Dental Technology (51.0601) T-Chart

Mix chemicals in proper proportions =	Use reasoning to solve equations and justify the solution method

Program Task: Describe and determine the proportional relationship between various quantities of measurement.

PA Core Standard: CC.2.2.HS.D.9

Description: Use reasoning to solve equations and justify the solution method.

Program Associated Vocabulary:
PROPORTIONS, EQUATIONS, FRACTIONAL RELATIONSHIPS

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

Program Formulas and Procedures:

Many chemicals used in the field of dentistry require mixing. In order to assure a safe environment in the dental office for the patients and the staff, directions must be read carefully and followed exactly.

A chemical used for surface disinfecting is Pathex. The directions for mixing this phenol is as follows:

- 15 ml. Pathex to 16 oz. of water

You have a gallon of water to use to mix a solution of Pathex. How much of the Pathex 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. As the amount of Pathex used increases, the amount of water used also increases. This information can be used to set up the following proportion:

$$\frac{x \text{ mL of Pathex}}{128 \text{ ounces}} = \frac{15 \text{ mL Pathex}}{16 \text{ ounces}}$$

Then, cross multiply and solve.

$x \cdot 16 = 128 \cdot 15$

$16x = 1920$

$x = 120 \text{ mL of Pathex}$

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, at 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 at 70 mph?

Step 1: Set up proportion.

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

Step 2: Cross multiply and divide to solve.

$50x = 70(100) \rightarrow 50x = 7000 \rightarrow x = 140 \text{ miles}$

Inverse 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, 100 miles is constant, 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, the time is halved.

Example 2: The time needed to complete a job is inversely proportional to the number of people working. If it takes one person 8 hours to paint the room alone, how long would it take 4 people to paint a room?

Step 1: Set up the proportion.   **Step 2:** Invert (flipA) one ratio

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

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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Instructor'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, or 2.25 cc per pint. The student must be able to recognize the proportional relationships in the various measurements. In other words, they will be given directions on the chemical bottles and will be required to recognize how to measure the chemical using different proportions depending on the daily, weekly and monthly needs for the chemical in the dental office.

By setting up a proportion and using cross multiplication, 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.

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, ounces and cc's so they do not use these measurements interchangeably.

Students 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.

CTE Instructor's Extended Discussion

There are many different chemicals used in the field of dentistry. In order to prepare the student for the work place, exposure to a variety of products and the directions for mixing would be advantageous. Directions can be copied off of reliable internet sources for a multitude of products, in order to provide the student with actual directions. Using these various directions, the instructor can develop word problems that describe possible scenarios in the dental office.

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

Problems	Career and Technical Math Concepts	Solutions
1. Du-More Vac is used to clean the evacuation system in the dental unit. The directions to mix this solution are as follows: Mix 1 ounce of Du-More Vac per ½ gallon of water. You only need to mix one quart of the solution. How much of the Du-More Vac will you need to add to the quart of water?		
2. An Iodophor disinfectant solution must be mixed as follows: Use 1 ounce of chemical per 2 gallons of water. How much Iodophor will you need to add to 1 quart of water?		
3. IodoFive surface disinfectant must be mixed daily. The directions read as follows: Mix 2.25 cc's per pint of water. In order to mix ½ gallon of this disinfectant for the day, how much of the chemical will you need to add to the ½ gallon of water?		

Problems	Related, Generic Math Concepts	Solutions
4. If you need 5 pounds of chicken to serve 20 people, how many pounds will you need to serve 50 people?		
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 14 castings?		

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 number of carrots?		

Problems	**Career and Technical Math Concepts**	**Solutions**
1. Du-More Vac is used to clean the evacuation system in the dental unit. The directions to mix this solution are as follows: Mix 1 ounce of Du-More Vac per ½ gallon of water. You only need to mix 1 quart of the solution, how much of the Du-More Vac will you need to add to the quart?	**(Direct)** $1 \text{ quart} = \frac{1}{4}$ gal; $\frac{x \text{ ounces of Du–More Vac}}{\frac{1}{4} \text{ gal}} = \frac{1 \text{ ounce of Du–More Vac}}{\frac{1}{2} \text{gal}}$ $\frac{1}{2}x = \frac{1}{4};\ x = \frac{1}{2}$ ounce of Du-More Vac	
2. An Iodophor disinfectant solution must be mixed as follows: Use 1 ounce of chemical per 2 gallons of water. How much Iodophor will you need to add to 1 quart of water?	**(Direct)** $1 \text{ quart} = \frac{1}{4}$ gal; $\frac{x \text{ ounces of Iodophor}}{\frac{1}{4} \text{ gal}} = \frac{1 \text{ ounce of Iodophor}}{2 \text{ gal}}$ $2x = \frac{1}{4};\ x = \frac{1}{8}$ ounce of Iodophor	
3. IodoFive surface disinfectant must be mixed daily. The directions read as follows: Mix 2.25 cc's per pint of water. In order to mix ½ gallon of this disinfectant for the day, how much of the chemical will you need to add to the ½ gallon of water?	**(Direct)** 1 gallon = 8 pints, so $\frac{1}{2}$ gal = 4 pints $\frac{x \text{ cc of Iodofive}}{4 \text{ pints}} = \frac{2.25 \text{ cc of Iodofive}}{1 \text{ pint}}; x = 4(2.25)$ $x = 9 \text{ cc's of IodoFive}$	

Problems	**Related, Generic Math Concepts**	**Solutions**
4. If you need 5 pounds of chicken to serve 20 people, how many pounds will you need to serve 50 people?	**(Direct)** $\frac{5 \text{ pounds}}{20 \text{ people}} = \frac{x \text{ pounds}}{50 \text{ people}} \rightarrow 20x = 5(50) \rightarrow 20x = 250$ $x = 12.5 \text{ pounds}$	
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)** $\frac{0.24 \text{ m}^3}{0.060 \text{ m}^3} = \frac{0.5 \text{ atm}}{x \text{ atm}}$ (Invert one ratio since it is an inverse proportion.) $\frac{0.24 \text{m}^3}{0.060 \text{m}^3} = \frac{x \text{atm}}{0.5 \text{atm}}$ $0.24(0.5) = 0.060x\ \ x = 2 \text{atm.}$	
6. If it takes 26 lbs. of metal to make 10 castings, how many pounds of metal will be needed to make 14 castings?	**(Direct)** $\frac{10 \text{castings}}{14 \text{castings}} = \frac{26 \text{lbs.}}{x \text{lbs.}} \rightarrow 10x = 26(14) \rightarrow x = 36.4 \text{lbs.}$	

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 number of carrots?	**(Inverse)** $\frac{1}{5} = \frac{x}{15} \rightarrow 5x = 1(15) \rightarrow x = 3$	