

Test #1

Data & variables
(6.5)

given

$$q'' = 700 \text{ W/m}^2 \quad \alpha = 0.90$$

$$T_{in} = 20^\circ\text{C} \quad h_w = 1000 \text{ W/m}^2 \cdot \text{K}$$

$$h_a = 10 \text{ W/m}^2 \cdot \text{K}$$

$$T_{\infty} = 25^\circ\text{C}$$

$$h_{con} = 50 \text{ W/m}^2 \cdot \text{K}$$

$$S = 1 \text{ in} \rightarrow 0.0254 \text{ m}$$

$$D_i = 0.528 \text{ in} \rightarrow 0.01341 \text{ m}$$

$$D_o = 0.625 \text{ in} \rightarrow 0.01588 \text{ m}$$

(a) $Q_{in} = (700)(0.90)(0.0254 \text{ m}) = 16.002 \text{ W/m}$

loss $\rightarrow \frac{1}{\text{used area}} + \frac{1}{\text{used area}} \rightarrow \frac{1}{0.254} + \frac{1}{1.27} = 3.94 \text{ K/W}$

$T_{avg} = \frac{20^\circ + 45^\circ}{2} = 32.5^\circ$

1 resistance $R_w = \frac{1}{h_w \cdot S} = \frac{1}{(1000)(0.01341)} = 0.0237 \text{ K/W}$

attempt but incorrect

0.787 W
 4.724 K/W

balance of energy equation $Q_{in} + \frac{T_p - T_{avg}}{R_w} + \frac{T_p - T_{\infty}}{R_t} = 0$

1 resistance

$16.002 = T_p \left(\frac{1}{0.0237} \right) + \left(\frac{1}{4.724} \right) - \left(\frac{32.5}{0.0237} \right) + \left(\frac{25}{4.724} \right)$

$16.002 = T_p (42.406) - 1376.6$
 $T_p = \frac{1392.6}{42.406} = 32.84$

$Q_{actual} = \frac{T_p - T_{avg}}{R_w} = \frac{32.84 - 32.5}{0.0237} = 14.34 \text{ W/m}$