Name _____ Date _____

1.2 Modeling with Linear Functions

For use with Exploration 1.2

Essential Question How can you use a linear function to model and analyze a real-life situation?

1 EXPLORATION: Modeling with a Linear Function

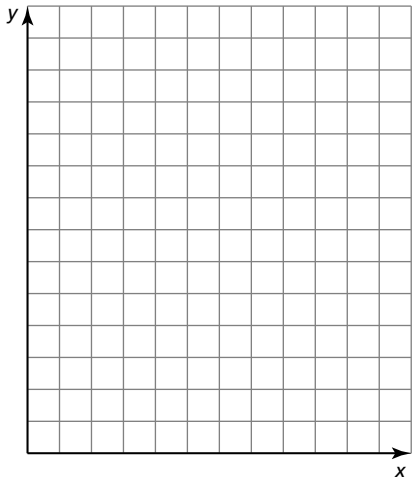
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. A company purchases a copier for $12,000. The spreadsheet shows how the copier depreciates over an 8-year period.

	A	B
1	**Year, *t***	**Value, *V***
2	0	$12,000
3	1	$10,750
4	2	$9,500
5	3	$8,250
6	4	$7,000
7	5	$5,750
8	6	$4,500
9	7	$3,250
10	8	$2,000
11		

a. Write a linear function to represent the value V of the copier as a function of the number t of years.

b. Sketch a graph of the function. Explain why this type of depreciation is called *straight line depreciation.*



c. Interpret the slope of the graph in the context of the problem.

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2 EXPLORATION: Modeling with Linear Functions

Work with a partner. Match each description of the situation with its corresponding graph. Explain your reasoning.

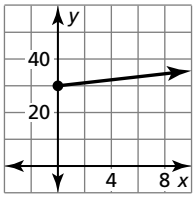
a. A person gives \$20 per week to a friend to repay a \$200 loan.

b. An employee receives \$12.50 per hour plus \$2 for each unit produced per hour.

c. A sales representative receives \$30 per day for food plus \$0.565 for each mile driven.

d. A computer that was purchased for \$750 depreciates \$100 per year.

A.



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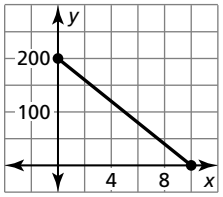

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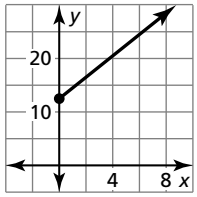

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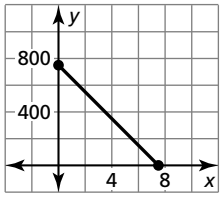


Communicate Your Answer

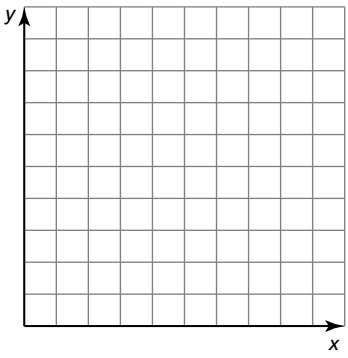
3. How can you use a linear function to model and analyze a real-life situation?

4. Use the Internet or some other reference to find a real-life example of straight line depreciation.

a. Use a spreadsheet to show the depreciation.

b. Write a function that models the depreciation.

c. Sketch a graph of the function.



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1.2 Practice
For use after Lesson 1.2

Core Concepts

Writing an Equation of a Line

Given slope *m* and *y*-intercept *b* Use slope-intercept form:

$$y = mx + b$$

Given slope *m* and a point (x_1, y_1) Use point-slope form:

$$y - y_1 = m(x - x_1)$$

Given points (x_1, y_1) and (x_2, y_2) First use the slope formula to find m. Then use point-slope form with either given point.

Notes:

Finding a Line of Fit

Step 1 Create a scatter plot of the data.

Step 2 Sketch the line that most closely appears to follow the trend given by the data points. There should be about as many points above the line as below it.

Step 3 Choose two points on the line and estimate the coordinates of each point. These points do not have to be original data points.

Step 4 Write an equation of the line that passes through the two points from Step 3. This equation is a model for the data.

Notes:

Worked-Out Examples

Example #1

MODELING WITH MATHEMATICS Two newspapers charge a fee for placing an advertisement in their paper plus a fee based on the number of lines in the advertisement. The table shows the total costs for different length advertisements at the Daily Times. The total cost y (in dollars) for an advertisement that is x lines long at the Greenville Journal is represented by the equation y = 2x + 20. Which newspaper charges less per line? How many lines must be in an advertisement for the total costs to be the same?

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1.2 Practice (continued)

Daily Times	
Number of lines, *x*	**Total cost, *y***
4	27
5	30
6	33
7	36
8	39

1. **Understand the Problem** You are given an equation that represents the total cost for an advertisement at the Greenville Journal and a table of values showing total costs for advertisements at the Daily Times. You need to compare costs.
2. **Make a Plan** Write an equation that models the total cost of advertisements at the Daily Times. Then compare the slopes to determine which newspaper charges less per line. Finally, equate the cost expressions and solve to determine the number of lines for which the total costs are equal.
3. **Solve the Problem** The slope is $m = \frac{30 - 27}{5 - 4} = 3$.
   Using point-slope form, the equation to represent the total cost for advertisements at Daily Times is

   $y - y_1 = m(x - x_1)$

   $y - 27 = 3(x - 4)$

   $y = 3x + 15.$

   Equate the cost expressions and solve.

   $2x + 20 = 3x + 15$

   $5 = x$

   Comparing the slopes of the equations, the Greenville Journal costs \$2 per line, which is less than the \$3 per line that the Daily Times charges. The total costs are the same if there are 5 lines in an advertisement.

Example #2

MODELING WITH MATHEMATICS The table shows the numbers of tickets sold for a concert when different prices are charged. Write an equation of a line of fit for the data. Does it seem reasonable to use your model to predict the number of tickets sold when the ticket price is \$85? Explain

Sample answer:

Ticket price (dollars), *x*	17	20	22	26
Tickets sold, *y*	450	423	400	395

Step 1 Draw a scatter plot of the data. The data show a linear relationship.

Step 2 Sketch the line that most closely appears to fit the data. One possible line is shown.

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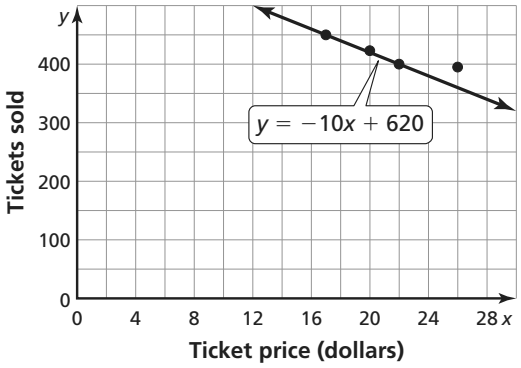
1.2 Practice (continued)



Step 3 Choose two points on the line. For the line shown, you might choose (17, 450) and (22, 400).

Step 4 Write the equation of the line. First, find the slope.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{400 - 450}{22 - 17} = \frac{-50}{5} = -10$$

Use point-slope form to write an equation.
Use $(x_1, y_1) = (17, 450)$.

$$y - y_1 = m(x - x_1)$$
$$y - 450 = -10(x - 17)$$
$$y - 450 = -10x + 170$$
$$y = -10x + 620$$

Use the equation to estimate the number of tickets sold.

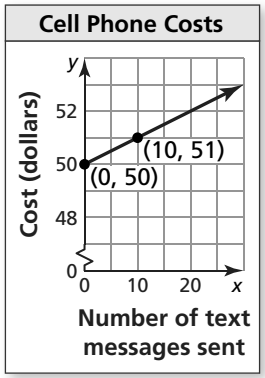
$$y = -10(85) + 620$$
$$= -230$$

The approximate number of tickets sold when the price is \$85 is −230. This does not seem reasonable because the number of tickets sold is less than zero.

Practice A

In Exercises 1–3, use the graph to write an equation of the line and interpret the slope.

1.



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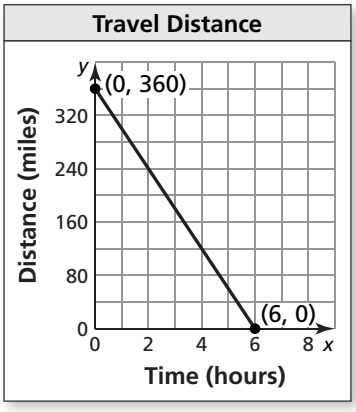

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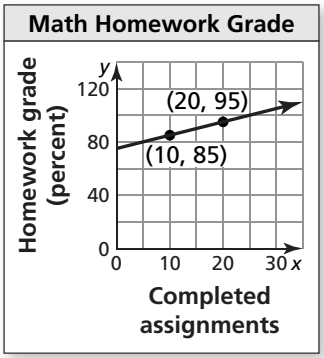

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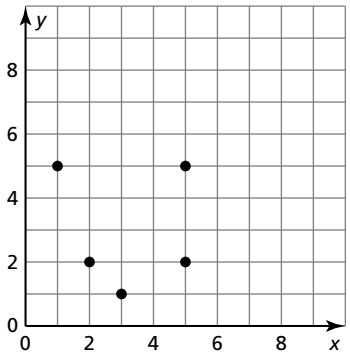
1.2 Practice (continued)

4. The cost of parking in a parking garage in Chicago is represented by the equation $y = 15x + 20$ where y is the total cost (in dollars) and x is the time (in hours). The table shows the total cost to park in a parking garage in Denver. Which city's parking garage charges more per hour and by how much more? After how many hours would parking in both cities cost the same?

Hours, *x*	2	3	4	5
Cost, *y*	43	51	59	67

In Exercises 5–7, use the *linear regression* feature on a graphing calculator to find an equation of the line of best fit for the data. Find and interpret the correlation coefficient.

5.



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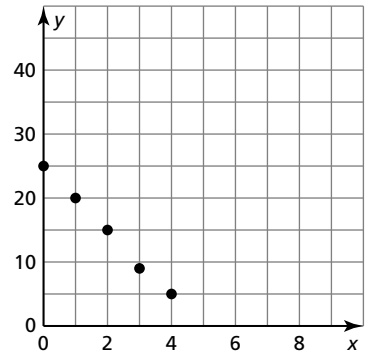

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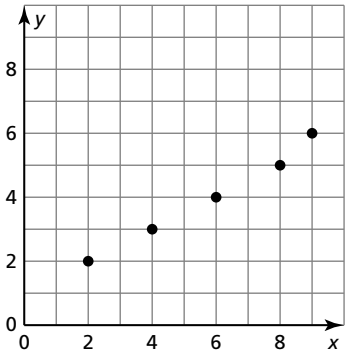

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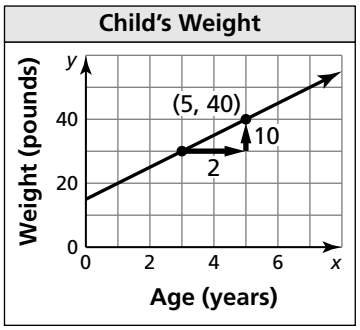
Practice B

In Exercises 1 and 2, use the graph to write an equation of the line and interpret the slope.

1.



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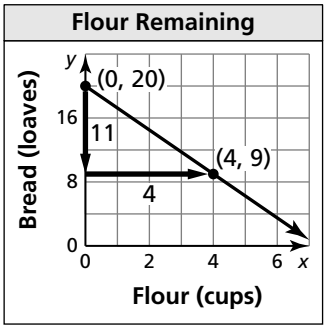


In Exercises 3 and 4, determine whether the data show a linear relationship. If so, write an equation of a line of fit. Estimate y when $x = 15$ and explain its meaning in the context of the situation.

3.

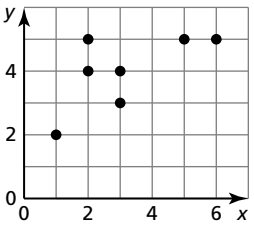
Days, x	3	7	11	14	20
Number of tickets sold, y	76	164	252	318	450

4.

Minutes running, x	6	10	17	25	40
Calories burned, y	70	118	200	295	472

In Exercises 5 and 6, use the *linear regression* feature on a graphing calculator to find an equation of the line of best fit for the data. Find and interpret the correlation coefficient.

5.



6.