

DPP 01

Solution

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

In later case

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

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

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

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

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

Area across CD is less.

So, temperature difference across CD will be more.

$$3. \quad \text{For the two sheets if } H = \text{is rate of heat transfer, then}$$

$$H_1 = H_2$$

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

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

$$4. \quad \text{For Balanced Wheatstone.}$$

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

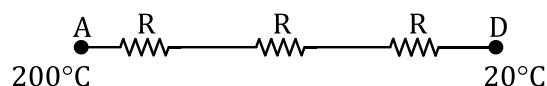
$$5. \quad k_1 A \frac{(T_1 - T)}{d_1} = k_2 A \frac{(T - T_2)}{d_2}$$

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

$$6. \quad \text{Temperature difference between A and D is } 180^\circ\text{C} \text{ which is equally distributed in all the rods.}$$

Therefore, temperature difference between A and B will be 60°C or temperature of B should be 140°C .

Equivalent electrical circuit.



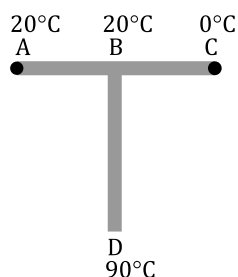
$$7. \quad K_C A \left(\frac{\Delta T_{Cu}}{\ell} \right) = K_B A \left(\frac{\Delta T_B}{\ell} \right)$$

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

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



$$\theta_B = 20^\circ\text{C}$$

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

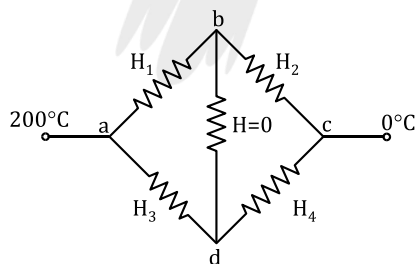
$$\Rightarrow \frac{(90^\circ - 20^\circ)}{\ell_{BD}/KA} = \frac{(20^\circ - 0^\circ)}{\ell_{BC}/KA} \Rightarrow \frac{\ell_{BD}}{\ell_{BC}} = \frac{7}{2}$$

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

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

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

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

$$T_b = 150^\circ\text{C}$$