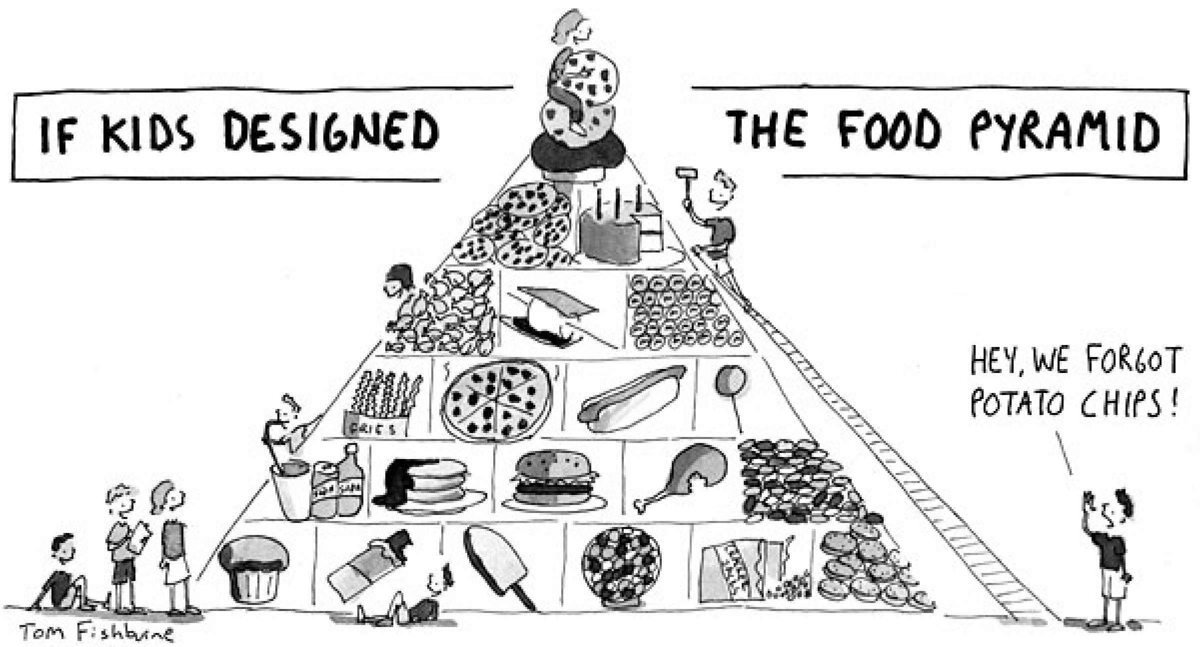
ACCELERATED MATHEMATICS: CHAPTER 5

FOOD AND RESTAURANTS



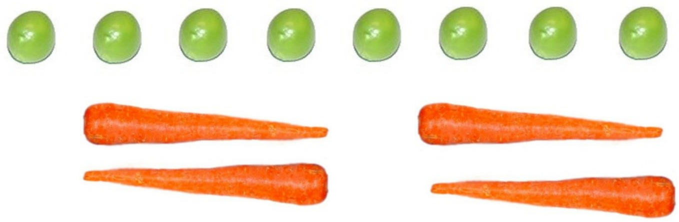
A PROPORTIONAL RELATIONSHIPS UNIT COVERING:

- Ratios, rates, and unit rates
- Understanding and solving proportions
- Proportion word problems
- Scale drawings / Using proportions to determine map distances
- Direct variation / Constant of proportionality
- Coordinate plane
- Unit rate and slope
- Graphs and tables of proportional relationships

Created by Lance Mangham, 6th grade math, Carroll ISD

Activity 5-1: **Ratios** Name:

"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	

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

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

Pancakes	10	40	80		
Syrup (oz)	1			11	16

Activity 5-2: **Ratios and Rates** Name: ______________________

Complete each ratio table.

1.

Cookies	1	4	7		
Cost	$0.05			$1.20	$4.00

2.

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

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	

15.	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?	

Activity 5-3: **Rates and Unit Rates** Name:

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

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

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

Calculate the unit rates or unit prices for the problems below. Show all your work!

7.	5 gallons of water costs $6.25. Find the unit price of each gallon.
8.	Albertsons charges $60 for a 20 pound turkey. Tom Thumb charges $25 for a 10 pound turkey. Which store charges less per pound?
9.	Four bottles of Gatorade costs $3.88. Find the unit price of each bottle.
10.	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?
11.	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?
12.	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?

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

	Ratio	**Rate**	**Unit Price or Unit Rate**
13.	$2.80 for 64 ounces of orange juice	$\frac{\text{\$2.80}}{\text{64 oz.}}$	$0.04 per ounce
14.	$28.45 for 5 pounds of roast beef		
15.	$0.50 for 16 ounces of spaghetti		

Activity 5-4: **Rates: Fire Alarm** Name:

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 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.)**	$\dfrac{\textbf{Total width of all doors}}{\textbf{Width of classroom door}}$	**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?

ManghamMart

ManghamMart competes with three other markets in the neighborhood. Mr. Mangham wants his prices to be the lowest. To makes 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.

Competitors				
Item	GoGrocery	FioFruits	MoMarket	ManghamMart
Corn	$0.30 each	4 for $1.00	3 for $0.87	6 for _______
Pears	3 lb for $2.67	5 lb for $4.59	2 lb for $1.89	4 lb for ______
Bananas	4 lb for $1.99	3 lb for $1.38	2 lb for $0.90	1 lb for ______
Apples	3 for $1.09	6 for $2.09	3 for $1.00	6 for ______
Cantaloupe	3 for $4.59	4 for $6.40	2 for $3.09	5 for ______
Grapes	2 lb for $3.49	2 lb for $3.44	3 lb for $5.19	6 lb for ______

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

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

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.

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

2. Complete the table for Lisa's hike

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

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?

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

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

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.

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

Find each unit rate.

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

Find each unit rate. Determine which is lower.

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

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

	Ratio	**Rate**	**Unit Price or Unit Rate**
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		

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

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?	

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?	

Activity 5-9: **Pizza Proportions** Name:

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:

Activity 5-10: **Proportions** Name:

A proportion is an equation that shows two ratios are equivalent.

Solve each proportion using the Butterfly Method.

1.	$\frac{8}{15}=\frac{m}{45}$		2.	$\frac{9}{12}=\frac{6}{c}$	
3.	$\frac{5}{p}=\frac{3}{9}$		4.	$\frac{v}{21}=\frac{4}{6}$	

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

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

Use ratios and proportions to answer the following questions.

19.	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?
20.	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 cos to fill your 16 oz. cup four times?
21.	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?
22.	The Cliff Drop can accommodate 720 people per hour. There are 444 people in front of you. How long until you get to ride?
23.	One gear on the Spiral Coaster turns 7 revolutions every 2 seconds. How many revolutions are on each minute and a half ride?

Activity 5-11: **Proportion Word Problems** Name: ____________________

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 40th Frosted Flakes commercial?

Survey of 20 students' favorite and least favorite colors

Color	**Least favorite**	**Favorite**
Blue	4	7
Green	3	2
Purple	11	8
Red	1	1
Orange	1	2

17. If 30 students were surveyed, how many students would choose blue as their least favorite color?

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?

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 Shedded 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.

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?

$$\frac{0.5 \text{ inches}}{6 \text{ miles}} = \frac{3.5 \text{ inches}}{x \text{ miles}}$$
$$0.5x = 6 \bullet 3.5$$
$$\frac{0.5x}{0.5} = \frac{21}{0.5}$$
$$x = 42 \text{ miles}$$

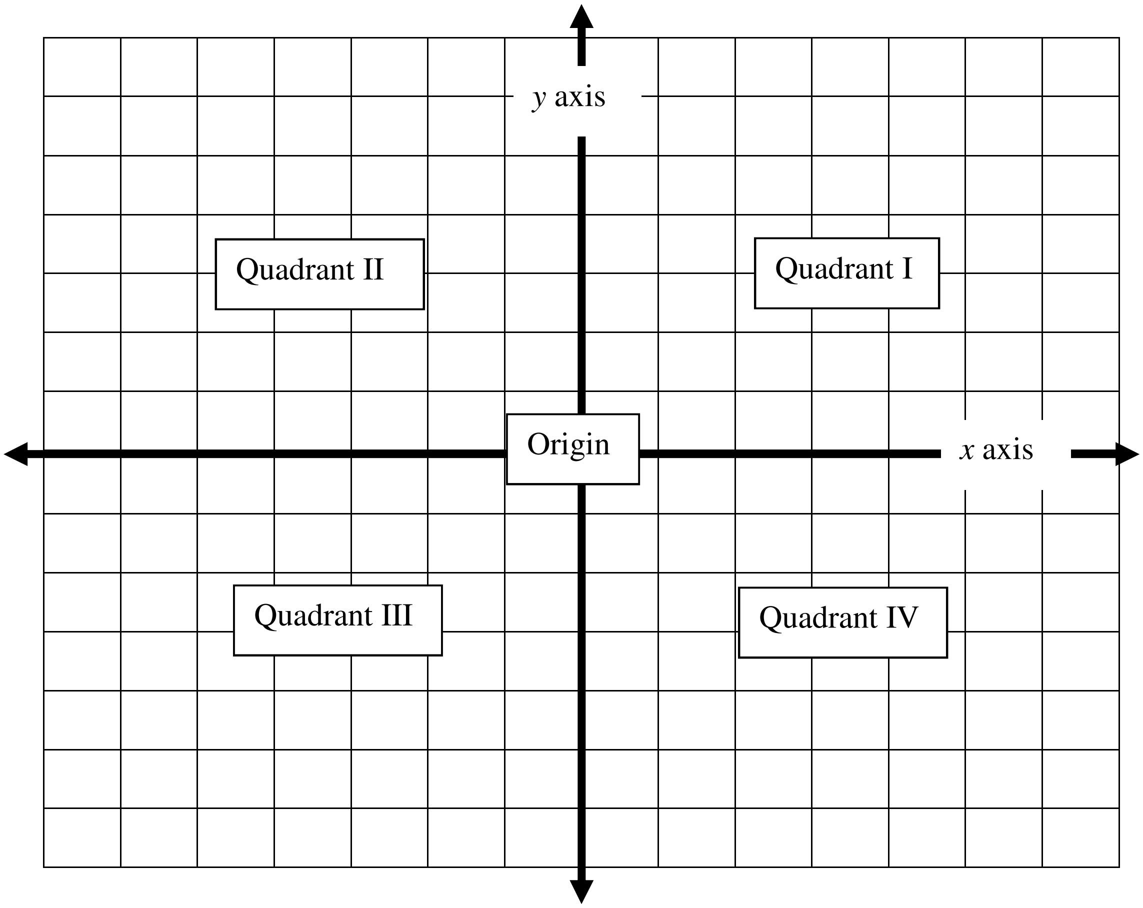
On a set of architectural drawings for an office building, the scale is 0.25 inches = 5 feet. Find the actual length of each room.

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	

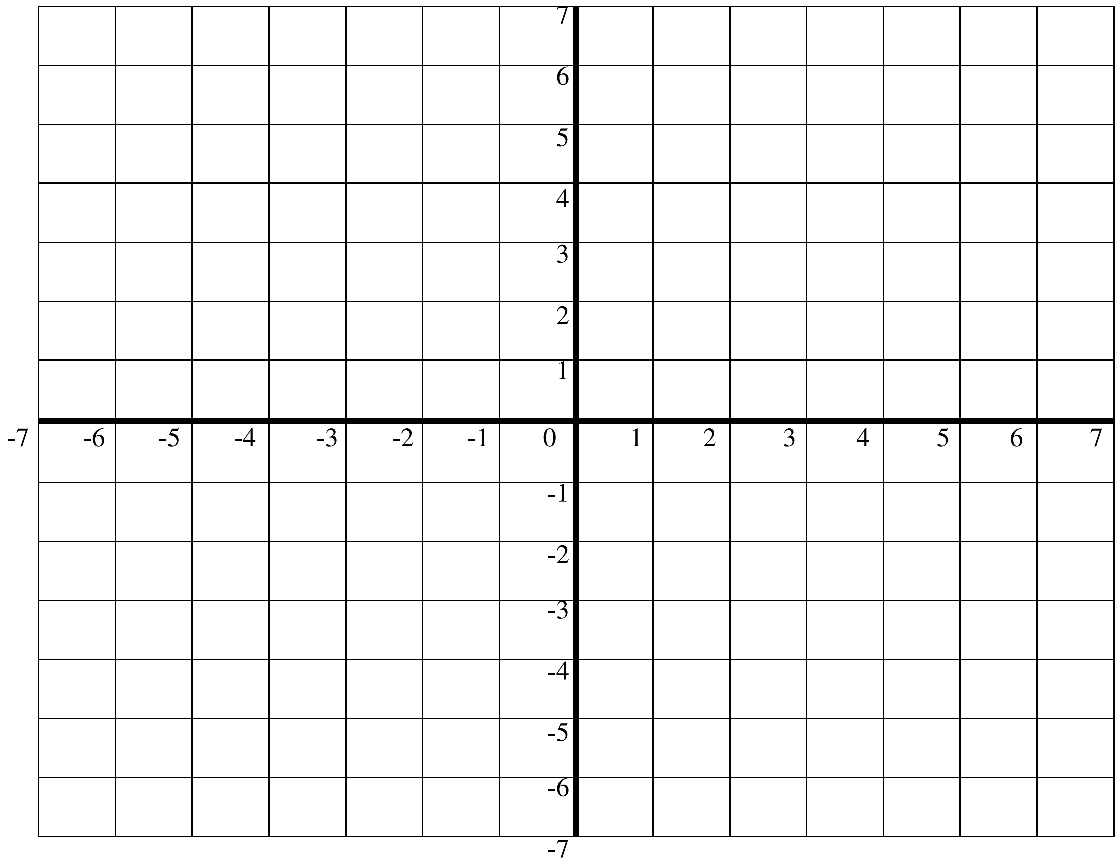
The Cartesian coordinate system is named after the French mathematician, Rene Descartes (1596-1650).



Write your answer in Roman numerals, where possible.

1.	In which quadrant would you find $(-3,2)$?	
2.	In which quadrant would you find $(-5,-8)$?	
3.	In which quadrant would you find $(4,7)$?	
4.	In which quadrant would you find $(8,-10)$?	
5.	In which quadrant would you find $(-13,6)$?	
6.	In which quadrant would you find $(7,-12)$?	
7.	In which quadrant would you find $(-5,-5)$?	
8.	In which quadrant would you find $(13,11)$?	
9.	On which axis would you find $(6,0)$?	
10.	On which axis would you find $(0,8)$?	
11.	On which axis would you find $(0,-13)$?	
12.	Where would you find $(0,0)$?	

Activity 5-15: **The Coordinate System** Name:



1.	First, plot two vertices of a right triangle on the coordinate plane above. Place dot A at (-2,-5) and dot B at (-4,3).	
2.	Name the two points that could represent the third vertex of the right triangle.	
3.	Which quadrant is dot A in?	
4.	Reflect dot B across the x-axis. What are the coordinates of the new point B?	
5.	Reflect dot A across the y-axis. What are the coordinates of the new point A?	
6.	Place dot D at (7,4). If dot is translated to the left 5 places and down 9 places where is the new dot D?	
7.	Draw one of the two possible triangles that you could have created in question #2.	
8.	If all three vertices of this triangle are translated up 2 and 5 to the right, what are the coordinates of the three new vertices?	

For this activity you need a piece of graph paper. Turn your graph paper portrait style. Draw an x-axis slightly above the midpoint and a y-axis directly down the middle.

Graph each of the points below. Connect the points in order as you graph them.

(-3,1)	(-9,-3)	(8,-1)	(-3,-14)
(-1,4)	(-9,-2)	(11,1)	(-2,-14)
(0,5)	(-7,0)	(11,0)	STOP
(5,7)	(-6,1)	(12,0)	(2,-14)
(8,8)	(-6,2)	(9,-2)	(2,-21)
(7,7)	(-8,4)	(8,-2)	(6,-21)
(2,0)	(-8,7)	(-8,-12)*	(6,-17)
(1,0)	(-3,12)	(-7,-10)	(4,-17)
(4,-2)	(-3,6)	(-6,-12)	(4,-18)
(6,-6)	(-1,4)	(-8,-12)	(5,-18)
(8,-12)	STOP	STOP	(5,-20)
(4,-7)	(5,7)	(-2,-14)	(3,-20)
(2,-7)	(8,9)	(-2,-21)	(3,-15)
(0,-10)	(8,8)	(-3,-21)	(6,-15)
(1,-6)	STOP	(-3,-18)	(6,-14)
(0,-3)	(-6,1)	(-5,-18)	(2,-14)
(-1,-4)	(-5,1)	(-5,-21)	STOP
(-4,-4)	STOP	(-6,-21)	
(-5,-3)	(-7,0)	(-6,-14)	
(-5,-4)	(-8,1)	(-5,-14)	
(-2,-9)	STOP	(-5,-17)	
(-8,-4)	(8,-2)	(-3,-17)	

* This is a long line. This line should go behind the acute angle at about (-2,-9).

Creating the circle around the outside:
Place dots at (11,0), (0,-11), (-11,0), (0,11). Connect these dots with a curve to create an inside circle (it will go behind the main drawing).
Then place dots at (12,0), (0,-12), (-12,0), (0,12). Connect these dots with a curve to create an outside circle (it will also go behind the main drawing).

Shade or color in the entire circle and then the rest of the drawing.

<u>Properties of Proportional Relationships</u>

- One quantity is a multiple of the other.
-
- If the first quantity is zero, the second quantity is zero.
- If you double one quantity, the other also doubles.
- The graph of the relationship is a straight line through the origin.

Constant of Proportionality Summary

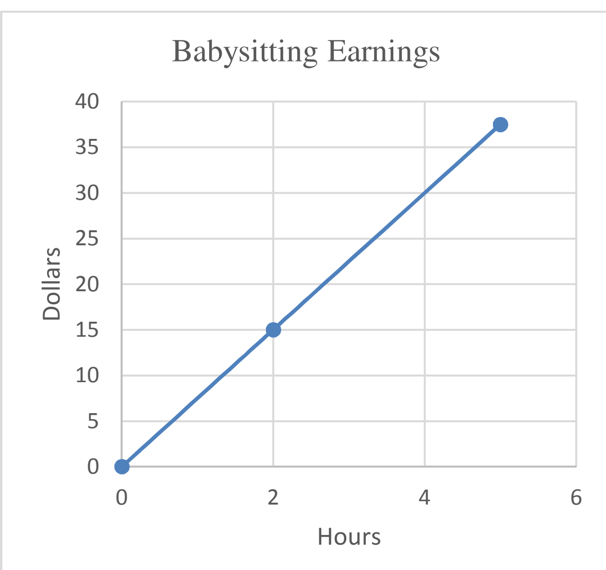
Verbal

A babysitter earns $15 in 2 hours and $37.50 in 5 hours.

Table

Hours	$ earned
2	15
5	37.50

Graph



Algebraic

$$y = 7.5x$$

Activity 5-17: **Direct Variation / Constant of Proportionality** Name:

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.

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

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

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

Activity 5-18: **Proportional Relationships / Direct Variation** Name:

If the relationship is proportional you can describe that relationship using the equation $y = kx$. The letter k is called the **constant of proportionality** (or **constant of variation**) and it represents the constant rate of change or constant ratio between x and y. The value of k is represented by the equation $k = \frac{y}{x}$. This proportional relationship is also called a **direct variation**. If there is a direct variation between x and y, y varies directly with x.

DIRECT VARIATION:

$y = kx \quad k \neq 0$

x and y → variables

k → constant of variation

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

5.	Write an equation for the relationship.	

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

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

Activity 5-20: **Writing an Equation for a Proportional Relationship** Name:

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 6,750 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.	

1. The table shows the widths and lengths of United States flags. Determine whether the data set shows direct variation.

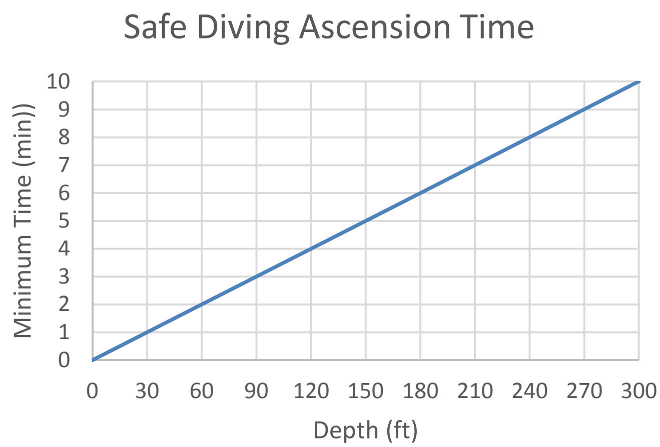
Width (ft)	0.5	1.25	2	4.5	24
Length (ft)	0.95	2.375	3.8	8.55	45.6

2. The minimum amount of time it takes a diver to ascent safely to the surface varies directly with the depth of the diver. How long does it take a diver to ascend safely from a depth of 450 feet?

   A. Find the constant of proportionality.

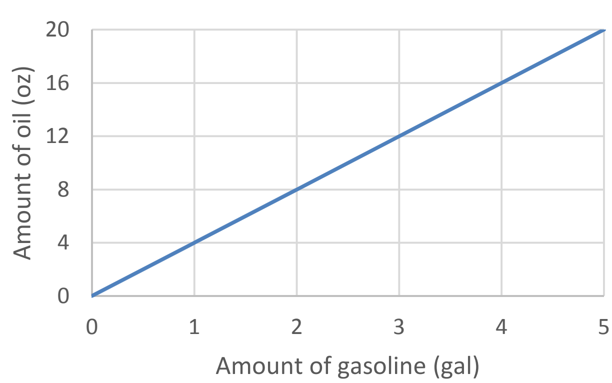
   B. Write an equation in the form $y = kx$.

   C. Predict the time it takes to ascend safely from a depth of 450 feet by substituting in for *x*.



3. Does the equation $y = \frac{3}{2}x - 5$ show a direct variation? Why or why not?

4. One brand of motorcycle uses an oil-to-gasoline ratio as shown in the graph. The amount of oil that should be added varies directly with the amount of gasoline. Write a direct variation equation that describes the relationship. Use your equation to determine the amount of oil that should be added to 6.5 gallons of gasoline.



Activity 5-22: **Direct Variation / Constant of Proportionality** Name:

Determine whether the data sets show direct variation. If so, write an equation that describes the relationship in the form $y = kx$.

1.

Resistance (amps)	3	5	6	8
Current (ohms)	4	2.4	2	1.5

2.

Weight (lb)	8	15	28	47
Dosage (mg)	160	300	560	940

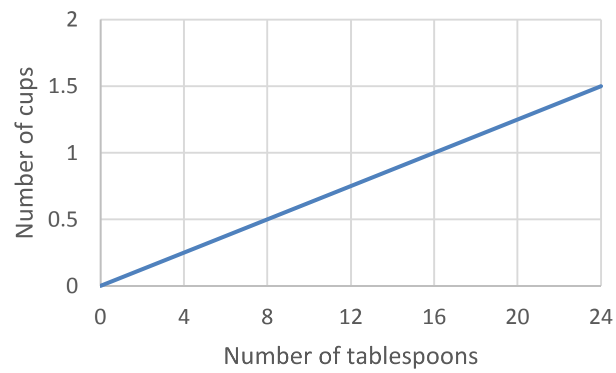
3.

Games	20	30	50	160
At-bats	62	93	155	496

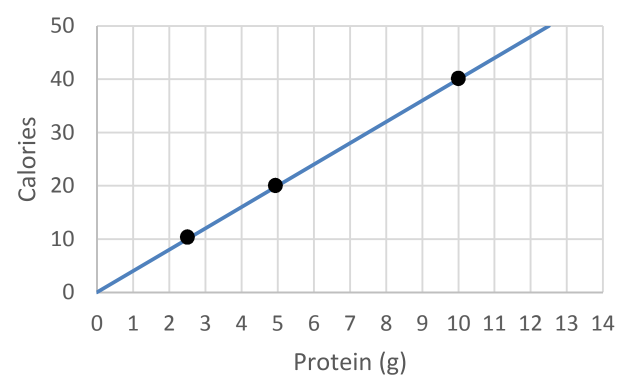
4.

Price ($)	4	12	36	60
Sales tax ($)	0.29	0.87	2.61	4.35

5. The number of cups in a measure varies directly as the number of tablespoons. Write a direct variation equation that describes the relationship. Use your equation to determine the number of cups in 56 tablespoons.



6. The number of calories varies directly with the number of grams of protein. Write a direct variation equation that describes the relationship. Use your equation to determine the number of calories from 25 grams of protein.



7. Which equations do NOT represent a direct variation?

$$y = \frac{1}{4}x \qquad y = -4x \qquad y = 5x + 1 \qquad y = 6x$$

$$y = -0.53x \qquad y = 4\sqrt{x} \qquad y = -8x + 3 \qquad y = x^3$$

1. Mischa bought an energy-efficient washing machine. The amount of water she saves per wash load compared to her old water is shown in the table.

Number of loads	1	2	5	6
Water (gal)	12	24	60	72

A. Determine whether the relationship is a direct variation. If so, write an equation that describes the relationship.

B. How much water will she save when washing 8 loads?

2. Sandy wants to build a square garden. Complete the table for the different side lengths.

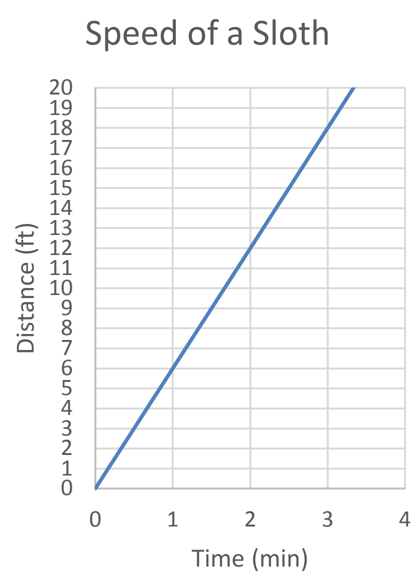
Side length (ft)	1	2	3	5	9
Perimeter (ft)					
Area (ft^2)					

A. Does the perimeter of a square vary directly with the side length? If so, write an equation that describes the relationship. Explain your answer.

B. Does the area of a square vary directly with the side length? Why or why not?

C. Sandy decides to build her garden with a side length of 3 feet. The border she buys for the perimeter costs \$1.99 for a 1.5 foot piece. The soil she buys covers an area of 3 square feet and costs \$4.99 a bag. How much does Sandy spend on border and soil for her garden?

3. The three-toed sloth is an extremely slow animal. Use the graph to write a direct variation equation for the distance y a sloth will travel in x minutes. How long will it take the sloth to travel 24 feet?



4. Martin is told that a graph includes the points (2,5) and (4,10). He says this is a graph of the direct variation $y = 2.5x$. Do you agree? Explain.

5. One graph of a direct variation equation goes through a point A in Quadrant I that is not at the origin. A second graph of a different variation equation goes through a point that is one unit to the right of A. Which direct variation equation has a greater constant of variation? Explain.

Activity 5-24: **Direct Variation / Constant of Proportionality** Name: ____________________

Does the data show direct variation? Write *yes* or *no*. If the data shows direct variation, write an equation to describe the relationship using the constant of proportionality.

1.

Time (s)	0.5	1	1.5	2
Distance (ft)	4	16	36	64

____

2.

Thickness (in)	1	2	3	4
R-value	3.14	6.28	9.42	12.56

____

3.

Hot air (ft^3)	50	100	500	1000
Lift (lb)	1	2	10	20

____

4.

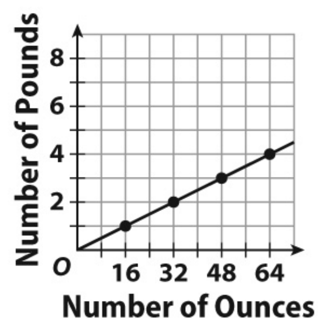
Celsius	5	10	20	30
Fahrenheit	41	50	68	86

____

Solve.

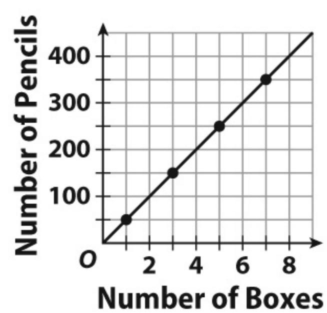
5. The number of pounds in a bag of flour varies directly with the number of ounces. Write a direct variation equation that describes the relationship. Use your equation to determine the number of pounds in 152 ounces.

   ____



6. The number of pencils for sale varies directly with the number of boxes. Write a direct variation equation that describes the relationship. Use your equation to determine the number of pencils in 14 boxes.

   ____



7. The fuel mileage of a hybrid vehicle is shown in the table below.

Fuel (gal)	6	9	27	40
Distance (mi)	192	288	864	1280

   a. Determine if the relationship is a direct variation. If so, write an equation that describes the relationship.

   ____

   b. How many miles can the car drive on 11 gallons of fuel? ________

Activity 5-25: **Proportional Relationships and Graphs** Name:

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.

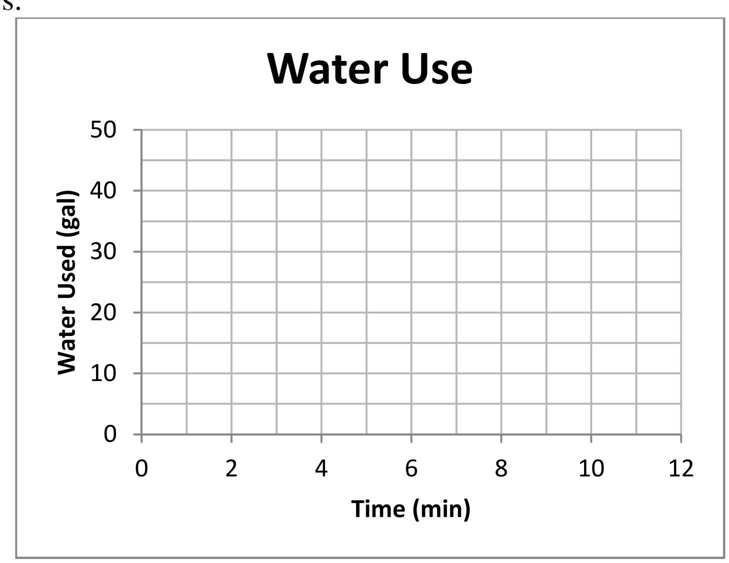
Time (min)	1	2	3		10
Water used (gal)	5			35	
$\frac{\text{Water Used}}{\text{Minute}}$					

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, ___)

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.

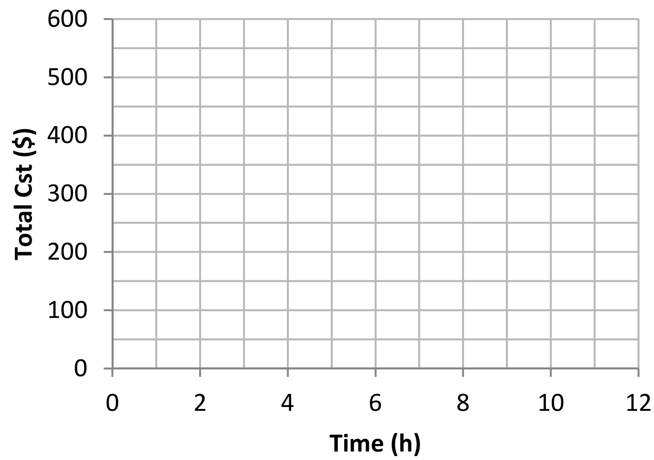
Activity 5-26: **Proportional Relationships and Graphs** Name:

There are two situations below: a cleaning company and a bowling game. One is a proportional relationship and one is not a proportional relationship. Determine which is which and answer the related questions.

A house cleaning company charges $45 per hour.

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

1. Write the data in the table as ordered pairs and graph the ordered pairs below.

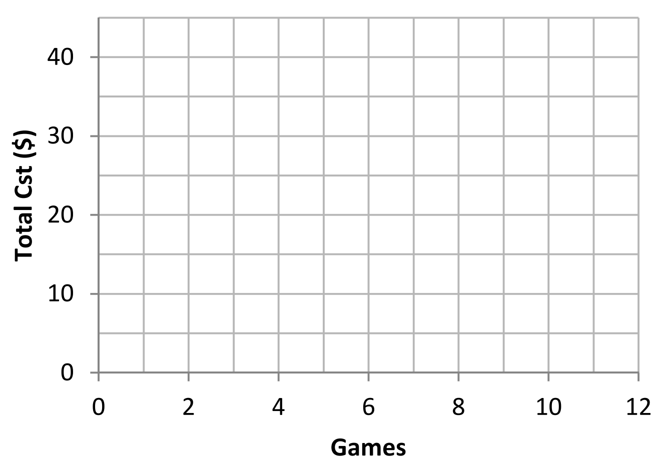


2. If this is the proportional relationship, write an equation for this relationship.

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

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

3. Write the data in the table as ordered pairs and graph the relationship below.



4. If this is the proportional relationship, write an equation for this relationship.

Activity 5-27: **Proportional Relationships and Graphs** Name: ______________________

Complete each table. Explain why the relationship is a proportional relationship.

1. A cashier earns $8 per hour.

Time (h)	2	4		
Pay ($)	16		40	72

____

____

2. Tomatoes cost $0.70 per pound.

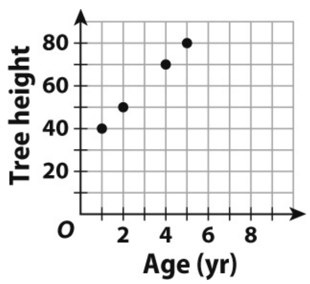
Weight (lb)	2		6	8
Price ($)	1.40	2.10		

____

____

Tell whether the relationship is a proportional relationship. Explain your answer.

3.



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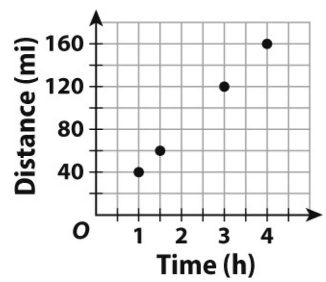
4.



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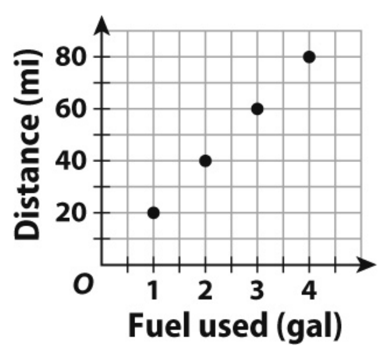
____

The graph shows the relationship between the distance traveled by a car and the amount of fuel used by the car.



5. Explain the meaning of (2, 40).

____

____

6. Write an equation for this relationship.

____

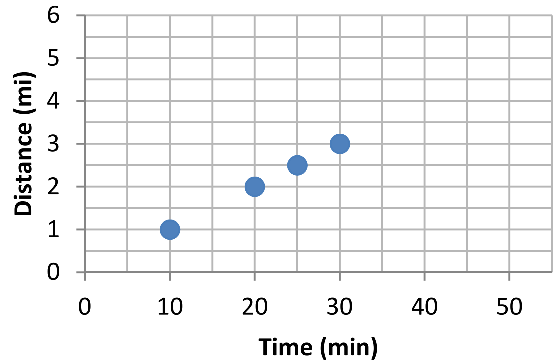
____

7. Suppose a compact car uses 1 gallon of fuel for every 27 miles traveled. How would the graph for the compact car compare to the graph for the car shown?

____

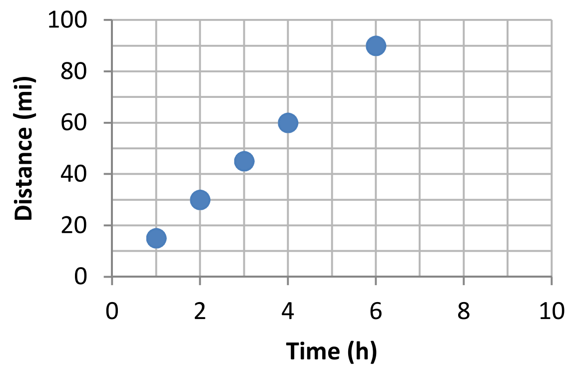
Activity 5-28: **Analyzing Graphs** Name:

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 that 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.	

Activity 5-29: **Analyzing Graphs** Name:

1-2. Complete each table. Tell whether the relationship is a proportional relationship. Explain why or why not.

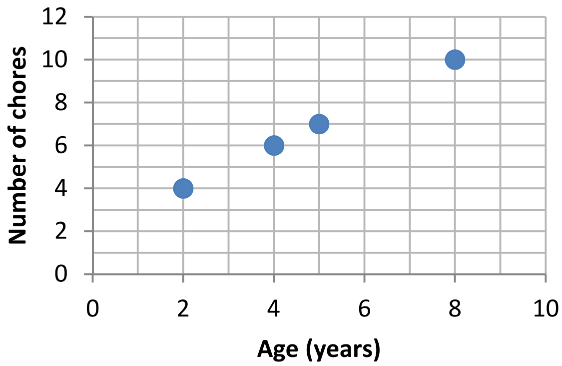
A student reads 65 pages per hour.

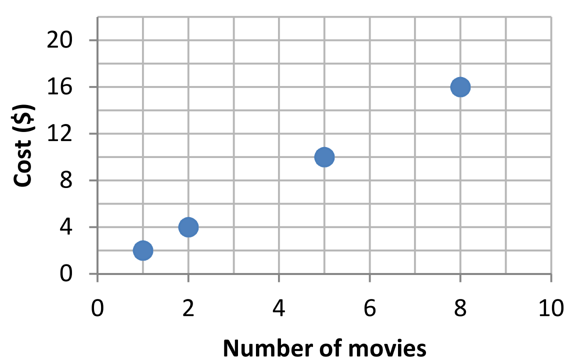
Time (h)	3	5		10
Pages			585	

A babysitter makes $7.50 per hour.

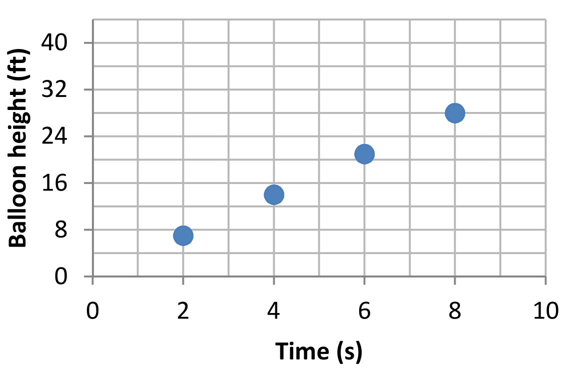
Time (h)	2		5	
$		22.50		60

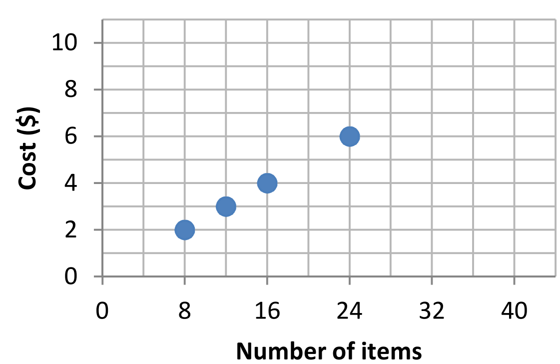
3-4.Tell whether the relationship is a proportional relationship. Explain why or why not.



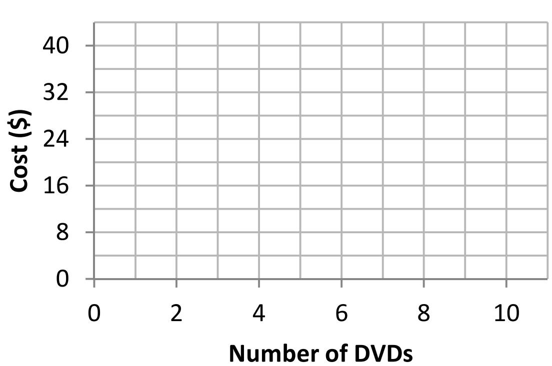


5-6. Write an equation of the form $y = kx$ for the relationship shown in each graph.



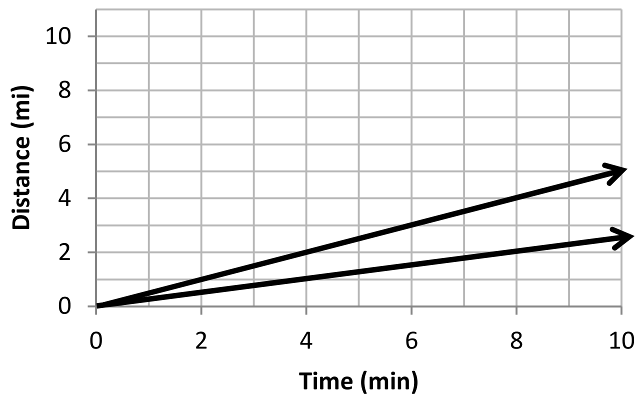


7. Bargain DVDs cost $5 each at Mega Movie. Graph the proportional relationship that gives the cost y in dollars of buying x bargain DVDs. Then give an ordered pair on the graph and explain its meaning in the real world context.



Activity 5-30: **Analyzing Graphs** Name:

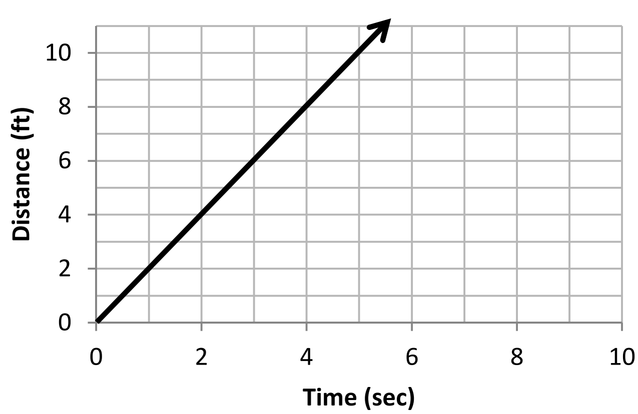
For the following questions use the graph below. The graph shows the relationship between time and distance run by two horses.



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?	

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



7.	Is this a proportional relationship? If so, write an equation that shows the relationship between time and distance.	

The tables show the distance traveled by three cars.

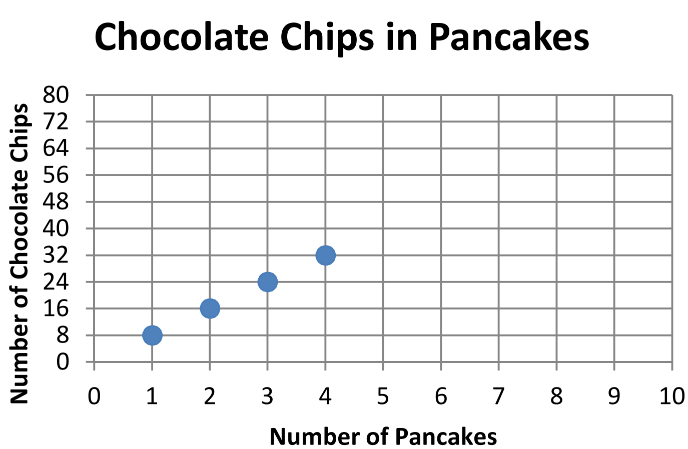
Car 1	
Time (h)	Distance (mi)
0	0
2	120
3	180
5	300
6	360

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

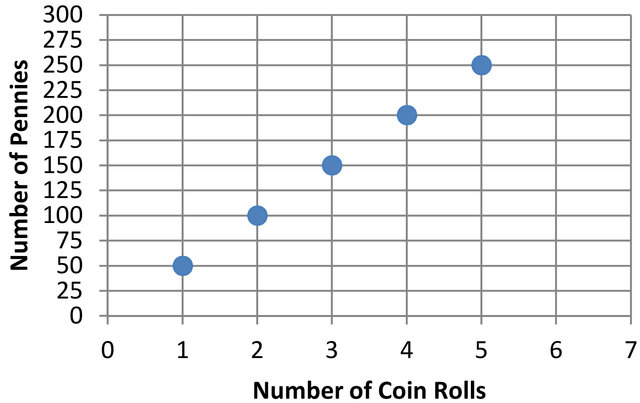
1.	Which car is not traveling at a constant speed? Explain your reasoning.	
2.	Car 4 is traveling at twice the rate of speed of car 2. How will the table values for car 4 compare to the table values for car 2?	

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.	Ralph opened a savings account with a deposit of \$100. Every month after that, he deposited \$100 more. Is this relationship proportional now?	
5.	How could the situation be changed to make the situation proportional?	



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

Pennies in Coin Rolls



1.	Plot a point at (0,0) and connect the points with a line. What does the point (0,0) represent in this situation?	
2.	Define the variables and write an equation in the form $y = kx$ for this situation.	
3.	Describe what the constant of proportionality means in this situation.	

4. Tell whether each relationship is proportional. If it is proportional, write an equation that describes the relationship. First define your variables.

Lemonade Recipe

Lemons	1	2	3	4	5	6
Sugar (c)	1.5	3	4.5	6	7.5	9
Water (c)	7	14	21	28	35	42

Use the table to determine whether the relationship is proportional. If so, write an equation for the relationship. Tell what each variable you used represents.

5.

Number of tickets	2	3	4	5
Total Cost ($)	54	81	108	135

a. Proportional?/Equation ___________

b. Number of tickets: ____________

c. Total Cost: ______________________

6.

Weight (lb)	4	5	46
Total Cost ($)	17.40	21.75	200.10

a. Proportional?/Equation __________

b. Weight: __________________

c. Total cost: ___________________

A **rate of change** is a ratio of the amount of change in the output to the amount of change in the input. For proportional relationships the rate of change is just like the unit rate, constant of proportionality, and direct variation.

Eve keeps a record of the number of lawns she has mowed and the money she has earned. Tell whether the rates of change are constant or variable.

	Day 1	Day 2	Day 3	Day 4
Number of lawns	1	3	6	8
Amount earned ($)	15	45	90	120

Step 1: Identify the input and output variables.

Input variable (x):
Output variable (y):

Step 2: Find the rate of change.

Day 1 to Day 2: $\dfrac{\text{change in \$}}{\text{change in lawns}} = \underline{\qquad} =$

Day 2 to Day 3: $\dfrac{\text{change in \$}}{\text{change in lawns}} = \underline{\qquad} =$

Day 3 to Day 4: $\dfrac{\text{change in \$}}{\text{change in lawns}} = \underline{\qquad} =$

The rates of change are constant: $____ per lawn.

The table shows the approximate height of a football after it is kicked. Tell whether the rates of change are constant or variable.

Time (s)	**Height (ft)**
0	0
0.5	18
1.5	31
2	26

Find the rates of change (change in height divided by change in time): ________________________

The rates of change are: __________________

You can also use a graph to find rates of change.

The graph shows the distance Nathan bicycled over time. What is Nathan's rate of change?

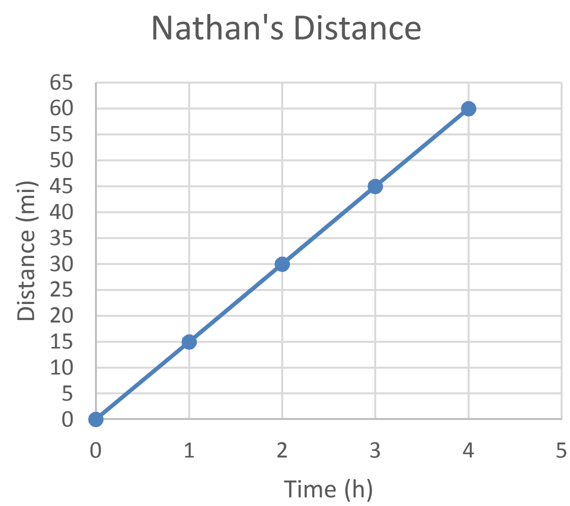
1. Find the rate of change from 1 hour to 2 hours.

$$\frac{\text{change in distance}}{\text{change in time}} =$$

2. Find the rate of change from 1 hour to 4 hours.

3. Find the rate of change from 2 hours to 4 hours.

4. Recall that the graph of a proportional relationship is a straight line through the origin. Explain whether the relationship between Nathan's time and distance is a proportional relationship.



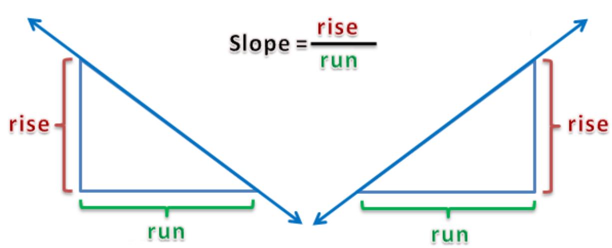
5. Does a proportional relationship have a constant rate of change?

6. Does it matter what interval you use when you find the rate of change of a proportional relationship?

Calculating Slope

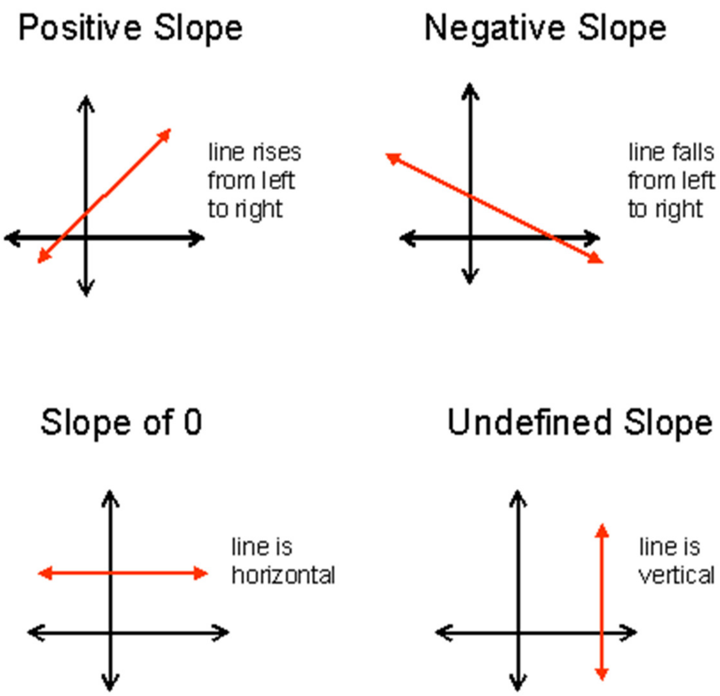
When the rate of change of a relationship is constant, every segment of its graph has the same steepness, and the segments together form a line. The constant rate of change is called the **slope** of the line.

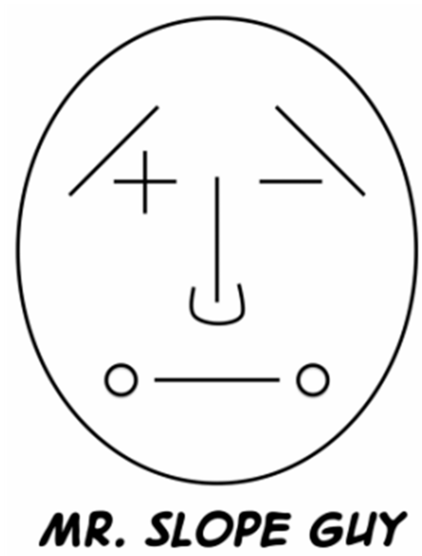
The slope of a line is the ratio of the change in y-values (rise) for a segment of the graph to the corresponding change in x-values (run).

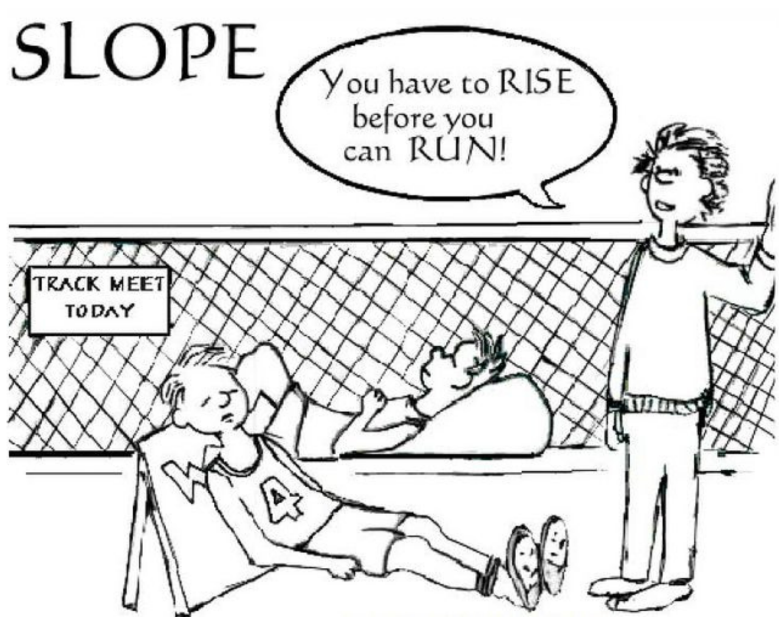


For proportional relationships:

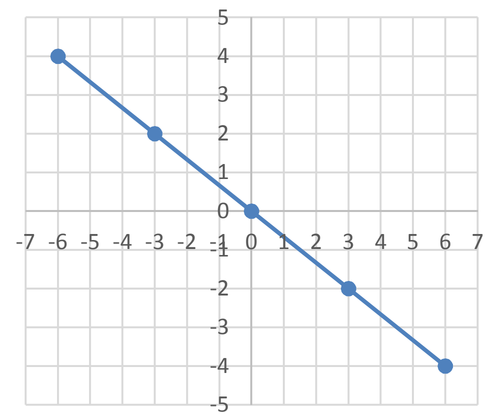
$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{\triangle y}{\triangle x} = \frac{y_2 - y_1}{x_2 - x_1} = \text{Unit Rate} = \text{Constant of Proportionality} = k = m$$


Positive Slope
line rises from left to right
Negative Slope
line falls from left to right
Slope of 0
line is horizontal
Undefined Slope
line is vertical


MR. SLOPE GUY


SLOPE
You have to RISE before you can RUN!
TRACK MEET TODAY

Find the slope of the line.



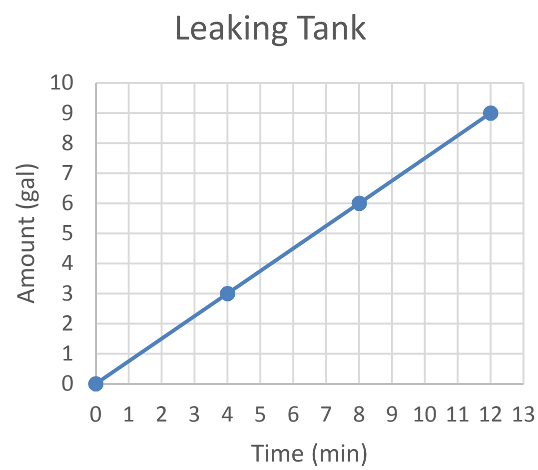
Step 1: Choose two points on the line.

Step 2: Find the change in y-values (rise) and the change in x-values (run) as you move from one point to the other.

$$\text{rise} = +2 \qquad \text{run} = -3$$

Step 3: $\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{2}{-3} = -\frac{2}{3}$

The graph shows the rate at which water is leaking from a tank. The slope of the line gives the leaking rate in gallons per minute.



Rise =

Run =

Rate of leaking = _____ gallons per minute

Tell whether the rates of change are constant or variable.

1. Building measurements _______________

Feet	3	12	27	75
Yards	1	4	9	25

2. Computers sold _________________

Week	2	4	9	20
Number Sold	6	12	25	60

3. Distance an object falls _____________

Time (s)	1	2	3	4
Distance (ft)	16	64	144	256

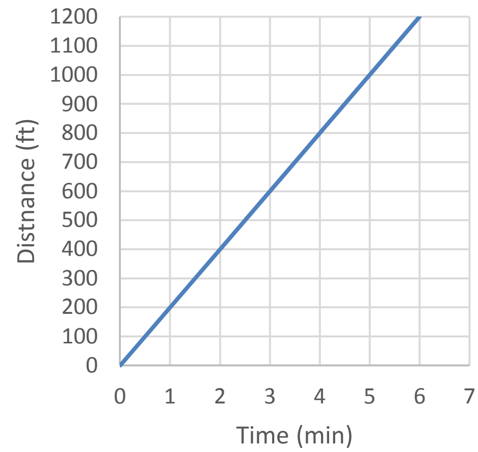
4. Cost of sweaters ________________

Number	2	4	7	9
Cost ($)	38	76	133	171

Find the slope (or rate of change) between each pair of points.

5.	$(1,4),(3,16)$		6.	$(-6,5),(4,13)$	

Erica walks to her friend Philip's house. The graph shows Erica's distance from home over time.



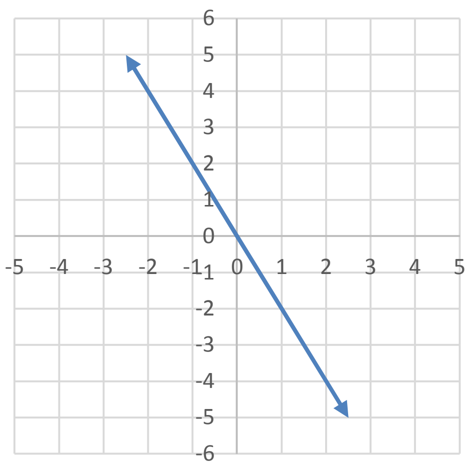
1. Find the rate of change from 1 minute to 2 minutes.

2. Find the rate of change from 1 minute to 4 minutes.

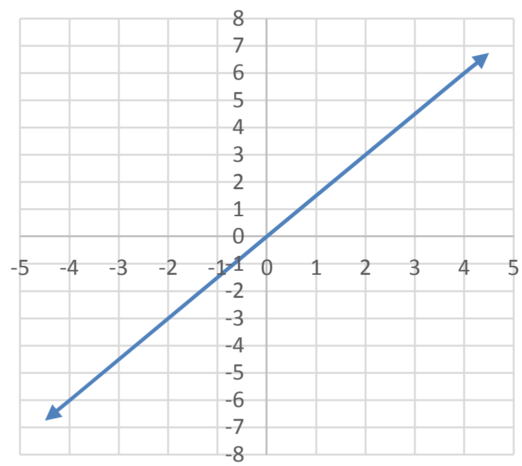
3. If you know two points on a line, how can you find the rate of change of the variables being graphed?

Find the slope of each line.

4.



5.



6. Rectangle EFGH is graphed on a coordinate plane with vertices at

$$E(-3,5), F(6,2), G(4,-4), H(-5,-1)$$

A. Graph the rectangle above on graph paper.
B. Find the slopes of each side.
C. What did you notice about the slopes of opposite sides?
D. What do you notice about the slopes of adjacent sides?

Find the slope (or rate of change) between each pair of points.

7.	$(-3,-4),(-9,-22)$		8.	$(0,3),(8,3)$	
9.	$(2,8),(-6,-8)$		10.	$(0,0),(-3,-4)$	
11.	$(-1,1),(1,-1)$		12.	$(-10,14),(-7,-1)$	

Activity 5-38: **Rate of Change and Slope (3.2)** Name: ____________________

1. A bicyclist started riding at 8:00AM. The diagram below shows the distance the bicyclist had traveled at different times. What was the bicyclist's average rate of speed in miles per hour?



8:00AM 4.5 miles 8:18AM 7.5 miles 8:48AM

2. A line passes through $(6,3),(8,4),$ and $(n,-2)$. Find the value of n.

3. A large container holds 5 gallons of water. It begins leaking at a constant rate. After 10 minutes, the container has 3 gallons of water left.

   A . At what rate is the water leaking?

   B. After how many minutes will the container be empty?

4. Billy found the slope of the line through the points $(2,5)$ and $(-2,-5)$ using the equation $\frac{2-(-2)}{5-(-5)}=\frac{4}{10}=\frac{2}{5}$. What mistake did he make?

5. Graph parallelogram ABCD on a sheet of graph paper with vertices $A(3,4),B(6,1),C(0,-2),D(-3,1)$.

   A. Find the slope of each side.

   B. What do you notice about the slopes?

   C. Draw another parallelogram on the coordinate plane. Do the slopes have the same characteristics?

6. Ben and Phoebe are finding the slope of a line. Ben chooses two points on the line and used them to find the slope. Phoebe used two different points to find the slope. Did they get the same answer?

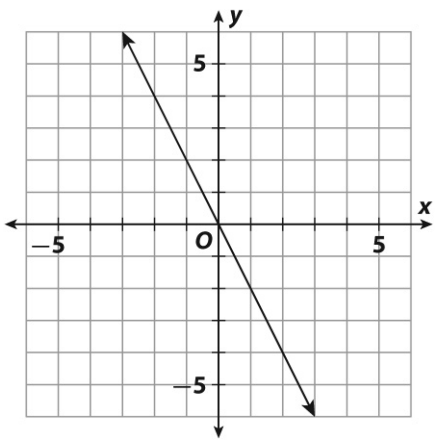
7. Two lines pass through the origin. The lines have slopes that are opposites. Compare and contrast the lines.

8. What is the slope of the x-axis? Explain.

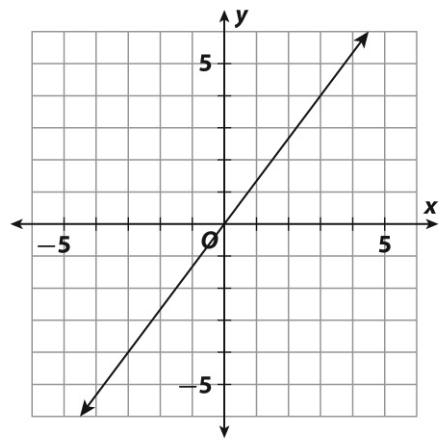
9. What is the slope of the y-axis? Explain.

Find the slope of each line.

1. slope ________________



2. slope ________________



Solve.

3. Jasmine bought 7 yards of fabric. The total cost was $45.43. What was the average cost per yard of the fabric she bought?

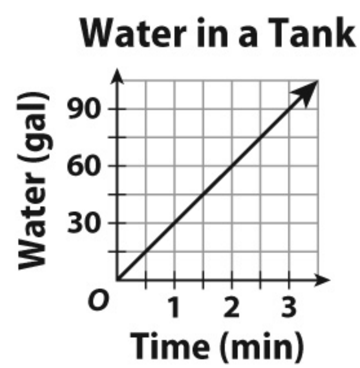
____

4. A train traveled 325 miles in 5 hours. What was the train's average rate of speed in miles per hour?

____

5. The graph at the right shows the amount of water in a tank that is being filled. What is the average rate of change in gallons per minute?

____



6. Suppose the size of the tank in question 5 is doubled. Will the average rate of change in gallons per minute change? Explain your answer.

____

____

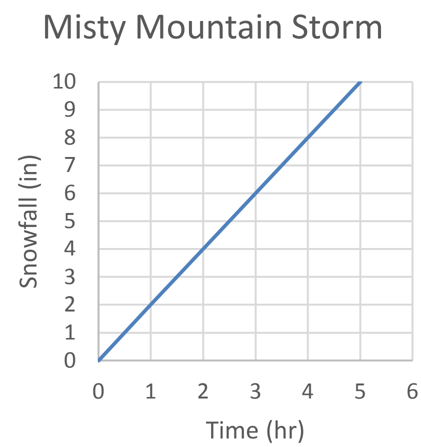
7. A line passes through (1, 1), (−2, 4), and (6, *n*). Find the value of *n*.

____

Activity 5-40: **The Unit Rate as Slope (3.3)** Name:

A rate is a comparison of two quantities that have different units, such as miles and hours. A unit rate is a rate in which the second quantity in the comparison is one unit.

A storm is raging on Misty Mountain. The graph shows the constant rate of change of the snow level on the mountain.



1. Find the slope of the graph using the points (1,2) and (5,10). Remember that the slope is the constant rate of change.

2. Find the unit rate of snowfall in inches per hour.

3. Compare the slope of the graph and the unit rate of change in the snow level. What do you notice?

4. Which point on the graph tells you the slope of the graph and the unit rate of change in the snow level? Explain how you found the point.

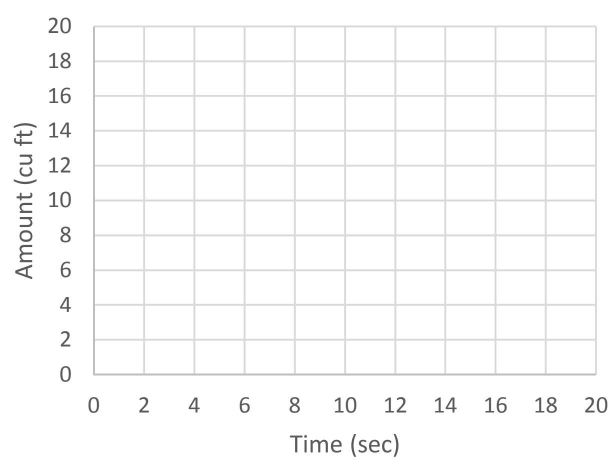
You can use a table and a graph to find the unit rate and slope that describe a real-world proportional relationship. The constant of proportionality for a proportional relationship is the same as the slope.

5. Every 3 seconds, 4 cubic feet of water pass over a dam. Draw a graph of the situation. Find the unit rate of this proportional relationship.

A. Make a table.

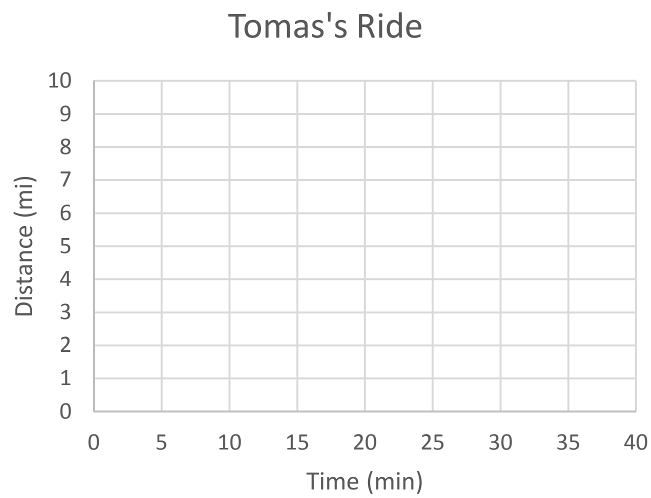
Time (s)	3			
Volume (ft^3)	4			

B. Draw a graph.



C. Without referring to the graph, how do you know that the point $\left(1, \frac{4}{3}\right)$ is on the graph?

1. Tomas rides his bike at a steady rate of 2 miles every 10 minutes. Graph the situation. Find the unit rate of this proportional relationship.

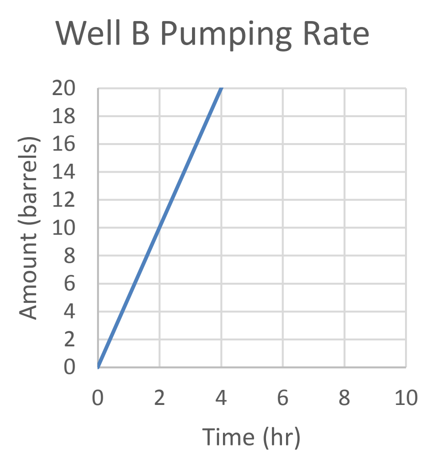


You can compare proportional relationships presented in different ways.

2. The equation $y = 2.75x$ represents the rate, in barrels per hour, that oil is pumped from Well A. The graph represents the rate that oil is pumped from Well B. Which well pumped oil at a faster rate?

A. Create a table for Well A

Time (hr)	1	2	3	4
Quantity (barrels)				



B. What is the unit rate (slope) of Well A?

C. What is the unit rate (slope) of Well B?

D. Which slope is higher?

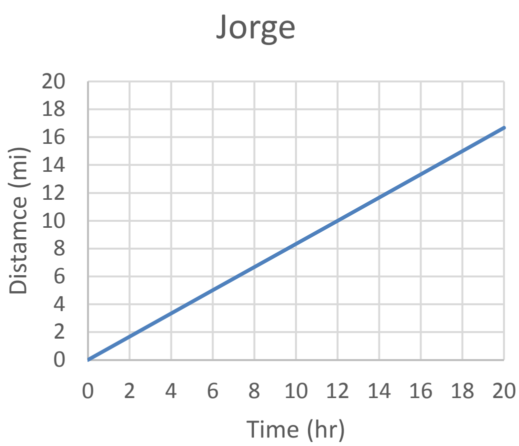
E. Describe the relationships among the slope of the graph of Well A's rate, the equation representing Well A's rate, and the constant of proportionality.

3. The equation $y = 375x$ represents the relationship between x, the time that a plane flies in hours, and y, the distance the plane flies in miles for Plane A. The table represents the relationship for Plane B. Find the slope of the graph for each plane's rate of speed. Determine which plane is flying at a faster rate of speed.

Time (hr)	1	2	3	4
Distance (mi)	425	850	1275	1700

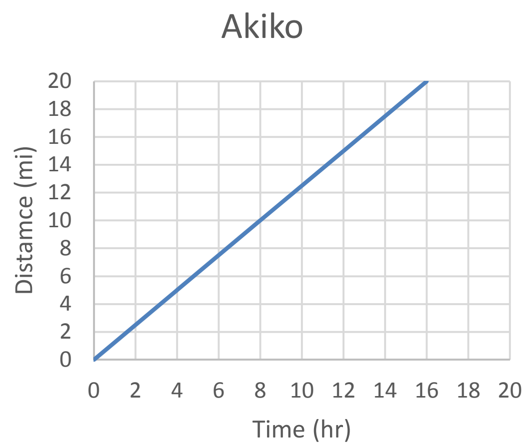
Give the slope of the graph and the unit rate.

1. Jorge: 5 miles every 6 hours

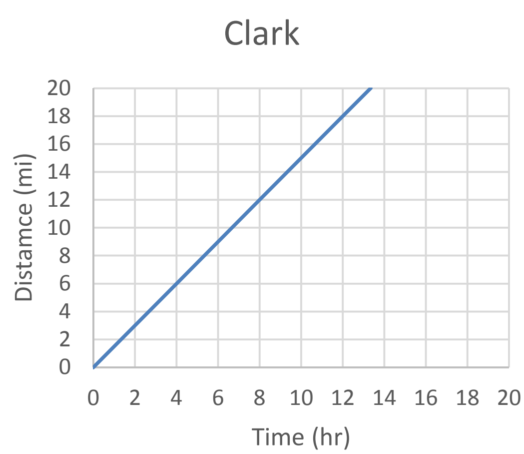


2. Akiko

Time (hr)	4	8	12	16
Distance (mi)	5	10	15	20



3. The equation $y = 0.5x$ represents the distance Henry hikes in miles over time in hours. The graph represents the rate that Clark hikes. Determine each hiker's slope/unit rate/speed and which hiker is faster.



Write an equation relating the variables in each table.

4.

Time (x)	1	2	4	6
Distance (y)	15	30	60	90

5.

Time (x)	16	32	48	64
Distance (y)	6	12	18	24

6. Describe methods you use to show a proportional relationship between two variables, *x* and *y*. For each method, explain how you can find the unit rate and the slope.

Activity 5-43: **The Unit Rate as Slope (3.3)** Name:

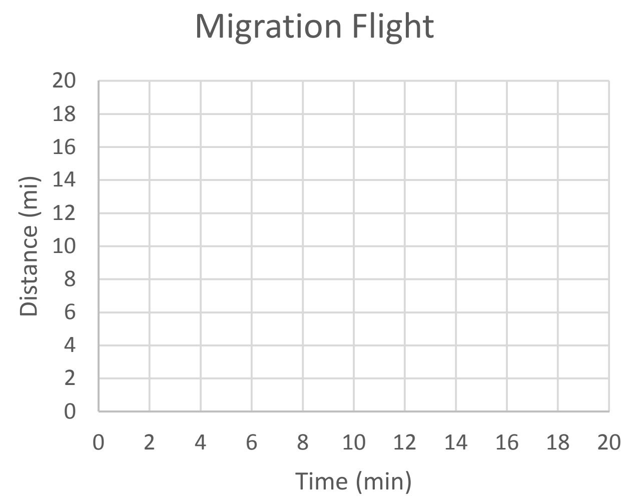
1. A Canadian goose migrated at a steady rate of 3 miles every 4 minutes.

   A. Fill in the table to describe the relationship.

Time (min)	4	8			20
Distance (mi)					

   B. Graph the relationship.

   C. Find the slope of the graph and describe what it means in the context of this problem.

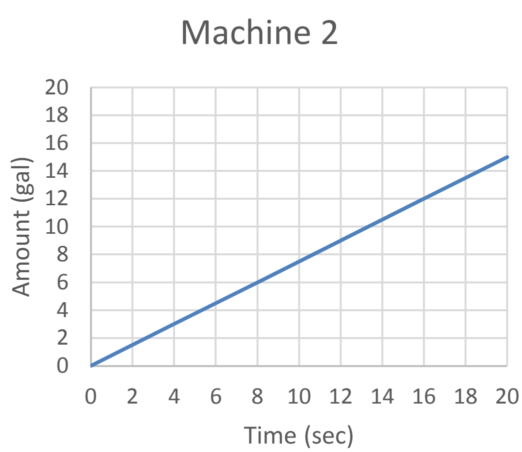


2. The table and the graph represent the rate at which two machines are bottling milk in gallons per second.

Machine 1

Time (sec)	1	2	3	4
Amount (gal)	0.6	1.2	1.8	2.4

Machine 2



   A. Determine the slope and the unit rate of each machine.

   B. Determine which machine is working at a faster rate.

1. The equation $y = \frac{1}{9}x$ represents the distance *y*, in kilometers, that Patrick traveled in *x* minutes while training for the cycling portion of a triathlon. The table shows the distance *y* Jennifer traveled in *x* minutes in her training. What is each person's training rate and who is faster?

Time (min)	40	64	80	96
Distance (km)	5	8	10	12

2. There is a proportional relationship between minutes and cost in dollars. The graph passes through the point (1, 4.75). What is the slope of the graph? What is the unit rate? Explain.

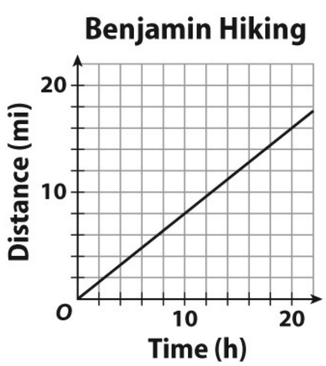
3. Two cars start at the same time and travel at different constant rates. The graph of the distance in miles given the time in hours for Car A passes through the point (0.5, 27.5) and the graph for Car B passes through the point (4, 240). Which car is traveling faster? Explain.

4. The table shows the rate at which water is being pumped into a swimming pool. Use the unit rate and the amount of water pumped after 12 minutes to find how much water will have been pumped into the pool after $13\frac{1}{2}$ minutes. Explain your reasoning.

Time (min)	2	5	7	12
Amount (gal)	36	90	126	216

For the two questions below find the slope and unit rate.

5.



6. **Marcy Hiking**

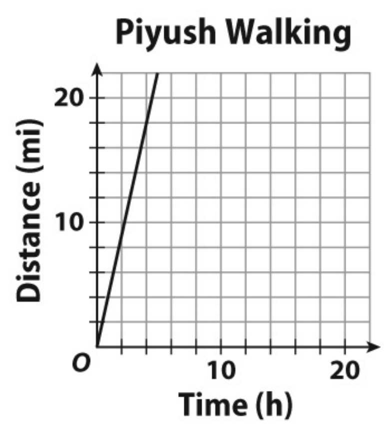
Time (h)	5	10	15	20
Distance (mi)	6	12	18	24

7. The equation $y = 3.5x$ represents the rate, in miles per hour, at which Laura walks.

   The graph at right represents the rate at which Piyush walks. Determine who walks faster. Explain.

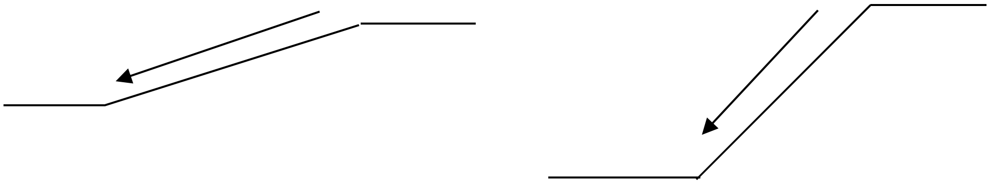
   ____

   ____

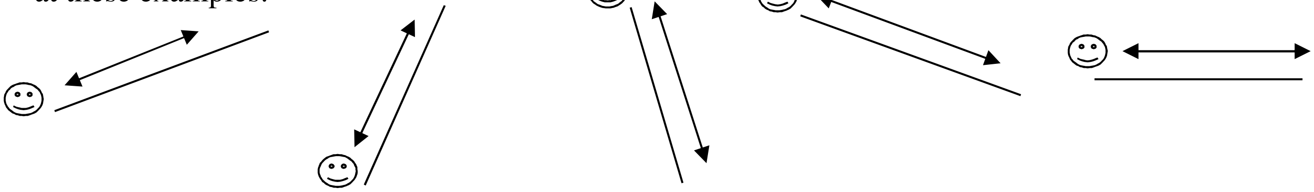


Activity 5-45: **Slope of a Line** Name: ______________________________

Which would be a harder ski slope to ski down?



If you said the first one, you have not been skiing before! The second one is much more difficult because it has a greater slope. **Slope** is a mathematical term that we can actually measure. Take a look at these examples:



Small positive Slope	Large positive slope	Large negative slope	Small negative slope	No slope

When looking at an equation you can determine whether the slope will be positive or negative using two methods:
1. Graph the equation or function and look at the direction of your line.
2. Look at the coefficient in front of the *x,* when the equation is written in the form of $y = mx + b$. If it is a positive number, the slope will be positive. If it is a negative number, the slope will be negative.

Ex. $y = 2x - 1$ Two is the coefficient, so the slope will be positive.
Ex 2. $y = -2x - 1$ Negative two is the coefficient, so the slope will be negative.

Determine whether or not the slope of the following lines is **positive** or **negative**.

1.	$y = 5x$		2.	$y = 12x - 5$	
3.	$y = -9x + 2$		4.	$y = -x - 17$	
5.	$y = 5 - 3x$		6.	$y = 4 + 6x$	
7.	$y = 10 - x$		8.	$y = -54x$	
9.	$y = \frac{1}{5}x - 1$		10.	$y = -0.3x - 3$	
11.	$y = -5(-2x + 4)$		12.	$y = 3(-2x + 8)$	
13.	$y = 2(4 + 5 - 2x)$		14.	$y = x$	
15.	$y = 6$		16.	$x + y = 0$	

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.

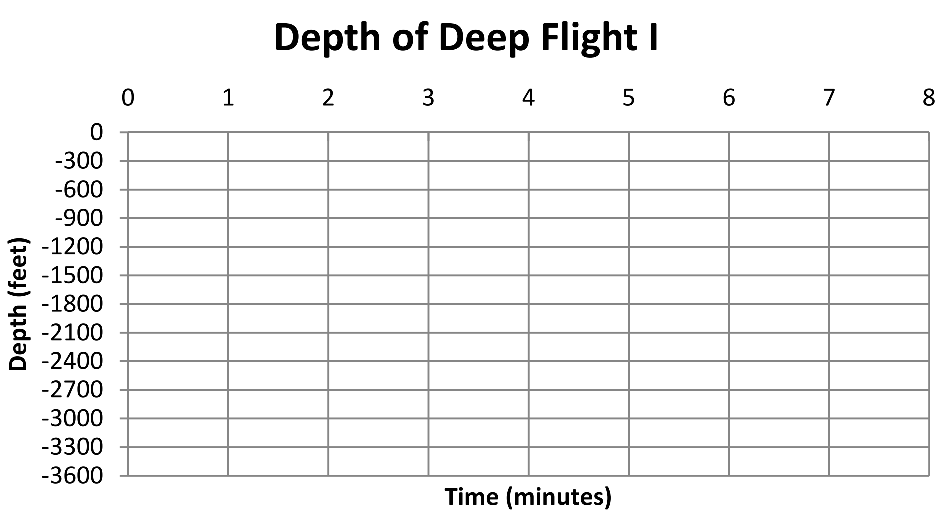
1.	Write an equation to represent the depth of Deep Flight I.	

Use your equation to complete the table below.

Independent Quantity = Minutes	**Dependent Quantity = Depth**	**Independent Quantity = Minutes**	**Dependent Quantity = Depth**
x	*y*	*x*	*y*
0		4	
1		5	
2		6	
3			

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

Construct a graph of this problem situation.



PROPORTIONAL RELATIONSHIPS: CHAPTER 6

Module 3.1

When unit rates are equal, that means a constant rate of change. This is a **proportional relationship.**

A proportional relationship can be written by the equation $y = kx$.

Unit Rate (Ratio)

The variable k is called the **constant of proportionality**.

When graphed a proportional relationship is a **straight line** through the **origin**.

In proportional relationships
Unit rate =
Constant rate of change =
Constant of proportionality =
k

Module 3.2

Rate of Change = Amount of change in the output to the amount of change in the input.

In proportional relationships the rate of change is constant.

When graphed the constant rate of change is called **slope**.

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{\text{Change in } y}{\text{Change in } x}$$

Module 3.3

Unit Rate

Unit Rate =
Slope =
Constant of proportionality

Module 3.4

Constant of proportionality k

A **direct variation** is a relationship that can be written as $y = kx$.

Constant of variation =
k =
Constant of proportionality

Graphs of direct variation pass through the origin.

Created by Lance Mangham, 6th grade math, Carroll ISD