Graphic Communication (10.0399) T-Chart

Calculate press impressions	=	Use reasoning to solve equaations and justify the solution method

Program Task: Determine press impressions for estimating.

Program Associated Vocabulary:
IMPRESSIONS (IMP)

Program Formulas and Procedures:
Impressions are the number of sheets per hour a printing press can print.

Knowing a machine's impression rate, a printing company owner can use direct proportions to quickly calculate the amount of time required to print a job.

Example:
If a printing company runs their printing press at 8000 imp per 60 minutes, how long would it take the press to run 5000 impressions?

Solution:
Direct Proportion
Step 1: Set up the proportion.

$$\frac{8{,}000 \text{ imp}}{5{,}000 \text{ imp}} = \frac{60 \text{ minutes}}{x}$$

Step 2: Cross multiply and divide to solve.
$8{,}000x = 60\,(5000) \rightarrow 8000x = 300{,}000 \rightarrow x = 37.5$ min.

Example:
If a printing company runs their printing press at 8000imp/60min, is it possible to run 65,000 impressions in an 8 hour shift?

Solution:
Direct Proportion
8hours x 60 = 480 min.

$$\frac{8000 \text{ imp}}{x \text{ imp}} = \frac{60 \text{ min.}}{480 \text{ min.}}$$

$60x = 3840000$

$$\frac{60x}{60} = \frac{3840000}{60}$$

$x = 64{,}000$ imp

You can only make a maximum of 64,000 imp in an 8 hour shift, and that does not take into account any breaks in productions (clearing jams, replacing ink, i.e.).

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

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

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

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.

$50x = 70(100) \rightarrow 50x = 7000 \rightarrow x = 140$ 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 pain the room alone, how long would it take 4 people to paint a room?

Step 1: Set up the proportion.

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

Step 2: Invert (flip) one ratio.

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

Step 3: Cross-multiply and divide to solve.
$4x = 8$, $x = 2$
4 people can paint the room in 2 hours.

Instructor's Script – Comparing and Contrasting

The example shown on the Graphic Communications side of the T-Chart represents a direct proportion. If the speed (impressions per 60 minutes) remains the same and the number of impressions decreases, the time it takes to complete the job will also decrease. Direct proportions are often easier for students to understand than inverse proportions.

It should be noted that there are trade related applications of inverse proportions in Graphic Communications. For example, if it takes 2 employees 1 hour to staple 200 packets, it would take 3 employees less time. The more employees you have working the less time the job will take.

Example:

If it takes 2 employees 1 hour to staple 200 packets, how long will it take 3 employees to staple the same amount of packets?

Step 1: Set up the proportion. Step 2: Invert one ratio.

$$\frac{2\,\text{employees}}{3\,\text{employees}} = \frac{1\,\text{hour}}{x\,\text{hours}} \qquad \frac{2\,\text{employees}}{3\,\text{employees}} = \frac{x\,\text{hours}}{1\,\text{hour}}$$

Step 3: Cross-multiply and divide to solve.

$$3x = 2$$

$$\frac{3x}{3} = \frac{2}{3}$$

$$x = 0.67\,\text{hours}$$

Common Mistakes Made By Students

When students compare direct and inverse proportional relationships, they may become confused and have difficulty differentiating one from the other. One way to keep them straight is to:

1. Set up one pair of values on the same line, e.g., $\frac{12}{24} = \frac{100\text{ lbs.}}{x\text{ lbs.}}$
2. Beneath that line, place the other pair of values,
3. Students need to be aware that direct proportions mean that as one variable increases so does the other variable. An inverse proportion means that one variable increases when the other one decreases. Students struggle with this concept.
4. If the problem is a direct proportion, students should cross multiply (24 times 100) and (12 times x) and then divide to solve the problem.
5. If an inverse relationship exists, then students should first invert one ratio before cross multiplying and dividing to solve the problem.
6. If need be, have the student set up the problem and do it both ways to see which answer makes sense! We know in problem #9, for example, that it won't take 5 rabbits more time than it took 1 rabbit to eat 20 carrots, so it must be an inverse proportion.

CTE Instructor's Extended Discussion

This is great way of quickly calculating the amount of time required to print a job. Proportions can also be used to be used to solve other problems in Graphic Communication. For example, resizing images is an application of direct proportions. If the height of a 3"x 5" image is enlarged to 30", what would be the new width?

$$\frac{3"}{5"} = \frac{x}{30"}$$

$$5x = 90$$

$$\frac{5x}{5} = \frac{90}{5}$$

$$x = 18"$$

The new dimensions would be 18" x 30".

Graphic Communication (10.0399) T-Chart

Problems	Career and Technical Math Concepts	Solutions
1. If a press run at 15,000 imp per 60 min., how long would it take to print 18,000 imp?		
2. If it takes 5 people 30 min. to collate 120 books, how long would it take 3 people?		
3. If a press run at 4,000 imp per 60 min., how many impresssions can you print in 300 minutes?		
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 atmospheres (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. If a press run at 15,000 imp per 60 min., how long would it take to print 18,000 imp?	**(Direct)** $\frac{15000\text{ imp}}{18000\text{ imp}} = \frac{60\text{ min.}}{x\text{ min.}}$ $15000x = 1080000$ $\frac{15000x}{15000} = \frac{1080000}{15000}$ $x = 72\text{ min.}$	
2. If it takes 5 people 30 min. to collate 120 books, how long would it take 3 people?	**(Inverse)** $\frac{5\text{ people}}{3\text{ people}} = \frac{30\text{ min.}}{x\text{ min.}}$ Flip a Ratio $\frac{5\text{ people}}{3\text{ people}} = \frac{x\text{ min.}}{30\text{ min.}}$ Solve $3x = 150$ $\frac{3x}{3} = \frac{150}{3}$ $x = 50\text{min}$ It will take 3 people 50 minutes to complete the job	
3. If a press run at 4,000 imp per 60 min., how many impresssions can you print in 300 minutes?	**(Direct)** $\frac{4000\text{ imp}}{x\text{ imp}} = \frac{60\text{ min.}}{300\text{ min.}}$ $60x = 1200000$ $\frac{60x}{60} = \frac{1200000}{60}$ $x = 20,000\text{imp}$	
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 atmospheres (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.) $\frac{0.24\text{ m}^3}{0.060\text{ m}^3} = \frac{x\text{ atm}}{0.5\text{ atm}}$ $.24 \times 0.5 = .060x$ $x = 2\text{ atm}$	
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)** $\frac{1}{5} = \frac{x}{15} \rightarrow 5x = 1(15) \rightarrow x = 3\text{ hours}$	