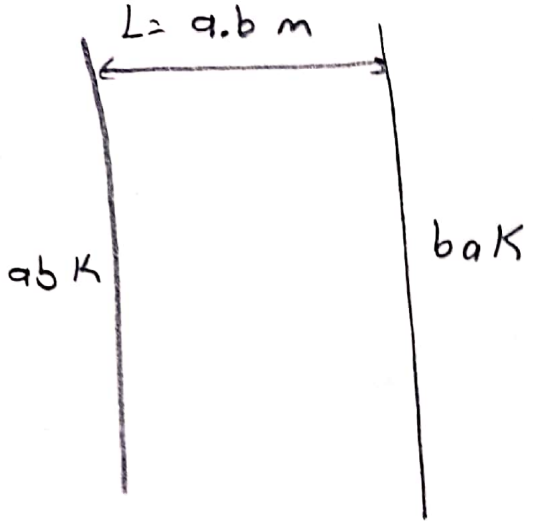
AE-331 - Quiz-1



$k = a + bT$ (since k is not constant we will not have linear temperature distribution inside the wall)

Steady-state and no heat generation.

$$\nabla.(k.\nabla T) + \dot{q} = \rho C_p \frac{\partial T}{\partial t}$$

($\dot{q} = 0$, $\frac{\partial T}{\partial t} = 0$)

$$\frac{d}{dx}\left(k.\frac{dT}{dx}\right) = 0 \quad \text{(one dimensional)}$$

$\frac{dT}{dx} = -q''_x$

Integrate

$$-q'' = C_1 \qquad \boxed{q''_x = C_1} \quad \text{heat flux} \qquad \text{b.)}$$

$$k.\frac{dT}{dx} = C_1 \quad \text{where} \quad k = a + bT$$

$$(a + b.T)\frac{dT}{dx} = C_1 \implies (a + b.T)dT = C_1.dx$$

Integrate

$$a.T + \frac{b.T^2}{2} = C_1.x + C_2$$

at $x = 0$, $T = ab$ K

$$C_2 = a.ab + b.\frac{(ab)^2}{2}$$

at $x = L$, $T = ba$ K

$$C_1 = \frac{a.ba + b.\frac{(ba)^2}{2} - a.ab + b.\frac{(ab)^2}{2}}{L}$$

rearange $\Rightarrow$

$$\frac{b}{2}T^2 + a.T - (C_1 x + C_2) = 0$$

(remember the formula for the roots $x_{1,2} = \left(\frac{-b \mp \sqrt{b^2-4ac}}{2a}\right)$)

$$T(x) = \frac{-a + \sqrt{a^2 - 4.\frac{b}{2}.-(C_1 x + C_2)}}{2.\frac{b}{2}}$$

Temperature distribution

a.)

(This can't be minus (-) because there is no - Kelvin)