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1 st	1	2	3	4	5	
2 nd	1	2	3	4	5	

Name: _____

Membrane Transport

LAB REPORT / QUESTIONS

Before you begin:

- 1) Prepare and attach a graph of Distance vs Time for Exercise A - Osmosis Across an Artificial Semi-permeable Membrane.
- 2) Prepare and attach a graph of Distance vs Time for Exercise C - Simple Diffusion (combine averaged data for temperature, diffusion medium & molecular weight effects on one graph).

Note: you can access the entire class data set and preliminary graphs from the course web page. To prepare your graph you may elect to isolate your individual groups data and/or use averaged class data to prepare your graph. If averaging data you may need to exclude some data sets that are clearly in error (use caution not to exclude valid data). Graphs may be hand prepared or prepared using Excel. All graphs must be clearly titled and labeled.

Exercise A - Osmosis Across An Artificial Semi-Permeable Membrane

1. Define osmosis. What factors are required for osmosis to take place?
2. Define osmotic pressure.
3. Which solution will exert the greatest osmotic pressure: 20% sucrose or 40% sucrose?
4. What effect does changing the concentration of sucrose have on the rate of osmosis?
Explain.
5. Why does the rate of osmosis change over time?
6. Would the same results be obtained in exercise A if maltotriose (an impermeable trisaccharide, MW 504) was used in place of sucrose (an impermeable disaccharide, MW 342)? **Explain.**

Exercise B – Simple Diffusion

Averaged Data: Temperature Effects

Cold (add the distances for all four cold tubes at 30 min etc. and divide by 4)

Warm (add the distances for all four warm tubes at 30 min etc. and divide by 4)

	Averaged Total distance in mm at 30, 60 ,90...minutes						
	30	60	90	120	150	180	24 hours
Cold							
Warm							

Averaged Data: Diffusion Medium (viscosity) Effects

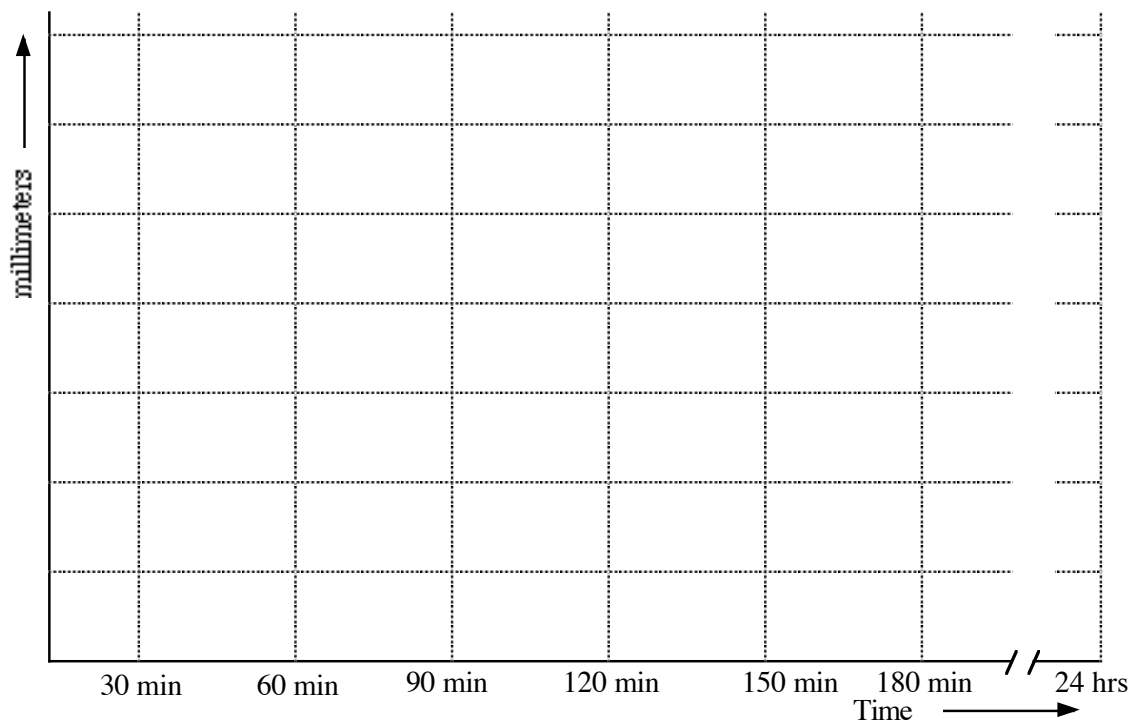
e.g. add the distances for all four 0.5% tubes or 2% at 30 min etc. and divide by 4)

	Averaged Total distance in mm at 30, 60 ,90...minutes						
	30	60	90	120	150	180	24 hours
0.5%							
2%							

Averaged Data: Molecular Weight Effects

e.g. add the distances for all four Eosin B or KmnO₄ tubes at 30 min etc. and divide by 4)

	Averaged Total distance in mm at 30, 60 ,90...minutes						
	30	60	90	120	150	180	24 hours
Eosin B							
KMnO ₄							



1. What effect does an increase in molecular size have on the rate of diffusion?

2. What effect does temperature have on the rate of diffusion?

3. What effect does the diffusion medium (viscosity) have on the rate of diffusion?

4. What other factors (not evaluated here) influence the rate of diffusion?

5. Does the concentration of one molecule influence the rate of diffusion of another? Explain.

6. Does the rate of diffusion change over time? Explain.

Exercise C – Differential Permeability

	<u>PART I</u>			<u>PART II</u>	
	Initial Weight	Weight (60 Min.)	Weight Change	Presence of Glucose	Presence of Starch
Dialysis Bag					
Tap Water (test-tube)					

1. Did any diffusion, osmosis, or both occur? Explain. Support your conclusions with data obtained from this experiment. (Note: you will need to evaluate the data from both parts of this experiment to answer this question).

2. Assume that instead of placing the dialysis bag in tap water that it was placed in a solution containing 1% starch (the dialysis bag still contains 5% glucose and 1% starch). What will happen to the following:
 - a. Glucose molecules
 - b. Starch molecules
 - c. Water molecules
 - d. Will the dialysis bag gain or lose weight?

3. Assume that instead of placing the dialysis bag in tap water that it was placed in a solution containing 5% glucose (the dialysis bag still contains 5% glucose and 1% starch). What will happen to the following:
 - a. Glucose molecules
 - b. Starch molecules
 - c. Water molecules
 - d. Will the dialysis bag gain or lose weight?

Exercise D - Tonicity

1. Label each of the following solutions as either isotonic, hypotonic or hypertonic.

10% _____	0.45% _____
3.5% _____	0.20% _____
0.85% _____	0.00% _____

2. Define the following terms. Include a describe and explanation of what will happen to a red blood cell placed in each of these solutions:
 - a) Isotonic

 - b) Hypotonic

 - c) Hypertonic.

3. Red blood cells will _____ in a hypertonic solution.

4. A 0.10 M NaCl solution is _____ tonic to a 0.10 M glucose solution.

QUESTIONS

1. Suppose a salt and a glucose solution are separated by a membrane that is permeable to water but not to the solutes. The NaCl solution has a concentration of 1.95 g per 250 ml (molecular weight = 58.5). The glucose solution has a concentration of 9.0 g per 250 ml (molecular weight = 180). Calculate the molarity, millimolarity, and milliosmolarity of both solutions. State whether or not osmosis will occur and, if it will, in which direction. Explain your answer.
2. When the body needs to conserve water, the kidneys excrete a hypertonic urine. What do the terms isotonic and hypertonic mean? Since the fluid that is to become urine begins as an isotonic solution, what must happen to change it to a hypertonic urine?
3. The receptors for thirst are located in a part of the brain called the hypothalamus. These receptors are osmoreceptors—they are stimulated by an increase in blood osmolality. How would dehydration lead to a sense of thirst? What effect would drinking seawater have on his sense of thirst? Explain.
4. Before the invention of refrigerators, pioneers preserved meat by salting it. Explain how meat can be preserved by this procedure. (Hint: Think about what salting the meat would do to decomposer organisms, such as bacteria and fungi.)

Review Calculations - Solution Concentrations

- 1.) Define molecular weight and gram molecular weight.
- 2.) Define Mole.
- 3.) Define Molarity.
- 4.) Define solvent, solute and solution.
- 5.) How much solute is in:
 - a) 1 liter of a 1 Molar solution?
 - b) 500 ml of a 1 Molar solution?
 - c) 500 ml of a 2 Molar solution?
- 6.) Determine the molecular weight (MW) of the following:
 - a) water (H₂O)
 - b) NaCl
 - c) CaCl₂
 - d) glucose (C₆H₁₂O₆)
 - e) KCl
- 7.) Given 22 grams of NaCl determine:
 - (a) the number of moles, (b) the number of molecules.
- 8.) Given 121 grams of CaCl₂ determine:
 - (a) the number of moles, (b) the number of molecules.
- 9.) Given 3.5 moles of CaCl₂ determine:
 - (a) the number of grams, (b) the number of molecules.
- 10.) Calculate the following (convert from grams to moles):
 - a) 0.9 grams of water = ___ moles
 - b) 111 milligrams of CaCl₂ = ___ millimoles
 - c) 1 gram of glucose = ___ millimoles
 - d) 0.103 pounds of NaCl = ___ moles
 - e) 13 grams of KCl = ___ moles
 - f) 121 milligrams of water = ___ moles of water
- 11.) Calculate the following (convert from moles to grams):
 - a) 0.2 moles of NaCl = ___ grams
 - b) 1.25 millimoles of water = ___ milligrams
 - c) 25 millimoles of glucose = ___ grams
 - d) 1.2 moles of glucose = ___ grams
 - e) 4.015×10^{23} molecules of NaCl = ___ grams
- 12.) Complete the following conversions:
 - a) 0.2 molar solution of NaCl = ___ grams NaCl per liter
 - b) 2.5% solution of KCl in water = ___ molar solution
 - c) 15 grams of glucose in a 0.5 liter solution = ___ % solution
 - d) 10 grams of NaCl in a 1.5 liter solution = ___ osmoles
- 13.) Enough water is added to 8.5 grams of NaCl to make a one liter (1L) solution of salt water.
Determine the concentration of this solution in the following units:
 - a) percent (g%)
 - b) molarity (M)
 - c) osmolarity (Osm)
 - d) milliosmolarity (mOsm)
- 14.) Enough water was added to 21.95 grams of CaCl₂ to make a one liter (1L) solution of salt water.
Determine the concentration of this solution in the following units:
 - a) percent (g%)
 - b) molarity (M)
 - c) osmolarity (Osm)
 - d) milliosmolarity (mOsm)
- 15.) Given the following solutions: 1) 12g NaCl / 100 ml soln., 2) 12g glucose / 100 ml soln.
 - a) What are the osmolarities of each solution (in osmoles)?
 - b) If the two solutions are separated by a selectively permeable membrane (to water only) in which direction will water move?

- 16.) Given the following solutions: 1) 15.3g glucose/100ml, 2) 26.35g NaCl/1L
- What are the osmolarities of each solution (in milliosmoles)?
 - If the two solutions are separated by a selectively permeable membrane (to water only) in which direction will water move?
 - If the membrane is also permeable to sodium in which direction will sodium move and how will this effect the potential (voltage) across the membrane?
- 17.) Given the following solutions:
- 1.53g NaCl / 100ml soln., 2) 23.5g CaCl₂ / liter soln.
- What are the osmolarities of each solution (in milliosmoles)?
 - If the two solutions are separated by a selectively permeable membrane (to water only) in which direction will water move?
 - If the membrane is also permeable to sodium in which direction will sodium move and how will this effect the potential (voltage) across the membrane?

Answers:

<p>(1) Molecular weight = the sum of the atomic weights of the constituent atoms Gram molecular weight = the weight (measured in grams) of one mole (Avogadro's number) of molecules. Numerically equals the molecular weight (in grams).</p> <p>(2) Mole = 6.023×10^{23} molecules (Avogadro's number). The measured weight (in grams) of this number of molecules will equal the sum of atomic weights (molecular weight).</p> <p>(3) Molarity = moles of solute in one liter of solution.</p> <p>(4) Solvent = in a gas-liquid or solid-liquid solution the liquid is defined as the solvent, in a liquid-liquid solution the liquid present in greater amount is the solvent Solute = the non-solvent component of a solution (that which is dissolved). Solution = a transparent and uniform mixture of two or more molecules (solvent and solute) that will not separate spontaneously</p> <p>(5) a) 1 mole b) 0.5 moles c) 1 mole</p> <p>(6) a) 18.016 or 18 b) 58.44 or 58.5 c) 110.98 or 111 d) 180.156 or 180 e) 74.5</p> <p>(7) a) 0.376 moles b) 2.265×10^{23} molecules</p> <p>(8) a) 1.09 moles b) 6.566×10^{23} molecules</p> <p>(9) a) 388.5 grams b) 21.081×10^{23} molecules</p>	<p>(10) a) 0.05 moles d) 0.8 moles b) 1 millimole e) 0.174 moles c) 5.6 millimoles f) 0.0067 moles</p> <p>(11) a) 11.7 g d) 216 grams b) 22.5 mg e) 39 grams c) 4.5 g</p> <p>(12) a) 11.7 grams b) 0.335 molar c) 3 % d) 0.228 osmolar</p> <p>(13) a) 0.85 g% or 0.85% b) 0.145 M c) 0.290 Osm d) 290 mOsm</p> <p>(14) a) 2.195 g% or 2.195% b) 0.198 M c) 0.594 Osm d) 594 mOsm</p> <p>(15) a) NaCl = 4.1 osm, glucose = 0.666 osm b) from the glucose side towards the NaCl side</p> <p>(16) a) glucose = 850 mOsm, NaCl = 900 mOsm b) from the glucose side to the sodium chloride side, c) sodium would move down its concentration gradient into the glucose side giving the glucose side a positive (+) potential and the NaCl side a negative (-) potential</p> <p>(17) a) NaCl = 523 mOsm, CaCl₂ = 635 mOsm b) from the NaCl side to the CaCl₂ side c) sodium would move down its concentration gradient into the CaCl₂ side giving the CaCl₂ side a positive (+) potential and the NaCl side a negative (-) potential</p>
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