Horticulture (41.0601) T-Chart

MIX CHEMICALS IN PROPER PROPORTIONS = APPLY INVERSE OPERATIONS TO SOLVE EQUATIONS OR FORMULAS

Program Duty: 200 Demonstrate Safe And Proper Plant Health Care Practices

POS: 203 Properly calculate and mix quantities of horticultural products used in plant health care

Program Associated Vocabulary:
PROPORTIONS, EQUATIONS, FRACTIONAL RELATIONSHIPS

Program Formulas and Procedures:
Many procedures used in the field of Horticulture require mixing hazardous chemicals. In order to assure a safe environment in a greenhouse or in the field for employees and customers, directions must be carefully read and followed exactly.

Example:
For a particular chemical used to prevent mold growth on plants in a greenhouse, the directions for mixing this chemical are as follows:

- 15mL. to 16oz of water

You have a gallon of water to use to mix a solution of this chemical. How much of the chemical needs to be added to the gallon?

First, the student must be aware that 1 gallon is equal to 128 fluid ounces. Second, the student must recognize that a direct proportion must be used, because as the amount of the chemical used increases the amount of water used also increases. This information can be used to set up the following proportion:

$$\frac{x\,mL}{128\,oz} = \frac{15mL}{16\,oz}$$

Then, cross multiply to slove:

$$x \times 16 = 128 \times 15$$

$$16x = 1920$$

$$x = 120mL\ of\ chemical$$

PA Core Standard: CC.2.2.HS.D.8

Description: Apply inverse operations to solve equations or formulas for a given variable

Math Associated Vocabulary:
INVERSE, RECIPROCAL, PROPORTION, CROSS MULTIPLICATION, RATION, CONSTANT

Formulas and Procedures:

Direct Proportions

Two quantities, A and B, are directly proportional if by whatever factor A changes, B changes by the same factor.

Example 1: Take the formula distance = rate x time. If the rate remains constant, 30 miles per hour, then the time and distance are directly proportional.

d = 30t
when t = 2, d = 60
when t = 4, d = 120

*Note that when the time doubles, so does the distance.

Example 2: If speed is directly proportional to distance and a car can travel 100 miles at 50 miles per hour. How far can that car travel during the same time if it travels 70 mph?

Step 1: Set up proportion

$$\frac{50mph}{70mph} = \frac{100mi.}{x}$$

Step 2: Cross multiply and divide to solve

$$50x = 70(100) \rightarrow 50x = 700 \rightarrow x = 140\ miles$$

Indirect Proportions

Two quantities, A and B, are inversely proportional if by whatever factor A changes, B changes by the multiplicative inverse, or reciprocal of that factor.

Example 1: Take the formula distance = rate x time. If the distance is constant, 100 miles, then as the rate increases the time decreases

100=rt
When r=100, t=1
When r=50, t=2

*Note that when the rate doubles, time is halved.

Example 2: If the time needed to complete a job is inversely proportional to the number of people working, how long would it take 4 people to paint a room if 1 person needs 8 hours?

Step 1: Set up the proportion

$$\frac{1\ person}{4\ people} = \frac{8\ hours}{x\ hours}$$

Step 2: Invert (flipA) one ratio

$$\frac{1\ person}{4\ people} = \frac{x\ hours}{8\ hours}$$

Step 3: Cross-multiply and divide to solve

$4x = 8, x = 2$ 4 people can paint the room in 2 hours

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Teacher's Script - Comparing and Contrasting
Students must be able to use proportions for a variety of measurements and conversions. Some chemicals must be mixed in dilutions of 1 oz. to 32 oz., or 1 part to 10 parts. The student must be able to recognize the proportional relationships in the various measurements. In other words, they will be given directions on the bottles and will be required to recognize how to measure the chemical using different proportions depending on the daily, weekly and monthly needs.

By setting up a proportion and solving using the cross products property, just as a student would in an algebra problem regarding proportions, the proper amount of a chemical needed in a mixture can be easily determined in a small amount of time.

Common Mistakes Made By Students:
Students need to refresh their memories regarding liquid measurements. They often forget how many ounces are in a pint or quart, etc. Students also need to review the terms milliliters, and ounces so they do not use these measurements interchangeably. Student must also be sure that the correct units are being placed in the numerator and denominator of each ratio.

Also, students should always do a self-check to determine if a direct or inverse relationship should be used. The student should ask himself or herself, "As this variable increases, is the other variable going to increase or decrease at the same time?" This will help the student decide how to set up the correct proportion.

Lab Teacher's Extended Discussion
There are many different chemicals used in the field of horticulture. In order to prepare the student for the work place, and their exposure to a variety of products, using actual materials would be advantageous. Directions can be copied for a multitude of products from the internet in order to provide the student with actual directions.

Many students tend to be visual learners. Liquid measurements can be demonstrated by having containers for each of the measurements from an ounce to a gallon. If a student is having difficulty visualizing how many ounces are in the various measuring tools, then the teacher can direct the student to pour ounces into the different containers in order to actively learn the measurements.

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Problems	Occupational (Contextual) Math Concepts	Solutions
1. A particular chemical is used to neutralize the pesticides in the pesticide sprayers. The directions to mix this solution are as follows: Mix 2 ounces of the chemical per ½ gallon of water. Calculate the following problem: You only need to mix 1 quart of the solution, how much chemical will you need to add to the quart?		
2. A disinfectant solution must be mixed as follows: Use 2 ounces of chemical per 4 gallons of water. Calculate the following: How much disinfectant solution will you need to add to 1 quart of water?		
3. A powerful surface disinfectant must be mixed daily. The directions read as follows: Mix 4.5 cc per pint of water. In order to mix ½ gallon of this disinfectant for the day, calculate how much of the chemical will you need to add to the ½ gallon of water?		
Problems	**Related, Generic Math Concepts**	**Solutions**
4. If it takes 12 eggs to make 1 dozen, how many eggs will be needed to make 9 dozen?		
5. The pressure of a gas and its corresponding volume are inversely proportional. If the pressure of 0.24 m3 is 0.5 atm, what would the pressure be of 0.060 m3 of the same gas at the same temperature?		
6. If it takes 26 lbs. of metal to make 10 castings, how many pounds of metal will be needed to make 14castings?		
Problems	**PA Core Math Look**	**Solutions**
7. Given that y and x are **directly** proportional and y = 2, when x = 5, find the value of y when x = 15.		
8. Given that y and x are **inversely** proportional and y = 2, when x = 5, find the value of y when x = 15.		
9. If one rabbit can chew 20 carrots in 15 hours, how long will it take 5 rabbits to chew the same 20 carrots?		

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Problems	Occupational (Contextual) Math Concepts	Solutions
1. A particular chemical is used to neutralize the pesticides in the pesticide sprayers. The directions to mix this solution are as follows: Mix 2 ounces of the chemical per ½ gallon of water. Calculate the following problem: You only need to mix 1 quart of the solution, how much chemical will you need to add to the quart?		$1qt = 1/4gal; \frac{x\ oz\ chemical}{1/4\ gal} = \frac{2\ oz\ chemical}{1/2\ gal}$ $\frac{1}{2}x = \frac{2}{4}; x = 1\ oz\ chemical$
2. A disinfectant solution must be mixed as follows: Use 2 ounces of chemical per 4 gallons of water. Calculate the following: How much disinfectant solution will you need to add to 1 quart of water?		$1qt = 1/4gal; \frac{x\ oz\ chemical}{1/4\ gal} = \frac{2\ oz\ chemical}{4\ gal}$ $4x = \frac{2}{4}; x = \frac{2}{16} = 1/8\ oz\ chemical$
3. A powerful surface disinfectant must be mixed daily. The directions read as follows: Mix 4.5 cc per pint of water. In order to mix ½ gallon of this disinfectant for the day, calculate how much of the chemical will you need to add to the ½ gallon of water?		1 gallon = 8 pints, so ...1/2 gal = 4 pints $\frac{\text{x cc of disinfectant}}{\text{4 pints}} = \frac{\text{4.5 cc of disinfectant}}{\text{1 pint}}$ x=4(4.5); x=18 oz of disinfectant
Problems	**Related, Generic Math Concepts**	**Solutions**
4. If it takes 12 eggs to make 1 dozen, how many eggs will be needed to make 9 dozen?		**(Direct)** $\frac{12\ eggs}{x\ eggs} = \frac{1\ doz}{9\ doz} \rightarrow 1x = 12(9) \rightarrow x = 108\ eggs$
5. The pressure of a gas and its corresponding volume are inversely proportional. If the pressure of 0.24 m3 is 0.5 atm, what would the pressure be of 0.060 m3 of the same gas at the same temperature?		**(Inverse)** $\frac{0.24m^3}{0.060m^3} = \frac{0.5atm}{xatm}$ Inverse one ratio since it is an inverse proportion. $\frac{0.24m^3}{0.060m^3} = \frac{xatm}{0.5atm} \rightarrow 0.24(0.5) = 0.060x \rightarrow z = 2atm$
6. If it takes 26 lbs. of metal to make 10 castings, how many pounds of metal will be needed to make 14castings?		**(Direct)** $\frac{10\ castings}{14\ castings} = \frac{26lbs}{xlbs} \rightarrow 26(14) \rightarrow x = 36.4lbs$
Problems	**PA Core Math Look**	**Solutions**
7. Given that y and x are **directly** proportional and y = 2, when x = 5, find the value of y when x = 15.		**(Direct)** $\frac{5}{15} = \frac{2}{y} \rightarrow 5y = 2(15) \rightarrow y = 6$
8. Given that y and x are **inversely** proportional and y = 2, when x = 5, find the value of y when x = 15.		**(Inverse)** $\frac{5}{15} = \frac{y}{2} \rightarrow 15y = 2(5) \rightarrow y = 0.667$
9. If one rabbit can chew 20 carrots in 15 hours, how long will it take 5 rabbits to chew the same 20 carrots?		**(Inverse)** $\frac{1}{5} = \frac{x}{15} \rightarrow 5x = 1(15) \rightarrow x = 3\ hours$