BIOLOGY 100
SOLUTIONS TO PROBLEMS

MEMBRANES

1. If a dialysis sack with a weight of 15.0 g is placed in a 0.4 M sucrose solution and the sack had a weight of 15.5 g after 15 minutes, was the concentration of water in the initial dialysis sack greater or less than that of the 0.4 M sucrose solution? How did the weight of the dialysis sack change on a percentage basis?

Since the mass of the dialysis sack increased while in the 0.4 M sucrose solution, water must have entered the dialysis sack. Water will move "down a concentration gradient;" that is, it will move from an area of high water concentration to an area of low water concentration. The concentration of water in the dialysis sack, at the start, must have been lower than the water concentration in the 0.4 sucrose solution.

$$\text{Percent mass change} = \frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100 = \frac{15.5\text{ g} - 15.0\text{ g}}{15.0\text{ g}} \times 100 = 3.33\%$$

2. Dialysis sack A had an initial mass of 18.2 g and sack B had an initial weight of 10.6 g; both sacks were placed in a 0.8 M sucrose solution. After 15 minutes, the sacks were reweighed; sack A was 16.2 g and sack B was 8.9 g. Which sack had the higher initial water concentration? Explain your logic.

$$\text{Percent mass change} = \frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100$$

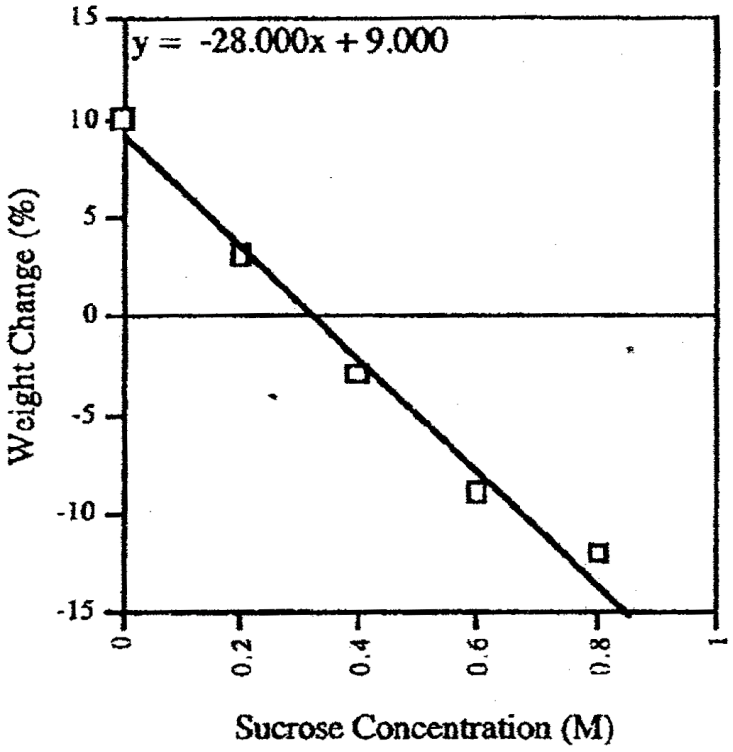
$$\text{Sack A: Percent mass change} = \frac{16.2\text{ g} - 18.2\text{ g}}{18.2\text{ g}} \times 100 = -10.99\%$$

$$\text{Sack B: Percent mass change} = \frac{8.9\text{ g} - 10.6\text{ g}}{10.6\text{ g}} \times 100 = -16.04\%$$

Since both dialysis sacks lost water to the 0.8 M sucrose solution, we can assume that the concentration of water in the sacks was higher than that in the 0.8 M sucrose solution. Since a greater percent of water was lost from sack B, we can conclude that the concentration of water in sack B was greater than the water concentration in sack A.

3. A series of dialysis sacks were filled with a sucrose solution of unknown concentration. Each sack was weighed and placed in a sucrose solution of known concentration. The % weight change for the sacks in the various solutions was as follows: 0.0 M sucrose = +10%; 0.2 M sucrose = +3%; 0.4 M sucrose = -3%; 0.6 M sucrose = -9%; 0.8 M sucrose = -12%. What is the concentration of the unknown solution, the sucrose solution used to fill the sacks? **Hint:** Plot % wt. change vs. the external sucrose concentration; when there is no concentration gradient, there is no net movement of water across the dialysis membrane.

Plot percent weight change vs. sucrose concentration of the solutions. At the point where the line crosses the x-axis (the x-intercept, y = 0), the bathing solution and the solution in the dialysis sack will have the same water concentration (be isotonic) since there was no weight change.



To have no weight change in the dialysis sack, the bathing solution would have to have a concentration of approximately 0.32 M sucrose. Hence a 0.32 M solution of sucrose would be isotonic with that in the dialysis sack.

4. Slices of potato were placed in a series of sorbitol solutions after recording the initial weights. After incubation for 30 minutes the following data were obtained:

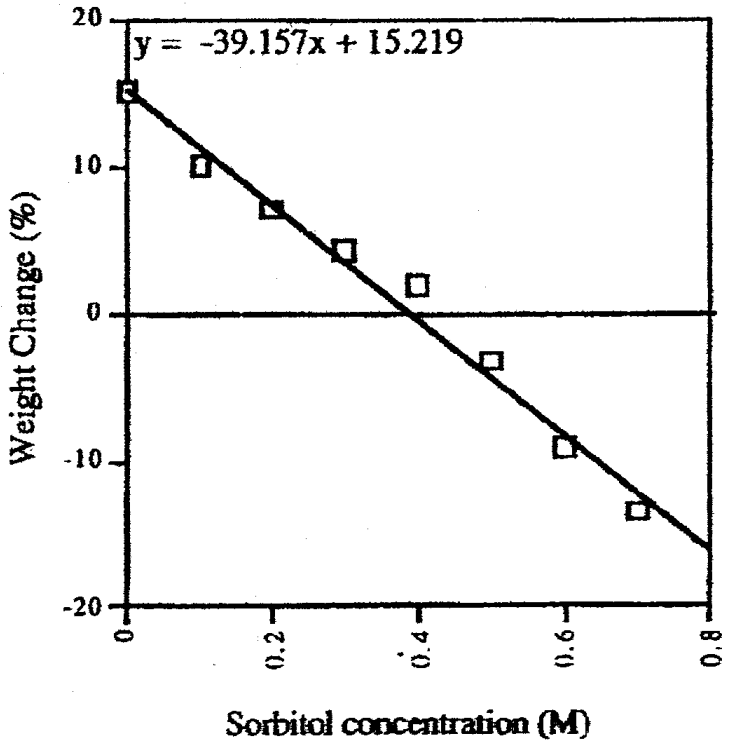
	Sorbitol Concentration (M)							
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Initial Tissue Weight (g)	12.0	13.0	10.0	14.0	11.0	12.0	11.0	14.0
Final Tissue Weight (g)	13.8	14.3	10.7	14.6	11.2	11.6	10.0	12.1

What is the isotonic sorbitol solution for potato tissue? See hint in above question.

First determine the percent weight change in the various tissue samples and then plot sucrose concentration vs. percent weight change.

Percent mass change = $\frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100$

	Sorbitol Concentration (M)							
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Initial Tissue Weight (g)	12.0	13.0	10.0	14.0	11.0	12.0	11.0	14.0
Final Tissue Weight (g)	13.8	14.3	10.7	14.6	11.2	11.6	10.0	12.1
Percent weight change	15.0	10.0	7.0	4.3	1.8	-3.3	-9.1	-13.6



The point on the line where there is no weight change (y = 0) is the concentration of the isotonic solution. From the above graph the estimated isotonic solution is about 0.4 M sorbitol (0.39 M).