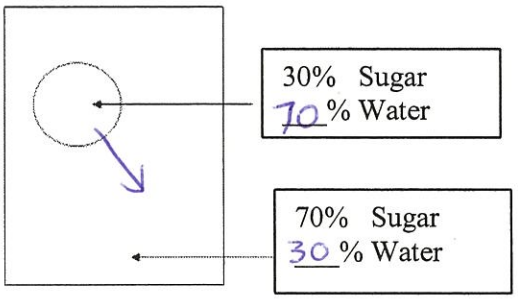
Name Key

MOVEMENT of MOLECULES to MAINTAIN HOMESTASIS PROBLEMS

1. Below is a diagram of a cell submerged in a solution.
   a. The *solution* in this example is – hypotonic, hypertonic or isotonic - compared to the cell.

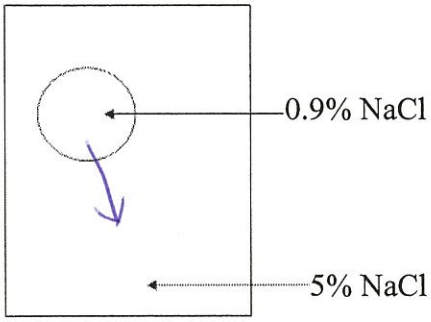
   b. What *process* is going to take place in this example? (diffusion or osmosis)
   c. Describe exactly what is going to happen to the cell in this example.

water will leave cell – shrink lose mass



This membrane is **NOT** permeable to sugar

2. The cell in this beaker is bathed in a 5% NaCl solution. The membrane is permeable to water but not to NaCl.



i. In which direction is the net movement of water here?

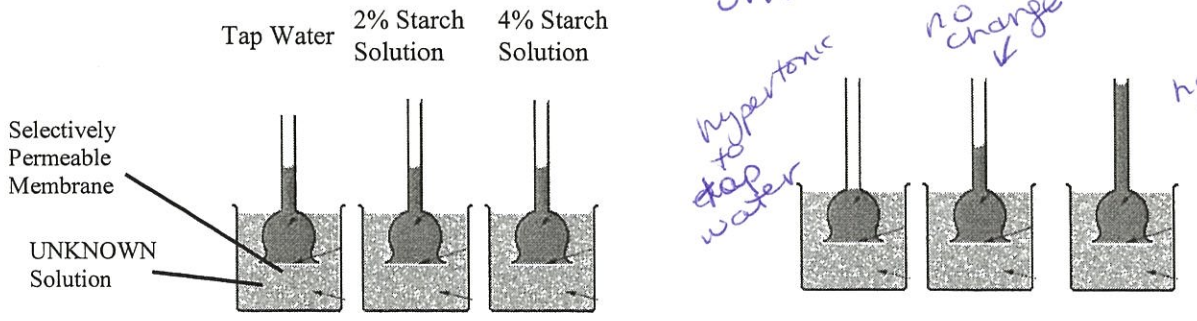
out of cell

ii. How will this affect the cell?

shrink / lose mass
crenation

3. 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.
   a. What can you say about the *concentration of the solution in the beaker* based on the results shown in the diagram?

unknown = 2% starch
no change in level
hypertonic to tap water
hypotonic to 4% star



START **AFTER 24 HOURS**

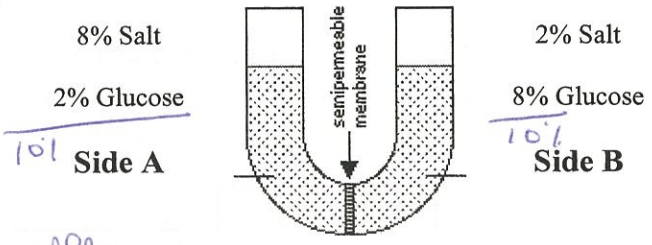
4. A U-tube is divided into 2 halves, A and B, by a membrane which is freely permeable to water and salt, but NOT to glucose. Side A is filled with a solution of 8% salt and 2% glucose, while side B is filled with 2% salt and 8% glucose.

   a. In terms of glucose concentration, which side is a hypotonic solution? A less concentrated than B

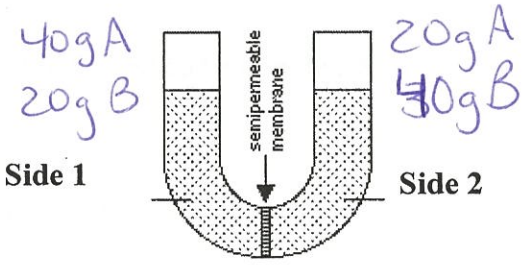
   b. What could you say about the water concentration on side A relative to side B? Same both 10% solute

   c. Which molecule(s) will move across the membrane and in which net direction(s)? not permeable to glucose
   salt A → B
   water A → B

   d. 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.**
   no water will move A → B



5. 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 30 g

   b. How many grams of solute A will be in solution on side 2 of the U-tube? 30 g

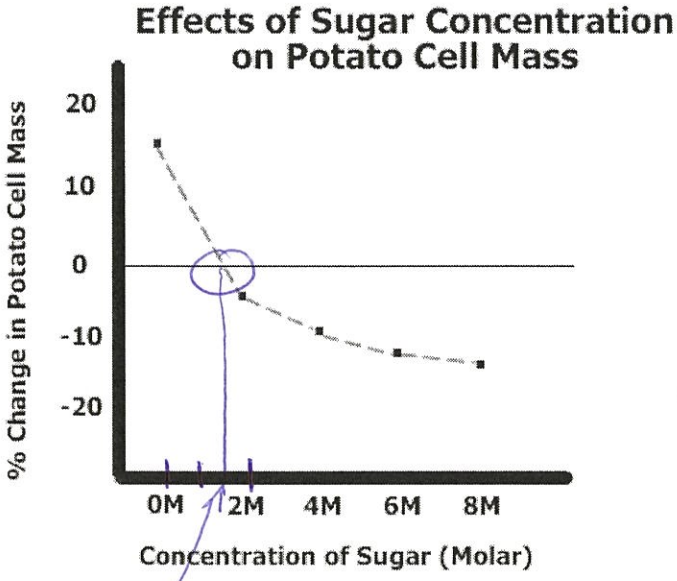
   c. Explain your answers to questions a & b.
   Impermeable to B
   A will move → equilibrium

   d. How many grams of solute B will be in solution on side 1 of the U-tube? 20 g

   e. How many grams of solute B will be in solution on side 2 of the U-tube? 40 g

   f. Explain your answers to questions d & e.
   Impermeable to B - won't move

   g. What will happen to the water level in the U-tube? Explain your answer.
   water will move Side 1 (50g) → Side 2 (70g)
   to reach equilibrium



10. Based on the information in the above graph, what is the approximate molarity of the potato cell? How do you know?

1.5 M no mass change so must be isotonic

11. What can you say about these solutions (2M, 4M, 6M, 8m) compared to the potato cells?

potato lost mass in these. so hypertonic >1.5 M

12. What then is the approximate solute potential of the potato cell (assume i = 1, and 22°C)? At what concentration should you place the cell in to ensure the turgor pressure inside the cell stays the same? SHOW YOUR WORK.

$\psi_s = -(1)(1.5)(.0831)(295)$

$\psi_s = -36.77$

cell needs to be in solution with $\psi_s \approx -36.77$

6. 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).

   0.5% (0.9%) water → into cell swell + gain mass
   hypotonic possibly lyse

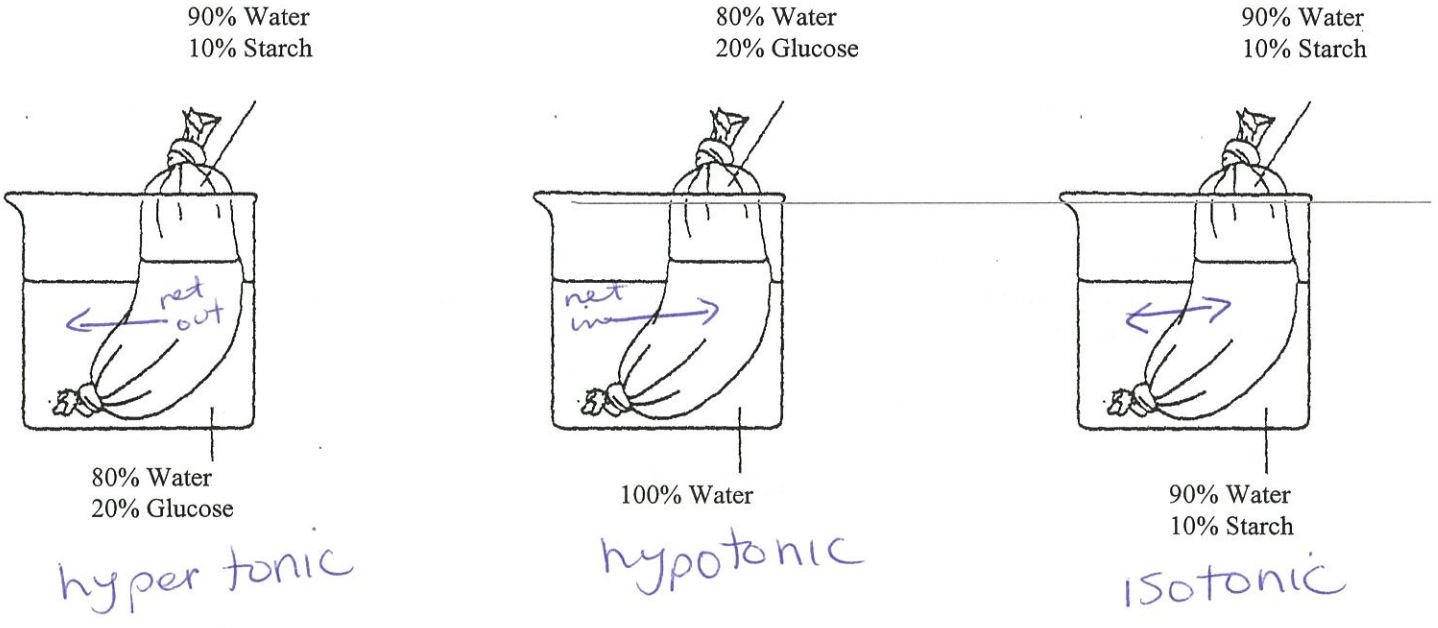
   b. Predict what will happen to the red blood cells in flask Y (hint: draw out the situation).

   0.9% (0.9%) no net movement
   isotonic stays same size

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

   1.5 (0.9) water will leave cell
   hypertonic shrink / lose mass

7. The direction in which water molecules move during osmosis depends on where the water molecules are more highly concentrated. Study the diagrams below.
   a. Decide whether the solution in each beaker is hypotonic, isotonic, or hypertonic in relation to the solution inside the cellulose bag, then write your answer below each beaker.
   b. Draw arrows to indicate the direction in which the water will move in each case.



8. What is the water potential for a solution that is 0.1M? (assume i = 1, and a temperature of 22°C)
SHOW YOUR WORK!

$\psi_s = -iCRT$
$= -(1)(.1M)(.0831\ \text{liter bar/mole K})(295K)$
$= -2.46$

$\psi = \psi_s + \psi_p$ $\psi = -2.46 + 0$ $\psi = -2.46$

9. What is the solute potential for a solution that is 0.5M? (assume i = 1, and a temperature of 0°C)
SHOW YOUR WORK!

$\psi_s = -(1)(.5m)(.0831)(273)$

$\psi = -11.34$ bar