cal)
Releases latent heat
Absorbs heat, which becomes latent

LATENT HEAT

(गुप्त ऊष्मा)



- The heat energy absorbed or released at constant temperature per unit mass for change of state is called latent heat.
- Heat energy absorbed or released during change of state is given by
- $Q = mL$ (L → Latent Heat)

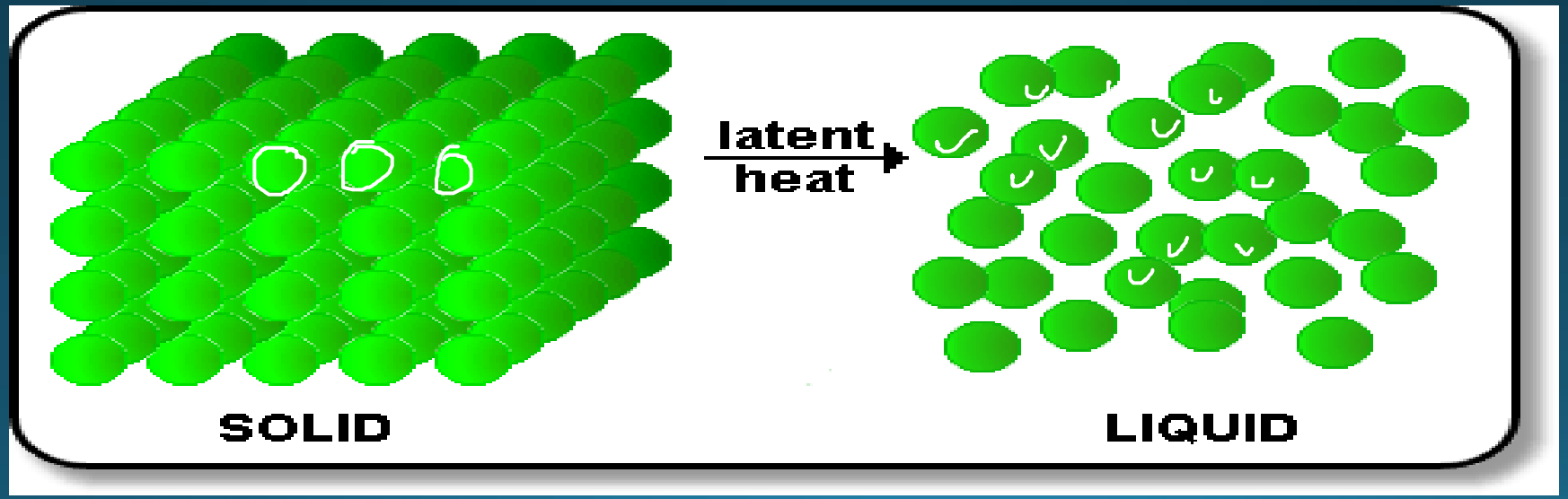
- where m = mass of the substance and L = latent heat.
- Its unit is cal/g or J/kg and its dimension is .....

- For water at its normal boiling point or condensation temperature (100°C), the latent heat of vaporisation is वाष्पन की गुप्त ऊष्मा

L = 540 cal/g = 40.8 kJ/ mol = 2260 kJ/kg (vapour)

- For water at its normal freezing temperature or melting point (0°C), the latent heat of fusion is (गलन की गुप्त ऊष्मा)

L = 80 cal/ g = 60 kJ/mol = 336 kJ/kg (Freezing)



Specific Heat (विशिष्ट उष्मा)

1 unit mass → 1°C

- The amount of heat required to raise the temperature of unit mass the substance through 1°C is called its specific heat.
- It is denoted by c or s.
- Its SI unit is joule/kilogram-°C'(J/kg-°C).
- Its dimensions is [L2T-2θ-1].
- The specific heat of water is 4200 J kg-1°C-1 or 1 cal g-1 C-1, which high compared with most other substances.

$Q = mc\Delta T$

c → Specific heat

Gases have two types of specific heat

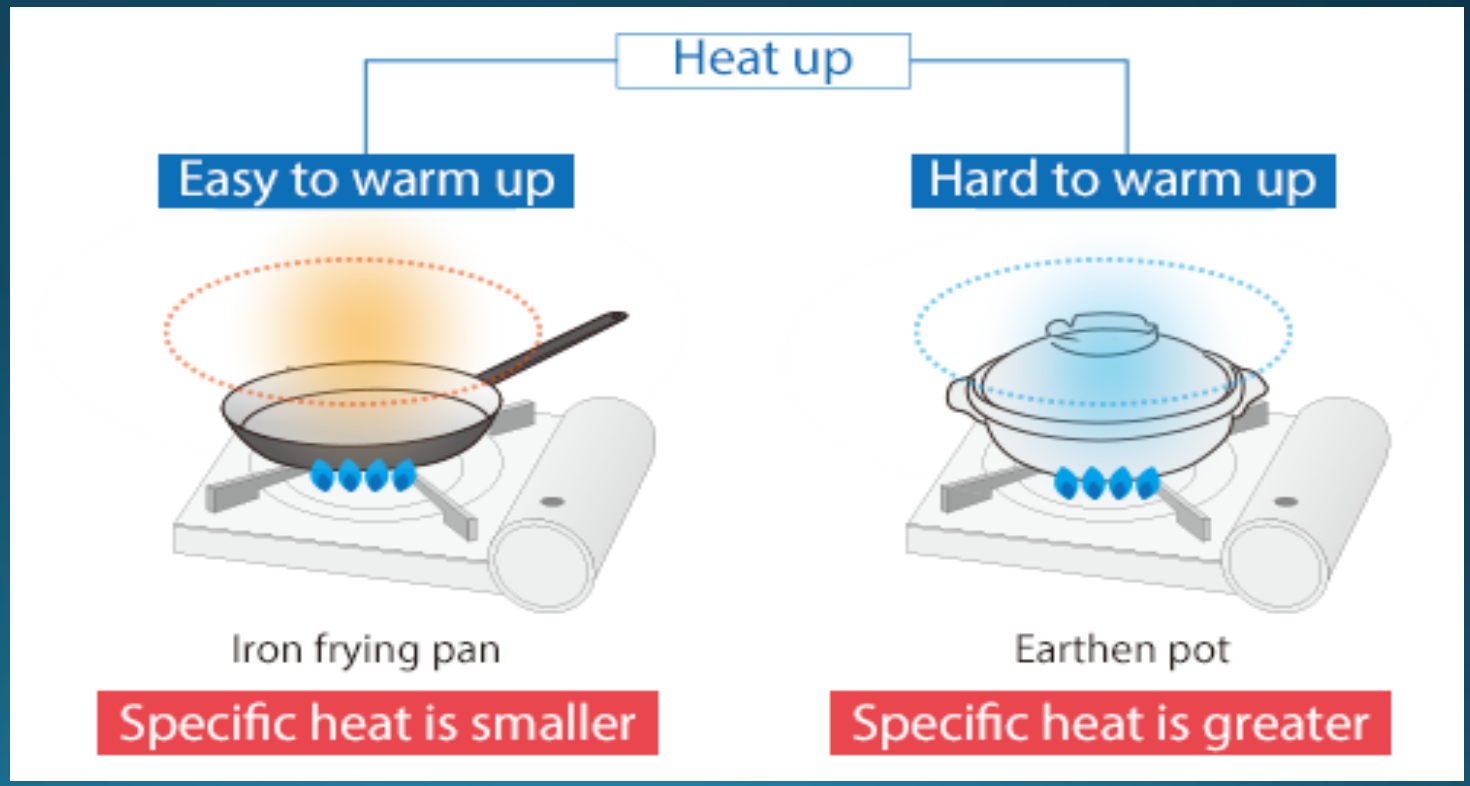
- 1. The specific heat capacity at constant volume (Cv).
- 2. The specific heat capacity at constant pressure (Cr).
- Specific heat at constant pressure (Cp) is greater than specific heat constant volume (CV), i.e., Cp > CV .
- For molar specific heats Cp – CV = R

where R = gas constant and this relation is called Mayer's formula.

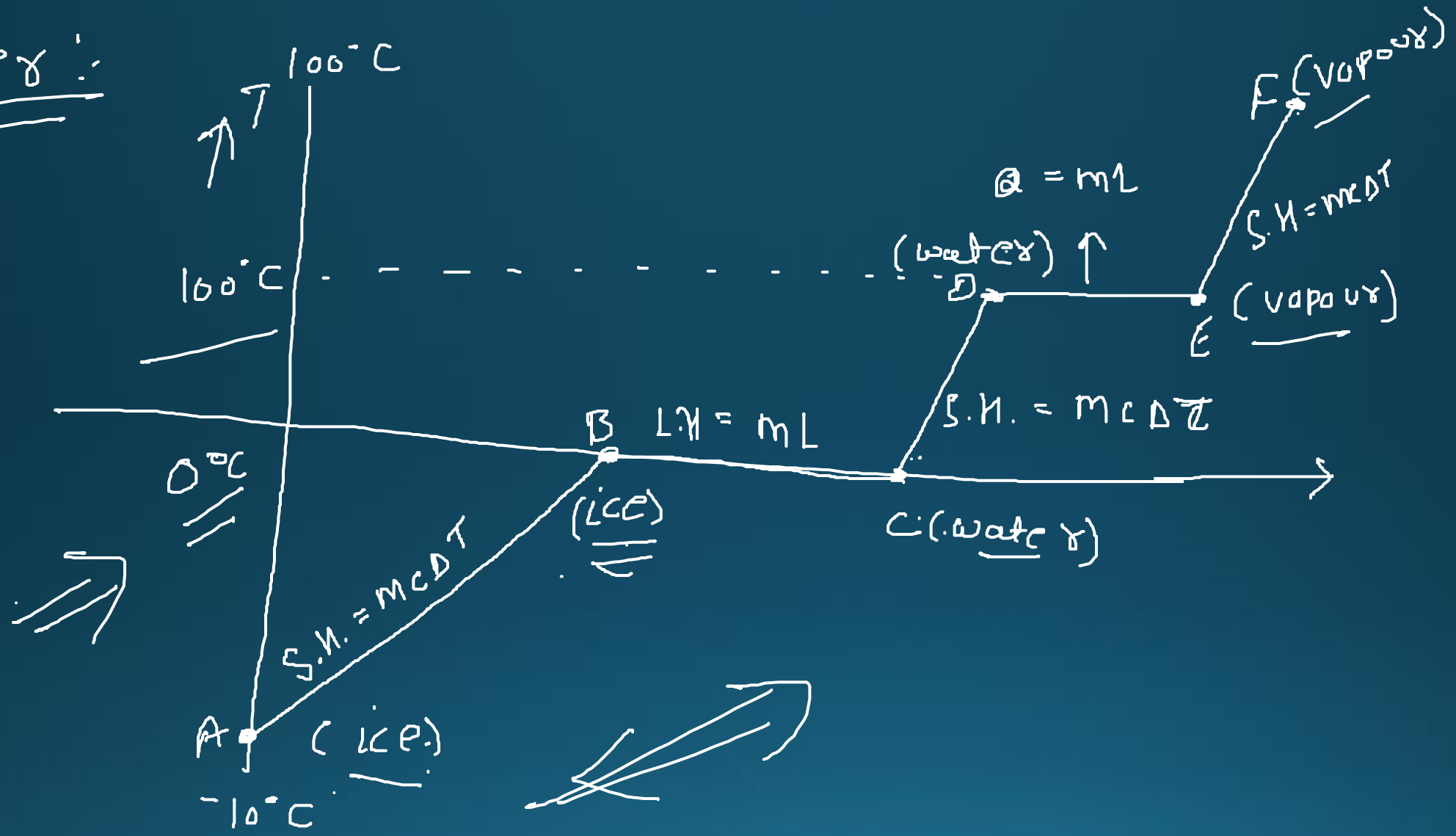
- The ratio of two principal sepecific heats of a gas is represented by γ.
- The value of γ depends on atomicity of the gas.

- Amount of heat energy required to change the temperature of any substance is given by

$$Q = mc\Delta t$$



Water :


T
100°C
160°C
0°C
-10°C
A
(ice)
S.H. = mcΔT
B
(ice)
L.H = mL
C: (water)
S.H. = mcΔT
D
(water)
Q = mL
E
(vapour)
S.H = mcΔT
F (vapour)

- # Thermal (Heat) Capacity

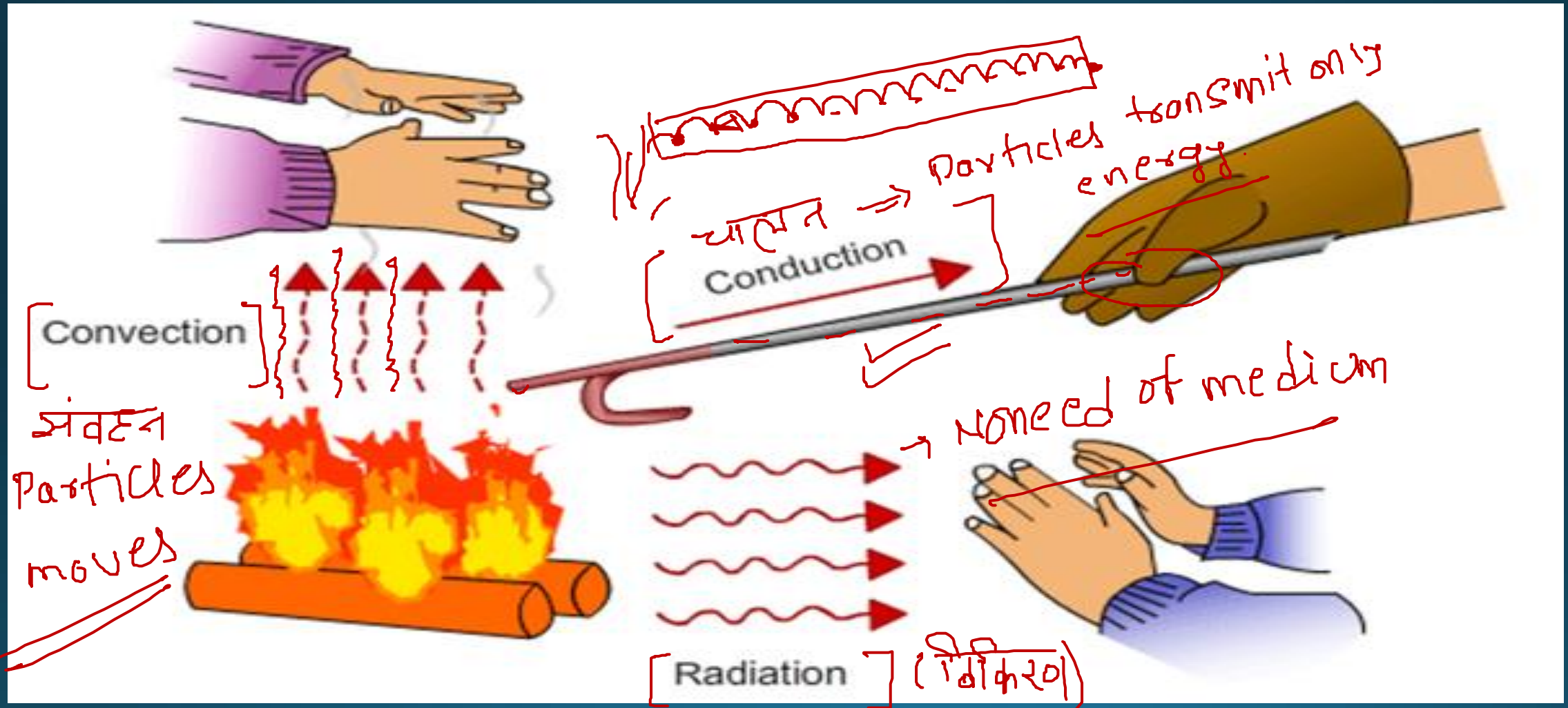
- Heat capacity of any body is equal to the amount of heat energy required to increase its temperature through 1°C.

- Heat capacity = mc

where c = specific heat of the substance of the body and m = mass of the body.

- Its SI unit is joule/kelvin (J/K).

TRANSMISSION OF HEAT



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