DPP 01

Solution

1. $H_1 + H_2 = \frac{KA(T_1 - T_2)}{3\ell} + \frac{KA(T_1 - T_2)}{\ell} = \frac{4}{3\ell}KA(T_1 - T_2)$

In later case

$$H_2 = 2H - H_1 = \frac{7KA}{3\ell}(T_1 - T_2) = \frac{K'A}{\ell}(T_1 - T_2) \Rightarrow K' = \frac{7}{3}K$$

2. Rate of flow of heat $\frac{dQ}{dt}$ or H is equal throughout the rod.

Since, $\Delta T = HR_{Th}$

where, $R_{Th} = \frac{\ell}{KA}$

$\Rightarrow R_{Th} \propto \frac{1}{A}$

Area across CD is less.

So, temperature difference across CD will be more.

3. For the two sheets if H = is rate of heat transfer, then

$H_1 = H_2$

$\Rightarrow \frac{\theta_1 - \theta}{R_1} = \frac{\theta - \theta_2}{R_2}$

Solving this we get, $\theta = \frac{\theta_1 R_2 + \theta_2 R_1}{R_1 + R_2}$

4. For Balanced Wheatstone.

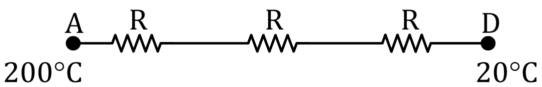
$\frac{k_1}{k_2} = \frac{k_3}{k_4} \Rightarrow k_1 k_4 = k_3 k_2$

5. $k_1 A \frac{(T_1 - T)}{d_1} = k_2 A \frac{(T - T_2)}{d_2}$

$\Rightarrow T = \frac{k_1 T_1 d_2 + k_2 T_2 d_1}{k_1 d_2 + k_2 d_1}$

6. Temperature difference between A and D is 180°C which is equally distributed in all the rods. Therefore, temperature difference between A and B will be 60°C or temperature of B should be 140 °C.

Equivalent electrical circuit.



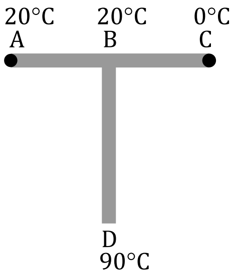
7. $K_C A\left(\frac{\Delta T_{Cu}}{\ell}\right) = K_B A\left(\frac{\Delta T_B}{\ell}\right)$

$\Rightarrow \frac{\Delta T_{Cu}}{\Delta T_B} = \frac{K_B}{K_C} < 1 \Rightarrow \Delta T_{Cu} < \Delta T_B$

Decrease in temperature for copper is less than brass and hence temperature at junction is greater than 50°C.

8. Since both the slabs are in series and hence $\frac{Q}{t}$ is same through both. Hence, required ratio is 1: 1.

9. Since, no heat flows through AB, so



$\theta_B = 20°C$

Since, $H_{DB} = H_{BC}$

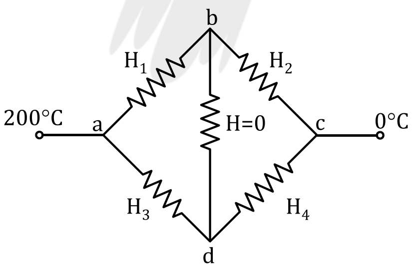
$\Rightarrow \frac{(90° - 20°)}{\ell_{BD}/KA} = \frac{(20° - 0°)}{\ell_{BC}/KA} \Rightarrow \frac{\ell_{BD}}{\ell_{BC}} = \frac{7}{2}$

10. In Wheatstone's bridge. There will be no heat flow through bd, if the bridge is balanced.

$\Rightarrow \frac{R_{ab}}{R_{bc}} = \frac{R_{ad}}{R_{dc}}$

Since, $R \propto \ell \Rightarrow \frac{\ell}{3\ell} = \frac{2\ell}{x} \Rightarrow x = 6\ell$

11. Since, $H_{bd} = 0$



$\Rightarrow H_1 = H_2 \Rightarrow H_3 = H_4$

$\Rightarrow \frac{200 - T_b}{\left(\frac{\ell}{KA}\right)} = \frac{T_b - 0}{\left(\frac{3\ell}{KA}\right)}$

Solving this equation, we get

$T_b = 150°C$