

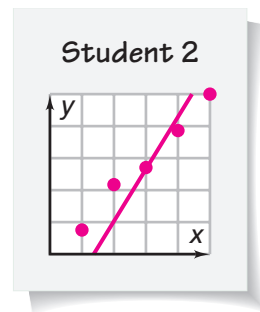
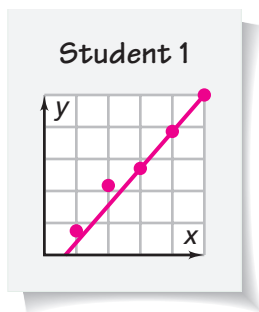
## Applications

1. Below are some results from the bridge-thickness experiment.

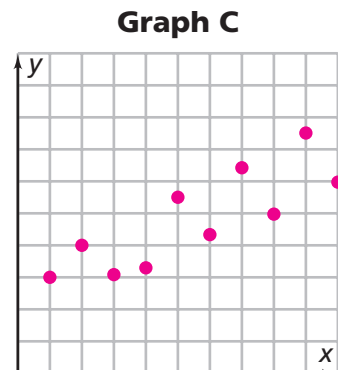
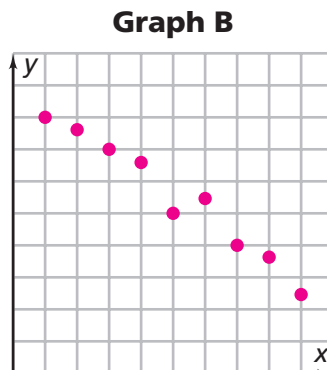
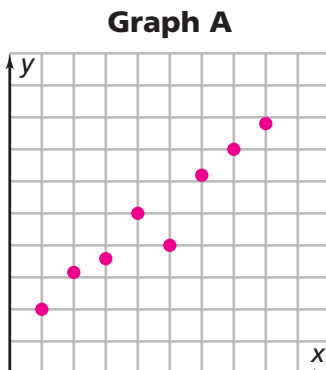
**Bridge-Thickness Experiment**

Thickness (layers)	2	4	6	8
Breaking Weight (pennies)	15	30	50	65

- Plot the (*thickness, breaking weight*) data. Draw a line that models the pattern in the data.
  - Find an equation for the line you drew.
  - Use your equation to predict the breaking weights of paper bridges 3, 5, and 7 layers thick.
2. Which line do you think is a better model for the data? Explain.



3. Copy each graph onto grid paper. Draw a line that fits each set of data as closely as possible. Describe the strategies you used.



4. This table gives the average weights of purebred Chihuahuas from birth to 16 weeks.

**Average Weights for Chihuahuas**

<b>Age (wk)</b>	0	2	4	6	8	10	12	14	16
<b>Weight (oz)</b>	4	9	13	17.5	21.5	25	30	34	39

SOURCE: *The Complete Chihuahua Encyclopedia*



- Graph the (*age, weight*) data. Draw a line that models the data pattern.
  - Write an equation of the form  $y = mx + b$  for your line. Explain what the values of  $m$  and  $b$  tell you about this situation.
  - Use your equation to predict the average weight of Chihuahuas for odd-numbered ages from 1 to 15 weeks.
  - What average weight does your linear model predict for a Chihuahua that is 144 weeks old? Explain why this prediction is unlikely to be accurate.
5. U-Wash-It Car Wash did market research to determine how much to charge for a car wash. The company makes this table based on its findings.

**U-Wash-It Projections**

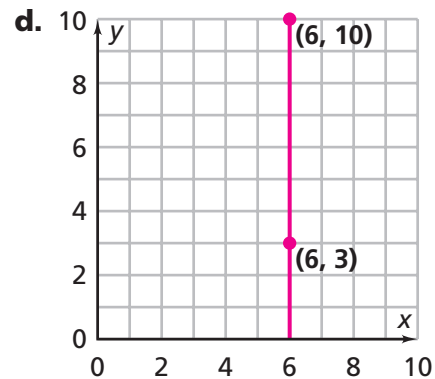
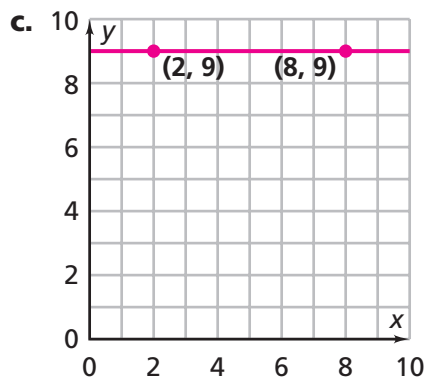
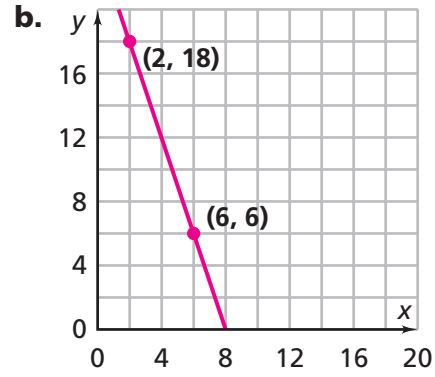
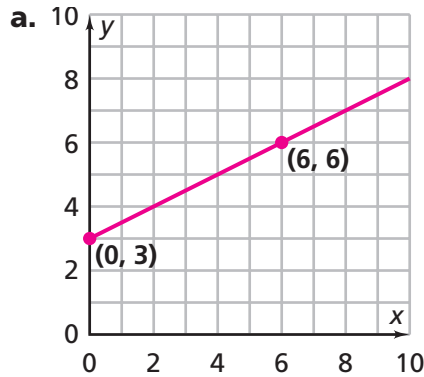
<b>Price per Wash</b>	\$0	\$5	\$10	\$15	\$20
<b>Customers Expected per Day</b>	100	80	65	45	20

- Graph the (*price, expected customers*) data. Draw a line that models the data pattern.
- Write an equation in the form  $y = mx + b$  for your graph. Explain what the values of  $m$  and  $b$  tell you about this situation.
- Use your equation to estimate the number of customers expected for prices of \$2.50, \$7.50, and \$12.50.

**Homework  
Help Online**  
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For: Help with Exercise 5  
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6. Find the slope,  $y$ -intercept, and equation for each line.



The relationships in Exercises 7–10 are linear.

7. a. A typical American baby weighs about 8 pounds at birth and gains about 1.5 pounds per month for the first year of life. What equation relates weight  $w$  in pounds to age  $a$  in months?  
 b. Can this model be used to predict weight at age 80? Explain.
8. Kaya buys a \$20 phone card. She is charged \$0.15 per minute for long-distance calls. What equation gives the value  $v$  left on her card after she makes  $t$  minutes of long-distance calls?
9. Dakota lives 1,500 meters from school. She leaves for school, walking at a speed of 60 meters per minute. Write an equation for her distance  $d$  in meters from school after she walks for  $t$  minutes.
10. A car can average 140 miles on 5 gallons of gasoline. Write an equation for the distance  $d$  in miles the car can travel on  $g$  gallons of gas.



11. Write a linear equation for each table relating  $x$  and  $y$ .

a.

$x$	0	3	6	10
$y$	2	8	14	22

b.

$x$	0	3	6	10
$y$	20	8	-4	-20

c.

$x$	2	4	6	8
$y$	5	8	11	14

d.

$x$	0	3	6	9
$y$	20	11	2	-7

For Exercises 12–17, find an equation for the line that satisfies the conditions.

12. Slope 4.2;  $y$ -intercept  $(0, 3.4)$

13. Slope  $\frac{2}{3}$ ;  $y$ -intercept  $(0, 5)$

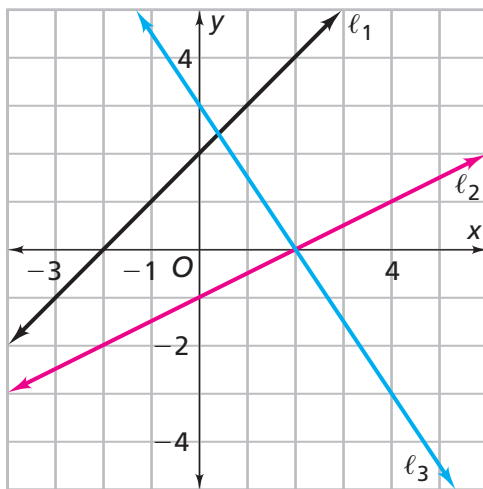
14. Slope 2; passes through  $(4, 12)$

15. Passes through  $(0, 15)$  and  $(5, 3)$

16. Passes through  $(-2, 2)$  and  $(5, -4)$

17. Parallel to the line with equation  $y = 15 - 2x$  and passes through  $(3, 0)$

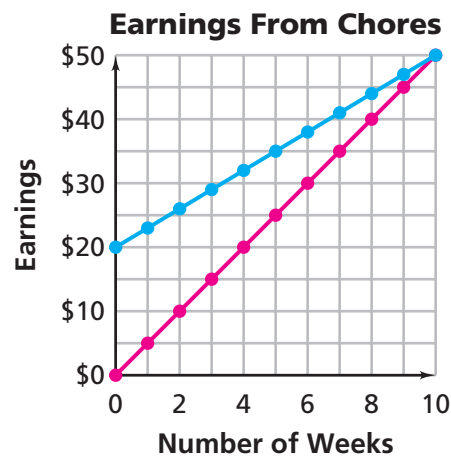
18. Write an equation for each line.



19. Anchee and Jonah earn weekly allowances for doing chores over the summer.

- Anchee's father pays her \$5 each week.
- Jonah's mother paid him \$20 at the beginning of the summer and now pays him \$3 each week.

The relationships between number of weeks worked and dollars earned are shown in this graph.



- Which line represents Jonah's earnings? Which line represents Anchee's earnings? Explain.
- Write two linear equations in the form  $y = mx + b$  to show the relationships between Anchee's earnings and the number of weeks she works and between Jonah's earnings and the number of weeks he works.
- What do the values of  $m$  and  $b$  in each equation tell about the relationship between the number of weeks and the dollars earned?
- What do the values of  $m$  and  $b$  tell about each line?



For Exercises 20–23, do the following:

a. Solve the equation. Show your steps.

b. Graph the associated line (for example, for  $5.5x + 32 = 57$ , graph  $y = 5.5x + 32$ ). Label the point that shows the solution.

20.  $5.5x + 32 = 57$

21.  $-24 = 4x - 12$

22.  $5x - 51 = 24$

23.  $74 = 53 - 7x$

24. At Water Works Amusement Park, the daily profit from the concession stands depends on the number of park visitors. The equation  $p = 2.50v - 500$  gives the estimated profit  $p$  in dollars if  $v$  people visit the park. In parts (a)–(c), use a graph to estimate the answer. Then, find the answer by writing and solving an equation or inequality.

a. For what number of visitors will the profit be about \$2,000?

b. One day 200 people visit the park. What is the approximate concession-stand profit for that day?

c. For what number of visitors will the profit be at least \$500?

25. The following formulas give the fare  $f$  in dollars that two bus companies charge for trips of  $d$  miles.

Transcontinental:  $f = 0.15d + 12$

Intercity Express:  $f = 5 + 0.20d$

In parts (a)–(c), use a graph to estimate the answer. Then, find the answer by writing and solving an equation or inequality.

a. For Transcontinental, how many miles is a trip that costs \$99?

b. For Intercity Express, how far can a person travel for a fare that is at most \$99?

c. Is there a distance for which the fare for the two bus lines is the same? If so, give the distance and the fare.

Solve each equation. Show the steps in your solutions.

26.  $5x + 7 = 3x - 5$     27.  $7 + 3x = 5x - 5$     28.  $2.5x - 8 = 5x + 12$

Find at least three values of  $x$  for which the inequality is true.

29.  $4x \leq 12$

30.  $3x < 18$

31.  $4x + 5 \leq 13$

32.  $3x - 9 \leq 18$

33. Every Friday, the mechanic for Columbus Public Schools records the miles driven and the gallons of gas used for each school bus. One week, the mechanic records these data.

**Data for Columbus Bus Fleet**

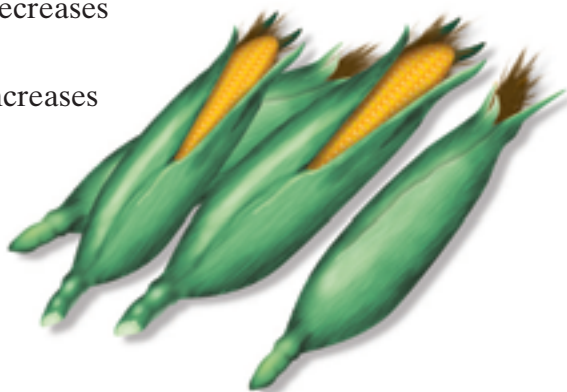
<b>Bus Number</b>	1	2	3	4	5	6	7	8
<b>Gas Used (gal)</b>	5	8	12	15	18	20	22	25
<b>Miles Driven</b>	80	100	180	225	280	290	320	375

- Write a linear equation that models the relationship between miles driven  $d$  and gallons of gas used  $g$ .
  - Use your equation to predict the number of miles such a bus could travel on 10 gallons of gas.
  - Use your equation to predict the number of gallons of gas required to drive such a bus 250 miles.
  - What do the values of  $m$  and  $b$  in your equation  $d = mg + b$  tell about the fuel efficiency of the school bus fleet?
34. One of the most popular items at a farmers' market is sweet corn. This table shows relationships among the price for the corn, the demand for the corn (how much corn people want to buy), and the leftovers of corn (how much corn the market has at the end of the day).

**Sweet Corn Supply and Demand**

<b>Price per Dozen</b>	\$1	\$1.50	\$2.00	\$2.50	\$3.00	\$3.50
<b>Demand (dozens)</b>	200	175	140	120	80	60
<b>Leftovers (dozens)</b>	40	75	125	175	210	260

- Why do you think the demand for corn decreases as the price goes up?
- Why do you think the leftovers of corn increases as the price goes up?
- Write a linear equation that models the relationship between demand  $d$  and price  $p$ .
- Write a linear equation that models the relationship between leftovers  $\ell$  and price  $p$ .
- Use graphs to estimate the price for which the leftovers equals the demand. Then, find the price by solving symbolically.



# Connections

35. Tell whether each table represents a linear relationship. Explain.

a.

x	2	4	6	8	10	12	14
y	0	1	2	3	4	5	6

b.

x	1	2	3	4	5	6	7
y	0	3	8	15	24	35	48

c.

x	1	4	6	7	10	12	16
y	2	-1	-3	-4	-7	-9	-13

36. For parts (a)–(d), copy the table. Then, use the equation to complete the table. Tell whether the relationship is linear. Explain.

a.  $y = -3x - 8$

x	-5	-2	1	4
y	■	■	■	■

b.  $y = 4(x - 7) + 6$

x	-3	0	3	6
y	■	■	■	■

c.  $y = x(3x + 2)$

x	-3	0	3	6
y	■	■	■	■

d.  $y = 4 - 3x$

x	-3	0	3	10
y	■	■	■	■

Copy each pair of numbers in Exercises 37–42. Insert  $<$ ,  $>$ , or  $=$  to make a true statement.

37.  $-5$  ■  $3$

38.  $\frac{2}{3}$  ■  $\frac{1}{2}$

39.  $\frac{9}{12}$  ■  $\frac{3}{4}$

40.  $3.009$  ■  $3.1$

41.  $\frac{-2}{3}$  ■  $\frac{-1}{2}$

42.  $-4.25$  ■  $-2.45$



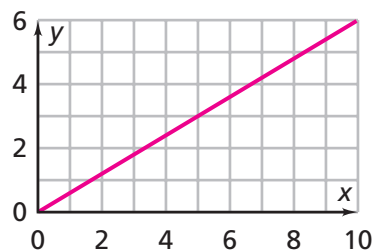
- 43.** Madeline sets a copy machine to enlarge by a factor of 150%. She then uses the machine to copy a polygon. Write an equation that relates the perimeter of the polygon after the enlargement  $a$  to the perimeter before the enlargement  $b$ .



**For Exercises 44–52, evaluate the expression without using a calculator.**

- |                           |                              |                               |
|---------------------------|------------------------------|-------------------------------|
| <b>44.</b> $-15 + (-7)$   | <b>45.</b> $-7 - 15$         | <b>46.</b> $-7 - (-15)$       |
| <b>47.</b> $-15 + 7$      | <b>48.</b> $-20 \div 5$      | <b>49.</b> $-20 \div (-5)$    |
| <b>50.</b> $20 \div (-4)$ | <b>51.</b> $-20 \div (-2.5)$ | <b>52.</b> $-20 \cdot (-2.5)$ |

- 53.** You can express the slope of a line in different ways. The slope of the line below is  $\frac{6}{10}$ , or 0.6. You can also say the slope is 60% because the rise is 60% of the run.



These numbers represent slopes of lines.

$\frac{-4}{-2}$       60%       $\frac{4}{4}$       1.5      150%      200%

- Which numbers represent the same slope?
- Which number represents the greatest slope? Which represents the least slope?

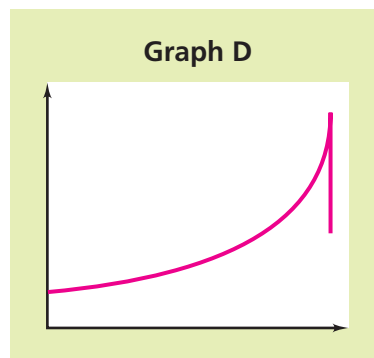
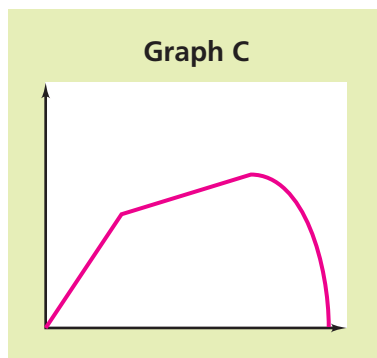
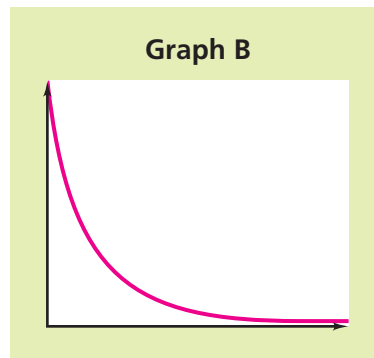
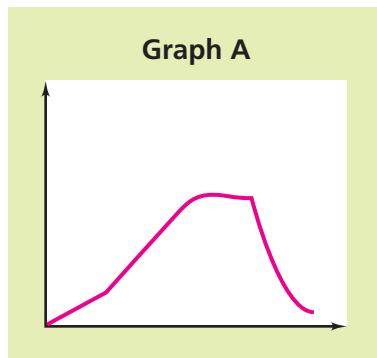
54. Consider the following stories and the graphs.

- a. Match each story with a graph. Tell how you would label the axes. Explain how each part of the story is represented in the graph.

**Story 1** A parachutist is taken up in a plane. After he jumps, the wind blows him off course. He ends up tangled in the branches of a tree.

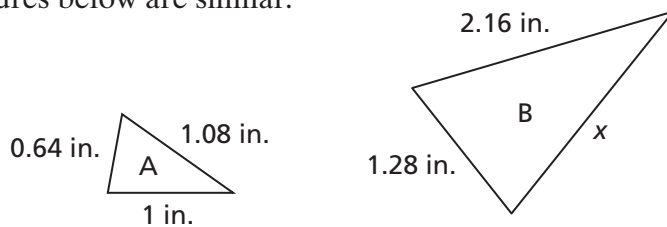
**Story 2** Ella puts some money in the bank. She leaves it there to earn interest for several years. Then one day, she withdraws half of the money in the account.

**Story 3** Gerry has a big pile of gravel to spread on his driveway. On the first day, he moves half of the gravel from the pile to his driveway. The next day he is tired and moves only half of what is left. The third day he again moves half of what is left in the pile. He continues in this way until the pile has almost disappeared.



- b. One of the graphs does not match a story. Make up your own story for that graph.

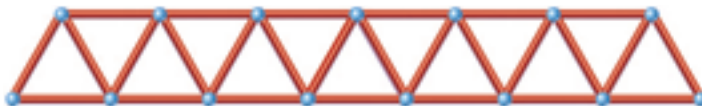
55. The figures below are similar.



- Find  $x$ .
- What is the scale factor from Triangle A to Triangle B?
- What is the scale factor from Triangle B to Triangle A?
- How are the scale factors in parts (b) and (c) related?

## Extensions

56. A bridge-painting company uses the formula  $C = 5,000 + 150L$  to estimate painting costs.  $C$  is the cost in dollars, and  $L$  is the length of the bridge in feet. To make a profit, the company increases a cost estimate by 20% to arrive at a bid price. For example, if the cost estimate is \$10,000, the bid price will be \$12,000.
- Find bid prices for bridges 100 feet, 200 feet, and 400 feet long.
  - Write a formula relating the final bid price to bridge length.
  - Use your formula to find bid prices for bridges 150 feet, 300 feet, and 450 feet long.
  - How would your formula change if the markup for profit was 15% instead of 20%?
57. Recall that Custom Steel Products builds beams from steel rods. Here is a 7-foot beam.



7-foot beam made from 27 rods

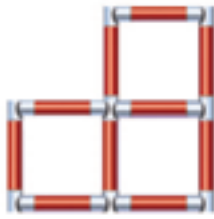
- Which of these formulas represents the relationship between beam length  $\ell$  and number of rods  $r$ ?
 

$r = 3\ell$	$r = \ell + (\ell - 1) + 2\ell$
$r = 4(\ell - 1) + 3$	$r = 4\ell - 1$
- How might you have reasoned to come up with each formula?

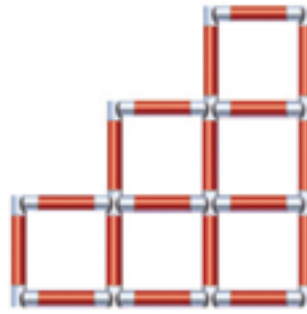
58. Recall that Custom Steel Products uses steel rods to make staircase frames. Here are staircase frames with 1, 2, and 3 steps.



1 step  
made from 4 rods



2 steps  
made from 10 rods



3 steps  
made from 18 rods

Which of these formulas represents the relationship between the number of steps  $n$  and number of rods  $r$ ?

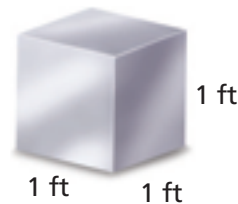
$$r = n^2 + 3n$$

$$r = n(n + 3)$$

$$r = n^2 + 3$$

$$r = (n + 3)n$$

Custom Steel Products builds cubes out of square steel plates measuring 1 foot on a side. At right is a 1-foot cube. Use this information for Exercises 59–61.



59. How many square plates are needed to make a 1-foot cube?
60. **Multiple Choice** Suppose CSP wants to triple the dimensions of the cube. How many times the number of plates in the original cube will they need for this larger cube?  
**A.** 2                      **B.** 3                      **C.** 4                      **D.** 9
61. **Multiple Choice** Suppose CSP triples the dimensions of the original cube. How many times the volume of the original cube is the volume of the new cube?  
**F.** 8                      **G.** 9                      **H.** 27                      **J.** 81
62. At Yvonne's Auto Detailing, car washes cost \$5 for any time up to 10 minutes, plus \$0.40 per minute after that. The managers at Yvonne's are trying to agree on a formula for calculating the cost  $c$  for a  $t$ -minute car wash.
- Sid thinks  $c = 0.4t + 5$  is correct. Is he right?
  - Tina proposes the formula  $c = 0.4(t - 10) + 5$ . Is she right?
  - Jamal told Tina her formula could be simplified to  $c = 0.4t + 1$ . Is he right?

**63.** Write an equation for each relationship.

- a.** One taxi company charges \$1.50 for the first 2 miles of any trip, and then \$1.20 for each mile after that. How is the taxi *fare* related to the *distance* of a trip?
- b.** An airport offers free parking for 30 minutes and then charges \$2.00 for each hour after that. How is the *price* for parking related to the *time* a car is parked?
- c.** A local cinema makes \$6.50 on each ticket sold. However, it has operating expenses of \$750 per day. How is *daily profit* related to *number of tickets* sold?



- d.** Rush Computer Repair sends technicians to businesses to fix computers. They charge a fixed fee of \$50, plus \$50 per hour. How is total *cost* for a repair related to *time* the repair takes?