Algebra I

Lesson 12.1 – Inverse Variation

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In chapter 5 we learned that when two variable quantities have a constant (unchanged) ratio, their relationship is called a **direct variation**. We say that y varies directly as x. The constant ratio, **k**, is called the **constant of variation**. The formula for direct variation is: $y = kx \quad where: \ k = \frac{y}{x}$. Basically, our constant of variation is our slope.

There is another relationship between x and y that is known as **Inverse Variation**. In an inverse variation, the values of the two variables change in an opposite manner, that is, as one value increases, the other proportionately decreases. We say that y varies inversely to x or y is inversely proportional to x.

Vocabulary

Inverse Variation – A relationship that can be written in the form $y = \frac{k}{x}, \ or \ x = \frac{k}{y}, \ where \ \boldsymbol{k} = \boldsymbol{xy}$

Direct Variation – A relationship that can be written in the form $y = kx, \ where \ \boldsymbol{k} = \frac{\boldsymbol{y}}{\boldsymbol{x}}$

Constant of Variation – is the number that relates two variables that are directly proportional or inversely proportional to one another. The constant ***k*** in direct and inverse variation equations.

Question: Is the graph of an inverse variation linear? What is the form of a linear equation?

How can we tell if a set of data is direct or inverse variation? Well, what is our constant of variation equal to for our different variation problems?

Direct variation	**Inverse variation**
look for a constant rate of change: $\boldsymbol{k} = \frac{\boldsymbol{y}}{\boldsymbol{x}}$	look for a constant product: $\boldsymbol{k} = \boldsymbol{xy}$

Are the relationships direct or inverse variations? Write the equation that models the data.

x	1	2	3	4
y	2.5	5	7.5	10

x	-2	-1	1	5
y	-5	-4	4	.8

x	1	2	4	5
y	-2.5	-1.25	-.625	-.5

x	2	4	6
y	3.2	1.6	1.1

When given an equation and asked to determine if it is an inverse relationship, see if the equation can be written in the form $y = \frac{k}{x}$.

Which are inverse variation equations?

$-7xy = 49$	$2x + y = 8$	$3y = 3x - 2y$	$4xy + 5x = 6 + 5x$

Example: Given y varies inversely as x. Write a variation function when $y = 1.4\ and\ x = 0.3$.

What is the value of $y, when\ x = 5$?
$x\ when\ y = -0.3$?

1. Using our equation for inverse variation, substitute the values for x and y. Solve for k.
2. With the value of k, write the equation for inverse variation.
3. You now have an equation that for any given value of x you can find y and visa versa.

x and y vary inversely. When $x = 16, y = 0.5$. Write an equation that models this relationship.

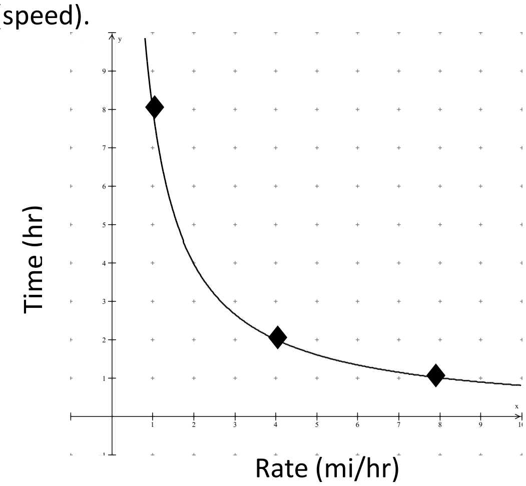
What is x when $y = 30$? What is y when $x = -2$?

Let's look at an example. How long will it take a cycler to bike 8 miles? Well that depends on his speed. A biker traveling at 8 mph can cover 8 miles in 1 hour. If the biker's speed decreases to 4 mph, it will take the biker 2 hours to cover the same distance.

Rate (mi/hr)	Time (hr)
8	1
4	2
1	8

Notice that as the rate decreases, the time increases. Cut the rate in half, the time doubles. Our rate equation may be written as $t = \frac{d}{r}$, at distance equal to 8 miles we get: $t = \frac{8}{r}\ or\ tr = 8$

Graphically we see can see the relation between time and rate (speed).

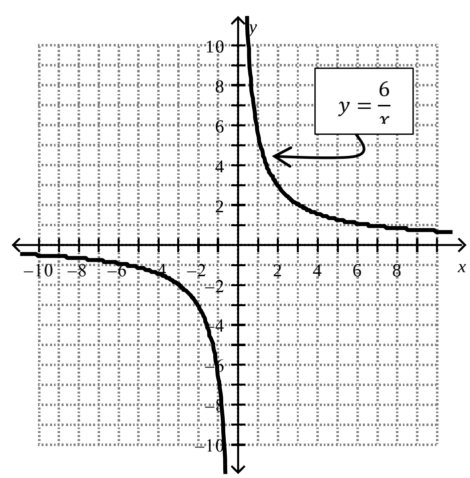


Graph: $y = \frac{6}{x}, \quad y = -\frac{2}{x}, \ and\ y = \frac{1}{x}$

Yes! Table of values, choose both negative and positive values for x. You

x	y
-8	
$-\frac{1}{2}$	
0	
2	
8	

x	y



An inverse variation graph is made up of 2 parts or branches. Note the graph of an inverse variation will never contain the point (0, 0). Why?

Well, look at the equation, can x=0?
There are **Asymptotes** at $x = 0\ and\ y = 0$