EXTRA MASS TRANSFER PROBLEM

$V = 100\,mL$ eitemium sphere

$\rightarrow D = 1.5\,cm$

$R = 0.75\,cm$

SURFACE AREA $= 7.07\,cm^2$ $(4\pi r^2)$

a) $\frac{11.4\,mmoles}{L} \times \frac{100\,mL}{} \times \frac{L}{1000\,mL} \times \frac{mole}{1000\,mmoles}$

$= 0.00114$ moles eitemium

b) AVERAGE FLUX OVER 45S

$$\Phi = \frac{0.00114\,moles}{(45s)(7.07cm^2)} = 3.58 \times 10^{-6}\ moles/cm^2 s$$

c) $\Phi_E = k_L (C_E^* - \bar{C}_E)$

$C_E(t=0) = 0$

$C_E(t=45s) = \frac{0.00114\,moles}{100\,cm^3} = 1.14 \times 10^{-5}\ \frac{moles}{cm^3}$

$\bar{C}_E = 5.7 \times 10^{-6}\ moles/cm^3$

$C_E^* = \frac{66\,mmoles}{L} \times \frac{L}{1000\,mL} \times \frac{moles}{1000\,mmoles} = 6.6 \times 10^{-5}\ \frac{moles}{cm^3}$

So

$3.58 \times 10^{-6}\ \frac{moles}{cm^2 s} = k_L (6.6 \times 10^{-5} - 5.7 \times 10^{-6})$

$k_L = 0.059\,cm/s$

AN ALTERNATE SOLUTION FOR PART c)

$$\frac{d(c_E V)}{dt} = \Phi A = k_L \frac{A}{V}\left(c_E^* - c_E\right)$$

$$\int_0^{11.4} \frac{dc_E}{c_E^* - c_E} = k_L \frac{A}{V} t$$

$$= \ln\left[\frac{c_E^*}{c_E^* - c_E}\right] = k_L \frac{A}{V} t$$

$$= \ln\left[\frac{66}{66 - 11.4}\right] = k_L \left(\frac{7.07\,cm^2}{100\,cm^3}\right)(45\,s)$$

$$\underline{k_L = 0.060\ cm/s}$$