Dental Physiology Quiz 1
Monday, April 28, 2008
Cell Processes, Dr. Driska

Name (please print) _____

1. My chewing gum contains xylitol, a 5-carbon sugar alcohol sweetener that should not cause cavities. Xylitol is a hydrophilic nonelectrolyte, has a molecular weight of 152 grams per mole, and cannot diffuse across the cell membrane; in other words, σ=1. Which of these solutions containing xylitol will be isotonic? (In other words, in which solution will a cell maintain its normal volume?)

   A. 145 mM xylitol ($\sigma = 1$)
   B. *290 mM xylitol ($\sigma = 1$)
   C. 580 mM xylitol ($\sigma = 1$)
   D. 145 mM xylitol ($\sigma = 1$) plus 290 mM urea ($\sigma = 0.2$)
   E. 580 mM xylitol ($\sigma = 1$) plus 290 mM urea ($\sigma = 0.2$)

2. Use the Nernst equation to calculate the K^+ equilibrium potential for a cell under these conditions: intracellular $[K^+] = 150$ mM; extracellular $[K^+] = 3.0$ mM; temperature = 37 °C

   A. $E_K = +60$ mV
   B. $E_K = 0$ mV
   C. $E_K = -55$ mV
   D. $E_K = -90$ mV
   E. *$E_K = -104$ mV

3. In red blood cells there is a countertransporter called the chloride-bicarbonate exchanger that moves 1 Cl^- ion in one direction and 1 HCO_3^- ion in the opposite direction. Which is a **true** statement about this transporter?

   A. This is an electrogenic transporter.
   B. *The value of the cell's membrane potential will not affect the transport rate of these ions.
   C. If Cl^- is absent, HCO_3^- can still be transported by this protein.
   D. If HCO_3^- is absent, Cl^- can still be transported by this protein.

4. The distance that an average solute molecule moves by diffusion in free solution in a given time is expressed by this relationship: $\overline{\Delta x} = \sqrt{2Dt}$ If a solute moves an average distance of 20 μm in 10 milliseconds, how far would it move, on average, in 20 milliseconds?

   A. 10 μm
   B. 14.14 μm
   C. 20 μm
   D. *28.28 μm
   E. 40 μm