

Concentrate on the Solution Answer Key

Answers may vary, depending on the assigned nutrient deficiency.

Our Challenge

Our nutrient deficiency (given): Nitrogen

Supplemental nutrient amount needed (given): 230 ppm

The fertilizer compound we will apply: Calcium Nitrate $\text{Ca}(\text{NO}_3)_2$ *(Answers will vary)*

Example for Steps 1 - 3

What percent of the fertilizer compound contains the desired nutrient, by weight? (Show all work)

<i>Nutrient</i>	<i>Atomic Weight</i>				
Ca	40.08	$x 1 = 40.08$	40.08		
N	14.01	$x 2 = 28.02$	28.02	$\frac{28.02 \text{ N atomic weight}}{164.04 \text{ molecular mass}}$	$= .170 = 17\%$
O	15.99	$x 3 \times 2 = 95.94$	+95.94		
			164.04	$= \text{molecular mass}$	

What solute to solvent ratio will you use? (Show your work) *Hint: ppm=mg/l*

$$\frac{230 \text{ ppm N}}{.17 \text{ N}} = \frac{x \text{ ppm Ca}(\text{NO}_3)_2}{1} \qquad \frac{230 \text{ ppm N}}{.17} = \frac{.17x}{.17}$$

$$x = 1352.94 \text{ ppm or } 1352.94 \text{ mg Ca}(\text{NO}_3)_2 \text{ per liter of water}$$

When comparing the % content of the desired nutrient from the two fertilizer compounds, students should choose to use the one with the highest percentage of the nutrient, since they will need to use the least amount which is cost effective.

Explain your next steps after preparing this fertilizer solution along with any additional information you might need about the farm before taking action.

Possible next steps include: *Identify the irrigation system being used. Set the fertilizer injector at the proper delivery rate. Determine the crop's water requirements and create a larger quantity of the solution (at the same concentration) for application. Apply the solution to fertilize the plant. Test the water runoff for fertilizer residue.*

Possible questions include: *Do the plants have any additional nutrient deficiencies besides the one given? What stage of the growth cycle are plants in? Are the plants currently producing fruit? What is the existing nutrient composition of the growing medium? Are any nutrients found in the irrigation water? Where does the water go after irrigation occurs? How many plants are there? How much total water will be used for irrigating?*

Concentrate on the Solution Answer Key (continued)

Step 4

Answers will vary but should include concise, step-by-step directions of how the calculations were done, the best fertilizer compound selected and mixed to the appropriate concentration.

Congratulations, your experience working on the school farm has earned you an interview for a summer job with a local farm. Answer the following questions to prepare for the interview:

1. The farm has two different fertilizers in the barn. One is K_2SO_4 and the other is KCl . The two fertilizers cost the same per ton, but we want to be conscious of costs by using the fertilizer with the highest percentage of potassium, since we won't have to apply as much. Which fertilizer should we use? Show your calculations.

$$K_2SO_4 = 158.25 \quad \%K = 78.12/158.25 \times 100 = 49\% K$$

$$KCl = 74.55 \quad \%K = 39.1/74.55 \times 100 = 52\% K$$

KCl would be the most cost effective

2. Animal manures are often used to add nutrients to soil. Assume that the average price for chicken manure is \$30 per ton (*cost is an estimate only*) and contains 31 pounds of nitrogen per ton.
 - ▶ What percentage of nitrogen does the manure contain? $31 \text{ lbs N}/2000 \text{ lbs} = 0.0155$ or *1.55% Nitrogen*
 - ▶ What is the cost per pound of nitrogen? $\$30/31 \text{ lbs} = \0.97 per pound
3. Ammonium nitrate contains 35% nitrogen, so a ton of ammonium nitrate would contain 700 pounds of nitrogen. Assume ammonium nitrate costs \$300 per ton, what is the cost per pound of nitrogen?
 $\$300/700 \text{ lbs of nitrogen in a ton} = \0.43 per pound of nitrogen
4. Which is more cost effective to apply, chicken manure or ammonium nitrate? *Ammonium nitrate*
5. What are some issues other than price that might affect which of the fertilizers a grower would choose to use? *Ease of application, effect on soil microbes, plant's need for other nutrients, effect on soil organic matter, availability of nitrogen for immediate and/or delayed uptake by plants, transportation costs, safety, reduced nitrogen loss to the environment, etc.*
6. What types of valuable experience might you gain during a summer job at the farm? *Math skills including algebra and unit conversions, knowledge of plant physiology, mechanical skills for maintaining and assembling irrigation systems and farm machinery, chemistry knowledge (specifically plant nutrients), how to accurately weigh materials, formulating solutions to problems, explaining directions, etc.*