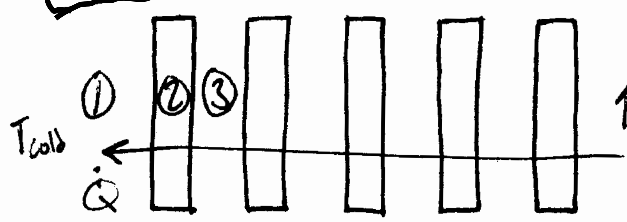
Meng 263 - a4 - Matt Heywood   P1

The Answer

Part 1



① outer surface air
② synthetic fabric
③ air space between layers

$\Delta T = T_{hot} - T_{cold} = 28 - -5 = 33°C$

Conductive Resistance

$R_2 = \frac{L_2}{K_2 A} = \frac{(0.0001)}{(0.13)(1.1)} = 6.993 \times 10^{-4}$ °C/W   5 layers ∴ $R_2 = 3.497 \times 10^{-3}$ °C/W

$R_3 = \frac{L_3}{K_3 A} = \frac{(0.0015)}{(0.026)(1.1)} = 0.0524$ 4 layers   ∴ $R_3 = 0.2098$ °C/W

Convective Resistance

$R_1 = \frac{1}{hA} = \frac{1}{(25)(1.1)} = 0.03636$ °C/W

Total Resistance $\Sigma R = 0.2497$ °C/W

Heat Loss Rate $\dot{Q} = \frac{\Delta T}{\Sigma R} = 132.18$ W ✓

Part 2

$\Sigma R = 0.0371$ °C/W   ∴ $\dot{Q} = \frac{\Delta T}{\Sigma R} = 890.46$ W ✓   Brrr

Part 3

$\dot{Q} = \frac{\Delta T}{\Sigma R} \longrightarrow R_1 + R_2 = \frac{\Delta T}{\dot{Q}} \longrightarrow R_2 = \frac{\Delta T}{\dot{Q}} - R_1$

$\frac{L_2}{K_2 A} = \frac{\Delta T}{\dot{Q}} - R_1 \longrightarrow L_2 = K_2 A \left[\frac{\Delta T}{\dot{Q}} - R_1\right]$

$\therefore L_2 = (0.035)(1.1)\left[\frac{33}{132.18} - 0.03636\right] = 8.21$ mm ✓