Temp. → Heat C_1

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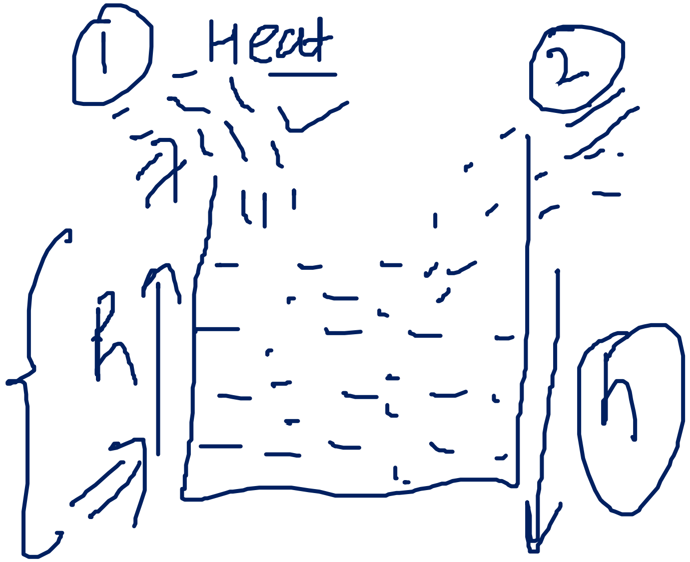
THERMODYNAMICS

- The branch dealing with measurement of temperature is called thremometry and the devices used to measure temperature are called thermometers.

Heat

energy

- 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.



⇒ SI unit - joule (J). = N = E

- The practical unit of heat energy is calorie.
- 1 cal = 4.18 J
- W = JQ

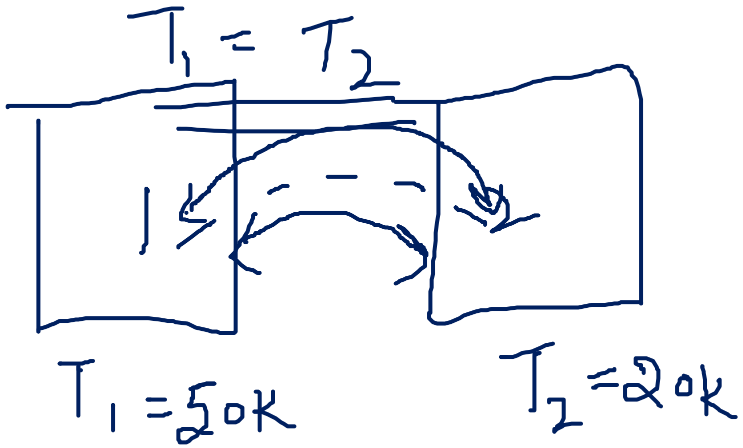
CGS:- erg [1 erg = 10^{-7} J]

- J is a conversion factor (not a physical quantity) and its value is 4.186 J/cal.

Temperature

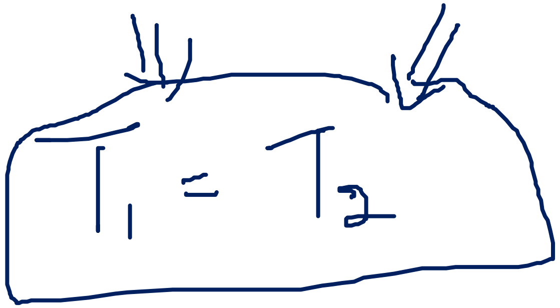
- Temperature of a body is the degree of hotness or coldness of the body. A device which is used to measure the temperature, is called a thermometer.

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



SI ⇒ Kelvin (K)

* Thermal equilibrium:-



(7) (1) Temp → Kelvin

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 or mercury)

Min. Temp. ⇒ $-30°C$

Hig. Temp. ⇒ $357°C$

② Gas Thermometer:- (Limit) ⇒ $-200°C$ – $500°C$ (H_2)

⇒ (Limit) ⇒ $-200°C$ – $1000°C$ (N_2)

⇒ Limit → $< -200°C$ ⇒ He Gas

(3) Clinical Thermometer :- 'Hg'

(i) Highly visible.

(ii) Density → High.

(iii) Non - Sticky.

(iv) expand → Temp ↑

(v) Specific Heat Capacity → Low

Scale

⇓

96°F → 110°F

⇒ 107.6 ✓

(4) Platinum Resistance Thermometer:-

Limit → -200°C – 1200°C → Platinum

(5) Total Radiation Thermometer | Pyrometer:-

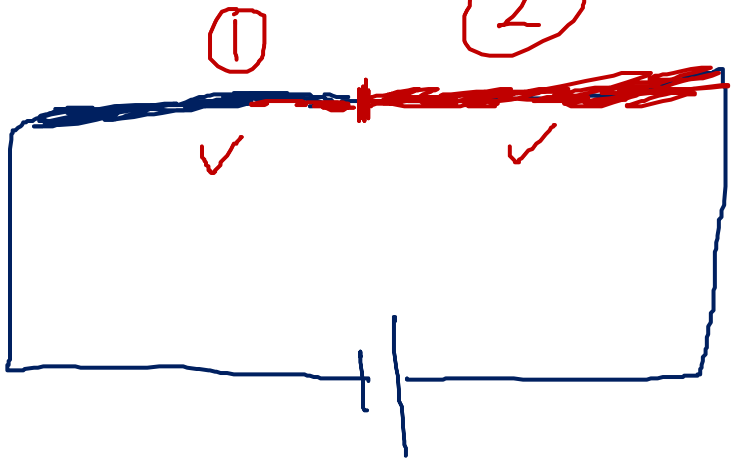
Limit :- -800°C → 4000°C

{ sun surface ⇓ 6000°C }

* Sun Temp. ✓

(6) Thermo-Couple Thermometer:-

(Seeback Effect) Limit → (-200°C - 1600°C)



⇒ current Flow

⇒ (Thermo electric Current)

$E = \sigma T^4$

$E \propto T^4$

* Room Temp:- 20°C - 25°C
(68°F - 77°C)

* When water freezes,
it expand by 9% ✓

* Centre of Sun:- 15 million °C

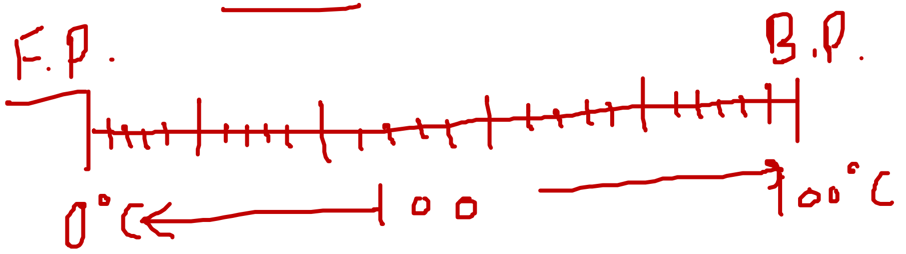
Different Scale of Temperature

① Celsius Scale / Centigrade Scale :- (1730)

exp: water ⇒

F. P. ⇒ 0°C

B. P. ⇒ 100°C

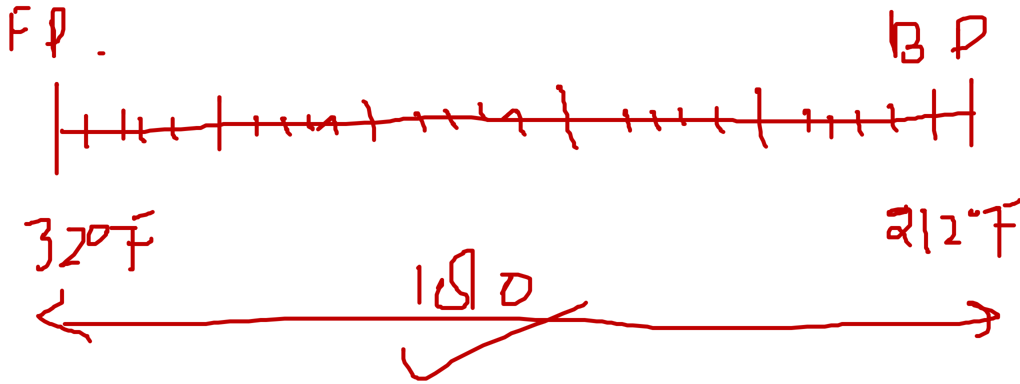


② Fahrenheit Scale :- (°F) :- (1717)

exp. water ⇒

F. P. ⇒ 32°F

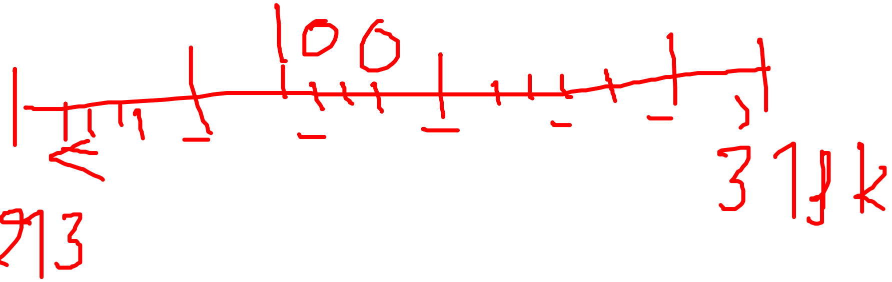
B. P. ⇒ 212°F



(3) Kelvin: (K) ⇒ (1852)

water ⇒ F.P. = 273K

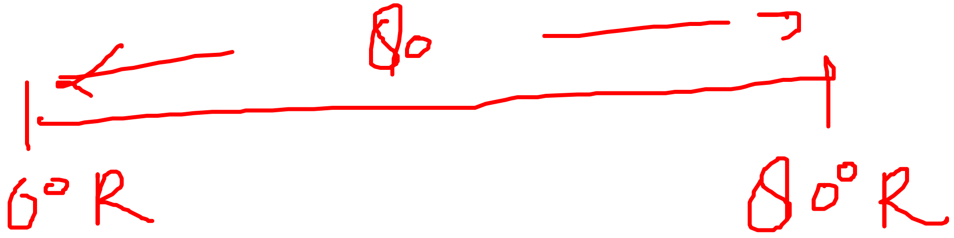
B.P. ⇒ 373K



(4) Reaumur scale (1731) (°R):-

F.P. ⇒ 0°R

B.P. ⇒ 80°R



(5) Rankine scale:- (°Ra)

F.P. ⇒ 492°Ra

B.P. ⇒ 672°Ra

Relation between Different Scales of Temperatures

$$\left\{ \frac{C}{100} = \frac{F-32}{180} = \frac{K-273}{100} = \frac{R}{80} = \frac{Ra-492}{180} \right\}$$

$$* \left\{ \frac{Sc.Name - F.P.}{B.P. - F.P} \right\} \Rightarrow \left\{ \frac{R - 10^\circ Ris}{120^\circ Ris - 10^\circ Ris} \right\}$$

Water ✓

* 1 °C = °F ⇒ Ans ⇒ (−40°)

$\Delta C = \frac{5}{9} \Delta F$

−40°C = −40°F

−40°C → __°F ⇒ $\frac{C}{100} = \frac{F-32}{180}$

$\frac{9}{5} \frac{180}{100} C = F - 32$

$\frac{9}{5} \times (-40) = F - 32$

$F = -40°F$

* °F = K

⇒ 574.25°

* 25° C ⟹ °F

⟹ $\frac{9}{5} \times 25 = F - 32$

$45 = F - 32$

$F = 77°F$

Triple Point of Water

- 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.

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

⇒ Solid → Liquid → Gas

Specific Pressure:- 0.458 cm of Hg

* Specific Temp:- 273.16 K (0.01°C)

Absolute Zero Temperature

* Atomic activity → Lowest.

* ⇒ (−273.15°C) (0 K)

Change of State

* Melting:- { Solid —Heat→ Liquid }

* Vaporisation:- { liquid —Heat→ Gas (vapour) }

* Condensation:- { vapour —cold→ liquid }

* Freezing:- { liquid —cold→ Solid }

* ① Heat → enter → (Shape / size → increase)

② Heat → exhale → (Size → Decrease)

* **Boiling Point:-** ① water → (100°C) → Specific → Density → Pressure]

⇒ ① Pressure ↑ → B.P. ↑

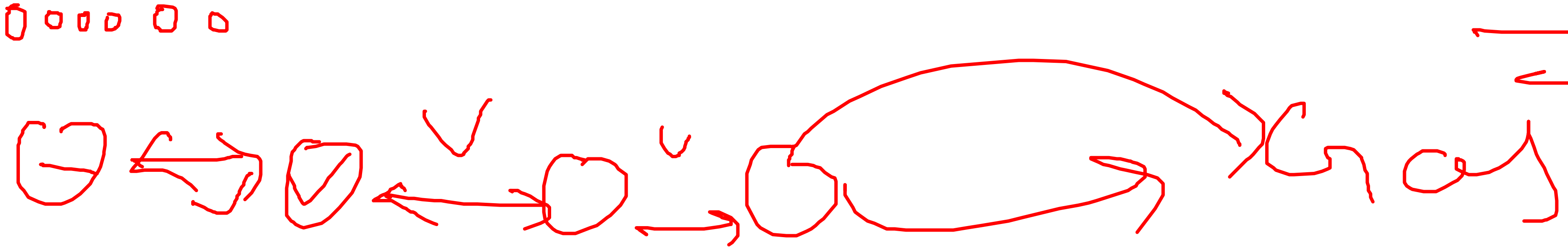
⇒ ② Add impurity → B.P. ↑

BOILING POINT

EVAPORATION

1. Surface Area :- S.A ↑ → Rate of EVP → ↑
2. Temp :- Temp ↑ → Rate of EVP → ↑
3. Humidity :- Hum. ↑ → Rate of EVP → ↓
4. Speed of Air :- Air ↑ → Rate of EVP → ↑

⇒ Latent heat



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

- **<u>Sublimation</u>** The conversion of a solid into vapour state is called sublimation.

Solid $\xrightarrow{\text{Heat}}$ Gas

exp: dry ice, {Solid CO_2}, Nephthelein

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

Gas $\xrightarrow{\text{cold}}$ Solid

Latent Heat

- 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
- 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

L = 540 cal/g = 40.8 kJ/ mol = 2260 kJ/kg

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

L = 80 cal/ g = 60 kJ/mol = 336 kJ/kg

Specific Heat

- 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.

Gases have two types of specific heat

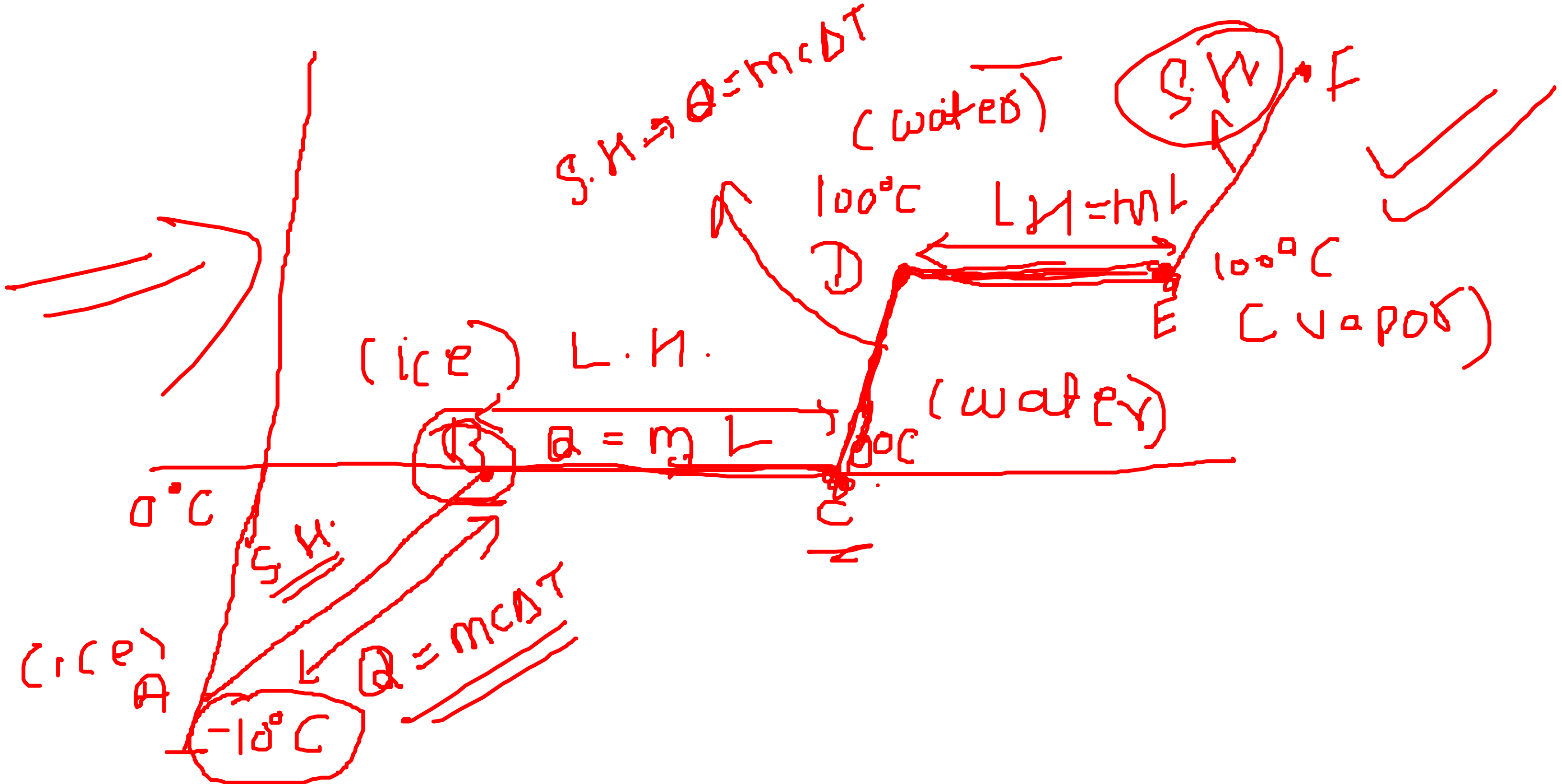
- 1. The specific heat capacity at constant volume (Cv).
- 2. The specific heat capacity at constant pressure (Cr).
- Specific heat at constant pressure (Cp) is greater than specific heat constant volume (CV), i.e., Cp > CV .
- For molar specific heats Cp – CV = R

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

liquid & Solid ⇒ 1 Specific heat

- 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

$$Q = mc\Delta t$$



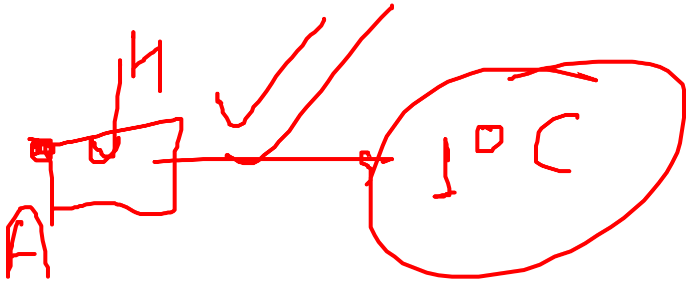
Thermal (Heat) Capacity

- 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.

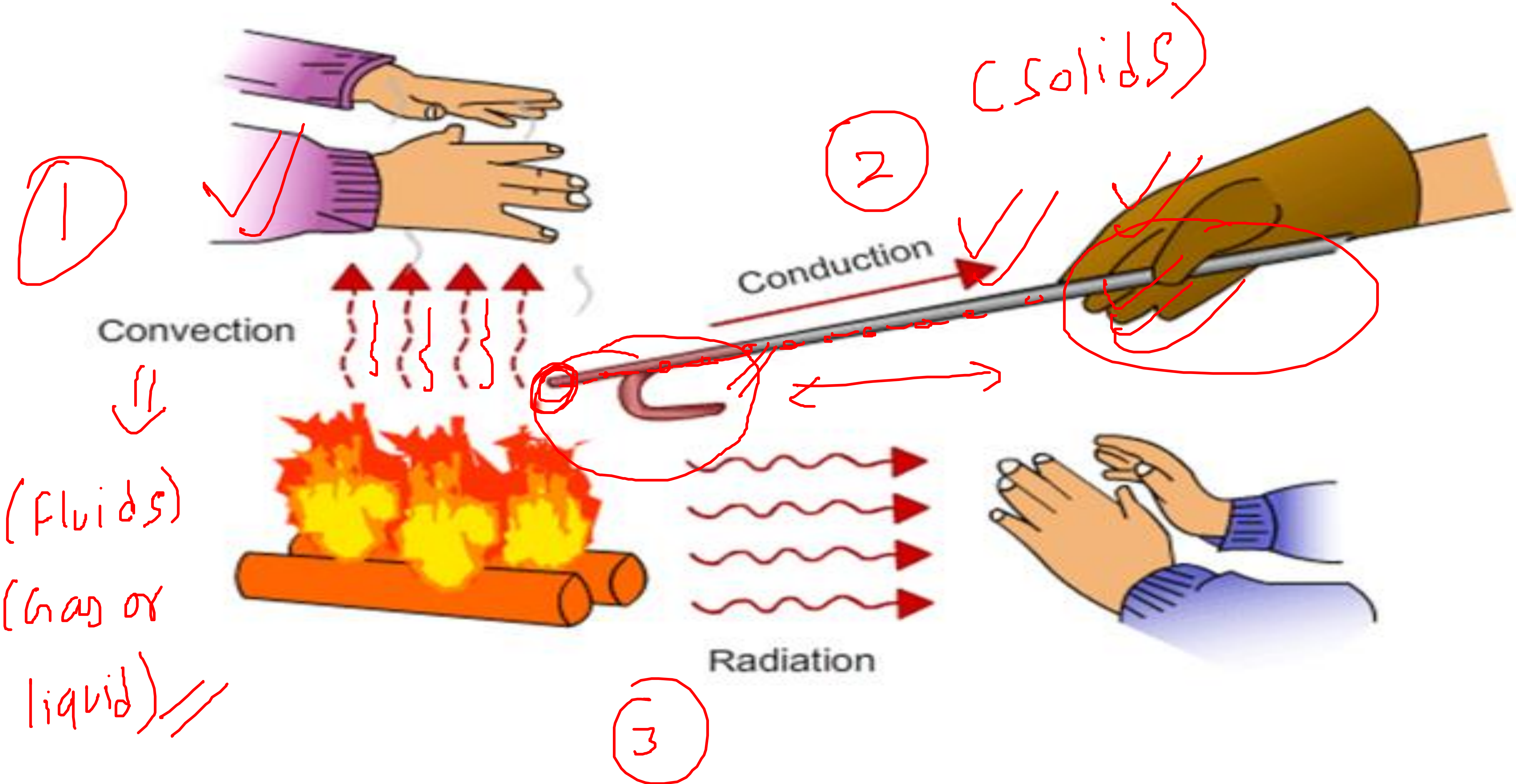
- Its SI unit is joule/kelvin (J/K).



* molar Heat Capacity:- 1 mole → Temp (1°C) → Heat Req.

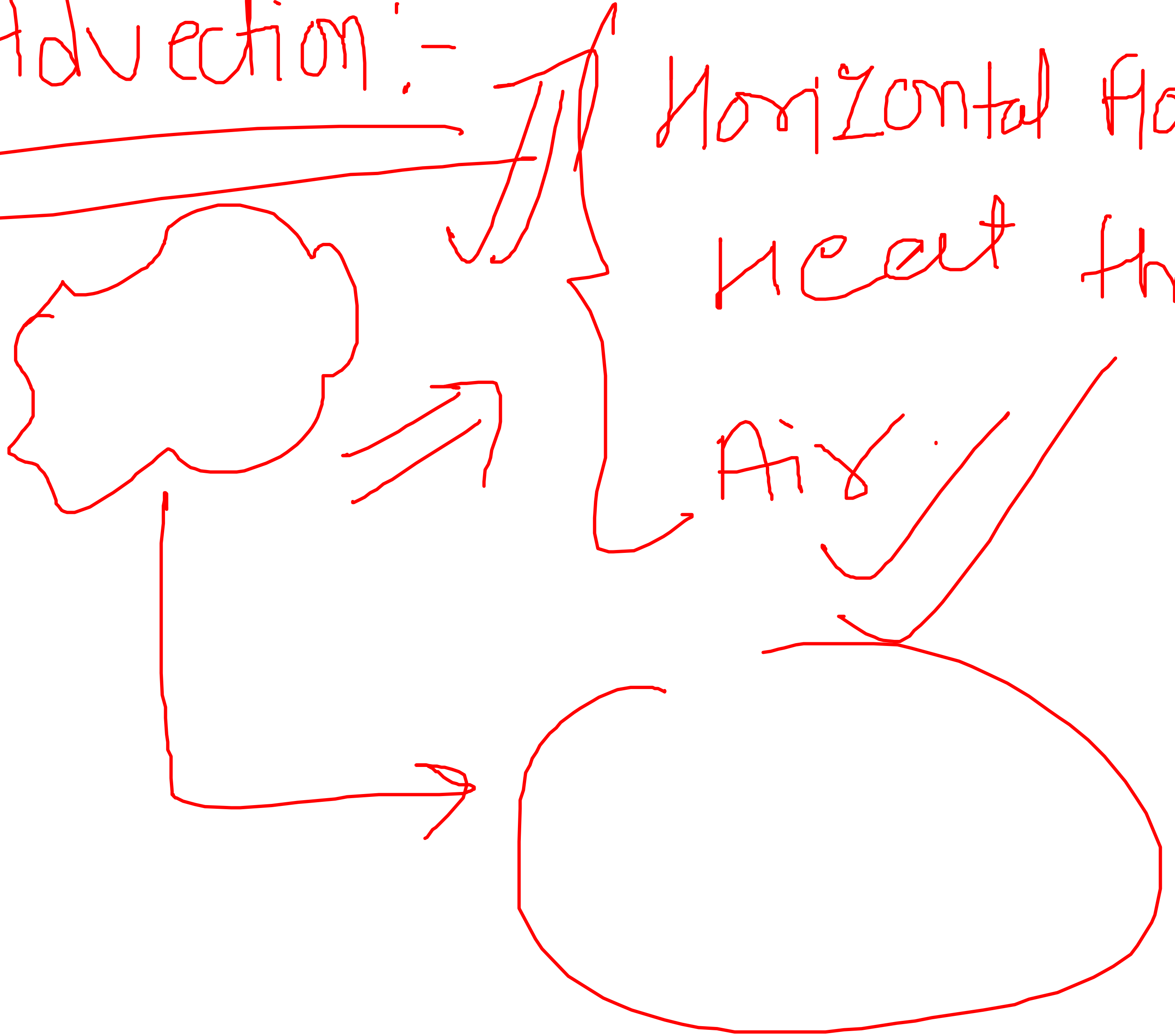
$Q = mol \cdot C \cdot \Delta T$

TRANSMISSION OF HEAT



* Advection:-

Horizontal flow of heat through Air



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