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MET 440

HW 2.1

5-9]

$$T(x) = \frac{qL^2}{2K}\left(\frac{1}{4} - \left(\frac{x}{L}\right)^2\right) + T_w \qquad \text{if } x = 0$$

$$= \frac{qL^2}{2K}\left(\frac{1}{4} - \left(\frac{0}{L}\right)^2\right) + T_w$$

$$= \frac{qL^2}{8K} + T_w$$

6-7]

$$q\left(\frac{L}{2}\right) = -k \left.\frac{dT(x)}{dx}\right|_{x=\frac{L}{2}} \qquad x = \frac{L}{2}$$

$$= -K \frac{dT\left(\frac{L}{2}\right)}{dx}$$

$$= \frac{qL}{2} \quad W/m^2$$

5-12]

$$q\left(-\frac{L}{2}\right) = -K \left.\frac{dT(x)}{dx}\right|_{x=-\frac{L}{2}} \qquad x = -\frac{L}{2}$$

$$= -K \frac{dT\left(-\frac{L}{2}\right)}{dx}$$

$$= -\frac{qL}{2} \quad W/m^2$$

5-34]

$$T(r) = \frac{qb^2}{4K}\left(1 - \left(\frac{r}{b}\right)^2\right) + \frac{qb}{2h_\infty} + T_\infty \qquad h_\infty \to \infty$$

$$= \frac{qb^2}{4K}\left(1 - \left(\frac{r}{b}\right)^2\right) + T_\infty$$

$h_\infty \to 0$

5-41

$$T(r) = \frac{b_g^2}{6k}\left(1-\left(\frac{r}{b}\right)^2\right) + \frac{b_g}{3h_\infty} + T_\infty \qquad h_\infty \to \infty$$

$$= \frac{b_g^2}{6k}\left(1-\left(\frac{r}{b}\right)^2\right) + T_\infty$$

4)

$t = 0.1\ m$

$x = 0$

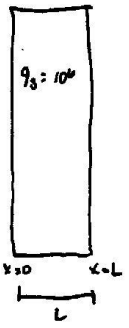
$x = L$

$h = 200\ W/(m^2 \cdot °C)$

$T = 150°C$

$k = 40.0\ W/m \cdot °C)$

$q = 10^6\ W/m^3$



$$T = \frac{q \times t_0}{L \times n^2 \times k}$$

$$= \frac{10^6 \times 150}{(0.1)(200)^2\,(40)}$$

$$= 3750°C$$

26) $I = 600A$ $\quad h = 50\ W/m^2 \cdot °C$

$D = 5mm$ $\quad k = 60\ W/m \cdot °C$

$R = 5 \times 10^{-4}\ \Omega/m$

$T_\infty = 0°C$

$$q = \frac{5\times10^{-4}\,(600)}{\left(\frac{(\pi)(5mm)}{4}\right)\pi^2} = 6369.426\ \frac{kW}{m^3}$$

$$T_s = n \times 2\pi r_0 L\,(T_s - T_\infty) = \frac{\pi I^2 R}{(\pi D)^2}$$

$$= 60 \times 2\pi \times 25\times10^{-3}\,(T_s - 0) = 600^2 \times 5\times10^{-4}$$

$$= \boxed{159.235°C}$$

$$T(r) = \frac{q}{4k}r^2 + \left(1 - \frac{r^2}{r_0^2}\right) + T_s$$

$$= \frac{6369.426}{4(60)} + (0.0025)^2 + 159.235$$

$$T_c = \boxed{159.4°C}$$