Heat and Temperature

Temp Conversion :-

$$\frac{R - L.P}{U.P - L.P} = \text{constant}$$

{NOTE :- -ve temp is not possible in 'K'}

Linear	Areal	Volumetric
$L_f = L_0(1+\alpha\Delta T)$	$A_f = A_0(1+\beta\Delta T)$	$V_f = V_0(1+\gamma\Delta T)$
or, $\Delta L = L_0\alpha\Delta T$	$\Rightarrow \Delta A = A_0\beta\Delta T$	$\Delta V = V_0\gamma\Delta T$
$\alpha \rightarrow$ coefficient of linear expansion	$\beta \rightarrow$ coefficient of Areal expansion	$\gamma \rightarrow$ coefficient of volumetric expansion.

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

or, $\alpha : \beta : \gamma = 1 : 2 : 3$

Thermal Stress (σ_T)

$$\boxed{\sigma_T = Y\alpha\Delta T}$$

Expansion in solids

$$\rho' = \rho_0(1 - \gamma\Delta T)$$

NOTE :-

Water

⊛ Reading

⊛ $R_T = R_s(1+\alpha\Delta T)$

⊛ $\% \text{ error} = \frac{\Delta R}{R} \times 100 = \frac{\cancel{R_0}\alpha\Delta T}{\cancel{R_0}} \times 100$

$$\boxed{\therefore \% \text{ error} = \alpha\Delta T \times 100}$$

Calorimetry

Specific Heat Capacity (s) :-

Used when temperature is different but phases are same

$$\boxed{Q = Ms\Delta T}$$

s → specific Heat capacity

NOTE :- $1\ J = 4.2\ cal$

Mixing of water / or any other liq :-

Concept :-

$S_\omega = 1$

Assume a Temperature 'T' and then

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

calculate T from here.

Latent Heat

→ Used when phase is different but temperature is same

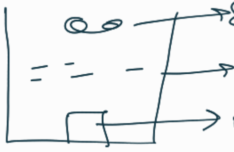
** $\boxed{Q = ML}$

$L_v = 540\ cal/gm$

$L_f = 80\ cal/gm$

(*) Mixed Phase

Let's see by an example.



1 : Assume a phase and its temperature (100°c water)

2 :- Convert all those phase into the above mentioned temp and phase

3 :- Calculate $Q_{Rejected}$ and $Q_{Absorbed}$ respectively

(4) if, $Q_R > Q_A$, Temp will increase

if, $Q_R < Q_A$, Temp will decrease

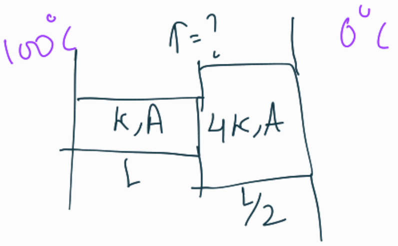
Heat Transfer

Conduction | Convection | Radiation

$$\frac{dQ}{dt} = \frac{KA}{l}\,\Delta T$$

$K \rightarrow$ Thermal conductivity

(*) $\text{Flux} = \dfrac{\left(\frac{dQ}{dt}\right)}{A}$

(*) 

What is the temperature at junction?

$$\Rightarrow \frac{KA}{L}(100 - T) = \frac{4KA}{L/2}(T - 0)$$

$$\Rightarrow T = \_\_\_\_ \quad (\text{Ans})$$

(*) Thermal Resistance :-

$$\boxed{R = \frac{l}{kA}} \quad , \quad i_T = \frac{\Delta T}{\left(l/kA\right)}$$

Radiation

$$\text{Absorptive Power} = \frac{a}{P_0}$$

$$\text{Transmissive Power} = \frac{t}{P_0}$$

$$\text{Reflective Power} = \frac{r}{P_0}$$

Emissive Power, $e = \dfrac{Q}{A\,\Delta t}$

$Q \rightarrow$ Heat

$\Delta t \rightarrow$ time

$A \rightarrow$ Area

Kirchoff's law :→

$$\frac{\text{emissive power}}{\text{adsorptive power}} = \text{Const.} \Rightarrow \text{emissive power} \propto \text{adsorptive power}.$$

i.e $\frac{E_1}{a_1} = \frac{E_2}{a_2} = \frac{E_B}{a_B \to 1} = E_B$

* absorption power = $\frac{\text{Heat absorbed}}{\text{Total Heat}}$

* $E = \frac{Q}{\Delta A \, \Delta t}$

Now, Emissivity (e)

* $e = \frac{E}{E_b}$, $e \in [0, 1]$

* $e_1 = a_1$ [emissivity = absorptivity]

* Stephan's law :→

$$P = \sigma A T^4$$

amount of energy radiated

Area

Temperature of Surface (K)

stephan's const.

only for Black Body

$$\boxed{P = e\sigma A T^4}$$

emissivity

for normal object

* Power absorped :-

$P_a = \sigma A T_s^4$ | $P_{net} = A\sigma(T_s^4 - T_0^4)$

for black body | For black Body

* for normal object → * $P_a = eA\sigma(T_s^4 - T_0^4)$

* Wein's Displacement law :-

$T\lambda_m = \text{Const} = b(0.282 \text{ cm-K})$

Kelvin

meters