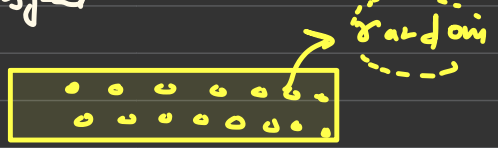
POM-1

VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

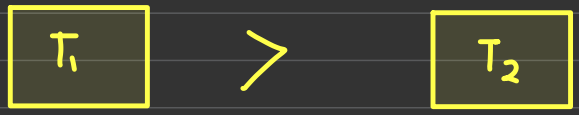
1. Calorimetry
2. Thermal Expansion
3. Radiation
4. Elasticity

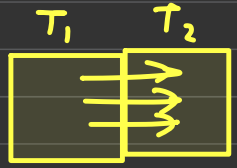
Calorimetry: (Study of measurement of Heat)

≥ **Heat:** "form of energy associated with random motion of molecules inside matter/object"



$T_1 > T_2$





"Heat always flows from H.T to Lr"

1 Cal: "amount of Heat required to raise the temp of 1 gram of water by 1°C { 13.5° → 14.5° }"

Specific Heat Capacity :

"Amount of Heat required to raise temp of 1 gram Substance by 1°C "

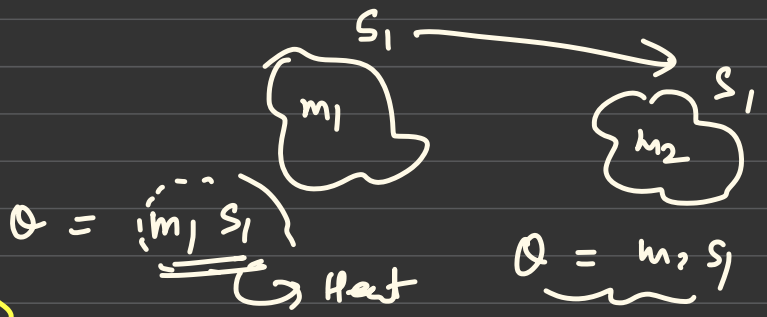
- Sw = 1 cal / g 1°C
- Sice = 0.5 cal / g 1°C
- Svapour = 0.5 cal / g 1°C

$$\theta = m \times s \times \Delta\theta$$

- θ : Heat supplied
- m : mass of object
- s : Specific Heat capacity
- $\Delta\theta$: Temp

Property of Substance

Heat Capacity of body: "Amount of Heat required to raise temp of body by 1°C."



$Q = m \times S$

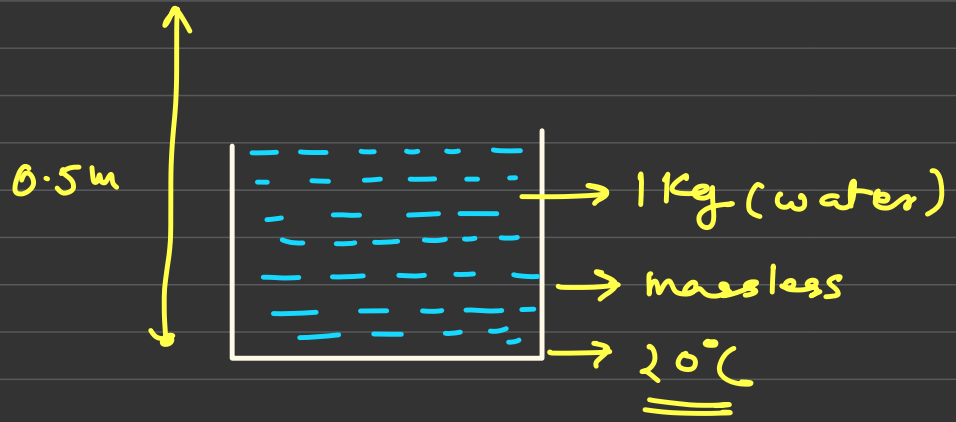
"Heat Capacity of body"

"Mechanical equivalent of Heat:"

Work → Heat

"1 Cal = 4.2 Joules"

Q):



How many shakes? to increase Temp of water upto 100°C

= 2 × (1 × 10 × 0.5) = 20 × 0.5 = 10 Joules

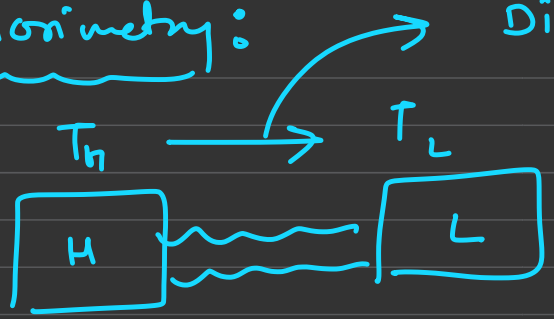
$n \times \frac{10}{4.2}$ cal $=$ 1000 gram $\times$ 1 cal/g/°C $\times \Delta\theta$

$n \times \frac{10}{4.2} = 1000 \times 80$

$n = \frac{8000 \times 4.2}{10} = \frac{8000 \times 4.2}{}$

$= 33600$ Shalok

Principle of calorimetry:



"Heat will flow till bodies achieve thermal equilibrium"

"if we put 0°C ice in 0°C water"

$T_H > T_L$

$\Downarrow$

$T_H' = T_L' = T_e$

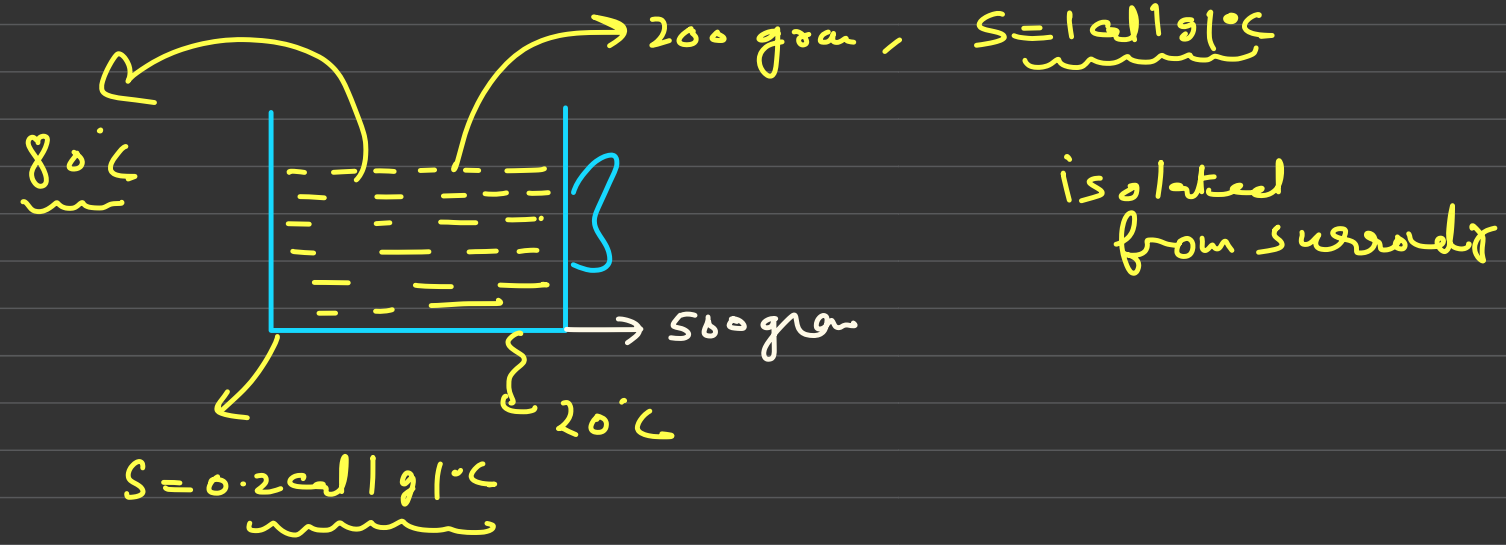
"Two streams of two°C water"

"Heat will not flow until there is Temp diff"

loss = gain

In - final = final - initial

8)



loss = gain

$200 \times 1 \times [80 - \theta_f] = 500 \times 0.2 \times [\theta_f - 20]$

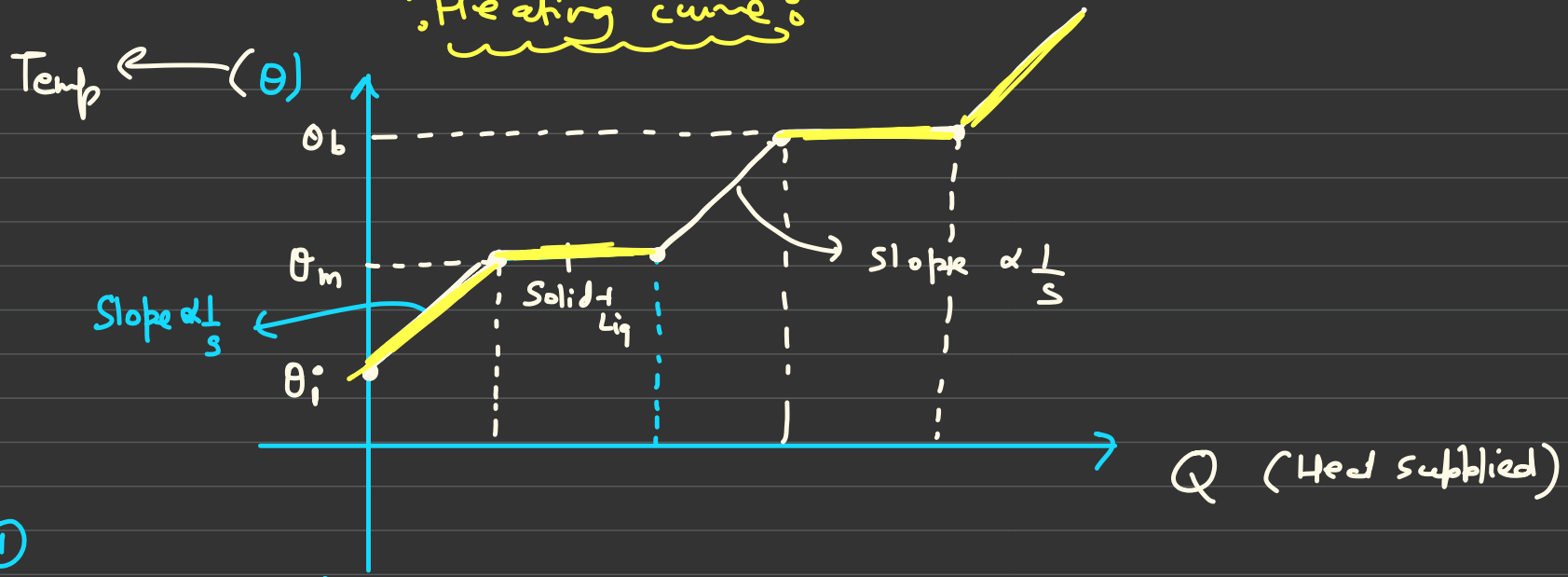
$2[80 - \theta_f] = \theta_f - 20$

$160 - 2\theta_f = \theta_f - 20$

$3\theta_f = 180$

$\theta_f = 60^\circ$ Ans

Heating curve



① $Q = m \times s \times \Delta\theta$

$\Delta\theta = \frac{\theta}{ms}$

② Latent Heat of fusion: "amount of Heat required to melt 1 gram of Substance"

$Q = m L_f$

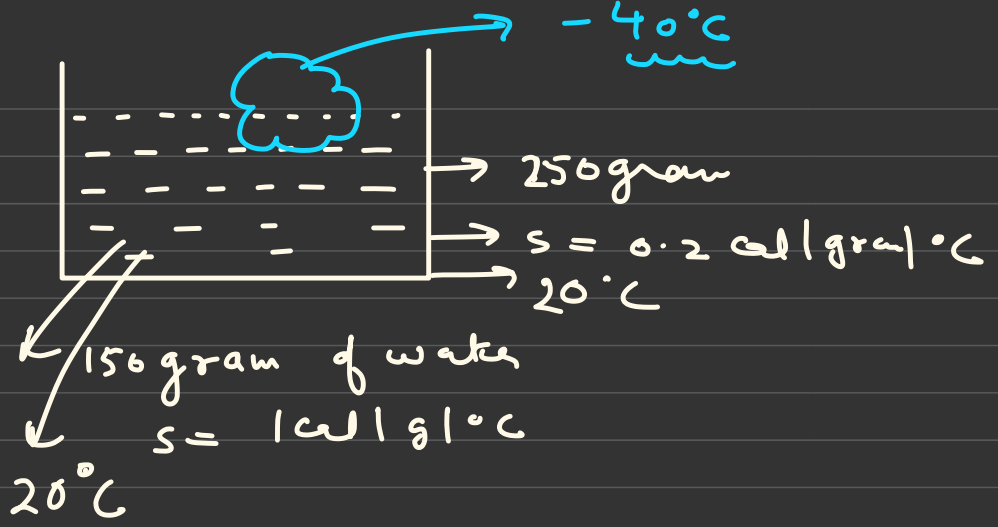
Latent Heat of fusion

$L_f = 80 \text{ cal/gram}$

(3) Latent Heat of Vaporisation (L_v) amount of Heat required to convert 1 gram of liquid into 1 gram of gas

$L_v = 540 \text{ cal/g}$

θ)



" isolated from surrounding"

(i) " find amount of ice for which final temp of System is 0°C with No-ice melted ?" Sice = 0.5

$250 \times 0.2 \times (20) + 150 \times 1 \times 20 = m \times 0.5 \times (0-(-40))$

$1000 + 3000 = 20m$

$4000 = 20m$

$m = 200$ gram

(ii) find amount of ice (mass of ice) for which final temp of system $0^\circ C$ with all ice melted?

loss of (cal + water) = gain of ice

$\Rightarrow$ $250 \times 0.2 \times (20-0) + 150 \times 1 \times 20 = m \times 0.5 (0-(-40)) + m \times 80$

$4000 = 100m$

$(m = 40$ gram) at $-40^\circ C$

(iii) if we take 30 gram of ice at -40°C

then find final temp of System

water + cal (20°C)

loose

{ 20 → 0 {

1000 + 3000 = 4000 cal

ice (-40°C)

-40 → 0°C gain

30 × 0.5 × 40 = 600 cal

melt 30 × 80 = 2400

3000 cal

finally: { gain → final - initial
loss → initial - final {

$250 \times 0.2 (20 - \theta) + 150 \times 1 \times (20 - \theta) = 30 \times 0.5 \times (0 - (-40)) + 30 \times 80 + 30 \times 1 (\theta - 0)$

$\theta = 4.3$

(iv) if we take 50 gram of ice at $-4.0^{\circ}C$ then find final temp of System ?

Cal + water

4000 cal ↓

$0^{\circ}C$

$= 50 \times 0.5 \times 40$

$= 1000$ Cal

$\Rightarrow 50 \times 80 =$ 4000

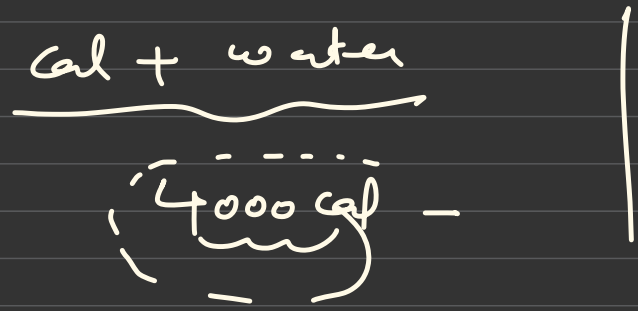
final temp of System = $0^{\circ}C$

amount of ice in the system = finally

$\frac{3000}{80} = 37.5$ gm melt

Remaining ice at $0^{\circ}C = 12.5$ gram.

(v) find amount of ice for which final temp of system is 0°C with all water freezed?



m → −40 → °C

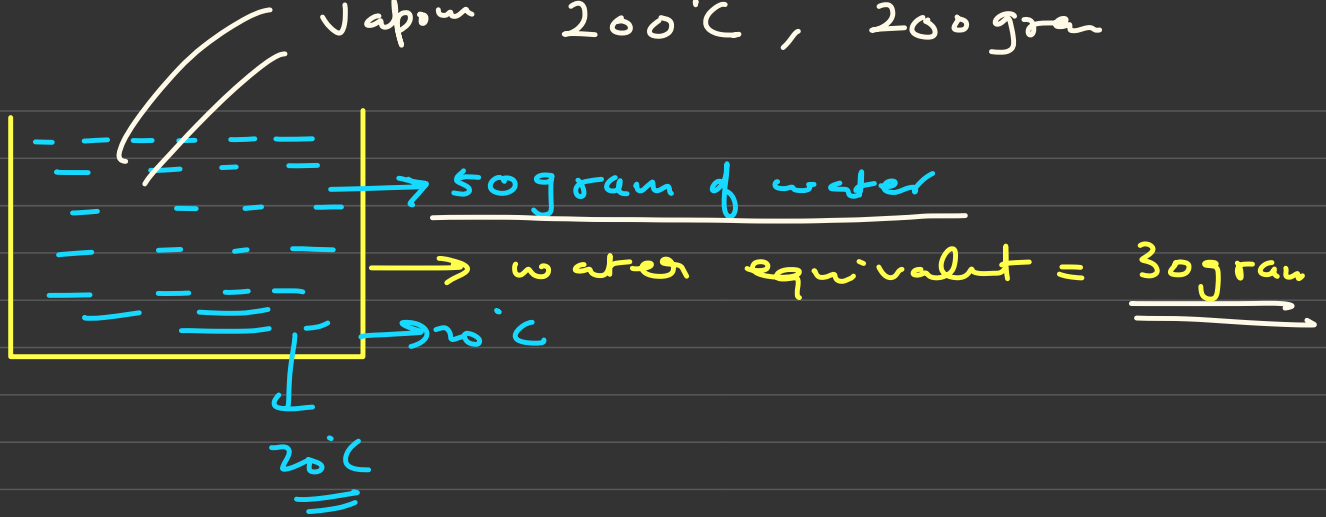
$$4000 + 150 \times 80 = m \times 0.5 \times (0 - (-40))$$

$$4000 + 12000 = 20m$$

$$20m = 16000 \Rightarrow m = 800gm$$

(VI) if we take 100 gm of ice at -40°C then find final temp of system!

Q) ①



30 water equivalent = we can assume mass of calorimeter as 30gm of water.

bc Heat capacity of water = Heat of Calorimeter then mass of water is water equivalent

Vapour

Cal + water

$\Rightarrow 200 \times 0.5 \times 100$

$\Rightarrow 10000 \text{ cal}$

$= 80 \times 1 \times (100 - x)$

$= 6400 \text{ cal}$

final temp of system = 100°C

$\frac{3600}{540} = 6.6 \text{ gram}$

(ii)

100 gram of vapour at 200°C the find final temp of system & composition?

Solution:

$200^\circ C \rightarrow 100^\circ$

$100 \times 0.5 \times 100$

$= 5000$ cal

Cal + water

80 gram $\quad 20 \nearrow 100$

$= 6400$ cal

100°C

1 gm $= 2.5$ gram.

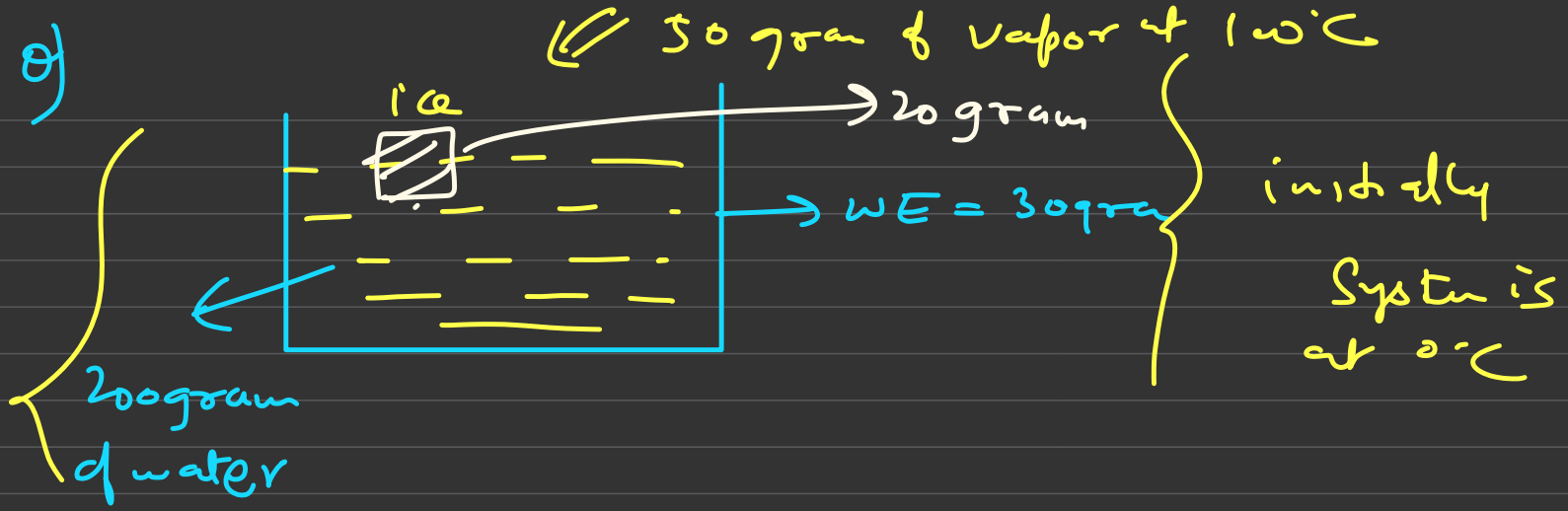
40 gm / 54 gm

Water $\{50 + 2.5 \text{ gm}\}$ & Vapour $= 92.5$ gm

(iii) find amount of vapour 200°C for which final temp of System = 100° with all water become vapour

(iv) " " " at 200°C for which " final temp " " = 100°C with all vapor condense?

Homework



if pour 50 gram of vapor at 100°C then find temp and composition?