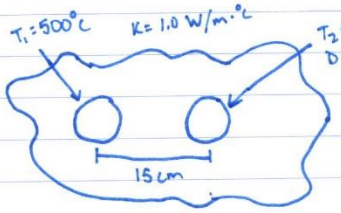
MICHAEL DELAIRD2

MET 440

HW 1.3

4]



$L = 8\ m$

$D = 0.1\ m$

$$Q = \frac{KA\Delta T}{L}$$

$A = D \times L = (0.1 \times 8)2 = 1.6\ m^2$

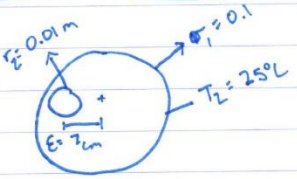
$\Delta T = 500 - 400 = 100°C$

$$= \frac{(1.0)(1.6)(100)}{0.15}$$

$$= 1066.67\ W$$

$$= \boxed{1.067\ KW}$$

5]



$K = 1\ W/m·°C$

$Q = 100\ W/m$

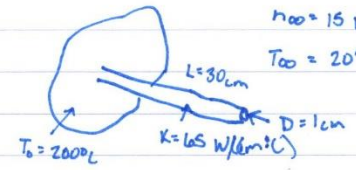
$$Q = -k \frac{2\pi L}{\cosh^{-1}\left(\frac{r_1^2 + r_2^2 + \varepsilon}{2 r_1 r_2}\right)} \cdot (T_2 - T_1)$$

$$100 = \frac{1 \times 2\pi(1)}{\cosh^{-1}\left(\frac{0.1^2 + 0.01^2 - 0.07^2}{2 \times 0.01 \times 0.1}\right)} \cdot (T_1 - 25)$$

$$\frac{100 \times 1.609}{2\pi} = T_1 - 25$$

$$\boxed{T_1 = 50.62°C}$$

54



$h_\infty = 15\ W/(m^2 \cdot °C)$

$T_\infty = 20°C$

$P = \pi_d = \pi(0.01)$

$= 0.031459\ m$

$A_c = 7.8539 \times 10^{-5}\ m^2$

$$\frac{T - T_\infty}{T_0 - T_\infty} = \frac{\cosh[m(L-x)] + \frac{h_\infty}{mK}\sinh(m(L-x))}{\cosh(mL) + \frac{h_\infty}{mK}\sinh(mL)}$$

$$m = \sqrt{\frac{h_\infty P}{KA_c}} = \sqrt{\frac{15 \times 0.031415}{65 \times (7.8539 \times 10^{-5})}} = 9.6077$$

FOR $x = 0.1m$

$$\frac{T_{x=0.1} - 20}{200 - 20} = \frac{\cosh(9.6077(0.3-0.1)) + \frac{15}{(9.6077 \times 65)}\sinh(9.6077(0.3-0.1))}{\cosh(9.6077(0.3)) + \frac{15}{(9.6077 \times 65)}\sinh(9.6077(0.3))}$$

$$= \frac{3.4889 + 0.024(8.3425)}{8.9557 + 0.024(8.8997)}$$

$T_{x=0.1} = 90.06°C$

FOR $x = 0.2m$

$$\frac{T_{x=0.2} - 20}{200 - 20} = \frac{\cosh(9.6077(0.3-0.2)) + \frac{15}{(9.6077 \times 65)}\sinh(9.6077(0.3-0.2))}{\cosh(9.6077(0.3)) + \frac{15}{(9.6077 \times 65)}\sinh(9.6077(0.3))}$$

$$= \frac{1.4981 + 0.024(1.1185)}{8.9557 + 0.024(8.8997)}$$

$T_{x=0.2} = 49.93°C$

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$L = 20\,cm$

$D = 2\,cm$

$K = 65\ W/(m \cdot °C)$

$T_0 = 150°C$

$T_\infty = 20°C$

$h_\infty = 15\ W/(m^2 \cdot °C)$

$$Q = \sqrt{hPKA}\ (\Delta T)$$

$$= \sqrt{15\left(\pi \times 0.2 \times 0.02\right)(65)\left(\pi \frac{(0.02)^2}{4}\right)}\ (150-20)$$

$$= \boxed{8.0613\ W}$$