FREE APP CLASS SCHEDULE

MECHANICAL ENGINEERING

GATE

HMT	MONDAY Live @11AM	YOGESH SIR
PRODUCTION	TUESDAY Live @11AM	GAURAV SIR
SOM	WEDNESDAY Live @8PM	MUKESH SIR
THERMODYNAMICS	THURSDAY Live @11AM	KANISTH SIR
ENGINEERING MATHEMATICS	FRIDAY Live @11AM	ANANT SIR

No class

Sat & Mond

No class

Variation of Conductivity in Liquids :→

$$K = \frac{A C \rho^{4/3}}{M^{1/3}}$$

$A \rightarrow$ Constt

→ Value depends on collision Velocity

$C \rightarrow$ Sp heat

$\rho \rightarrow$ Density

$M \rightarrow$ Mol Wt of liquid

$A = C$, $C = C$, $M = C$

$K = f(\rho)$

$\rho = f(P, T)$

$K_{liquids} = f(P, T)$

$P\uparrow, \rho\uparrow, K\uparrow$

liquids → Incomp

$\rho \simeq$, $P\uparrow$, $K \simeq C$

$T\uparrow, \rho\downarrow, K\downarrow$

$$K = \frac{A C \rho^{4/3}}{M^{1/3}}$$

For any liquids at two diff temp

$$\frac{K_1}{K_2} = \left(\frac{\rho_1}{\rho_2}\right)^{4/3}$$

For two liquids at same temp

$$\frac{K_1}{K_2} = \left(\frac{A_1}{A_2}\right)\left(\frac{C_1}{C_2}\right)\left(\frac{\rho_1}{\rho_2}\right)^{4/3}\left(\frac{M_2}{M_1}\right)^{1/3}$$

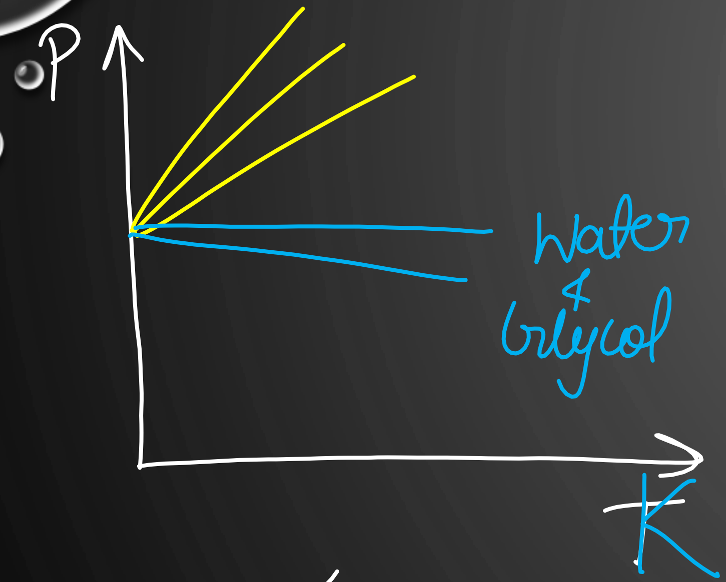
For two liquids, $\rho_1 = \rho_2$, $A_1 = A_2$, $C_1 = C_2$

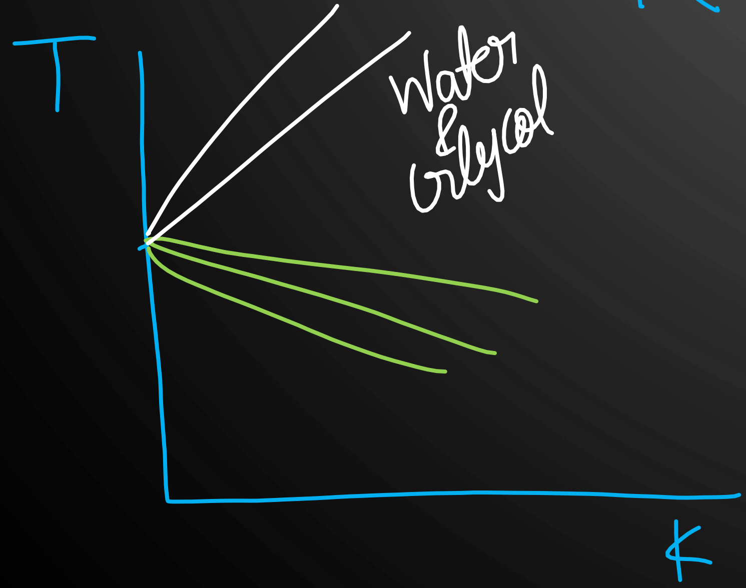
$$\frac{K_1}{K_2} = \left(\frac{M_2}{M_1}\right)^{1/3}$$

$$K \propto \frac{1}{M}$$ ✓

In General

$P\uparrow$, $\rho\uparrow$, $K\uparrow$
$T\uparrow$, $\rho\downarrow$, $K\downarrow$
} Water & Glycol





Variation of Conductivity in Gasses

$$K = \frac{1}{3} c \rho L V_{rms}$$

V_{rms} → RMS Velocity

C → Sp heat

ρ → Density

L → Avg Mol Distance

Cylinder

L↓, P↑

P↓, L↑

$\rho \propto \frac{1}{L}$

$K \neq f(\rho, L)$

$\rho = f(P, T)$

$K = f(V_{rms})$

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

R → Universal GAS constt

M → Mol wt

$\bar{R} = 8314 \frac{KJ}{Km\text{-}K}$ or $\frac{J}{m\text{-}K}$

$V_{rms} \propto \sqrt{\frac{T}{M}}$

$K \propto \sqrt{\frac{T}{M}}$

For two GASSES

$$\frac{K_1}{K_2} = \sqrt{\frac{T_1}{T_2}} \times \sqrt{\frac{M_2}{M_1}}$$

For two gasses at same temp

$$\frac{K_1}{K_2} = \sqrt{\frac{M_2}{M_1}}$$

For a GAS at Diff. Temp

$$\frac{K_1}{K_2} = \sqrt{\frac{T_1}{T_2}}$$

$K = f(T)$, $T\uparrow, K\uparrow, \mu\uparrow$

$K \neq f(P)$

Ex: $K \propto \frac{1}{\sqrt{M}}$

H_2, O_2, N_2, CO_2, NH_3

$H_2 \rightarrow 2$, $O_2 \rightarrow 32$, $N_2 \rightarrow 24$, $CO_2 \rightarrow 44$, $NH_3 \rightarrow 17$

$K_{CO_2} < K_{O_2} < K_{N_2} < K_{NH_3} < K_{H_2}$

Conduction :→

└→ Governing Law

↓

Fourier Law

Fourier Law :→

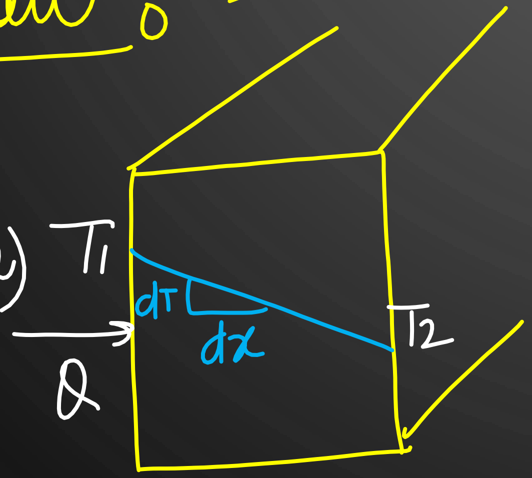
$Q \neq f(x)$

$Q \neq f(\text{time})$

$T = f(x)$

$T \neq f(t)$

$T \neq f(y)$



$$Q \propto -\frac{dT}{dx}$$

$$Q \propto A_\perp$$

$$Q \propto A_\perp \left(\frac{dT}{dx}\right)$$

$$\boxed{Q = -KA\frac{dT}{dx}}$$

Conduction HT Through a Plain wall :→

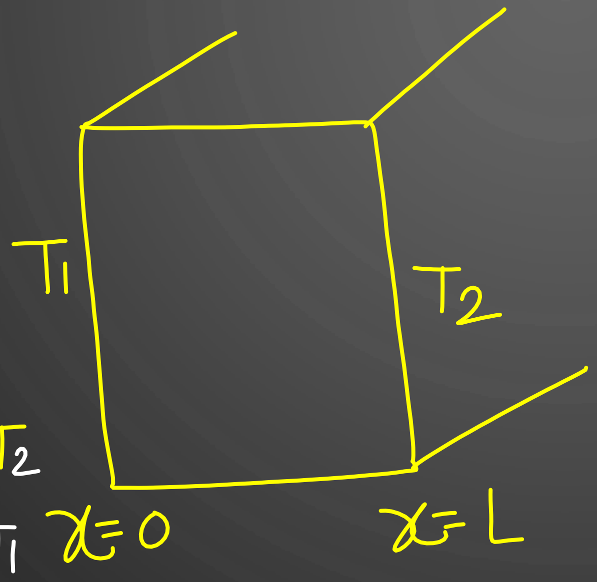
$$Q = -KA\frac{dT}{dx}$$

$$\int Q\,dx = -\int KA\,dT$$

$$Q[x]_0^L = -KA[T]_{T_1}^{T_2}$$

$$QL = -KA(T_2 - T_1)$$

$$\boxed{Q = \frac{KA(T_1 - T_2)}{L}}$$



$$Q = \frac{KA\,\Delta T}{L}$$

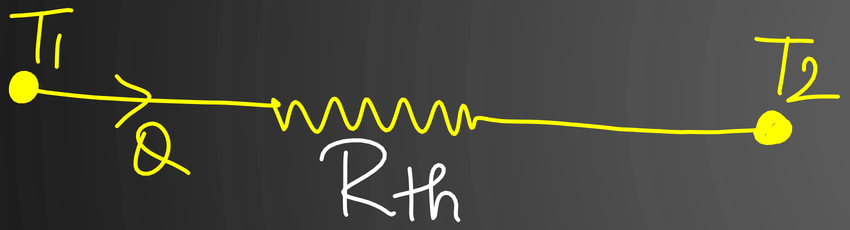
$\Delta T \rightarrow T_1 - T_2$ ✓

Electrical Analogy of Condn

HT :→

$$\Delta V = iR$$

$$\boxed{i = \frac{\Delta V}{R}}$$



$$Q = \frac{\Delta T}{R_{th}}$$

$$i = \frac{\Delta V}{R}$$

$$Q = \frac{KA\Delta T}{L}$$

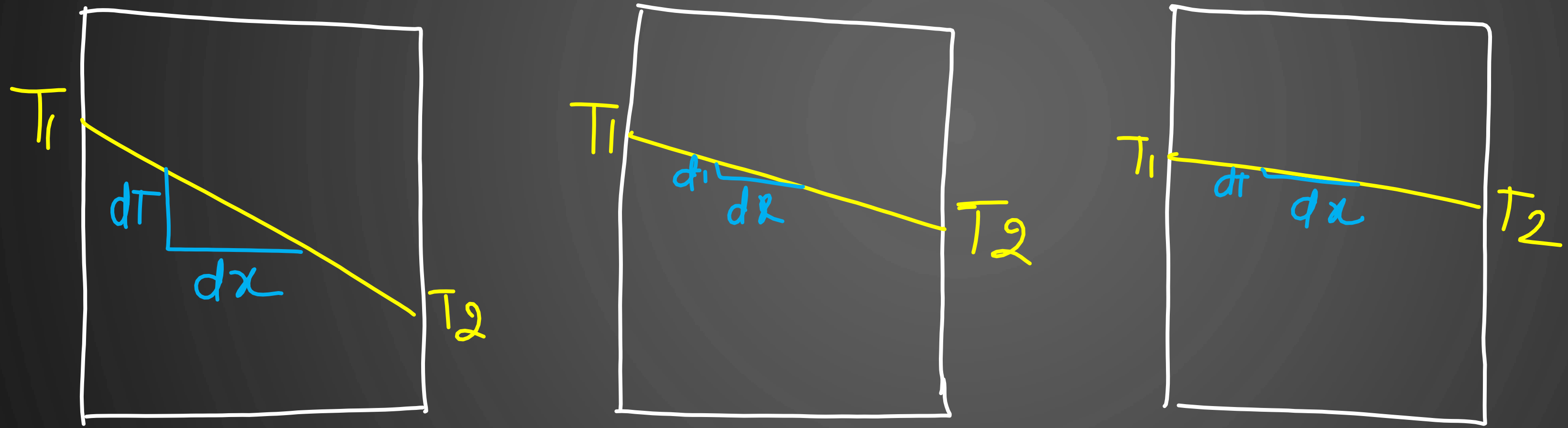
$$Q = \frac{\Delta T}{\left(\frac{L}{KA}\right)} = \frac{\Delta T}{R_{th}}$$

$$R_{th} = \frac{L}{KA}$$

$L\uparrow,\ R_{th}\uparrow,\ Q\downarrow$

$K\uparrow,\ R_{th}\downarrow,\ Q\uparrow$

$$Q \propto \frac{1}{R_{th}}$$



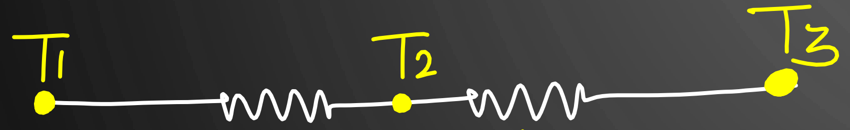
$$R_{th_1} > R_{th_2} > R_{th_3}$$

$$\left(\frac{dT}{dx}\right)_1 > \left(\frac{dT}{dx}\right)_2 > \left(\frac{dT}{dx}\right)_3$$

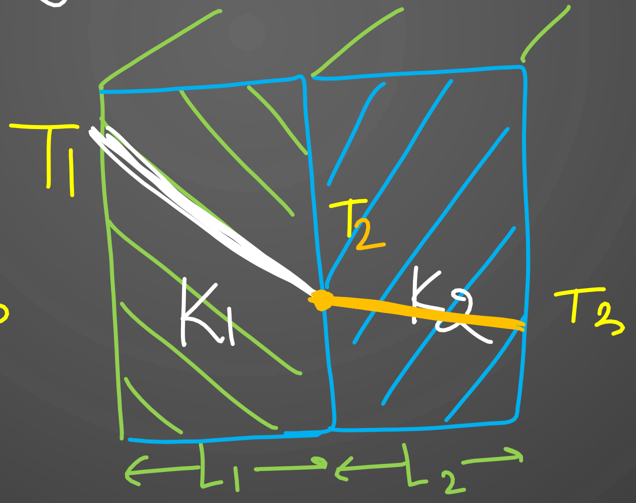
$$K_1 < K_2 < K_3$$

Cond^n Heat Transfer through composite wall:→

$$Q = \frac{\Delta T}{R_{th}}$$



$R_{th_1} = \frac{L_1}{K_1 A}$, $R_{th_2} = \frac{L_2}{K_2 A}$

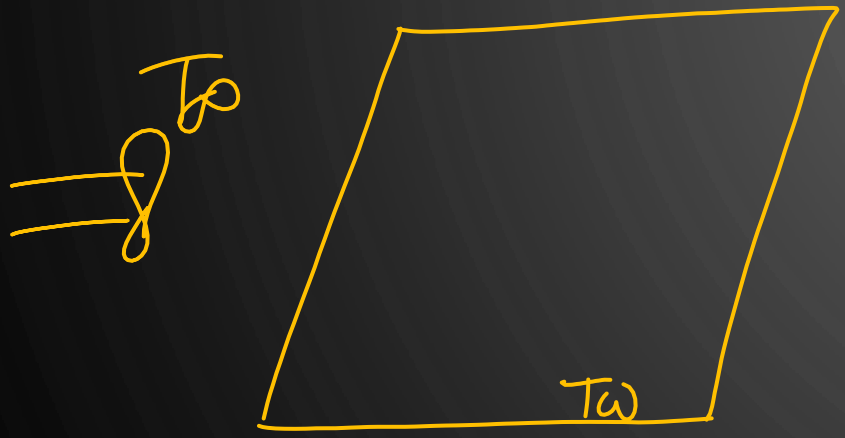


$K_1 < K_2$

$$Q = \frac{T_1 - T_3}{\sum R_{th}}$$

$$Q = \frac{T_1 - T_3}{\frac{L_1}{K_1 A} + \frac{L_2}{K_2 A}} = \frac{T_1 - T_2}{\frac{L_1}{K_1 A}} = \frac{T_2 - T_3}{\frac{L_2}{K_2 A}}$$

Convection: →



Newton's Law of Cooling.

$$Q \propto (T_w - T_\infty)$$

$$Q \propto A$$

$$Q \propto A(T_w - T_\infty)$$

$$Q = hA(T_w - T_\infty)$$

A → Surface Area

→ Area of Exposure

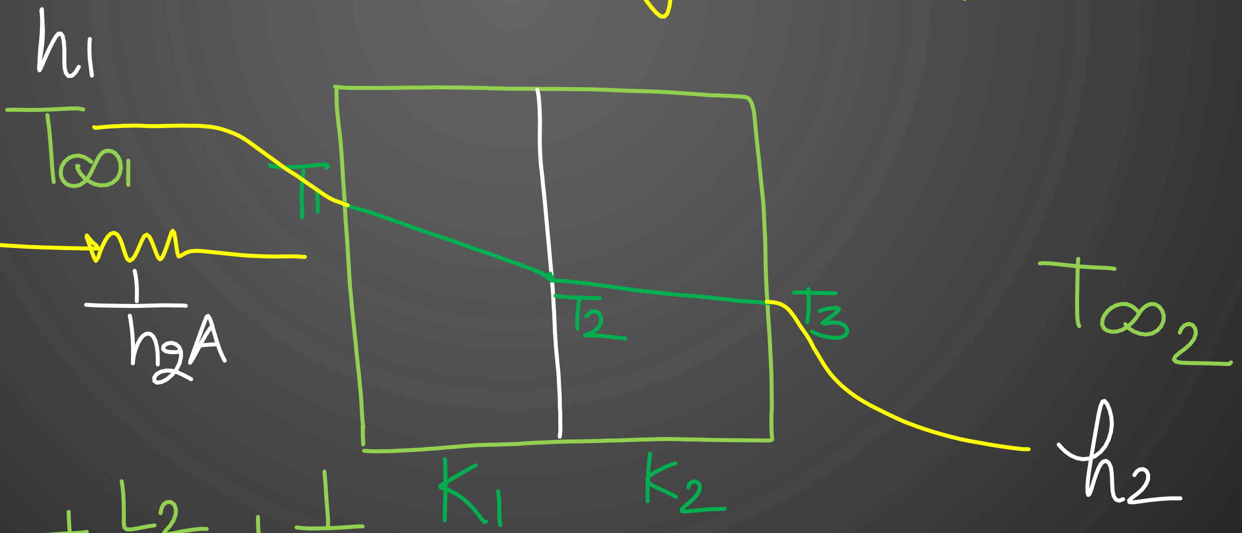
$$Q = hA(T_w - T_\infty)$$

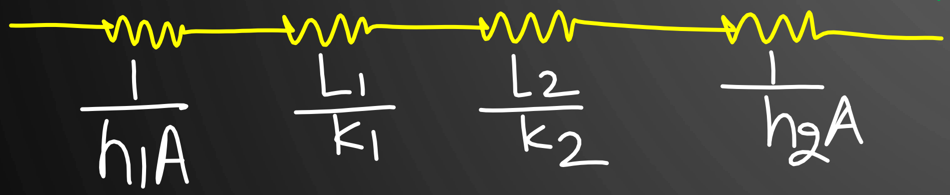
$$Q = \frac{T_w - T_\infty}{1/hA} = \frac{\Delta T}{1/hA}$$

$$Q = \frac{\Delta T}{R_{th}} = \frac{1}{hA}$$

$$R_{th_{conv}} = \frac{1}{hA}$$

Conduction-Convection HT Throug a Composite Wall:→





$$R_{th} = \frac{1}{h_1A} + \frac{L_1}{k_1A} + \frac{L_2}{k_2A} + \frac{1}{h_2A}$$

$$Q = \frac{\Delta T}{R_{th}} = \frac{T_{\infty 1} - T_{\infty 2}}{\frac{1}{h_1A} + \frac{L_1}{k_1A} + \frac{L_2}{k_2A} + \frac{1}{h_2A}} = \frac{T_{\infty 1} - T_1}{\frac{1}{h_1A}} = \frac{T_1 - T_2}{\frac{L_1}{k_1A}}$$