(1) $$\theta = \theta_0 - \frac{\theta_0 - \theta_m}{l} x$$

Here $\theta_0 = 100^\circ C$, $\theta_m = 60^\circ C$, $l = 10$ cm, $x = 20$ cm

$$\therefore \theta = 100 - \frac{100-60}{\cancel{1}0} 20 = 100 - 80 = 20^\circ C.$$

Conduction

(2) $$t = \frac{\rho L}{2K\theta}(x_2^2 - x_1^2).$$ Here $x_2 = 10 + 0.1 = 10.1$ cm

$$= \frac{0.917 \times 80}{2 \times 0.005 \times 5}(10.1^2 - 10^2) \doteq 2949 \text{ sec} = 49 \text{ min } 9 \text{ sec}.$$

(3) $$\frac{dx}{dt} = \frac{K\theta}{x\rho L} = \frac{0.004 \times 15}{2 \times 0.9 \times 80} \text{ cm/sec} = \frac{0.004 \times 15 \times 3600}{2 \times 0.9 \times 80} \text{ cm/hour}$$

$$= 1.5 \text{ cm/hour}.$$

(4) Here $x_1 = x_2$ & let the temperature of the welded surface be θ.

$\theta_1 = 100^\circ C$, $\theta_2 = 0^\circ C$. Formula for the composite slab

$$q = \frac{K_1 A(\theta_1 - \theta)}{x_1} = \frac{K_2 A(\theta - \theta_2)}{x_2}$$

$$\therefore \frac{0.92 \times \cancel{A} \times (100 - \theta)}{\cancel{x_1}} = \frac{0.5 \times \cancel{A} \times (\theta - 0)}{\cancel{x_1}} \quad \therefore 92(100 - \theta) = 50\theta$$

$$\therefore \theta = 64.79^\circ C.$$

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