

215

given:

$D = 0.01 \text{ m}$ $r_o = 0.005 \text{ m}$
 $T_i = 20^\circ \text{C}$ $T_\infty = 5^\circ \text{C}$ $T_{\text{target}} = 10^\circ \text{C}$
 $h = 20 \text{ W/m}^2 \cdot \text{C}$ $k = 0.6 \text{ W/m} \cdot \text{C}$
 $\rho = 1100 \text{ kg/m}^3$ $C = 4200 \text{ J/kg} \cdot \text{C}$
 sphere!

$$L_c = \frac{V}{A_s} = \frac{\frac{4}{3}\pi r_o^3}{4\pi r_o^2} \rightarrow \frac{r_o}{3} = \frac{0.005}{3} = 0.001667 \text{ m}$$

Biot # -

$$Bi = \frac{hL_c}{k} \rightarrow \frac{(20)(0.001667)}{0.6} = 0.0556$$

$Bi < 0.1$ internal resistance is neg.

$$b = \frac{hA_s}{\rho V C} = \frac{h}{\rho L_c} = \frac{20}{(1100)(4200)(0.001667)} = 0.0025943 \text{ s}^{-1}$$

Temp decay:

$$T(t) - T_\infty = e^{-bt} \rightarrow \frac{10-5}{20-5} = e^{-bt}$$

$$\frac{1}{3} = e^{-bt} \rightarrow \ln(1/3) = -bt$$

$$= -1.098 = -0.0025946 \cdot t$$

$$t = \frac{423.47 \text{ sec}}{60} = 7.06 \text{ min}$$