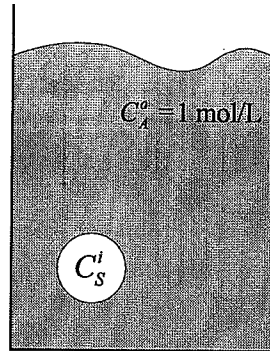
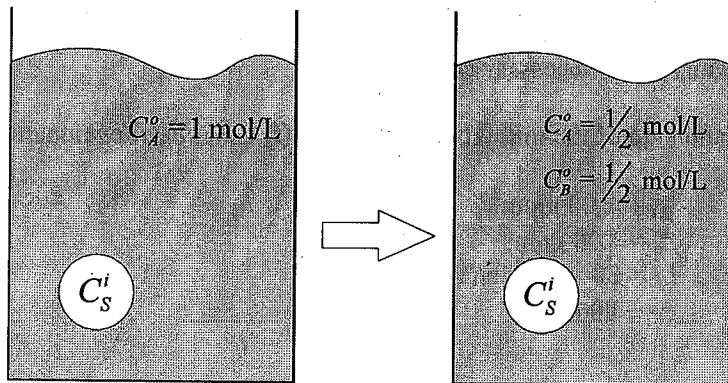


Problem 1 We load an animal cell with a single impermeant nonionic solute S . Assume the cell has $v_C^i = 0$.

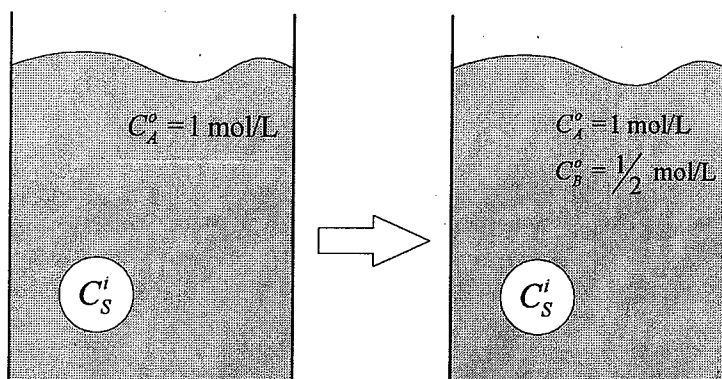
a) We place the cell in a large bath with impermeant nonionic solute A with $C_A^o = 1 \text{ mol/L}$. Once we allow the cell to equilibrate, the final cell volume is 1 pL . How much S is in the cell?



b) Now change the bath so it contains two substances, an impermeant solute A ($C_A^o = 0.5 \text{ mol/L}$) and a permeant nonionic solute B ($C_B^o = 0.5 \text{ mol/L}$). What is the equilibrium volume of the cell?



c) Instead, we put the cell from part a) and add permeant solute B ($C_B^o = 0.5 \text{ mol/L}$). What is the equilibrium volume of the cell?



9/26/06

③ Problem 1

Ⓐ No diffusion

At EQ:

$$C_S^i = C_B^o$$

$$C_S^i = C_A^o = \frac{N_S^i}{V_C}$$

$$N_S^i = C_A^o V_C = 1 \text{ pmol}$$

Ⓑ S, A cannot diffuse

B can diffuse

At t=0 osmotic EQ YES

diffusive EQ NO

$$C_{\Sigma}^i(\infty) = C_{\Sigma}^o(\infty) \quad \text{osmosis}$$

$$\text{At EQ: } C_B^i(\infty) = C_B^o(\infty) \quad \text{diffusion}$$

$$C_S^i(\infty) + C_B^i(\infty) = C_A^o(\infty) + C_B^o(\infty)$$

Ⓒ At t=0 osmotic EQ NO

diffusive EQ NO

B/c bath is large $C_B^o(\infty) = C_B^o(0)$

$$\text{At EQ: } C_{\Sigma}^i(\infty) = C_{\Sigma}^o(\infty)$$

$$\Rightarrow C_S^i(\infty) = C_A^o(\infty) = C_A^o(0) = \frac{1}{2} M$$

$$C_B^i(\infty) = C_B^o(\infty)$$

$$V_C(\infty) = \frac{N_S^i}{C_S^i(\infty)} = \frac{1 \text{ pmol}}{\frac{1}{2} \text{ mol/L}} = 2 \text{ pL}$$

cell volume doubles ↑

$$\text{Same as } \textcircled{b} \Rightarrow V_C(\infty) = \frac{N_S^i}{C_S^i(\infty)} = \frac{1 \text{ pmol}}{\frac{1}{2} \text{ mol/L}}$$

No EQ volume change! ⇒ = 1 pL

Time course:

