



NAME \_\_\_\_\_

**Module 16** Solving Rational Equations  
**Lesson 3** Solving Problems Using Inverse Variation

Does  $y$  vary inversely as  $x$ ? If so, find the constant of variation and write the inverse variation function.

1. 

$x$	$y$
4	16
8	8
-2	-32

yes;  $k = 64$ ;  $xy = 64$

2. 

$x$	$y$
$\frac{2}{3}$	27
2	9
-3	-6

yes;  $k = 18$ ;  $xy = 18$

3. 

$x$	$y$
2	8
4	-4
16	1

no

4. 

$x$	$y$
-2	-4
4	2
16	0.5

yes;  $k = 8$ ;  $xy = 8$

5. 

$x$	$y$
0	0
5	0
0	-3

no

6. 

$x$	$y$
0.3	0.4
0.1	1.2
6	0.02

yes;  $k = 0.12$ ;  $xy = 0.12$

**Solve.**

7. The variable  $y$  varies inversely as  $x$ :  $y$  is 16 when  $x$  is 4. Find  $x$  when  $y$  is 2.  
 $x = 32$

8. The variable  $y$  varies inversely as  $x$ :  $y$  is 15 when  $x$  is -5. Find  $y$  when  $x$  is -25.  
 $y = 3$

9. The variable  $y$  varies inversely as  $x$ :  $y$  is  $\frac{1}{2}$  when  $x$  is 8. Find  $x$  when  $y$  is 4.  
 $x = 1$

10. The variable  $y$  varies inversely as  $x$ :  $y$  is -6 when  $x$  is  $-\frac{2}{3}$ . Find  $x$  when  $y$  is 2.  
 $x = 2$

11. The variable  $y$  varies inversely as  $x$ :  $y$  is 2.4 when  $x$  is 0.2. Find  $x$  when  $y$  is -0.1.  
 $x = -48$

12. The variable  $y$  varies inversely as  $x$ :  $y$  is  $\frac{3}{2}$  when  $x$  is 4. Find  $y$  when  $x$  is  $\frac{1}{2}$ .  
 $y = 12$

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13. The time needed to rake leaves varies inversely as the number of people raking. If 4 people rake the leaves in 4 hours, how long will it take 8 people to rake leaves?

**2 hours**

15. If a seesaw is balanced, the weight of each person varies inversely with that person's distance from the fulcrum of the seesaw. Barb, who weighs 75 pounds, is sitting 48 inches from the fulcrum. To balance the seesaw, how far away from the fulcrum must Billy sit if he weighs 60 pounds?

**60 inches**

17. The frequency of a vibrating string varies inversely as its length. If a 30-inch piano string vibrates at a frequency of 660 cycles per second, find the frequency of a 36-inch string.

**550 cycles per second**

19. The mass of a given object varies inversely as the acceleration of the object. A cart with a mass 40 g has an acceleration  $2.5 \text{ m/s}^2$ . What is the acceleration of a 50 g cart?

**$2 \text{ m/s}^2$**

21. Rate varies inversely as time. Sandy rode her bicycle to Micah's house at a rate of 5 mi/h. She returned home at a rate of 4 mi/h. If the first leg of the trip took 20 minutes, how long did the second leg of the trip take?

**25 minutes**

23. A frequency,  $F$ , varies inversely as wavelength,  $W$ . The constant of variation is speed,  $S$ . Write a formula to express this relationship.

**$FW = S$**

14. A triangle has a length of 6 inches and a height 10 inches. A second triangle with the same area has a length 8 inches. What is the height of the second triangle?

**7.5 inches**

16. Michael weighs 150 pounds, and Carma weighs 100 pounds. They are seated at opposite ends of a seesaw where the weight of each person varies inversely with that person's distance from the fulcrum of the seesaw. Michael is 75 inches from the fulcrum. How far is Carma from the fulcrum?

**$112\frac{1}{2}$  inches**

18. The volume of a gas varies inversely with applied pressure. If the pressure acting on  $90 \text{ m}^3$  of a gas is raised from 2 atmospheres to 3 atmospheres, what new volume does the gas occupy?

**$60 \text{ m}^3$**

20. The density of an object varies inversely as its volume. The density of an object which has a volume of  $240 \text{ cm}^3$  is  $3 \text{ g/cm}^3$ . Find the density of an object with the same mass that has a volume of  $180 \text{ cm}^3$ .

**$4 \text{ g/cm}^3$**

22. Rate varies inversely as time. If it takes Marci 10 hours to travel from Fargo, ND, to Kansas City, MO, at 60 mi/h, how long will it take her to make the trip at 50 mi/h?

**12 hours**

24. Voltage,  $V$ , varies inversely as current  $I$ . The constant of variation is power,  $P$ . Write a formula to express this relationship.

**$VI = P$**

## Journal

1. The variable  $y$  varies inversely as  $x$ . Explain what happens to the value of  $y$  when the value of  $x$  is doubled.
2. The variable  $y$  varies inversely as the square of  $x$ . Explain what happens to the value of  $y$  when the value of  $x$  is doubled.
3. James claims that Ray's grade varies inversely as the amount of time he sleeps in class. Write an algebraic equation to explain this statement.
4. Explain how you could find the constant of variation in an inverse variation problem.
5. Compare and contrast direct variation with inverse variation.

## Cumulative Review

Simplify each rational expression. State the restricted values of each variable.

1.  $\frac{2x}{6x-4} \cdot \frac{x}{3x-2}; x \neq \frac{2}{3}$

2.  $\frac{x^2 + 3x - 40}{x + 8} \cdot \frac{x - 5}{x - 5}; x \neq -8$

3.  $\frac{25m^2 - 40m + 16}{25m^2 - 16} \cdot \frac{5m - 4}{5m + 4}; m \neq \pm \frac{4}{5}$

4.  $\frac{4z^2 + 16z - 8}{8z} \cdot \frac{z^2 + 4z - 2}{2z}; z \neq 0$

Solve. Assume the quantities vary directly.

5. The variable  $y$  is 3 when  $x$  is 8. Find  $y$  when  $x$  is 4.  $y = \frac{3}{2}$  or  $1\frac{1}{2}$

6. The variable  $y$  is 12 when  $x$  is 3. Find the constant of variation,  $k$ .  $k = 4$

7. If 5 pounds of sugar costs \$2.39, how much will 4 pounds cost to the nearest cent? **\$1.91**

8. A car uses 14 gallons of gas to travel 252 miles. How far can the car travel on 4 gallons? **72 miles**

## Calculator Problem

Use a graphing calculator to determine if  $y = 3\frac{1}{x}$  is a direct variation or an inverse variation function.

1. Press  $\text{Y=}$ . Enter the function  $y = 3\frac{1}{x}$  into  $Y_1$ . See Figure 1.
2. Press  $\text{GRAPH}$ . See Figure 2. (You may want to set your window measurement as in Figure 3.)
3. If the function is a direct variation, the graph will be a non-vertical and non-horizontal line through the origin. If the function is an inverse variation, the graph will be similar to the graph of  $y = \frac{1}{x}$ . The graph in Figure 2 is similar to the graph of  $y = \frac{1}{x}$ . This is an inverse variation.



Figure 1

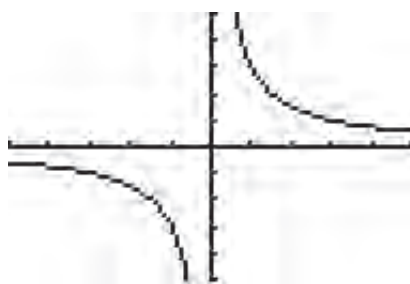


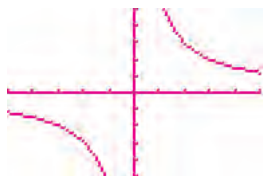
Figure 2



Figure 3

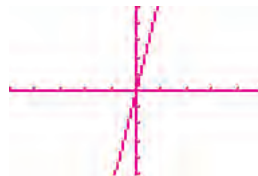
Graph each equation using a graphing calculator. Determine whether each equation is a direct variation, an inverse variation, or neither.

1.  $y = \frac{6}{x}$



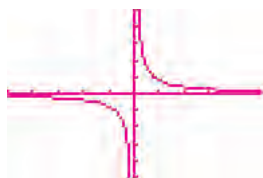
inverse variation

2.  $y = 6x$



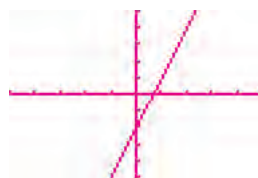
direct variation

3.  $y = \frac{7}{9x}$



inverse variation

4.  $y = 3x - 2$



neither

**Possible Journal Answers**

1. Since  $xy = k$ , if the value of  $x$  is doubled, the value of  $y$  must be divided by 2 in order to maintain equality. So,  $xy = (2x)(\frac{1}{2}y) = k$ .
2. Since  $x^2y = k$ , if the value of  $x$  is doubled, the value of  $y$  must be divided by 4 in order to maintain equality. So,  $x^2y = (4x^2)(\frac{1}{4}y) = k$ , because  $(2x)^2 = 2^2x^2 = 4x^2$ .
3. James claims that the Ray's grade,  $G$ , varies inversely as the amount of time he sleeps in class,  $T$ . The constant of variation is  $k$ . So, the equation  $GT = k$  explains the scenario in the problem.
4. To get the constant of variation in an inverse variation, calculate the product  $xy$  for an ordered pair of the function.
5. Both direct variation and inverse variation have a constant of variation. However, whereas direct variation is a linear relationship, inverse variation is not. In a direct variation, the quotient of  $x$  and  $y$  is constant. In an inverse variation, the product of  $x$  and  $y$  is constant.