

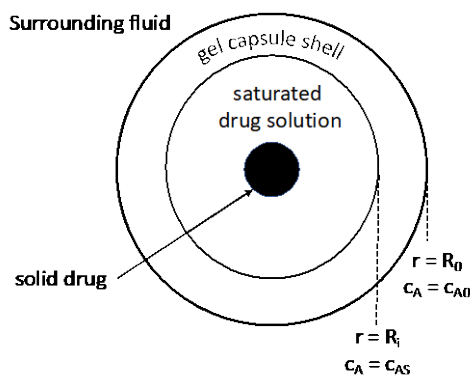
ChE 333 Transport Phenomena III, fundamentals of Mass Transfer
Studio Worksheet #7 Pseudo-steady state

NAME _____

Studio Section	Studio 12:00-12:50	Studio 13:00-13:50	Studio 14:00-14:50	Studio 15:00-15:50
----------------	-----------------------	-----------------------	-----------------------	-----------------------

Instructions: Open book, notes, and homework. Make sure to write your name and studio on any additional sheet of paper with your solution. Show your calculation, algebraic setup, and make sure to include units. Please turn in your studio at the end of class.

Capsule for slow drug release: The spherical gel capsule shown below is used for slow drug release. The drug capsule is made of a gel capsule filled with a saturated drug solution. The drug solution also has a lump of solid drug which maintains the concentration in the saturated drug solution over a longer time. The drug diffuses through the gel capsule into the surrounding fluid. Eventually, the solid drug is depleted and the concentration in the liquid goes down with time but as long as the solid drug exists the solution remains saturated and constant.



The diffusion coef. of the drug in the gel phase is $1.5 \times 10^{-5} \text{ cm}^2/\text{s}$, and the solubility of the drug in the gel capsule material is $c_A^* = 0.01 \text{ gmole}/\text{cm}^3$.
 $R_i = 0.2 \text{ cm}$ and $R_0 = 0.35 \text{ cm}$

(a) Identify the SOURCE, SINK, diffusing species, and phase for your control system.

(b) State your assumptions and boundary conditions

(c) Simplify the general differential and flux equation (you may assume dilute diffusion so $y_A \approx 0$)

- (d) Develop an analytical, integrated equation for the total drug release rate, (W_A) but $W_A = N_A \cdot S$ where S is surface area.

math hint: if

$$\frac{d}{dx} N_{A,z} = 0 \quad N_{A,z} \text{ is constant} \quad \int (N_{A,x}) dx = N_{A,x} \int dx$$

Similarly, if

$$\frac{d}{dr} (r N_{A,r}) = 0 \quad r N_{A,r} \text{ is constant} \quad \int (N_{A,r}) dr = \int \left(\frac{r}{r} N_{A,r} \right) dr = r N_{A,r} \int \frac{dr}{r}$$

$$\text{And } r N_{A,r} = R_0 N_{A,R0} = R_i N_{A,Ri}$$

- (e) What is the maximum possible rate of drug release from the capsule in gmole/hr? (the maximum rate would be when $c_{A0} \approx 0$)