AP® Biology
2002 Sample Student Responses

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4. The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0% NaCl, 1% NaCl, 5% NaCl , and 10% NaCl) were tested under identical conditions. Fifteen milliliters (mL) of 0% NaCl were put into a bag formed of dialysis tubing that is permeable to Na^+, Cl^-, and water. The same was done for each NaCl solution. Each bag was submerged in a separate beaker containing 300 mL of distilled water. The concentration of NaCl in mg/L in the water outside each bag was measured at 40-second intervals. The results from the 5% bag are shown in the table below.

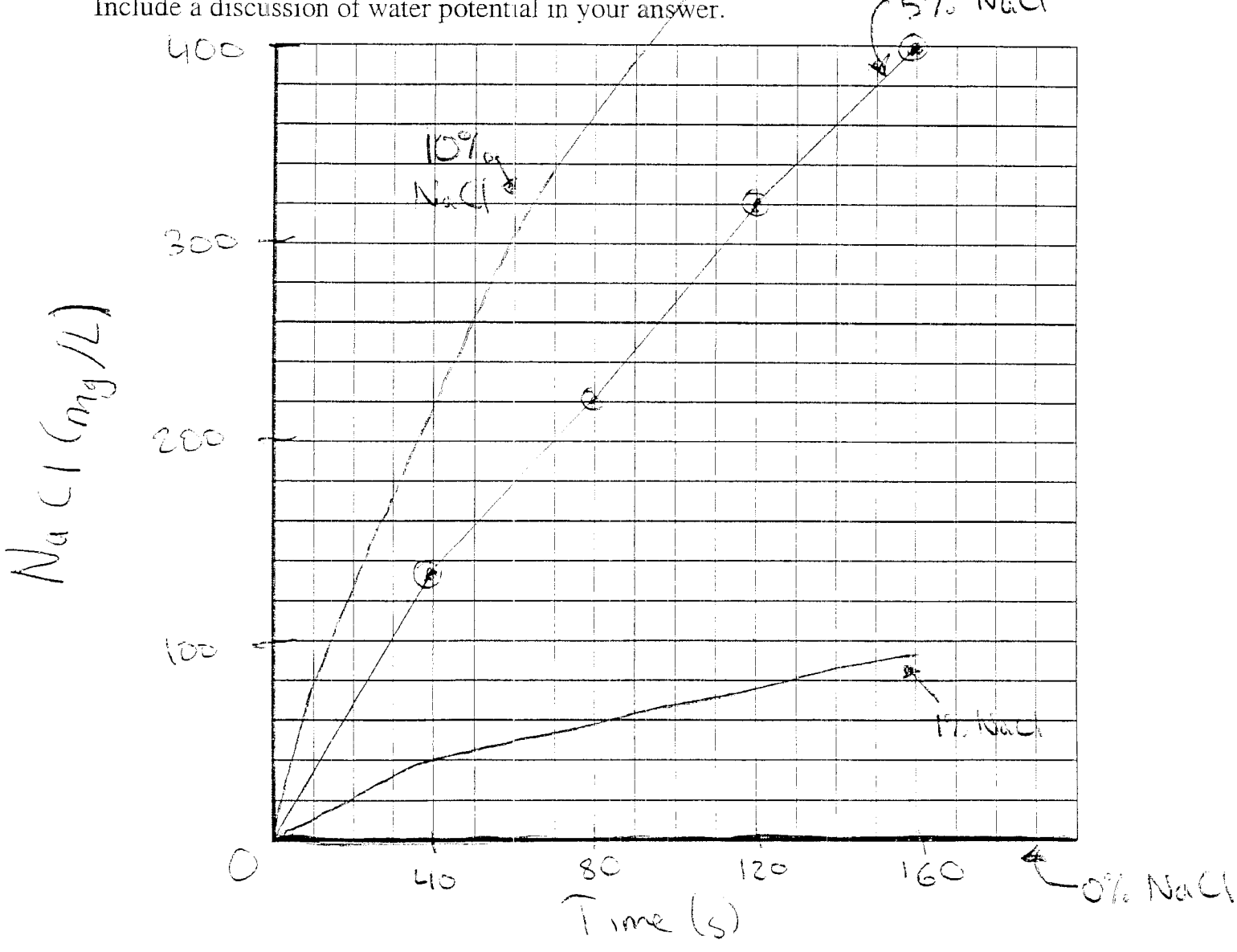
CONCENTRATION IN mg/L OF NaCl OUTSIDE THE 5% NaCl BAG

Time (seconds)	NaCl (mg/L)
0	0
40	130
80	220
120	320
160	400

(a) On the axes provided, graph the data for the 5% NaCl solution.

(b) Using the same set of axes, draw and label three additional lines representing the results that you would predict for the 0% NaCl, 1% NaCl, and 10% NaCl solutions. Explain your predictions.

(c) Farmlands located near coastal regions are being threatened by encroaching seawater seeping into the soil. In terms of water movement into or out of plant cells, explain why seawater could decrease crop production. Include a discussion of water potential in your answer.



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b. The 5% NaCl solution would be isotonic to the distilled water around it, and thus there would be not movement of solutes outside the bag because there were no solutes to begin with. The 1% NaCl solution would have a slower rate of movement than the 5% NaCl because the difference in water potential is not as great between the 1% NaCl and the water. Also, the 1% NaCl would show a smaller net movement. The 10% NaCl solution, however, would have a large difference in water potential and the rate of movement would be faster than the 5% NaCl solution. Also there would be a greater net movement in the 10% NaCl group.

c. Seawater in the soil is a major problem because the extra solutes in the water cause an unfavorable situation for the plant cells. The plant cells are hypertonic to the heavily-solute seawater. Since solutes decrease water potential, the solutes would have a low water potential and, thus, water would flow out of the plant cells into the seawater-soil environment. If the plant cells lose too much water, they can undergo plasmolysis, when the cell shrivels up and the plasma membrane pulls away from the cell wall. This condition causes unhealthy cells that cannot devote energy to undergoing photosynthesis,

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and the plant may eventually die. Another problem that could occur is a decrease in the rate of transpiration. Since the soil environment ~~[illegible]~~ now has more solutes, ~~[illegible]~~ water will not flow as quickly into a plants root system. This ~~[illegible]~~ slows down photosynthesis and the production of glucose & will be harmful to the plant.

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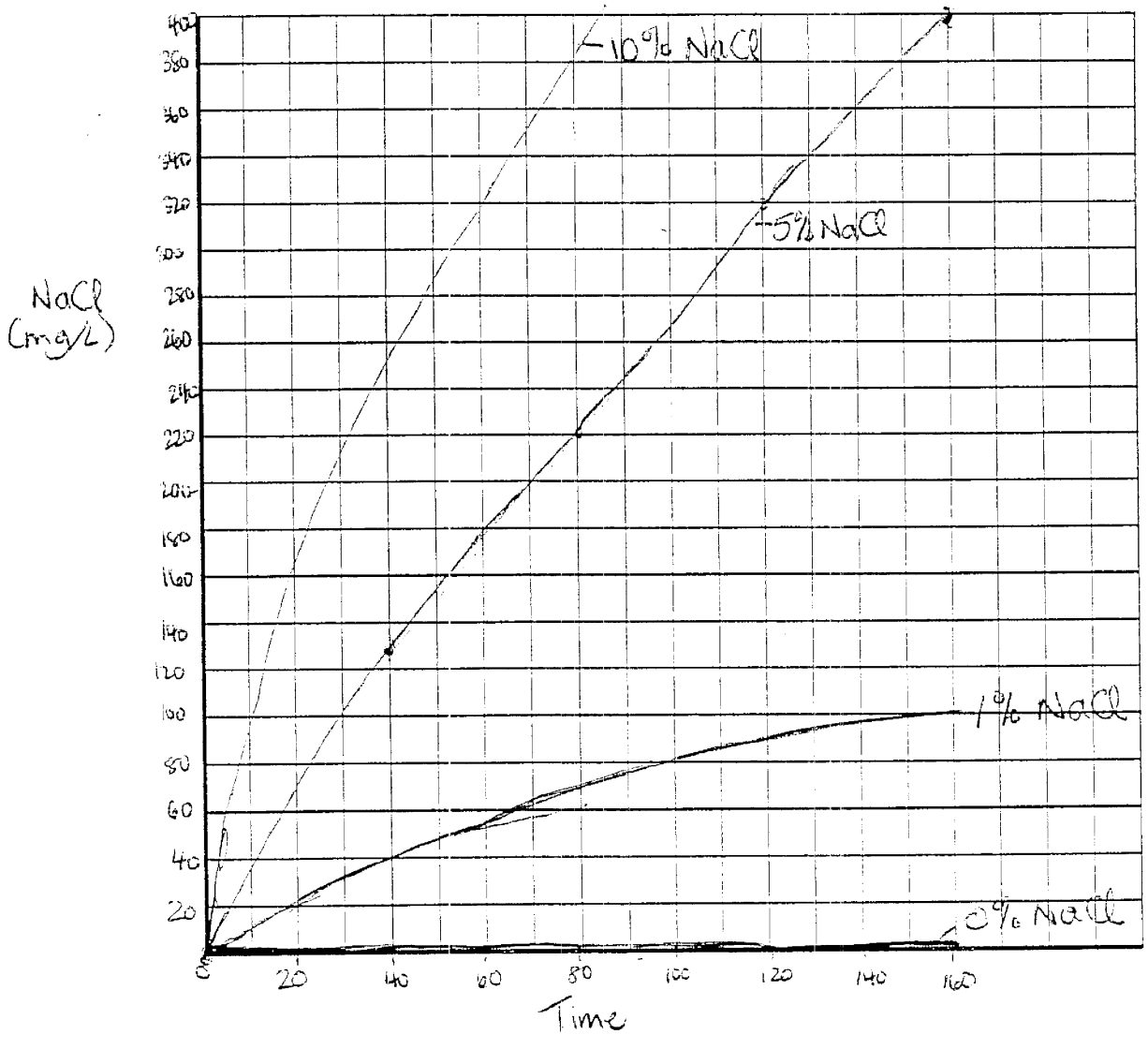

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b) In a solution with 0% NaCl placed in a dialysis tubing ~~and distilled water then there~~ placed in distilled water there would be no NaCl movement within the experiment which would mean that there would be 0 mg/L of NaCl for the duration of the experiment. I predicted that 1% NaCl would lie between 0% and 5% because it is only a small amount that will diffuse out of the dialysis tubing. I predicted 10% would reach 100 mg/L NaCl faster because it is a much more concentrated solution.

c) Most plants are fed with fresh water which means that the insides of the plants are at equilibrium with each

c) Almost all plant cells are accustomed to fresh water except for aqueous plants in sea water. Crops threatened with encroaching sea water in the soil will have low production because of the concentration gradients. Within the cells there is no salt which means that there is a gradient. ~~need~~ Since there is more salt outside the cell, water will diffuse out of the cell to attempt to equalize concentrations. In doing this, the plant cells shrink and shrivel which does not create appropriate space for cell respiration or photosynthesis to take place, which in the end does not produce enough energy for the crop to go to harvest.

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4. The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0% NaCl, 1% NaCl, 5% NaCl , and 10% NaCl) were tested under identical conditions. Fifteen milliliters (mL) of 0% NaCl were put into a bag formed of dialysis tubing that is permeable to Na^+, Cl^-, and water. The same was done for each NaCl solution. Each bag was submerged in a separate beaker containing 300 mL of distilled water. The concentration of NaCl in mg/L in the water outside each bag was measured at 40-second intervals. The results from the 5% bag are shown in the table below.

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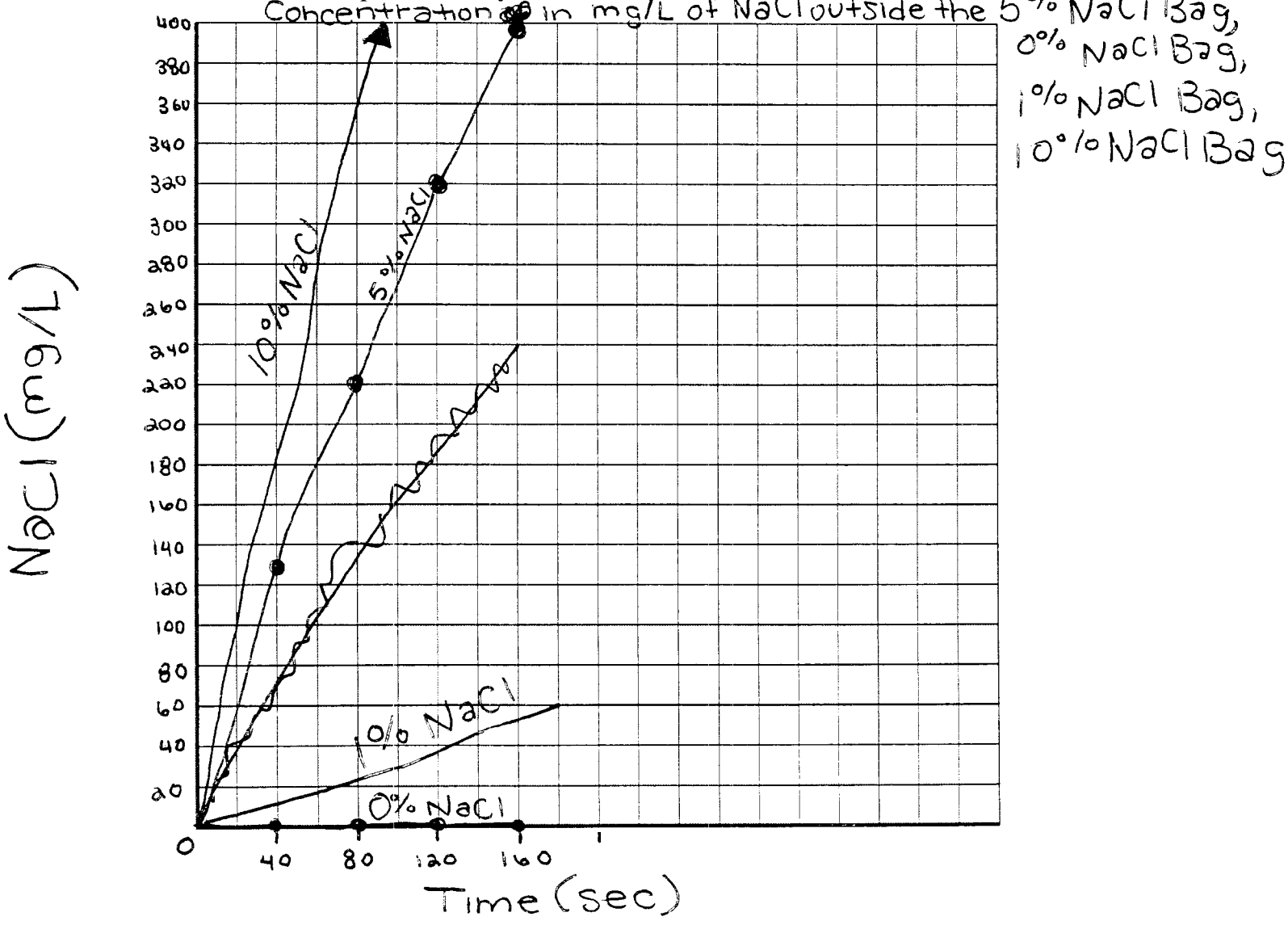

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If their is 0% NaCl to begin with, there will be none in solution. A 1% bag would diffuse, ~~bag~~ there wound not be very much in the solution. On the othe hand, 10% NaCl would yield a much higher concentration of NaCl outside the bag, as well as a higher rate of diffusion.

Seawater could ~~dea~~ decrease crop production because if it is in the soil, it will be taken up through the roots of the crop, and there will be a high concentration of NaCl, or the salt from the water, in the plant. This salt is a danger to the growth of the crop. Though there is other water in the soil, and the seawater will be diluted, it has the potential to concentrate the water with salt.