

Variation problems often set up as rational equations. Given two quantities x and y the following keywords indicate a particular relationship where k is called the variation constant.

<p><u>Direct Variation:</u></p> <p>y <i>varies directly as</i> x or y is <i>directly proportional</i> to x</p> <p>$y = kx$</p>	<p><u>Inverse Variation:</u></p> <p>y <i>varies inversely as</i> x or y is <i>inversely proportional</i> to x</p> <p>$y = \frac{k}{x}$</p>	<p><u>Direct Variation:</u></p> <p>y <i>varies jointly as</i> x or y is <i>jointly proportional</i> to x</p> <p>$y = kxy$</p>
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D. Variation Problems

Weight on Earth varies directly with the weight on the Moon. With his equipment, an astronaut weighs 360 pounds on earth but only 60 pounds on the moon. If another astronaut had landed on the moon that weighed 54 pounds with her equipment, how much would she weigh on Earth with equipment?

The weight of a body varies inversely as the square of its distance from the center of the Earth. If a person weighs 175 pounds on the surface of the earth ($r \approx 4000$ miles) how much will he weigh at 1000 miles above the Earths surface?

A passenger train can travel 20mph faster than a freight train. If the passenger train can cover 390 miles in the same time it takes the freight train to cover 270 miles, how fast is each train?

Billy rode his skateboard 24 miles to his grandmother's house for the day. It was a rough ride so he borrowed his grandmother's bicycle for the return trip. Going twice as fast on the bicycle the return trip took 2 hours less time. What was his average speed on the bicycle?

Brett lives on the river 45 miles upstream from town. When the current is 2mph he can row his boat downstream to town for supplies and back in 14 hours. What is his average rowing speed in still water?

Joe can complete his yard work in 3 hours. If his son helps it will only take 2 hours working together. How long would the yard work take if his son was working alone?

Norm and Cliff can paint the office in 5 hours working together. Being a professional painter, Norm can paint twice as fast as Cliff. How long would it take Cliff to paint the office by himself?

We have set up *uniform motion problems* using the formula $D = rt$. For the following motion problems we will need the equivalent formula $\frac{D}{r} = t$ to set up the equations.

C. Uniform Motion Problems

The first leg of Mary's road trip consisted of 120 miles of traffic. When the traffic cleared she was able to drive twice as fast for 300 miles. If the total trip took 9 hours how long was she stuck in traffic?

The difference between the reciprocals of two consecutive positive odd integers is $\frac{2}{15}$.
Find the integers.

We have two equivalent formulas to choose from when solving *work-rate problems*. If two people are working together on a job then their rates add and they can perform the job working together in a shorter amount of time.

If we let x = time it takes person 1 to complete the task then his work rate is $\frac{1}{x}$. In other words, he can complete the 1 job in x number of hours. If we let y = time it takes person 2 to complete the task and t = time it takes with both working together we get the following formulas:

Work – Rate Formulas: $\frac{1}{x} + \frac{1}{y} = \frac{1}{t}$ or alternatively $\frac{t}{x} + \frac{t}{y} = 1$

B. Work-Rate Problems

Bill's garden hose can fill the pool in 12 hours. His neighbor has a hose that can fill the pool in 15 hours. How long will it take to fill the pool using both hoses?

The set-up for the applications in this chapter will be rational equations. The keyword, **reciprocal**, appears often. Remember that the reciprocal of a number is 1 divided by that number.

A. Number Problems (w/ keyword reciprocal)

One positive integer is 5 more than the other. When the reciprocal of the larger number is subtracted from the reciprocal of the smaller the result is $\frac{5}{14}$. Find the two integers.

Blank space for solving the first word problem.

The difference between two integers is 5. If the reciprocal of the smaller is added to twice the reciprocal of the larger the result is $\frac{23}{66}$. Find the two integers.

Blank space for solving the second word problem.