STUDIO 13

A. Steady state flux model.

$$N_A = D_{AB} \frac{dc}{dz} \qquad \frac{\partial N_A}{\partial z} = 0.$$

$$N_A = \frac{D_{AE}}{L} [C_{A0} - C_{AS}].$$

B. Average flux across membrane and boundary layers.

$$N_A = k_c (C_{AS} - C_{A\infty})$$

$$C_{AS} = \frac{N_A}{k_c} + C_{A\infty}.$$

$$N_A = \frac{D_{Ae}}{L} [C_{A0} - C_{AS}] = \frac{D_{Ae}}{L} \left[C_{A0} - \frac{N_A}{k_c} - C_{A\infty}\right]$$

$$N_A = \frac{[C_{A0} - C_{A\infty}] \frac{D_{Ae}}{L}}{\left(1 + \frac{D_{Ae}}{k_c L}\right]} = \frac{C_{A0} - C_{A\infty}}{\frac{L}{D_{AE}} + \frac{1}{K_c}}.$$

$$N_A = \frac{C_{A0} - C_{A\infty}}{\frac{L}{D_{AE}} + \frac{1}{K_c}}.$$

C. If $K_c \gg D_{Ae}$, flux would be limited by the flux through the membrane.

D. Flux if transfer resistence is in the membrane.

$$N_A = \frac{D_{Ae}}{L}\left[C_{A0} - C_{A\alpha}\right]$$

$$= \frac{5.54\times10^{-7}}{0.1}\left[1-0.4\right]\times10^{-5}$$

$$N_A = 3.32\times10^{-11}\ mol/cm^2\cdot s.$$

E. flux if transfer resistance is in the boundary layer.

$$N_A = k_c\left[C_{A0} - C_{A\alpha}\right]$$

$$= 1.05\times10^{-4}\left(1-0.4\right)*10^{-5}$$

$$N_A = 6.3\times10^{-10}\ \frac{mole}{cm^2\cdot s.}$$

F Biot number $\quad Bi = \frac{k_c l}{D_e}$

$$Bi = \frac{1.05\times10^{-4}\times0.01}{5.54\times10^{-7}}$$

$$Bi = 18.95$$

Most of the resistance to mass transfer is through membrane.