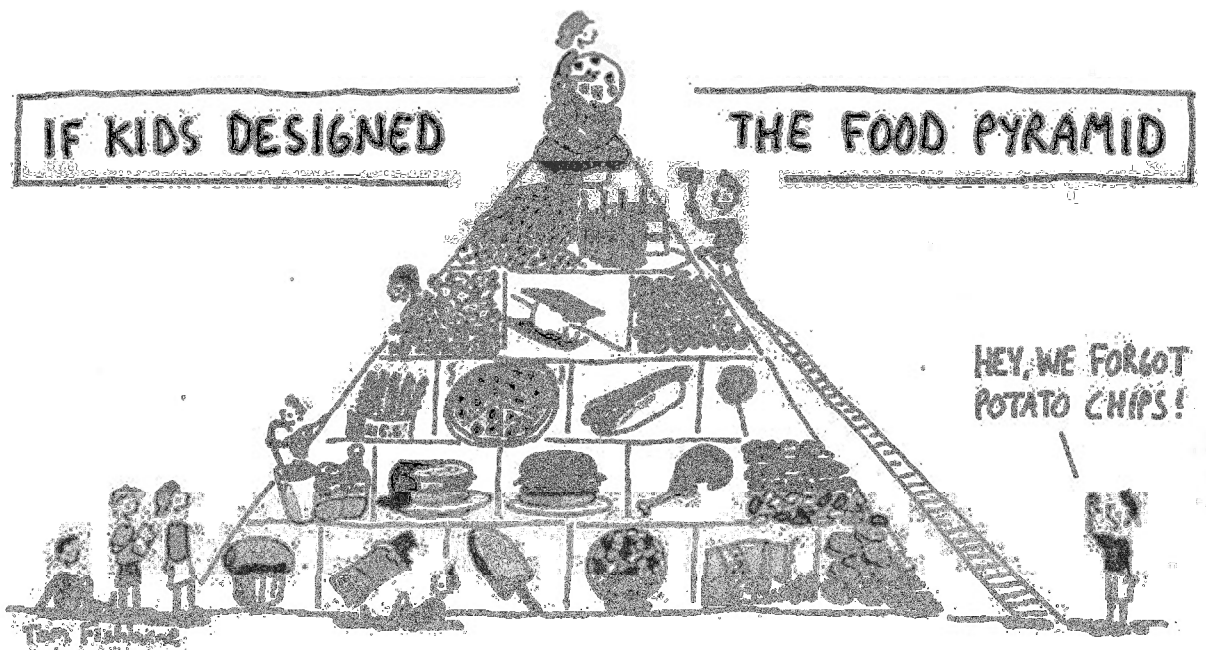


ACCELERATED MATHEMATICS: CHAPTER 6A

FOOD AND RESTAURANTS

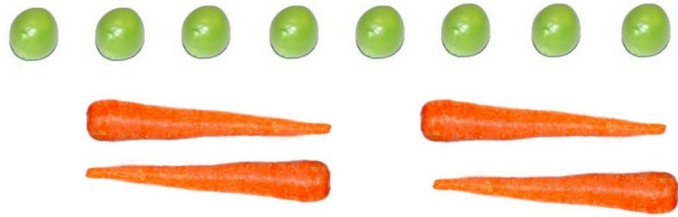


RATES, PROPORTIONS, AND RATIONAL NUMBERS UNIT COVERING:

- Ratios, rates, and unit rates
- Understanding proportions
- Solving proportions
- Constant of proportionality
- Word problems with proportions
- Using proportions to determine map distances
- Graphs and tables of proportional relationships

“We go together like peas and carrots.” – *Forrest Gump*

A ratio makes a comparison.
Forrest has 4 carrots and 8 peas.



You can write the ratio of carrots to peas in three different ways:

4 to 8 4:8 $\frac{4}{8}$

The ratio of peas to carrots is 8 to 4, 8:4, or $\frac{8}{4}$.

You can write a ratio in simplest form the same way you write a fraction in simplest form. The ratio of carrots to peas in simplest form is:

1 to 2 1:2 $\frac{1}{2}$

While not used as frequently, a ratio can compare more than two items. If there are 3 cakes, 4 cookies, and 5 brownies, you can write this ratio as 3:4:5.

Create a drawing below which represents a ratio of 3 clams to 9 shrimp without drawing exactly 3 clams.

Complete each ratio table.

Peanut Butter (lb)	5	10	15		50
Jelly (lb)	1	2		5	

Cost	\$0.50	\$1.00	\$2.00	\$8.00	
Macaroni (lb)	1	2			12

Lettuce (lb)	12	24	60		
Tomato (lb)	1	2		8	10

Syrup (oz)	1			11	16
Pancakes	10	40	80		

Complete each ratio table.

1.

Cookies	1	4	7		
Cost	\$0.05			\$1.20	\$4.00

2.

BBQ sauce (c)	4		16	28	
Wings	12	24			144

3.

Pizzas	1	3		8	
Large pepperonis	7		28		63

4.

Desserts	1		7		
Little Debbies	6	18		78	900

Ratios: Express each ratio in simplest form in one of the three ways.

Within 10 miles of Mr. Mangham's house there are: 31 McDonalds, 14 Burger Kings, 10 Wendy's, 12 KFC's					
5.	McDonalds to BKs		6.	Wendys to McDonalds	
7.	KFCs to BKs		8.	All 4 to McDonalds	
9.	BKs to McDonalds and KFCs		10.	Wendys and KFCs to BKs	
11.	All 4 to The Top 3		12.	The Top 2 to All 4	
13.	BKs to The Top 2		14.	All 4 to McDonalds, Burger Kings, Wendys, and KFCs	

A rate is a comparison of two quantities that have different units, such as miles and hours. Rates are often expressed as unit rates, that is, with a denominator of 1 unit.

Example: Ms. Johnsen can cook 135 cookies in 5 hours.

Expressed as a rate: $\frac{135 \text{ cookies}}{5 \text{ hours}}$

Expressed as a unit rate: $\frac{135 \text{ cookies}}{5 \text{ hours}} = \frac{27 \text{ cookies}}{1 \text{ hour}}$

Rates and Unit Rates: Express each rate as a unit rate.

	Rate	Unit Rate		Rate	Unit Rate
1.	$\frac{105 \text{ peas}}{3 \text{ minutes}}$		2.	$\frac{\$38}{2 \text{ steaks}}$	
3.	$\frac{2800 \text{ calories}}{7 \text{ days}}$		4.	$\frac{72 \text{ Little Debbies}}{24 \text{ wrappers}}$	
5.	$\frac{\$375}{5 \text{ days at Kroger}}$		6.	$\frac{\$315}{15 \text{ hamburgers}}$	

7.	The ratio of females to males in the restaurant is 6 to 5. If four females and six males leave, the ratio is 10 to 7. How many customers originally are in the restaurant?	
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Calculate the unit rates or unit prices for the problems below. Show all your work!

8.	5 gallons of water costs \$6.25. Find the unit price of each gallon.	
9.	Albertsons charges \$60 for a 20 pound turkey. Tom Thumb charges \$25 for a 10 pound turkey. Which store charges less per pound?	
10.	Four bottles of Gatorade costs \$3.88. Find the unit price of each bottle.	
11.	Archie bought 15 gallons of whip cream for \$23.85. Joe bought 16 gallons of whip cream for \$24.88. Who paid less per gallon?	
12.	Andy drove 264 miles using 12 gallons of gas to get to McDonalds. Rita drove 315 miles using 15 gallons of gas to get to Wendys. Who got more miles per gallon?	
13.	If a 12 oz. bottle of Mr. Pibb Xtra costs \$1.80 and a bottle containing 14 oz. costs \$1.96, which is a better buy?	

What are the fire safety rules in your school building? What if a fire were to happen in a restaurant? Would so many people be able to exit safely? Mr. Mangham is interested in fire prevention and safety. He knows that if rooms are too crowded, everyone might not be able to leave quickly.

The maximum occupancy of a room is the number of people that can be evacuated safely in 1 minute.

Do you know the maximum occupancy of your classroom or other rooms in your school? You can determine the maximum safe occupancy of your classroom, your cafeteria, or your school.

1. Have everyone in your class exit through the classroom door in an orderly fashion. Time how long this takes.

Number of students	Time to leave classroom (min.)	Rate (Students:Minute)	Unit Rate (Students:Minute)	Width of door (in.)

2. Make an estimate of the rate at which people can exit the cafeteria and the entire building through the doors.

Unit Rate in Cafeteria (Students:Minute)	Unit Rate of Building (Students:Minute)

3. Taking your yardstick, check the number and size of the cafeteria doors. Then calculate the rate at which people can exit the cafeteria through all its doors. Complete the same exercise for the school as a whole.

	Number of doors	Total width of all doors (in.)	$\frac{\text{Total width of all doors}}{\text{Width of classroom door}}$	Unit Rate* (Students:Minute)
Cafeteria				
School				

* The unit rate can be determined by taking the answer to the width division and multiplying this by the unit rate you calculated for your classroom. The unit rate is equal to the maximum occupancy.

4. Can your class safely evacuate your classroom?
5. Estimate the number of students in the cafeteria at lunch. Could the students safely evacuate the cafeteria?
6. At a local Chili's the maximum occupancy is listed as 120. What would the total width of all doors need to be? If each door was 3 feet, how many exit doors are needed?

“My momma always said, ‘Life was like a box of chocolates. You never know what you're gonna get.’” – *Forrest Gump*



Determine the cost per ounce for each of the items below.

When necessary, round to the nearest penny.

	Rate	Unit Rate		Rate	Unit Rate
Whitman's Sampler Assorted Chocolates					
1.	\$10 for 12 oz.		2.	\$14 for 16 oz.	
3.	\$19 for 24 oz.		4.	\$26 for 32 oz.	
5.	\$30 for 40 oz.		6.	\$5 for 6 oz.	
7.	\$3.10 for 3.6 oz.		8.	\$2 for 2 oz.	
Russell Stover Assorted Chocolates					
9.	\$5 for 5.5 oz.		10.	\$17 for 24 oz.	
11.	\$9 for 12 oz.		12.	\$1.80 for 2 oz.	
13.	\$25 for 36 oz.		14.	\$50 for 5 lbs.	

Express each ratio as a rate and a unit rate. Round to the nearest penny.

	Ratio	Rate	Unit Price or Unit Rate
15.	\$2.80 for 64 ounces of orange juice	$\frac{\$2.80}{64 \text{ oz.}}$	\$0.04 per ounce
16.	\$28.45 for 5 pounds of roast beef		
17.	\$0.50 for 16 ounces of spaghetti		
18.	\$7.60 for 24 cans of dog food		
19.	\$19.87 for 7 kg of chicken		
20.	\$1.60 for 6.5 ounces of tuna		
21.	\$2.20 for 2.2 L of cola		
22.	\$8.88 for 12 pairs of socks		

ManghamMart

ManghamMart competes with three other markets in the neighborhood. Mr. Mangham wants his prices to be the lowest. To make this happen, he figures out which of his competitors has the lowest unit rate (or unit price) for an item. Then he rounds that price to the nearest cent and makes his price 2 cents less per unit.

Find the price of each purchase in ManghamMart.

ManghamMart Competitors			
Item	GoGrocery	FioFruits	MoMarket
Corn	\$0.30 each	4 for \$1.00	3 for \$0.87
Pears	3 lb for \$2.67	5 lb for \$4.59	2 lb for \$1.89
Bananas	4 lb for \$1.99	3 lb for \$1.38	2 lb for \$0.90
Apples	3 for \$1.09	6 for \$2.09	3 for \$1.00
Cantaloupe	3 for \$4.59	4 for \$6.40	2 for \$3.09
Grapes	2 lb for \$3.49	2 lb for \$3.44	3 lb for \$5.19

ManghamMart Prices	
Item	ManghamMart's Low, Low Price
Corn	6 for _____
Pears	4 lb for _____
Bananas	1 lb for _____
Apples	6 for _____
Cantaloupe	5 for _____
Grapes	6 lb for _____

Help Mr. Mangham choose the best bargain for each item.

1.	Rubber erasers A. \$0.32 each C. Buy two for \$0.90 and get one free	B. Box of 24 for \$7.44	
2.	Pencils A. 12 packs of 12 for \$17.28 C. Buy a box of 12 for \$3.12 and get one free	B. 4 pencils for \$0.50	
3.	Chalk A. Box of eight sticks for \$0.64 C. Bulk box of 1 gross for \$10.80	B. Four packs of 8 sticks for \$2.72	
4.	Ballpoint pens A. \$0.27 each C. Buy 2 boxes of 12 for \$6.84, get half off the next box	B. Bulk pack of 100 for \$28	
5.	Calculators A. Set of four for \$16.92 C. Buy one for \$8.45, get one free	B. 10-pack for \$43	
6.	Markers A. Box of eight for \$2.60 C. Bulk pack of 32 for \$13.60, on sale for 20% off	B. 12-pack for \$4.02	
7.	Protractors A. \$0.52 each C. Buy three boxes of four for \$7.84, get one box free	B. Box of 24 for \$12.36	
8.	Glue sticks A. Box of 12 with 2 bonus for \$11.06 C. Buy one for \$1.64, get one free	B. Four-pack for \$3.08	

Jeff hikes $\frac{1}{2}$ mile every 15 minutes, or $\frac{1}{4}$ hour. Lisa hikes $\frac{1}{3}$ mile every 10 minutes, or $\frac{1}{6}$ hour. How far do they each hike in 1 hour? 2 hours?

1. Complete the table for Jeff's hike.

Distance (mi)	$\frac{1}{2}$				
Time (h)	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	2

2. Complete the table for Lisa's hike

Distance (mi)	$\frac{1}{3}$				
Time (h)	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{2}$	1	2

3.	Which hiker walks farther in one hour?	
4.	Which is faster?	

While remodeling her kitchen, Angela is repainting. She estimates that she paints 55 square feet every half-hour. How many square feet does Angela paint per hour?

Step 1: Determine the units of the rate. The rate is area in square feet per time in hours.

Step 2: Find Angela's rate of painting in area painted per time and convert it to a unit rate.

Area painted: 55 sq. ft. Time: $\frac{1}{2}$ hour

$$\frac{55}{\frac{1}{2}} = 55 \div \frac{1}{2} = \frac{55}{1} \cdot \frac{2}{1} = \frac{110 \text{ square feet}}{1 \text{ hour}}$$

5.	Paige mows $\frac{1}{6}$ acre in $\frac{1}{4}$ hour. How many acres does Paige mow per hour?	
6.	Greta uses 3 ounces of pasta to make $\frac{3}{4}$ of a serving of pasta. How many ounces of pasta are there per serving?	

1.	Two pools are leaking. After 15 minutes, pool A has leaked $\frac{2}{3}$ gallon. After 20 minutes, pool B has leaked $\frac{3}{4}$ gallon. Which pool is leaking faster?	
2.	One tank is filling at a rate of $\frac{3}{4}$ gallon per $\frac{2}{3}$ minute. A second tank is filling at a rate of $\frac{5}{8}$ gallon per $\frac{1}{2}$ minute. Which tank is filling faster?	

3. Brandon enters bike races. He bikes $8\frac{1}{2}$ miles every $\frac{1}{2}$ hour. Complete the table to find how far Brandon bikes for each time interval.

Distance (mi)	$8\frac{1}{2}$				
Time (h)	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$

Find each unit rate.

4.	Julio walks $3\frac{1}{2}$ miles every $1\frac{1}{4}$ hours.	
5.	Kenny reads $\frac{5}{8}$ page in $\frac{2}{3}$ minute.	

Find each unit rate. Determine which is lower.

6.	Brand A: 240 mg sodium for $\frac{1}{3}$ pickle	
7.	Brand B: 325 mg sodium for $\frac{1}{2}$ pickle	
8.	Ingredient C: $\frac{1}{4}$ cup for $\frac{2}{3}$ serving	
9.	Ingredient D: $\frac{1}{3}$ cup for $\frac{3}{4}$ serving	

The information for two pay-as-you-go cell phone companies is given.

On Call 3.5 hours: \$10	Talk Time $\frac{1}{2}$ hour: \$1.25
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1.	What is the unit rate in dollars per hour for each company?	
2.	Which company offers the better deal?	
3.	Another company offers a rate of \$0.05 per minute. How would you find the unit rate per hour?	
4.	Is the rate for this other company a better deal than OnCall or TalkTime?	

Terry and Jessie are training for a long-distance race. Terry trains at a rate of 6 miles for every half hour and Jessie trains at a rate of 2 miles every 15 minutes.

5.	What is the unit rate of each runner?	
6.	How long will each person take to run a total of 50 miles at the given rates?	
7.	Sandra runs at a rate of 8 miles in 45 minutes. How does her unit rate compare to Terry's and to Jessie's?	

8.	Eli takes a typing test and types all 300 words in $\frac{1}{10}$ hour. He takes the test a second time and types the words in $\frac{1}{12}$ hour. Was he faster or slower on the second attempt?	
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Amazon sells two packages of protein bars.

Package	10-pack of 2.1 ounce bars	12-pack of 1.4 ounce bars
Cost (\$)	15.37	15.35

9.	Which package has the better price per bar?	
10.	Which package has the better price per ounce?	
11.	Which package do you think is the better buy?	

Pizza Restaurant Name	
Owner of the restaurant	
Cook	
Cashier	
Trash person	
Hours of operation	
Number of pizzas made in 2 hours	
Special pizza sale	
Amount of trash	

Proportion to solve the number of pizzas made each day:

Proportion to solve the cost of the birthday pizzas:

Proportion to solve the total amount of trash:

A proportion is an equation that shows two ratios are equivalent. To determine if a pair of ratios form a proportion, you can find their cross products. If the cross products are equal, then the ratios form a proportion.

Example 1: Is $\frac{5}{6} = \frac{12}{18}$? $5 \cdot 18 = 90$ $6 \cdot 12 = 72$

Therefore, $\frac{5}{6}$ and $\frac{12}{18}$ do not form a proportion.

Use cross products to determine whether each pair of ratios forms a proportion.

1.	$\frac{8}{12}, \frac{5}{10}$		2.	$\frac{12}{30}, \frac{2}{5}$	
3.	$\frac{8}{24}, \frac{6}{18}$		4.	$\frac{10}{24}, \frac{5}{8}$	
5.	$\frac{12}{15}, \frac{3}{4}$		6.	$\frac{4}{5}, \frac{20}{25}$	

Proportions can be solved utilizing the BUTTERFLY method.

Example 2: Emily baked 60 cookies in 4 hours. How many cookies can she bake in 6 hours?

$$\frac{60 \text{ cookies}}{4 \text{ hours}} = \frac{x \text{ cookies}}{6 \text{ hours}}$$

$$60 \cdot 6 = 4 \cdot x$$

$$\frac{360}{4} = \frac{4x}{4}$$

$$90 \text{ cookies} = x$$

Solve each proportion using the Butterfly Method.

7.	$\frac{8}{15} = \frac{m}{45}$		8.	$\frac{9}{12} = \frac{6}{c}$	
9.	$\frac{5}{p} = \frac{3}{9}$		10.	$\frac{v}{21} = \frac{4}{6}$	
11.	$\frac{14}{8} = \frac{x}{4}$		12.	$\frac{9}{r} = \frac{27}{30}$	
13.	$\frac{10}{4} = \frac{m}{20}$		14.	$\frac{1}{c} = \frac{12}{24}$	

Use cross products to determine whether each pair of ratios forms a proportion.

1.	$\frac{4}{9}, \frac{12}{27}$		2.	$\frac{5}{6}, \frac{25}{36}$	
3.	$\frac{5}{12}, \frac{7}{18}$		4.	$\frac{2}{7}, \frac{16}{36}$	

Solve each proportion using the Butterfly Method. Show all work on a separate sheet of paper.

5.	$\frac{6}{7} = \frac{a}{56}$		6.	$\frac{27}{x} = \frac{3}{8}$	
7.	$\frac{0.4}{m} = \frac{2}{4.5}$		8.	$\frac{0.18}{0.09} = \frac{h}{0.06}$	
9.	$\frac{10}{2.4} = \frac{c}{2.64}$		10.	$\frac{85.8}{d} = \frac{70.2}{9}$	
11.	$\frac{0.6}{1.1} = \frac{s}{8.47}$		12.	$\frac{2}{3} = \frac{x+4}{18}$	
13.	$\frac{4.5}{y+5} = \frac{5}{10}$		14.	$\frac{0.25}{0.5} = \frac{m}{8}$	
15.	$\frac{x}{6} = \frac{x+2}{9}$		16.	$\frac{12}{x} = \frac{27}{x+5}$	
17.	$\frac{x+1}{2} = \frac{x+2}{3}$		18.	$\frac{2x}{20} = \frac{x+20}{50}$	
19.	$\frac{c}{28} = \frac{c+4}{35}$		20.	$\frac{w-5}{30} = \frac{w-7}{20}$	

Use ratios and proportions to answer the following questions.

21.	Each turnstile can admit 36 people per 2 minutes. There are 8 turnstiles at entrance A. How many people can enter the park at this entrance in one minute?	
22.	Each student was given an amusement park drink cup for attending as a group. Each time it is filled, the beverage cost 6 cents per ounce. How much does it cost to fill your 16 oz. cup four times?	
23.	The Whip-A-Round spins five times every 3 seconds. If you go on the minute-and-a-half ride how many times have you spun around?	
24.	The Cliff Drop can accommodate 720 people per hour. There are 444 people in front of you. How long until you get to ride?	
25.	One gear on the Spiral Coaster turns 7 revolutions every 2 seconds. How many revolutions are on each minute and a half ride?	

Use the tables on the next page to write a proportion that can be used to solve the problem. Solve with the Butterfly Method. Show all work on a separate sheet of paper. Label.

1.	How many calories will a person expend (use) in 3.5 hours of walking?
2.	Fred expended 990 calories playing basketball. How long did he play?
3.	Laura stretched for 0.25 hours. How many calories did she expend?
4.	George expended 55 calories doing yard work before he gave up. How long did he work?
5.	How much would 9 24-packs of water cost?
6.	Chris bought 3.7 pounds of baby back ribs. To the nearest penny, how much did he spend?
7.	To the nearest penny, how much would 5 12-packs of Coke cost?
8.	Mr. Mangham decided to have a shrimp feast and bought 5.2 pounds of wild shrimp and 4.6 pounds of gulf brown shrimp. What was his total bill?
9.	How many teaspoons of sugar would be in a 20 oz. glass of chocolate milk?
10.	If Carlee ate 45.5 teaspoons of sugar, all from M&Ms, how many bags did she eat?
11.	How many teaspoons of sugar would be in a 2.4 oz. muffin?
12.	Larry had Jell-O and an ice tea for lunch. If his total sugar was 34 teaspoons and he had 2 cups of Jell-O, how much tea did he drink?
13.	How many Lucky Charms commercials would a kid see in 6 months? (nearest whole number)
14.	If Bart Simpson saw 154 Corn Pop commercials, how long has he been watching TV?
15.	How many more Cocoa Puffs commercials than Froot Loops commercials would you expect to see in 2 years?
16.	If Michael watches TV twice as much as a normal kid, in what month will he see his 40 th Frosted Flakes commercial?

Survey of 20 students' favorite and least favorite colors			17. If 30 students were surveyed, how many students would choose blue as their least favorite color?
	Color	Least favorite	Favorite
	Blue	4	7
	Green	3	2
	Purple	11	8
	Red	1	1
Orange	1	2	18. If 120 students were surveyed, how many students would choose green as their favorite?
			19. If 120 students were surveyed, how many students would NOT choose green as their favorite?

20.	Write three interesting word problems using the data tables on the next page. The problems must use a least one proportion to be solved. The problems should be at the level of difficulty (or higher) as problems #1-16 above.
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Calories Expended per hour for an “average” person

Hiking	370	Bicycling (>10 mph)	590
Light gardening	330	Swimming	510
Dancing	330	Aerobics	480
Golf (walking)	330	Fast walking	460
Bicycling	290	Heavy yard work	440
Walking	280	Running/jogging	590
Weight lifting	220	Basketball	440
Stretching	180	Tennis	408

Grocery Store Ads

Water, 24 pk	2 for \$5	Kraft Shredded Cheese, 12 oz.	3 for \$5
Coke, 12 pk.	3 for \$11	Sirlion Steak	\$2.99/lb.
Angus Ground Chuck	\$1.99/lb.	Baby Back Ribs	\$2.99/lb.
Salmon Fillets	\$4.99/lb.	Peaches	\$0.77/lb.
Tombstone Pizza	4 for \$10	Tuna Steaks	\$7.99/lb.
Wild shrimp	\$6.00/lb.	Gulf Brown Shrimp	\$7.00/lb.

Sugar Content of some foods (teaspoons)

Coke, 12oz.	10	M&Ms, 1.7 oz bag	7
Iced Tea, sweetened, 12 oz.	8	Muffin, large 4oz.	6
Chocolate milk, 12 oz.	6	Chocolate Chip cookie, 1 oz.	2
Honey Smacks cereal, 1 oz	4	Donut, iced	6
Popcorn, caramel, cup	3.5	Apple pie, 1 piece	7
Chocolate bar, 1.5 oz.	6	Jell-O, 0.5 cup	4.5
Jam, 1 tbsp.	2.5	Syrup, maple 1 tbsp	3

The 10 Cereals with the Most Ads Targeted toward kids

	Views	Health Score		Views	Health Score
Cinnamon Toast Crunch	82	37	Frosted Flakes	58	43
Honey Nut Cheerios	80	44	Fruity/Cocoa Pebbles	54	38
Lucky Charms	78	36	Reese’s Puffs	52	34
Cocoa Puffs	68	39	Corn Pops	44	36
Trix	58	38	Froot Loops	43	38

Views represent the number of ads seen by an average 6-11yr old over a 15 month period.
The health score is on a scale of 1-100 with over 62 considered healthy.

Do you know what all those labels on items in the grocery store mean? What is the difference between a “good source of fiber” and “high fiber”? How about “low fat” and “reduced fat”?

Here is a label dictionary you can use the next time you go to the grocery store:

Low calorie	4 calories or less
Reduced calories	at least 25% fewer calories than normal
Light	33% fewer calories or 50% less fat
Sugar free	less than 0.5 grams of sugars
Reduced sugar	at least 25% less sugars than normal
Fat free	less than 0.5 grams of fat
Low fat	3 grams or less of fat
Reduced fat	at least 25% less fat than normal
Cholesterol free	less than 2mg cholesterol and 2g or less of saturated fat
Low cholesterol	20mg or less of cholesterol and 2g or less of saturated fat
Sodium free	less than 5 mg sodium
Very low sodium	35 mg or less sodium
Low sodium	140 mg or less sodium
High fiber	5g or more
Good source of fiber	2.5 to 4.9 g fiber

A scale gives the relationship between the measurements on the scale drawing or model and the measurements of the real object.

Example: A map shows a scale of 0.5 inches = 6 miles. The distance between Southlake and Ft. Worth on the map is 3.5 inches. What is the actual distance?

$$\begin{aligned}\frac{0.5 \text{ inches}}{6 \text{ miles}} &= \frac{3.5 \text{ inches}}{x \text{ miles}} \\ 0.5x &= 6 \cdot 3.5 \\ \frac{0.5x}{0.5} &= \frac{21}{0.5} \\ x &= 42 \text{ miles}\end{aligned}$$

On a set of architectural drawings for an office building, the scale is 0.25 inches = 5 feet. Find the actual length of each room.

1.	Lobby	1.6 in	2.	CEO Office	1.35 in
3.	Copy Room	0.55 in	4.	Secretary Office	0.6 in
5.	VP Office	0.9 in	6.	Library	1.525 in
7.	Storage Area	2.1125 in	8.	Manager Office	0.625 in
9.	Conference Room	2.62 in	10.	Cafeteria	2.3 in
11.	Kitchen	2 in	12.	Mail Room	2.2625 in

On a set of architectural drawings for a new school building, the scale is $\frac{1}{4}$ inch = 2 feet (or 0.25 inches = 2 feet). Find the missing lengths in the table.

13.	Principal's Office	1.25 in	
14.	Library		16 ft
15.	School Room	3 in	
16.	Science Lab	1.5 in	
17.	Cafeteria		48 ft
18.	Music Room	4 in	
19.	Gym		56 ft
20.	Teacher's Lounge	1.75 in	

Using the City of Southlake map, complete the following problems. Measure “as the crow flies” to the nearest quarter of an inch. All work may be completed on this paper.

1.	What is the listed scale for the map?	
2.	Write a proportion that can be used to find the distance from DIS to EIS.	
3.	Solve your proportion using the butterfly method.	
4.	Write a proportion that can be used to find the distance from RES to JES.	
5.	Solve your proportion using the butterfly method.	
6.	Write a proportion that can be used to find the distance from Bob Jones Park to the Southlake Senior Center.	
7.	Solve your proportion using the butterfly method.	
8.	Write a proportion that can be used to find the distance from CES to the Clariden School.	
9.	Solve your proportion using the butterfly method.	
10.	Write a proportion that can be used to find the distance from Florence Elementary School to the Public Works Facility.	
11.	Solve your proportion using the butterfly method.	
12.	What is the ratio of the distance between RES-JES and the distance between DIS-EIS.	
13.	Estimate the real-life area of the Carroll ISD.	
14.	Write a proportion that can be used to find the distance from your house to DIS.	
15.	Solve your proportion using the butterfly method.	

Many real-world relationships can be described by proportional relationships. Proportional relationships have special characteristics.

A giant tortoise moves at a slow but steady pace. It takes the tortoise 3 seconds to travel 10.5 inches.

Complete the table.

Distance (in)			10.5		
Time (sec)	1	2	3	4	5
$\frac{\text{Distance}}{\text{Time}}$					

1.	How do you think the distance a tortoise travels is related to the time?	
2.	Suppose the tortoise travels for 12 seconds. Explain how you could find the distance the tortoise travels.	
3.	How would you describe the rate of speed at which a tortoise travels?	

A **rate of change** is a rate that describes how one quantity changes in relation to another quantity.

A **proportional relationship** between two quantities is one in which the rate of change is constant, or one in which the ratio of one quantity to the other quantity is constant.

A **proportion** is a statement that two rates or ratios are equivalent.

Callie earns money by dog sitting. Based on the table, is the relationship between the amount Callie earns and the number of days a proportional relationship?

Number of days	1	2	3	4	5
Amount earned (\$)	16	32	48	64	80

Step 1: Find the unit rate for each day.

Step 2: Compare the unit rates. If they are all equal that means the rate is constant and the relationship is proportional.

The table below shows the distance Alison drove one day of her vacation. Is the relationship between the distance and the time a proportional relationship? Did she drive at a constant speed?

Time (h)	1	2	3	4	5
Distance (mi)	65	120	195	220	300

If the relationship is proportional you can describe that relationship using the equation $y = kx$. The variable k is called the **constant of proportionality** and it represents the constant rate of change or constant ratio between x and y . The value of k is represented by the equation $k = \frac{y}{x}$.

1. Cashews and their costs are shown in the table below. Show that the relationship between the number of pounds of cashews and the cost is a proportional relationship.

Number of pounds	2	3	8
Cost (\$)	19	28.50	76
$\frac{\text{Cost}}{\text{Number of pounds}}$			

2.	What is the constant rate of change (which is also the constant of proportionality)?	
3.	Let x represent the number of pounds of cashews. Let y represent the cost in dollars. Write an equation for the relationship.	

4. For a school field trip the number of adults who must accompany the students is listed in the table below. Show that the relationship between the number of adults and the number of students is a proportional relationship.

Number of students	12	36	60
Number of adults	1	3	5
$\frac{\text{Students}}{\text{Adult}}$			

5.	Write an equation for the relationship.	
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6. Based on the relationship in the table, is the relationship between time and the number of words typed a proportional relationship?

Time (h)	1	2	3	4
Number of words	45	90	135	180

1. Find the constant of proportionality k . Then write an equation for the relationship between x and y .

x	2	4	6	8
y	10	20	30	40

2. Find the constant of proportionality k . Then write an equation for the relationship between x and y .

x	8	16	24	32
y	2	4	6	8

Information on three car-rental companies is given.

Rent-All				
Days	3	4	5	6
Total Cost (\$)	55.50	74.00	92.50	111.00
A-1 Rentals			Car Town	
The cost y of renting a car for x days is \$10.00 for each half day.			The cost of renting a car from us is just \$19.25 per day.	

3.	Write an equation that gives the cost y of renting a car for x days from Rent-All.	
4.	What is the cost per day of renting a car from A-1?	
5.	Which company offers the best deal? Why?	

Steve earns extra money babysitting. He charges \$31.25 for 5 hours and \$50 for 8 hours.

6.	Explain why the relationship between how much Steve charges and time is a proportional relationship.	
7.	Write an equation to represent the relationship.	
8.	How much would Steve charge for 3 hours?	

A submarine dives 300 feet every 2 minutes and 6,759 feet every 45 minutes.

9.	Find the constant rate at which the submarine dives. Give your answer in feet per minute and in feet per hour.	
10.	Let x represent the time of the dive. Let y represent the depth of the submarine. Write an equation for the proportional relationship using the rate in feet per minute.	

Most showerheads that were manufactured before 1994 use 5 gallons of water per minute. Is the relationship between the number of gallons of water and the number of minutes a proportional relationship?

1. Complete the table below.

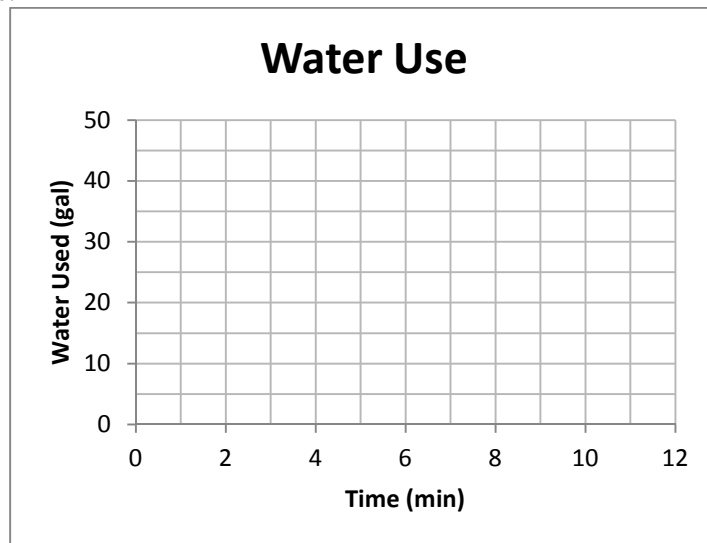
Time (min)	1	2	3		10
Water used (gal)	5			35	
$\frac{\text{Water Used}}{\text{Minute}}$					

2. Based on the table, is this a proportional relationship?

3. Write the data in the table as ordered pairs (time, water used).

(1,5)	(2, ___)	(3, ___)	(___, 35)	(10, ___)
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4. Plot the ordered pairs.



5.	If the showerhead is used for 0 minutes, how many gallons of water will be used? What ordered pair represents this situation? What is this location called?	
6.	If you continued the table to include 23 minutes, would the point (23, 125) be on this graph?	

A relationship is a proportional relationship if its graph is a straight line through the origin.

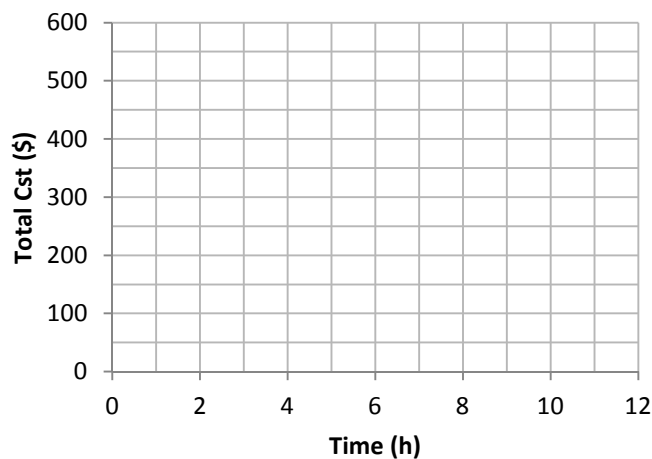
1. Most showerheads that were manufactured before 1994 use 5 gallons of water per minute. Is the relationship between the number of gallons of water and the number of minutes a proportional relationship?

A house cleaning company charges \$45 per hour.

Time (h)	1	2	3	5	8
Total cost (\$)	45	90	135	225	360

2. Write the data in the table as ordered pairs.

3. Graph the ordered pairs below.

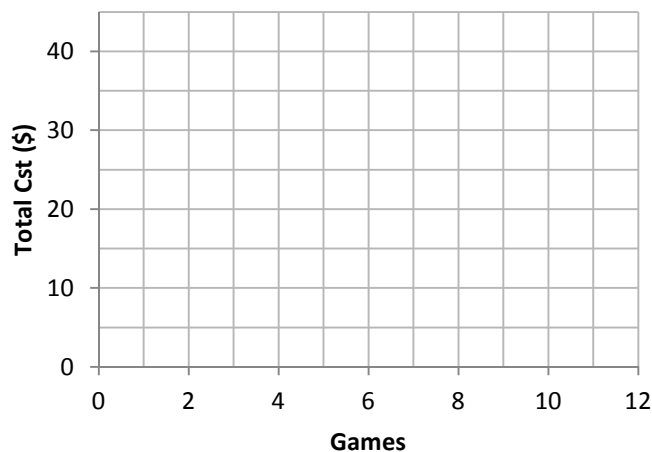


4. Is this a proportional relationship?

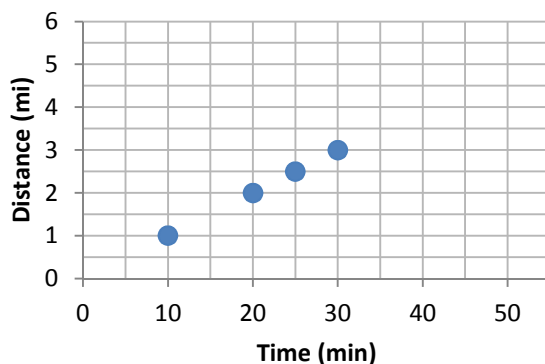
Jared rents bowling shoes for \$6 and pays \$5 per bowling game.

Games	1	2	3	4
Total cost (\$)	11	16	21	26

Graph the relationship below.

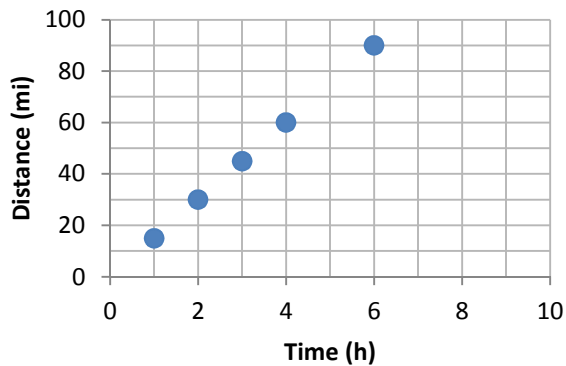


The graph below shows the relationship between time in minutes and the number of miles Darian runs.



1.	Choose a point on the graph and tell what the point represents.	
2.	What is the constant of proportionality?	
3.	Write an equation in the form $y = kx$.	
4.	Ester runs faster than Darian. Suppose you drew a graph representing the relationship between the time in minutes and distance run for Ester. How would the graph compare to the one for Darian?	

The graph shows the relationship between the distance a bicyclist travels and the time in hours.



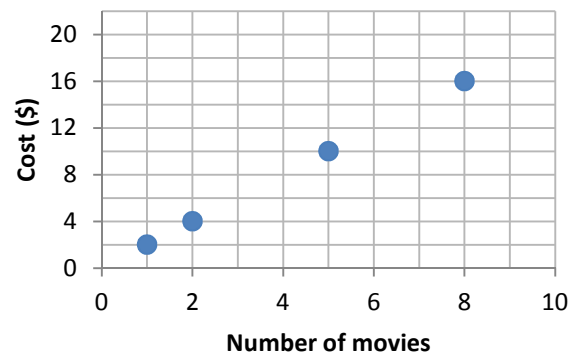
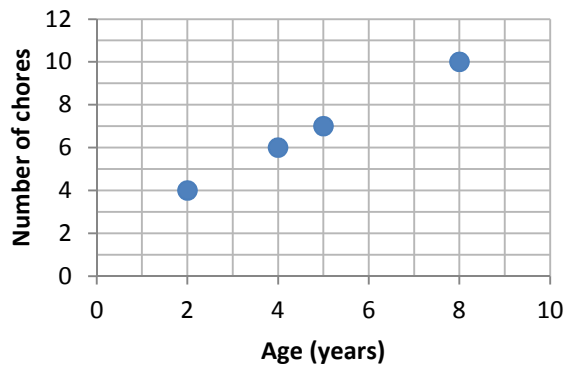
5.	What does the point (4,60) represent?	
6.	What is the constant of proportionality?	
7.	Write an equation in the form $y = kx$ for this relationship.	

Complete each table. Tell whether the relationship is a proportional relationship. Explain why or why not.

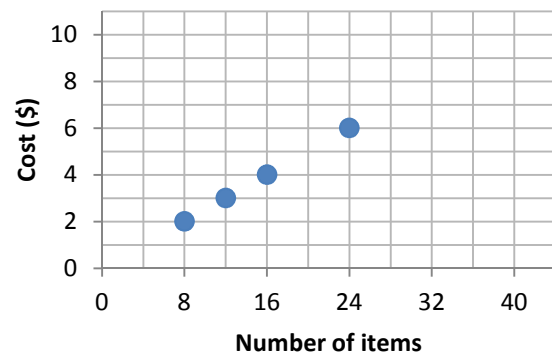
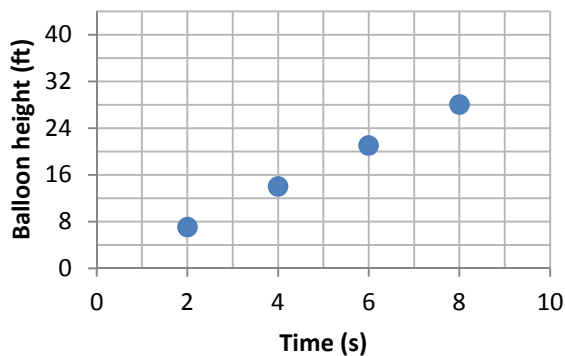
Time (h)	3	5		10
Pages			585	

Time (h)	2		5	
Pages		22.50		60

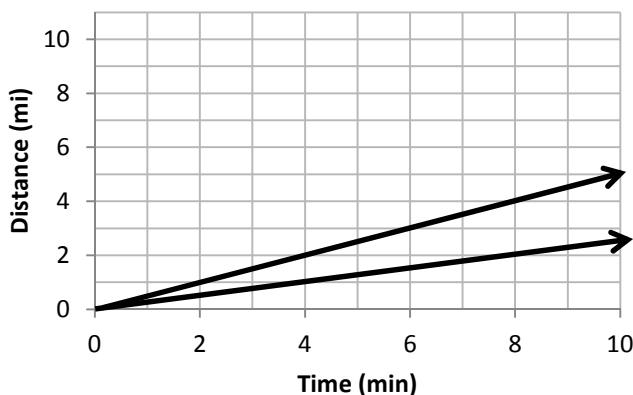
Tell whether the relationship is a proportional relationship. Explain why or why not.



Write an equation of the form $y = kx$ for the relationship shown in each graph.



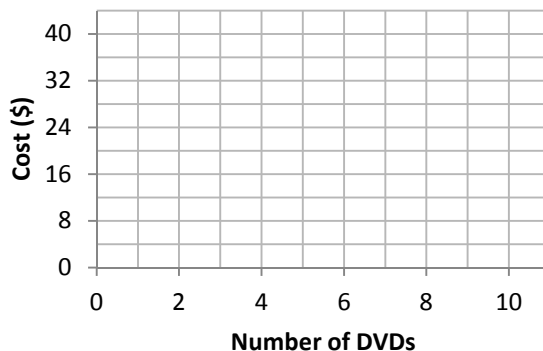
For the following questions use the graph below. The graph shows the relationship between time and distance run by two horses.



1.	Explain the meaning of the point (0,0).	
2.	How long does it take each horse to run a mile?	
3.	Write an equation for the relationship between time and distance for each horse.	
4.	At the given rates, how far would each horse run in 12 minutes?	
5.	Draw a line on the graph representing a horse that runs faster than horses A and B.	

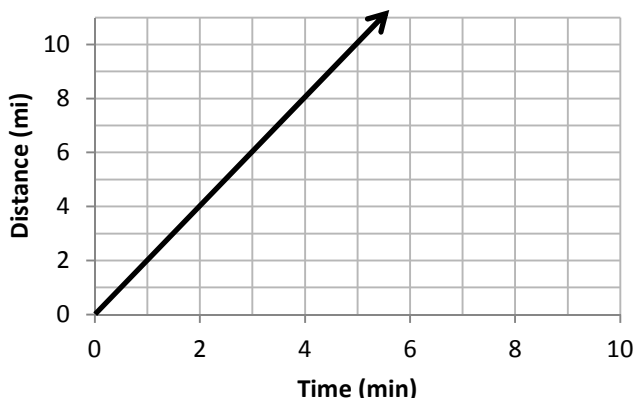
6.	A bullet train can travel at 170 miles per hour. Will a graph representing distance in miles compared to time in hours show a proportional relationship?	
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7. Bargain DVDs cost \$5 each at Mega Movie. Graph the proportional relationship that gives the cost y in dollars of buying x bargain DVDs.



8. Give an ordered pair on the graph and explain its meaning in the real world context.

The graph below shows the relationship between distance and time as Glenda swims.



1.	How far did Glenda swim in 4 seconds?	
2.	Is this a proportional relationship?	
3.	Write an equation that shows the relationship between time and distance.	

The tables show the distance traveled by three cars.

Car 1	
Time (h)	Distance (mi)
0	0
2	120
3	180
5	300
6	360

Car 2	
Time (h)	Distance (mi)
0	0
5	200
10	400
15	600
20	800

Car 3	
Time (h)	Distance (mi)
0	0
1	65
2	85
3	105
4	125

1.	Which car is not traveling at a constant speed? Explain your reasoning.	
2.	Car 4 is traveling at twice the rate of speed of car 2. How will the table values for car 4 compare to the table values for car 2?	

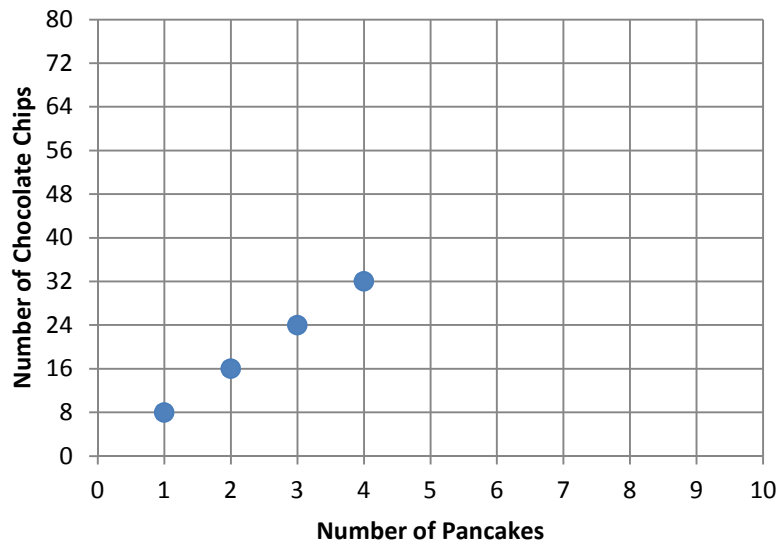
3.	Ralph opened a savings account with a deposit of \$100. Every month after that, he deposited \$20 more. Why is the relationship described not proportional?	
4.	How could the situation be changed to make the situation proportional?	

Complete the table.

Length of a side of square	1	2	3	4	5
Perimeter of square					
Area of square					

Are the length of a side and the perimeter related proportionally? Why or why not? Are the length of a side and the area related proportionally? Why or why not?

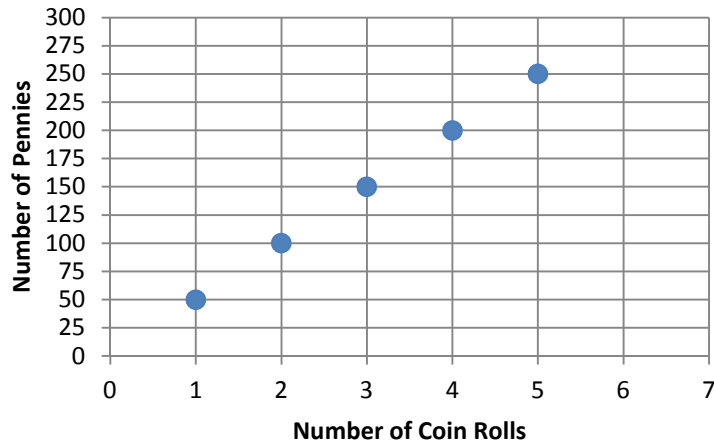
Chocolate Chips in Pancakes



1.	Using the graph, predict the number of chocolate chips in nine pancakes.	
2.	Predict the number of pancakes that would have 48 chocolate chips.	
3.	What does the point (1,8) mean in this situation?	
4.	Write an equation to represent this situation.	

When two quantities are proportional they have a constant rate of change. A **constant ratio** can be found between the output values and their corresponding input values.

Pennies in Coin Rolls



5.	Plot a point at (0,0) and connect the points with a line. What does the point (0,0) represent?	
6.	Create a table showing this information.	
7.	Why do the points in the graph lie on a straight line?	
8.	What is the ratio of number of pennies to the number of coin rolls?	
9.	Define the variables and write an equation in the form $y = kx$ for this situation.	
10.	What is the constant of proportionality in this situation?	
11.	Describe what the constant of proportionality means in this situation.	

Nickels come in rolls of 40 nickels per roll. Create a graph representing the number of rolls and the number of nickels. Write an equation to represent this situation. What is the constant of proportionality in this situation?

1 out of 4 students like country music	1 out of 3 students like pop music
1 out of 5 students like hip-hop music	The rest of the students have no preference

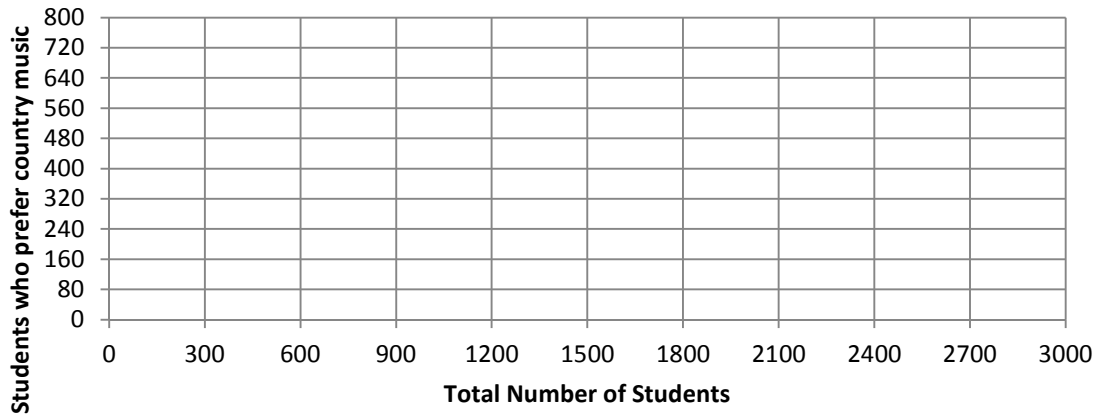
Use this information to interpret the survey results given the total number of students.

Total students	Prefer country	Prefer pop	Prefer hip-hop	No preference
60				
120				
180				
240				
As the total number of students increases by 60, by how much does each music style increase?				

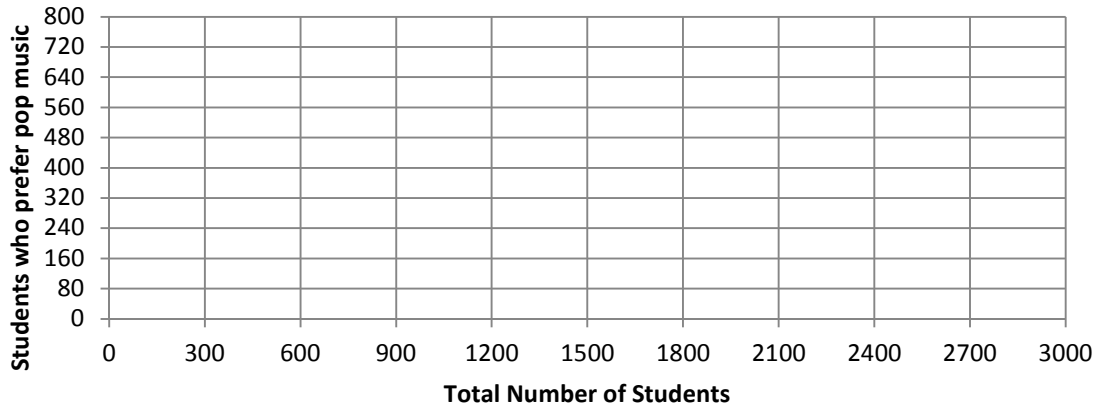
Total students	Prefer country	Prefer pop	Prefer hip-hop	No preference
600				
	300			
		600		
			480	
				650

On the next page, complete a graph for each category.

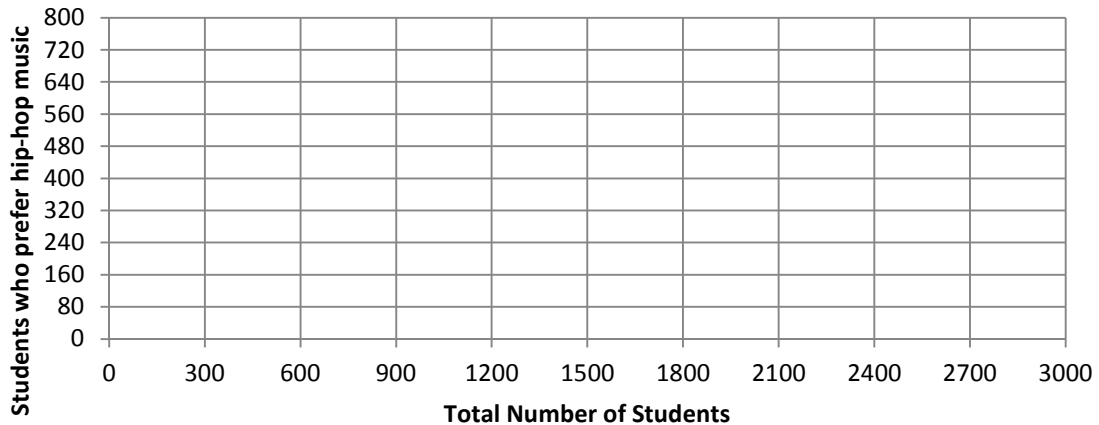
Country Music Preferences



Pop Music Preferences



Hip-Hop Music Preferences



Drawing a line through the data set of a graph is a way to represent relationships. In certain problems all the points will be on a line.

When values vary so that as one increases or decreases a specific amount, the other value increases or decreases by a constant, the values are said to vary directly, or the relationship between the values is called a **direct variation**.

It is important to know that to determine if two quantities vary directly, the points on a graph form a **straight line** and that line must run through the **origin**. You can also describe the quantities of a direct variation relationship as **direct proportions**.

A car driving at a constant rate of 60 miles per hour is an example of direction variation.

Bert and Ernie had enough money to build 10 bird feeders. Is this a form of direct variation?

Number of bird feeders built by Bert	Number of bird feeders built by Ernie
0	10
2	8
4	6
6	4
8	2
10	0

Mangham Music, a company that produces new recording artists, determines that 4 out of 5 girls like the new recording group, Five Directions.

1.	If 4000 girls were surveyed, how many liked Five Directions?	
2.	In one group of girls, 300 girls like Five Directions. How many girls were in this group?	

Complete the table on the next page.

Number of girls who liked Five Directions	Total Number of Girls	Ratio of Girls who like Five Directions to Total Number of Girls
4	5	
	4000	
300		
120		
	1200	
248		

In a proportional relationship that ratio of inputs to outputs is constant. This ratio is called the **constant of proportionality**. Generally you use the variable k to represent the constant of proportionality.

What is the constant of proportionality, k , for the ratio between the number of girls who like Five Directions and the total number of girls?

Durham Intermediate School has determined that 5 out of 7 boys play sports. The constant of proportionality, k , is $\frac{5}{7}$.

1.	Write an equation showing the relationship between the number of boys who play sports, s , and the total number of boys, b , and the constant of proportionality.	
2.	If 175 boys play sports, how many total boys are there?	
3.	There are 287 boys. How many play sports?	
4.	How many boys play sports if there are 784 boys at the school?	
5.	How many boys are there if 55 play sports?	
6.	Describe how the first equation shown was rewritten into the second equation. $\frac{y}{x} = k$ $y = kx$	

There are 4 girls for every 3 boys enrolled in Carroll Middle School.

1.	Set up a proportion to determine how many girls are enrolled at CMS if there are 15 boys.
2.	Set up a proportion to determine how many boys are enrolled at CMS is there are 12 girls.
3.	Define variables for the quantities that are changing in this situation.
4.	Set up a proportion using the variables for the quantities to the ratio given for the enrollment of girls to boys enrolled at CMS.
5.	Use your proportion to write an equation for the number of girls enrolled at CMS to the number of boys enrolled.
6.	What is the constant of proportionality in this equation?
7.	What does the constant of proportionality represent in this problem situation?
8.	Use your proportion to write an equation for the number of boys enrolled at CMS to the number of girls enrolled.
9.	What is the constant of proportionality in this equation?
10.	What does the constant of proportionality represent in this problem situation?

You can think of the constant of proportionality as a way to predict outcomes of a situation.

11.	If there are 79 boys enrolled, use the constant of proportionality to determine how many girls are enrolled.
12.	If there are 113 girls enrolled in the school how many boys are enrolled?

Solve each using the equation for the constant of proportionality, $\frac{y}{x} = k$.

13.	$k = 0.7$ and $y = 4$		14.	$k = \frac{3}{11}$ and $x = 9$	
15.	$k = 5$ and $x = 1\frac{1}{2}$		16.	$k = \frac{1}{6}$ and $y = 3\frac{1}{3}$	

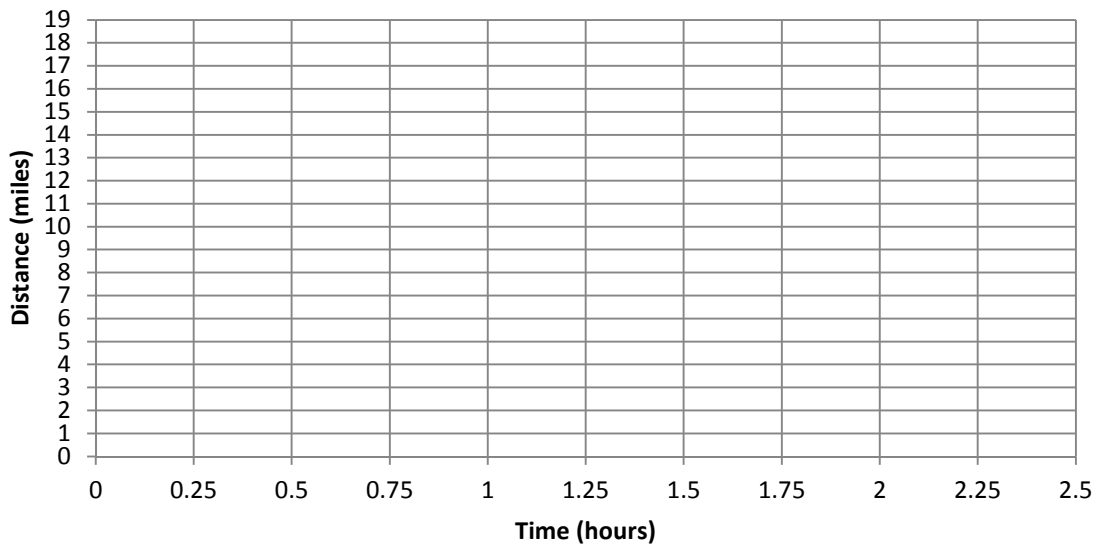
The distance (d) in miles a runner runs varies directly with the amount of time, t , in hours spent running. Suppose Mr. Mangham's constant of proportionality is 9.

1. Write an equation that represents the relationship between the distance ran and the time spent running.
2. Complete the table assuming Mr. Mangham's rate is constant.

Time (hours)	Distance (miles)	$\frac{\text{Distance}}{\text{Time}}$
0		
0.25		
	4.5	
0.75		
	9	
1.25		
1.5		
	18	

3. Graph the values in the table you completed.

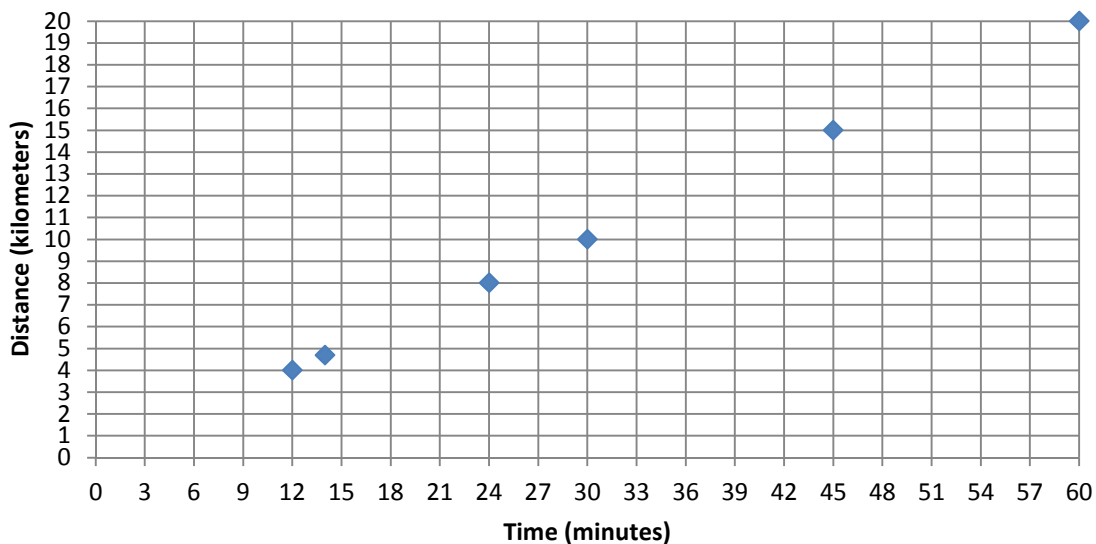
Mr. Mangham's Running Rate



Remember the graph of two variables that are directly proportional, or that vary directly, is a straight line that passes through the origin, (0,0).

When analyzing the graph of two variables that are directly proportional the ratio of the y-coordinate to the x-coordinate for any point is equivalent to the constant of proportionality.

Mrs. Snow's Runs



1.	Does the distance Mrs. Snow runs vary directly with the time? How do you know?	
2.	Pick two points on the graph to form the ratio $\frac{\text{y-coordinate}}{\text{x-coordinate}}$.	
3.	Determine the constant of proportionality.	
4.	Write an equation representing the relationship between Mrs. Snow's distance and time.	
5.	How far can Mrs. Snow run in 15 minutes?	
6.	How long does it take Mrs. Snow to run 15 kilometers?	

Show several graphs to determine which ones vary directly. Add this to functions unit when they create graphs.

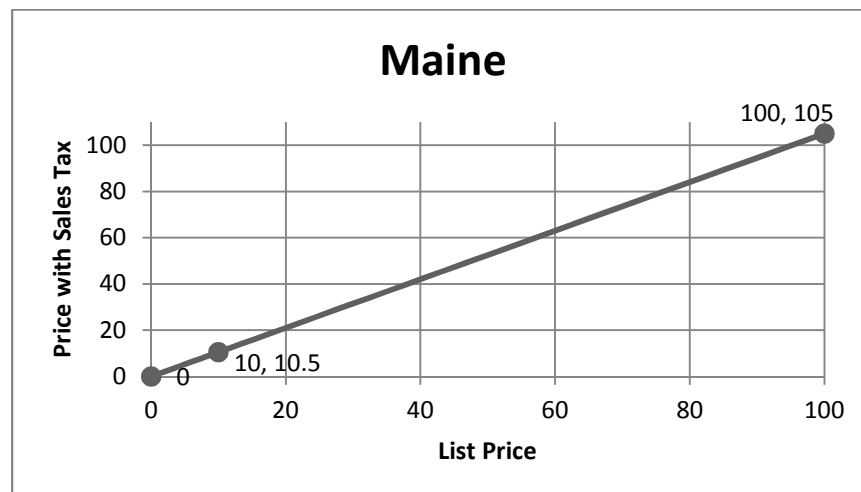
A painter needs 1.5 gallons of paint to cover every 180 square feet of wall space. Using the same method that we have on the problems above create:

- A table of values comparing gallons to square feet
- A graph comparing gallons to square feet
- Is this situation directly proportional?
- If so, what is the constant of proportionality?

Sales tax is a percentage of the selling price of a good or service which is added to the price. Tax rates vary state to state, though the percentage is generally between 4% and 7%. Sales tax is one of the largest sources of earnings for state governments, funding transportation and public schools.

Analyze the information shown for California, Maine, and Texas.

California		Texas
List Price	Price including Sales Tax	
12	12.99	$y = 1.0625x$
30	32.48	
117	126.65	
200	216.50	
250	270.63	
369.52	400	



1.	For each state determine the cost, including sales tax, of an item which has a list price of \$150.
2.	For each state determine the list price of an item that costs \$200 including sales tax.
3.	Which of these three states has the highest sales tax?
4.	What is the sales tax percentage in each of the three states?

Deep Flight I is a submarine that can dive to a depth of 3300 feet below sea level at a rate of 480 feet per minute. Supposed Deep Flight I is going to do a dive starting at sea level.

1.	Identify the independent and dependent quantities.	
2.	Write an equation to represent the depth of Deep Flight I.	

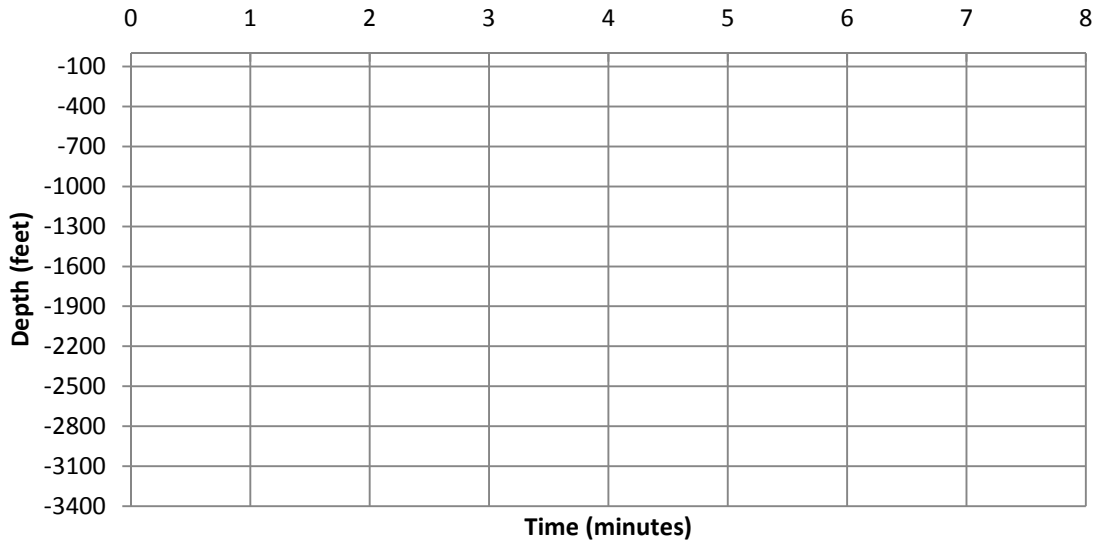
Use your equation to complete the table below.

	Independent Quantity	Dependent Quantity
Quantities		
Units of Measure		
Variables		
	0	
	1	
	2	
	3	
	4	
	5	
	6	

3.	Why does the table end at 6 minutes?	
4.	What do you notice about each depth value in relation to the one before and one after.	
The unit rate of change is the amount that the dependent value changes for every one unit that the independent value changes.		
5.	In this problem what is the unit rate of change?	
6.	How deep would the submarine be after 2.5 minutes?	
7.	After 90 seconds?	
8.	After 45 seconds?	
9.	How many minutes would it take Deep Flight I to be 1400 feet below sea level?	
10.	2100 feet below sea level?	
11.	At its maximum depth?	

Construct a graph of this problem situation.

Depth of Deep Flight I



A tank that currently contains 2500 gallons of oil is being emptied at a rate of 25 gallons per minute. The capacity of this tank is 3000 gallons.

1.	How many gallons are currently in the tank	
2.	How fast is the tank being emptied?	
3.	What are the two quantities that are changing?	
4.	Define variables for these quantities.	
5.	Identify which is the independent variable and which is the dependent variable.	
6.	What is the unit rate of change in this situation?	
7.	Write an equation that relates the two quantities.	
8.	How many gallons will be in the tank after a quarter of an hour?	
9.	After 5 and a half minutes?	
10.	After an hour and a half?	
11.	When will the tank be half full?	

12.	When will the tank be empty?	
13.	How long ago did the tank contain 2600 gallons?	
14.	How long ago was the tank full?	

Complete the table and then the graph based on the questions you answered above.

	Independent Quantity	Dependent Quantity
Quantities		
Units of Measure		
Variables		

Oil in the Tank

