TRANE

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(1) a) $\frac{d^2T}{dx^2} = 0 \rightarrow \frac{dT}{dx} = C_1 \rightarrow T(x) = C_1 x + C_2$

$-k \frac{dT(0)}{dx} = \dot{q}_0$ 1.

$T(0) = T_1 = 80°C$ 2.

b) $\frac{dT(0)}{dx} = -\frac{\dot{q}_0}{k} = C_1$

$C_1 = \frac{-700}{2,5} = -280$

$T(0) = 80$

$T(0) = C_1 \cdot 0 + C_2 = 80$

$C_2 = 80$

$T(x) = -280x + 80$

c) $T(4) = T(0,3) = -280 \cdot 0,1 + 80$

$T(0,1) = -4°C$

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2) a) $\frac{d^2T}{dx^2} = 0 \rightarrow \frac{dT}{dx} = c_1 \rightarrow T(x) = c_1 x + c_2$

$T(0) = 90$ 1.

$-k \cdot A \frac{dT(L)}{dx} = h A (T(L) - T_\infty)$ 2.

$-k \frac{dT(L)}{dx} = h (T(L) - T_\infty)$

b) $T(x) = T(0) = c_1 \cdot 0 + c_2 = 90$

$\boxed{c_2 = 90}$

$-k \underbrace{\frac{dT(L)}{dx}}_{c_1} = h (\overbrace{c_1 \cdot L + 90}^{T(L)} - \overbrace{25}^{T_\infty})$

$-1,8 \, c_1 = 24 \cdot (c_1 \cdot 0,4 + 90 - 25)$

$-1,8 c_1 = 9,6 c_1 + 1560$

$11,4 \, c_1 = 1560$

$\boxed{c_1 = -136,84}$

$T(x) = -136,84 x + 90$

c) $T(0,4) = -136,84 \cdot 0,4 + 90$

$= 35,26 °C$

$\dot{Q} = h \cdot A \cdot (T(L) - T_\infty)$

$24 \cdot 30 (35,26 - 25)$

$\boxed{\dot{Q} = 7387,2 W}$

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3) a) $\frac{d}{dr}\left(r\frac{dT}{dr}\right)=0 \rightarrow r\frac{dT}{dr}=q \rightarrow \frac{dT}{dr}=\frac{C_1}{r}$

$T(r)=C_1.\ln r+C_2$

$k\frac{dT(r_2)}{dr}=q_0$ (1)

$k\frac{dT(r_1)}{dr}=h(T(r_1)-T_\infty) \leftarrow A=A$ (2)

b) $\frac{dT(r_2)}{dr}=\frac{q_0}{k}=\frac{\frac{\dot{Q}_0 \times A}{A}}{k}=\frac{\frac{300\times 0,8}{2\pi(0,04).6}}{14}=\frac{169,1}{14}$

$\frac{dT(r_2)}{dr}=12,078$

$\frac{dT}{dr}=\frac{C_1}{r}$ $\quad \frac{dT(r_2)}{dr}=\frac{C_1}{r_2}=12,078$

$C_1=12,078\times 0,04$

$\boxed{C_1=0,481}$

$k.\frac{dT(r_1)}{dr}=h(T(r_1)-T_\infty)$

$k.\frac{C_1}{r_1}=h.(C_1.\ln(r_1)+C_2-T_\infty)$

$14.\frac{0,481}{0,037}=30(0,481.\ln(0,037)+C_2-(-10))$

$182,75=252,22+C_2.30$

$\boxed{C_2=-2,315}$

$T(r)=0,481\times\ln(r)-2,315$

c) $T(r_1)=0,481\ln(r_1)-2,315$ (0,037)

$\boxed{T(0,037)=-3,81°C}$

$T(r_2)=0,481\ln(r_2)-2,315$ (0,04)

$\boxed{T(0,04)=-3,87°C}$

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4) a) $\frac{1}{r}\frac{d}{dr}\left(r\frac{dT}{dr}\right)+\frac{\dot{g}}{k}=0 \rightarrow \frac{d}{dr}\left(r\frac{dT}{dr}\right)=-\frac{\dot{g}}{k}\cdot r$

$T(r_0)=180°C$ 1.

$\frac{dT(0)}{dr}=0$ 2. → Thermal symmetry

$r\frac{dT}{dr}=\frac{-\dot{g}}{k}\frac{r^2}{2}+C_1$

$\frac{dT}{dr}=\frac{-\dot{g}}{k}\frac{r}{2}+\frac{C_1}{r}$

$T(r)=\frac{-\dot{g}}{k}\frac{r^2}{4}+C_1\ln r+C_2$

b) $\frac{dT(0)}{dr}=-\frac{\dot{g}}{k}\frac{0}{2}+\frac{C_1}{r}=0$

$\boxed{C_1=0}$

$T(r_0)=\frac{-\dot{g}}{k}\frac{r_0^2}{4}+\underbrace{C_1.\ln r_0}_{0}+C_2$

$180=\frac{-5\times10^7}{6}\cdot\frac{(5\times10^{-3})^2}{4}+C_2$

$\boxed{C_2=127,92}$

$T(r)=\frac{-\dot{g}}{k}\frac{r^2}{4}+C_2$

$=\frac{-5\times10^7}{6}\frac{r^2}{4}+127,92$

$\boxed{T(r)=2083,33\,r^2+127,92}$

$T(r)=T(0,002)=2083,33\times0,002^2+127,92$

$\boxed{T(0,002)=127,91°C}$

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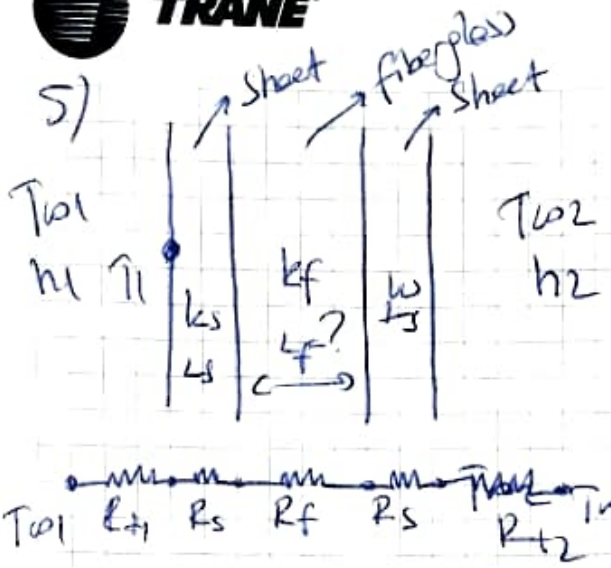
5)







$T_{\infty 1} = 25°C$

$h_1 = 9\ W/m^2K$

$T_1 = 20°C$

$T_{\infty 2} = 3°C$

$h_2 = 4\ W/m^2K$

$k_s = 15,1\ W/mK$

$L_s = 1\ mm = 0,001\ m$

$k_f = 0,035\ W/mK$

$L_f = ?$

$$Q = hA(T_{\infty 1} - T_1)$$

$$9.1.(25-20) = 45\ W$$

$$Q = \frac{T_{\infty 1} - T_{\infty 2}}{R_{top}} \rightarrow R_{top} = \frac{T_{\infty 1} - T_{\infty 2}}{Q}$$

$$= \frac{25-3}{45}$$

$$R_{top} = R_{t1} + R_s + R_f + R_s + R_{t2}$$

$$R_{top} = 0,488\ °C/W$$

$$R_{t1} = \frac{1}{h_1 A} = \frac{1}{9.1} = 0,111\ °C/W$$

$$R_s = \frac{L_s}{k_s A} = \frac{0,001}{15,1.1} = 6,62 \times 10^{-5}\ °C/W$$

$$R_{t2} = \frac{1}{h_2 A} = \frac{1}{4.1} = 0,25\ °C/W$$

$$0,488 = 0,111 + 6,62\times10^{-5} + R_f + 6,62\times10^{-5} + 0,25$$

$$R_f = 0,1268\ °C/W$$

$$R_f = \frac{L_f}{k_f A} \rightarrow L_f = R_f \times k_f$$

$$= 0,1268 \times 0,035$$

$$L_f = 0,0045\ m$$