Print Technology (10.0399) T-Chart

Digital Printing Press Calculations = Use units as a way to understand & solve problems

Program Task: Calculate digital press impressions for estimating

Program Associated Vocabulary
IMPRESSION, RATE

Program Formulas and Procedures
Knowing the number of impressions per minute a digital press can run helps to estimate the time needed to complete a job. A new digital printing press manual states that it can print 110 impressions per minute. Another press can print 85 impressions per minute.

Example:
A new digital printing press manual boasts that it can print 110 impressions per minute. A job requires 10,500 impressions. How long (in hours and minutes) will it take to run this job?

Step 1: Identify that 60 min = 1 hour.

Step 2: Set up the equation.

$$\frac{10{,}500\ \textbf{imp.}}{1} \times \frac{1\ min.}{110\ imp.} \times \frac{1\ hour}{60\ min.} = 1.6\ hours$$

Step 3:
Usually, you will rewrite this in terms of hours and minutes. .6 hours = .6 (60 minutes per hour) = 36 minutes.

The job takes 1 hour and 36 minutes.

PA Core Standard: CC.2.1.HS.F.4

Description: Use units as a way to understand problems and to guide the solution of multi-step problems

Math Associated Vocabulary
RATE, PERCENT, DECIMAL, PROPORTION, RATIO, DIMENSIONAL/UNIT ANALYSIS

Formulas and Procedures
Dimensional or Unit Analysis can be used to solve problems using operations because by analyzing the units, one can determine whether or not the equation was set up correctly.

Basic Steps:
1. Determine the unit given and the unit needed (answer).
2. Write the number with the unit you are given as a fraction over one on the left hand side and write an equal sign followed by the unit you need on the far right hand side.
3. Multiply by the rates you are given or conversion factors (write as fractions), making sure that the unit that was given (in numerator) is also on the bottom (denominator) of the given rate or conversion factor.
4. Remember, units cancel out just like numbers do! Continue to multiply by rates or conversion factors until the unit needed is the only unit that does not cancel.
5. Perform the indicated operations.

Example 1: A snail can crawl 13 feet in 2.5 hours. How far can it crawl in 240 minutes?

1. unit given = 240 minutes, unit needed = feet
2. $\frac{240\,\text{min}}{1}$ = feet
3. $\frac{240\,\text{min}}{1} \bullet \frac{1hr}{60\,\text{min}} \bullet \frac{13\,feet}{2.5hrs}$ = feet
4. $\frac{240\,\cancel{\text{min}}}{1} \bullet \frac{1\cancel{hr}}{60\,\cancel{\text{min}}} \bullet \frac{13\,feet}{2.5\cancel{hrs}}$ = feet
5. $\frac{240(1)(13)\,ft}{(1)(60)(2.5)} = 20.8\,ft$

Example 2: A savings account earns a simple interest rate of 3% per year over 12 years. If $3,000 is invested, how much will the account earn?

$$\frac{\$3{,}000}{1} \bullet \frac{.03}{1yr} \bullet \frac{12\,yrs}{1} = \$1{,}080$$

Teacher's Script - Comparing and Contrasting
The eligible content item appears to be similar to CC.2.1.HS.F.3, but there is a slight difference. Although this eligible content item can include proportional relationships, because the ratio itself is often a "rate", this eligible content item includes any operation using a rate or multiple rates and is often more complex.

Common Mistakes Made By Students
Use of incorrect conversion factors or omission of essential conversion factors.
For instance, in the problem shown below, a conversion factor (60 minutes = 1 hour) was omitted from the solution.

If you have 500 tasks to complete and each task takes 3 minutes, how many hours will it take to complete all of the tasks?

$$\frac{500\ tasks}{\mathbf{1}} \times \frac{3\ minutes}{1\ task} = 1500\ minutes$$

Incorrectly setting up the problem.
For instance, in the problem shown below, the problem has been set up incorrectly. Instead of starting with the 500 tasks, the solution begins with the conversion factor.

If you have 500 tasks to complete and each task takes 3 minutes, how many hours will it take to complete all of the tasks?

$$\frac{1\ tasks}{3\ min} \times \frac{\mathbf{1}}{500\ tasks} = \frac{\mathbf{1}}{1500\ minutes}$$

Lab Teacher's Extended Discussion
Many times the student will need to estimate how long a job will take in order to give the customer a quote for the job. This calculation is a great way to come up with the hours and minutes. A printer will then add this amount to a quote that already has product cost on it. You also will need this amount to calculate labor rate and overhead rate for the machine usage.

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Problems	Occupational (Contextual) Math Concepts	Solutions
1. Calculate the time it would take to run a job requiring 50,000 impressions on a digital press running at 85 impressions per minute.		
2. Calculate the time it would take to run a job requiring 50,000 impressions on a digital press running at 125 impressions per minute.		
3. Calculate the time it would take to run a job requiring 5,000 impressions on a digital press running at 110 impressions per minute.		
Problems	**Related, Generic Math Concepts**	**Solutions**
4. Since work equals force times distance, lifting 4 pounds (force) 5 feet off the ground (distance) equals 20 foot-pounds of work. If the same amount of work is applied to 10 pounds, how many feet off the ground will it be lifted?		
5. A worker has 6 gallons of a solution that is 50% water. If she adds one gallon of water, what is the new percentage of water in the solution?		
6. A worker unloads 9 crates every 36 minutes and is paid $2 per crate. How much money does he make in an 8 hour shift?		
Problems	**PA Core Math Look**	**Solutions**
7. Kathy and John are helping to create party favors for the school dance. Kathy can create 30 in one hour and Joe can create 40 in two hours. At that rate, how long will it take to create 500 party favors?		
8. Two trucks are plowing snow and moving in opposite directions. The first truck can plow snow at 23 mph and the other can plow at 17 mph. How long will it take them to plow 200 miles of road?		
9. A fuel-efficient car can drive 35 miles per gallon of gas. If the cost of gas is $3.97 per gallon, how much will it cost to make a 485-mile trip?		

Problems	Occupational (Contextual) Math Concepts	Solutions
1. Calculate the time it would take to run a job requiring 50,000 impressions on a digital press running at 85 impressions per minute.	$\frac{50{,}000\ \textbf{imp.}}{1} \times \frac{1\ min.}{85\ imp.} \times \frac{1\ hour}{60\ min.} = 9.8\ hours$	(9 hrs. 48 min)
2. Calculate the time it would take to run a job requiring 50,000 impressions on a digital press running at 125 impressions per minute.	$\frac{50{,}000\ \textbf{imp.}}{1} \times \frac{1\ min.}{125\ imp.} \times \frac{1\ hour}{60\ min.}$ = 6.7 hours	(6 hours 42 min)
3. Calculate the time it would take to run a job requiring 5,000 impressions on a digital press running at 110 impressions per minute.	$\frac{5{,}000\ \textbf{imp.}}{1} \times \frac{1\ min.}{110\ imp.} \times \frac{1\ hour}{60\ min.} = 0.76\ hours$	(45.6 minutes)
Problems	**Related, Generic Math Concepts**	**Solutions**
4. Since work equals force times distance, lifting 4 pounds (force) 5 feet off the ground (distance) equals 20 foot-pounds of work. If the same amount of work is applied to 10 pounds, how many feet off the ground will it be lifted?	20 foot-pounds / 10 pounds = 2 feet (distance)	
5. A worker has 6 gallons of a solution that is 50% water. If she adds one gallon of water, what is the new percentage of water in the solution?	6 * 0.5 = 3 gallons of water in original solution 6 + 1 = 7 total gallons in new solution 3 + 1 = 4 known gallons of water in new solution 4 / 7 = 57% water in new solution	
6. A worker unloads 9 crates every 36 minutes and is paid $2 per crate. How much money does he make in an 8 hour shift?	$\frac{8hrs}{1} \bullet \frac{60\min}{1hr} \bullet \frac{9crates}{36\min} \bullet \frac{\$2}{1crate} = \$\,240$	
Problems	**PA Core Math Look**	**Solutions**
7. Kathy and John are helping to create party favors for the school dance. Kathy can create 30 in one hour and Joe can create 40 in two hours. At that rate, how long will it take to create 500 party favors?	$\frac{40pf}{2hr} = \frac{20pf}{1hr}$, total rate = $\frac{20pf}{1hr} + \frac{30pf}{1hr} = \frac{50pf}{1hr}$ $\frac{500pf}{1} \bullet \frac{1hr}{50pf} = 10hrs$	
8. Two trucks are plowing snow and moving in opposite directions. The first truck can plow snow at 23 mph and the other can plow at 17 mph. How long will it take them to plow 200 miles of road?	Rate 1 + rate 2 = 23mph + 17mph = 40 mph $\frac{200miles}{1} \bullet \frac{1hour}{40miles} = 5hours$	
9. A fuel-efficient car can drive 35 miles per gallon of gas. If the cost of gas is $3.97 per gallon, how much will it cost to make a 485-mile trip?	$\frac{485miles}{1} \bullet \frac{1gallon}{35miles} \bullet \frac{\$3.97}{1gallon} = \$55.01$	