

3.5

Inverse Variation

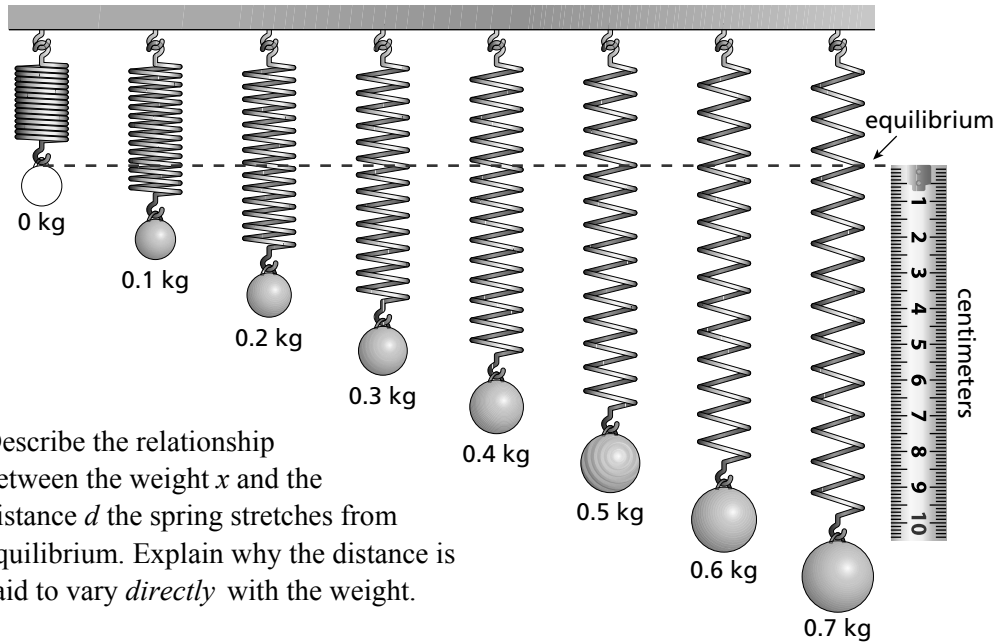
For use with Exploration 3.5

Essential Question How can you recognize when two quantities vary directly or inversely?

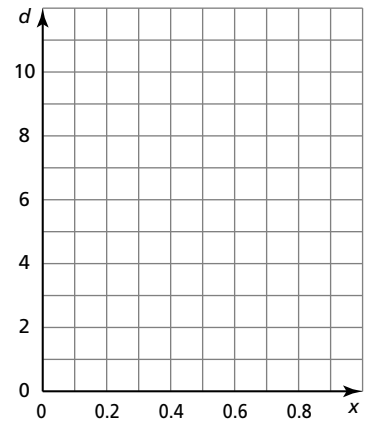
1 EXPLORATION: Recognizing Direct Variation

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. You hang different weights from the same spring.



- Describe the relationship between the weight x and the distance d the spring stretches from equilibrium. Explain why the distance is said to vary *directly* with the weight.
- Estimate the values of d from the figure. Then draw a scatter plot of the data. What are the characteristics of the graph?
- Write an equation that represents d as a function of x .
- In physics, the relationship between d and x is described by *Hooke's Law*. How would you describe Hooke's Law?

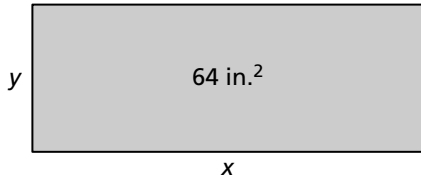


3.5 Inverse Variation (continued)

2 EXPLORATION: Recognizing Inverse Variation

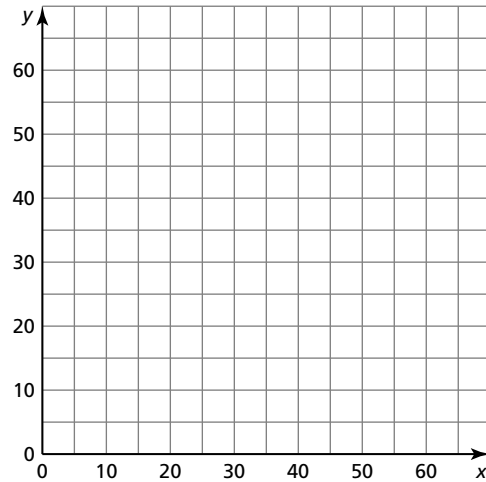
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. The table shows the length x (in inches) and the width y (in inches) of a rectangle. The area of each rectangle is 64 square inches.



x	y
1	
2	
4	
8	
16	
32	
64	

- Complete the table.
- Describe the relationship between x and y . Explain why y is said to vary *inversely* with x .
- Draw a scatter plot of the data. What are the characteristics of the graph?
- Write an equation that represents y as a function of x .



Communicate Your Answer

- How can you recognize when two quantities vary directly or inversely?
- Does the flapping rate of the wings of a bird vary directly or inversely with the length of its wings? Explain your reasoning.

3.5**Practice**

For use after Lesson 3.5

Core Concepts**Inverse Variation**

Two variables x and y show **inverse variation** when they are related as follows:

$$y = \frac{a}{x}, a \neq 0$$

The constant a is the **constant of variation**, and y is said to *vary inversely* with x .

Notes:**Worked-Out Examples****Example #1**

Tell whether x and y show **direct variation**, **inverse variation**, or **neither**.

$$y = \frac{2}{x}$$

Given Equation	Solved for y	Type of Variation
$y = \frac{2}{x}$	$y = \frac{2}{x}$	inverse

Example #2

The variables x and y **vary inversely**. Use the given values to write an equation relating x and y . Then find y when $x = 3$.

$$x = \frac{3}{4}, y = 28$$

$$y = \frac{a}{x}$$

$$28 = \frac{a}{\frac{3}{4}}$$

$$21 = a$$

The inverse variation equation is $y = \frac{21}{x}$. When $x = 3$,

$$y = \frac{21}{3} = 7.$$

3.5 Practice (continued)**Practice A**

In Exercises 1–9, tell whether x and y show *direct variation*, *inverse variation*, or *neither*.

1. $3xy = 1$

2. $\frac{5}{x} = y$

3. $x + 11 = y$

4. $x + y = -2$

5. $\frac{4}{5}x = y$

6. $x - 8y = 1$

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

8. $6xy = 0$

9. $\frac{y}{9x} = 1$

In Exercises 10–12, tell whether x and y show *direct variation*, *inverse variation*, or *neither*.

10.

x	2	4	6	8	10
y	4	16	36	64	100

11.

x	1	5	8	20	50
y	5	1	0.625	0.25	0.1

12.

x	2	5	8.4	12	15
y	0.5	1.25	2.1	3	3.75

3.5 Practice (continued)

In Exercises 13–16, the variables x and y vary inversely. Use the given values to write an equation relating x and y . Then find y when $x = 5$.

13. $x = 2, y = 2$

14. $x = 6, y = 3$

15. $x = 20, y = \frac{7}{20}$

16. $x = \frac{10}{9}, y = \frac{3}{2}$

17. When temperature is held constant, the volume V of a gas is inversely proportional to the pressure P of the gas on its container. A pressure of 32 pounds per square inch results in a volume of 20 cubic feet. What is the pressure if the volume becomes 10 cubic feet?
18. The time t (in days) that it takes to harvest a field varies inversely with the number n of farm workers. A farmer can harvest his crop in 20 days with 7 farm workers. How long will it take to harvest the crop if he hires 10 farm workers?

Practice B

In Exercises 1–6, tell whether x and y show *direct variation*, *inverse variation*, or *neither*.

1. $y = \frac{12}{x}$

2. $xy = 15$

3. $9x = y$

4. $y = x - 3$

5. $\frac{y}{x} = 9$

6. $xy = \frac{1}{3}$

In Exercises 7–10, tell whether x and y show *direct variation*, *inverse variation*, or *neither*.

7.

x	2.5	4	7.5	9
y	30	48	90	108

8.

x	12	5	2.5	1.5
y	35	84	168	280

9.

x	2.5	3	6	10
y	8	9.6	1.6	6

10.

x	2.5	10	16	21
y	672	168	105	80

In Exercises 11–13, the variables x and y vary inversely. Use the given values to write an equation relating x and y . Then find y when $x = 3$.

11. $x = 4, y = -3$

12. $x = \frac{2}{3}, y = -5$

13. $x = -10, y = -\frac{1}{5}$

14. The variables x and y vary inversely. Describe and correct the error in writing an equation relating x and y .

\times $x = \frac{1}{3}, y = 2$ $xy = a$ $\frac{1}{3} \cdot 2 = a$ $a = \frac{2}{3}$ So, $y = \frac{3x}{2}$.

15. The current y in a certain circuit varies inversely with the resistance x in the circuit. If the current is 8 amperes when the resistance is 20 ohms, what will the current be when the resistance increases to 25 ohms?