

20.110/2.772/5.601 Fall 2005
Recitation # 15
11/8/2005

1. Consider equal volumes of two liquids (we'll refer to them as **A** and **B**) in two separate but identical sealed containers. The rigid containers are held at constant temperature and volume.
 - a. What is the criterion for equilibrium to be achieved between each liquid and its vapor in the container?
 - b. Measurement of the vapor pressures for the two (separate) liquids reveals a vapor pressure of 16.9 KPa for liquid **A** and 2.8 KPa for liquid **B** at 25°C. If we assume to first approximation that the standard state chemical potentials of **A** and **B** in the vapor phases are identical at this temperature, what is the difference in bonding energies between these two liquids?

$$\Delta\omega = \omega_{AA} - \omega_{BB} = ?$$

Express your answer in units of k_bT - e.g., $10.7k_bT$, assume cubic lattice.

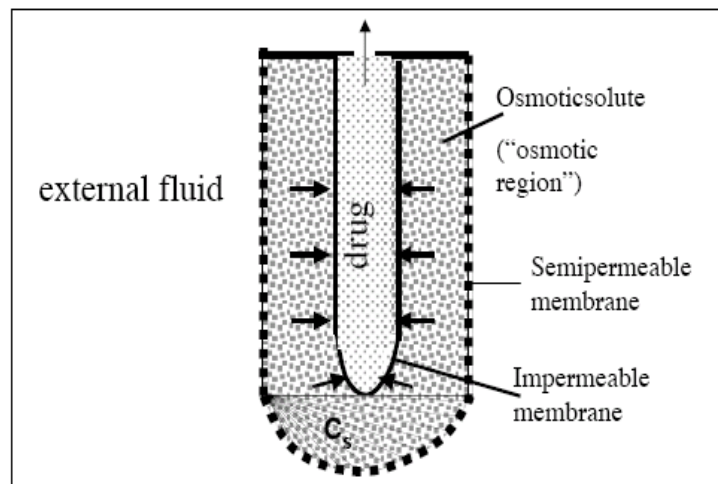
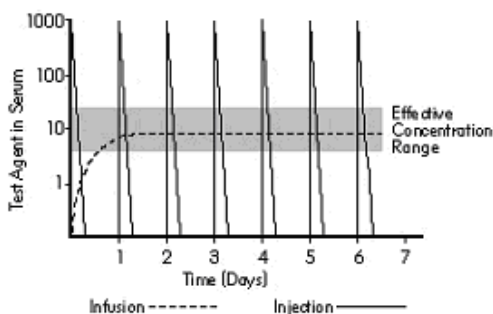
2. Osmotic pumps are used to provide slow release of drugs in the body over a long time period. A cross section of an osmotic pump is shown in the figure. Liquid drug solution is contained inside a flexible impermeable membrane pouch in the center of the device ("drug region"). Any pressure exerted on the membrane forces drug out of the hole shown at the top of the device. A rigid semipermeable membrane on the outside of the device surrounds a water-soluble solute that does not pass through either membrane and is present at a concentration of c_s ("osmotic region"). The rigid semipermeable membrane is permeable to water. For this problem, you may assume that the concentration of solute in the osmotic region, c_s , remains constant at 0.7 M (this is approximately true as the volume of the drug region is very small compared to the volume of the osmotic region).

Calculate the net pressure exerted on the drug region (i.e., the pressure on the impermeable pouch membrane minus the pressure of the external fluid) when the device comes to equilibrium with the following external fluids:

- a. Pure water
- b. 0.2 M sucrose, where sucrose does not cross the semipermeable membrane
- c. 0.2 M sucrose, where sucrose is able to cross the semipermeable membrane
- d. 0.1 M $MgCl_2$, where $MgCl_2$ does not cross the semipermeable membrane.

You may use the dilute solution assumption for these calculations. Assume constant body temperature = 37°C.

Image removed due to copyright reasons.



3. Purified embryonic cells in culture aggregate via cell-cell adhesion into spheres (often referred to as 'spheroids'), which evidences that their assembly is driven by interfacial tension. Why?
- What happens when two different cell types, having different interfacial tensions, are mixed?
 - Which arrangement is the equilibrium state for the system?