Diffusion and Osmosis Problems

Biology 6.0

For each of the following, determine the % concentration of the solute and the solvent for the solution outside the cell (environment) and for the inside of the cell.

A. Tell whether the solution outside the cell is hypotonic, hypertonic, or isotonic.
B. Give the direction of the net movement of water (into cell, out of cell, into & out of cell at equal rates).
C. Tell what will happen to the cell (shrink, swell or stay the same).

A. 

B. 

C. 

20 % solute  80 % solute
80 % solvent  20 % solvent

1.

A. Hypo

B. INTO CELL

C. SWELL

90 % solute  10 % solute
10 % solvent ← 90 % solvent

2.

A. Hyper

B. OUT OF

C. SHRINK

40 % solute  30 % solute
60 % solvent ← 70 % solvent

3.

A. Hyper

B. OUT

C. SHRINK
4. $50\%$ solute $50\%$ solute
   $50\%$ solvent $50\%$ solvent

5. $80\%$ solute $90\%$ solute
   $10\%$ solvent $10\%$ solvent

6. $70\%$ solute $30\%$ solute
   $70\%$ solvent $70\%$ solvent

A. **Iso**
B. **Stay the same/in out**
C. **Stay the same**

A. **Hypo**
B. **Into the cell**
C. **Swell**

A. **Isotonic**
B. **Stay the same**
C. **Stay the same**
1. Use the diagram to answer questions a, b, and c.

   ![Beaker A](100% Water)
   ![Beaker B](10% Sugar, 90% Water)
   ![Beaker C](40% Sugar, 60% Water)

   a. What is the solute concentration of Beaker A?  
   b. What is the solvent concentration of Beaker C?  
   Beaker B? 10%  

2. Use the diagram to the right of a cell submerged in a solution. The membrane is permeable to water but not to sugar.

   a. What is the solution in this example?  
   hypotonic  hypotonic  hypertonic  isotonic  
   b. How do you know?  
   70% Water  

   c. What process is going to take place in this example?  
   diffusion  osmosis  
   d. Describe exactly what is going to happen to the cell in this example.  
   The water will move from a more (hypotonic cell) to outside cell.  

3. The cell in this beaker is bathed in a 5% saline (NaCl) solution. The membrane is permeable to water but not to NaCl.

   ![beaker](0.9% NaCl, 5% NaCl)

   a. In which direction is the net movement of water here?  
   Out of cell  
   b. How will this affect the cell?  
   Shrink  

4. Three funnels containing three different starch solutions were placed for 24 hours into a beaker that contained a starch solution of UNKNOWN concentration. The end of each funnel was covered by a selectively permeable membrane.

   ![funnels](Selectively Permeable Membrane, Tap Water, 2% Starch Solution, 4% Starch Solution)

   a. Based on the results, what is the concentration of the unknown solution? How can you tell?  
   2% It stays in same height after 24 hours.
5. A U-tube is divided into 2 halves, side A and B, by a membrane which is permeable to water and salt, but NOT to glucose. Side A is filled with a solution of 8% salt and 2% glucose, while side B is filled with 2% salt and 8% glucose.

a. What could you say about the water concentration on side A relative to side B?

b. Which molecule(s) will move across the membrane and in which net direction(s)?

![Diagram of U-tube with solutions on each side]

Notice that the levels of liquid in both A and B are equal. Do you think they will appear this way when the system reaches equilibrium? Explain.

6. The solutions in the arms of the U-tube (at right) are separated by a selectively permeable membrane that is permeable to water and solute A, but not to solute B. 40g of solute A and 20g of solute B have been added to the water on side 1 of the U-tube. 20g of solute A and 40g of solute B have been added to the water on side 2 of the U-tube. Assume that after a period of time, equilibrium is reached.

a. How many grams of solute A will be in solution on side 1 of the U-tube? Explain.

b. How many grams of solute A will be in solution on side 2 of the U-tube? Explain.

c. How many grams of solute B will be in solution on side 1 of the U-tube? Explain.

d. How many grams of solute B will be in solution on side 2 of the U-tube? Explain.

e. What has happened to the water level in the U-tube? Explain your answer.

![Diagram of U-tube with solutions on each side]

7. Flasks X, Y, and Z contain solutions with different concentrations of the solute NaCl. Flask X has 0.5% NaCl, flask Y has 0.9% NaCl, and flask Z has 1.5% NaCl. Red blood cells (0.9% NaCl) will be placed into each flask.

a. Predict what will happen to the red blood cells in flask X (hint: draw out the situation).

b. Predict what will happen to the red blood cells in flask Y (hint: draw out the situation).

c. Predict what will happen to the red blood cells in flask Z (hint: draw out the situation).
8. In the U-tube diagram below, the membrane is permeable to solute A; however, it is NOT permeable to solute Z.

   a. What is going to happen to solute A (both direction and percentages)?

      Sol. A will move to side 2 so 13% on each side.

   b. What is going to happen to solute Z (both direction and percentages)?

      Solute will remain as side 1 = 10% Z = 40%

   c. What is going to happen to the water levels, specifically?

      The water will move from side 1 to side 2.
      Side 2 has only 97% H_2O.

9. Study the diagrams of the beakers to the right, noting the concentrations of various substances in the beakers and in the cellulose bags. Water molecules can pass through the cellulose, but starch cannot pass through.

   a. Draw arrows in the diagrams to show the direction in which water will move.

   b. Which of the beakers contains a solution that is hypertonic relative to the bag’s contents?

      [2] 100% Water 10% Starch

   c. What will eventually happen to the concentrations in beaker 2?

      They will become level or close to equilibrium.

10. Name two ways that active transport is different from passive transport.

      Active transport:
      1. Uses energy
      2. Goes against concentration gradient
         From [Low conc] to [High conc]