

4-4

Comparing Functions

Check Skills You'll Need

1. **Vocabulary Review**
What is a function?

Find the slope of the line through the points.

2. (2, 5), (3, 7)
3. (6, 8), (-2, 16)
4. (-3, -1), (1, 11)
5. (4, -4), (-6, -9)
6. (0, 12), (5, 0)

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Lesson 4-1

What You'll Learn

To compare properties of two functions represented in different ways

Why Learn This?

Functions can be represented using words, graphs, tables, or equations. Learning the relationships among these representations can help you compare the properties of two functions each represented in a different way.



The slope of a line describes the rate of change of that line. You can compare slopes of lines represented in different ways.

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8.F.2, 8.EE.5

EXAMPLE

Comparing Rates of Change of Linear Functions

- 1 Which function has the greater rate of change?

x	1	2	3	4
y	5	8	11	14

$$y = 4x + 2$$

Step 1 Find slope from a table.

Use (1, 5) and (4, 14).

$$\text{slope} = \frac{14 - 5}{4 - 1} = \frac{9}{3} = 3$$

Step 2 Find the slope of an equation using $y = mx + b$.

$$y = mx + b$$

$$y = 4x + 2$$

The slope, m , is 4.

Since $4 > 3$, the function $y = 4x + 2$ has the greater rate of change.

Vocabulary Tip

The slope of a line is its rate of change.

Quick Check

1. Which function has the greater rate of change? Explain.

x	1	3	4	6
y	5	13	17	25

$$y = 2x + 1$$

EXAMPLE

Comparing Initial Values of Linear Functions

- 2 **Athletics** Aki is trying to decide what baseball camp to attend. For each camp, the relationship between number of days and total cost is linear. Which camp has the greater initial cost?

Bright Future Baseball Camp	Home Run Baseball Camp
<ul style="list-style-type: none"> \$18 per day \$89 registration fee 	<ul style="list-style-type: none"> 2 days cost \$121. 7 days cost \$236.

Bright Future Baseball Camp

According to the data in the table, there is a registration fee of \$89. This is the initial cost.

Home Run Baseball Camp

Write the data in the table as ordered pairs: (2, 121) and (7, 236). The y-intercept of the line through these two points represents the initial cost. Use the ordered pairs to write an equation in slope-intercept form.

$$m = \frac{236 - 121}{7 - 2} = \frac{115}{5} = 23$$

← Find the slope.

$$y = mx + b$$

← Use slope-intercept form.

$$121 = 23(2) + b$$

← Substitute 23 for m , 2 for x , and 121 for y . Simplify.

$$121 = 46 + b$$

$$75 = b$$

← Solve for b .

The y-intercept is 75, so the initial cost is \$75.

Since $\$89 > \75 , the Bright Future Baseball Camp has the greater initial cost.

Quick Check

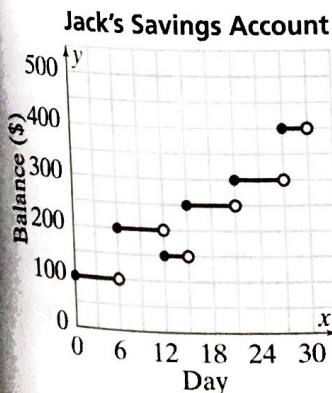
2. Steve's Scooter Rentals charges \$17 per hour plus a \$29 rental fee. Scooter World charges \$48 for 1 hour and \$108 for 4 hours. Both relationships are linear. Which company has the greatest initial cost?

To compare functions, find where the functions increase or decrease; whether they are continuous; and the highest and lowest values.

EXAMPLE

Comparing Nonlinear Functions

- 3 Jack and Manny each have a savings account. The graph at the left represents Jack's account. Manny deposited \$500 and withdrew \$20 each even-numbered day for 30 days. Compare the functions.



Jack's Account

Manny's Account

increases and decreases

decreases

not continuous

not continuous

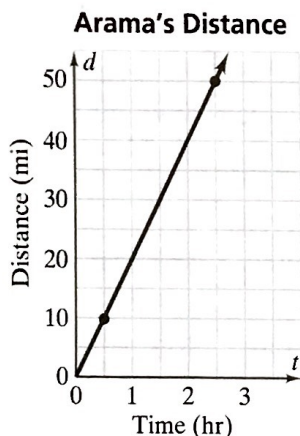
maximum \$400; minimum \$100

maximum \$500; minimum \$200

✓ Quick Check

3. Vikram opened a savings account with \$150. He deposits \$150 every two weeks. Compare Vikram's account to Jack's account.

EXAMPLE Comparing Proportional Functions



- 4 **Bicycle Racing** Arama and Francisco train for bicycle races. The graph at the left represents the distance Arama traveled during today's training session. Francisco's distance is given by the function $d = 18.5t$, where d represents distance in miles and t represents time in hours. Who traveled at the faster rate?

The rate is equal to the slope of the graph of the function.

Arama

Find the slope. Use the two points (0.5, 10) and (2.5, 50).

$$m = \frac{50 - 10}{2.5 - 0.5} = \frac{40}{2} = 20$$

Arama traveled 20 miles per hour.

Francisco

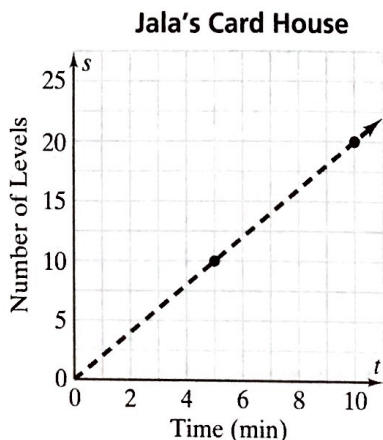
The equation $d = 18.5t$ is in slope-intercept form. The slope is 18.5.

Francisco traveled 18.5 miles per hour.

$20 > 18.5$, so Arama traveled at the faster rate.

✓ Quick Check

4. Jala and Caleb are having a card-house building competition. The functions below represent the number of levels each person built. Who built at the faster rate?



Caleb's Card House

Time (min)	Number of Levels
2	3
6	9
10	15
12	18

Check Your Understanding

1. **Reasoning** How can you find the rate of change from the graph of a linear function?

Match each linear function with its rate of change.

2.

x	2	5	6	10
y	6	15	18	30

A. 1

B. 2

3. $y = 2x - 5$

C. 3

4. $(5, 6), (12, 34)$

D. 4

5. John earns \$25 plus \$1 for every magazine subscription he sells.

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

GO for Help

For Exercises	See Examples
6-7	1
8-9	2
10	3
11	4

Determine which function has the greater rate of change.

6. $y = 3x - 4$;

x	1	2	3	4
y	8	10	12	14

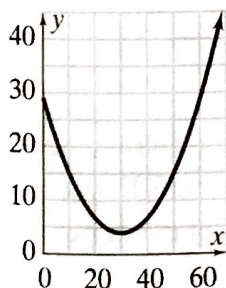
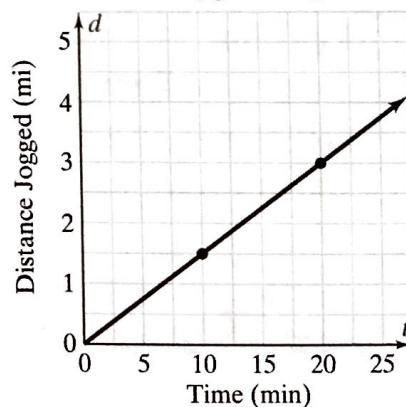
7. $y = 1.5x + 2$;

x	0	3	6	9
y	1	5	9	13

8. Twin Lakes Pool has a membership fee of \$150 and charges \$7 per visit. Duck Pond pool charges \$260 for 15 visits and \$316 for 22 visits. Which pool has the greater initial cost?

9. The graph at the right models the distance Reggie jogs over time. Linda jogs 2.5 miles in 25 minutes and 4 miles in 40 minutes. Who jogs faster?

Reggie's Jog



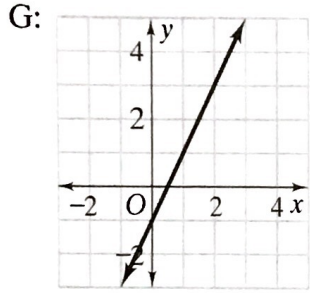
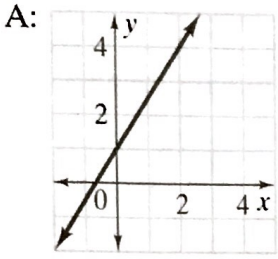
Compare the functions with the graph at the left.

10. When the value of x is 0, the value of y is 15. Each time the value of x increases by 1, the value of y increases by 3.

11. When the value of x is 0, the value of y is 640. Each time the value of x increases by 1, the value of y is halved.

GPS

12. **Guided Problem Solving** Order linear functions A, B, C, and D from least to greatest rate of change.



• Find the slope of each function.

B: $y = 0.5x - 0.25$

C:

x	-2	0	2	4
y	7	9	11	13

D: As x increases by 3 units, y increases by 2 units.

13. Order linear functions G, T, E, and W from least to greatest slope.

T:

x	-4	0	4	8
y	2	3	4	5

E: $y = \frac{5}{3}x + 2$

W: As x increases by 3 units, y increases by 1 unit.

14. Order the stocks from greatest to least rate of price increase.

Alpha, Inc.

Week	0	1	2	3	4
Price(\$)	16	19	22	25	28

Beta Co.

A starting price of \$54 decreases weekly by \$2.50.

Delta Corp.

Week	0	1	2	3	4
Price(\$)	21	16.5	12	7.5	3

Gamma, Inc.

$d = 3.5w - 27$
(w is weeks, d is dollars)

Luxury:

d	2	3	7	14
C	100	130	250	460

15. **Writing in Math** The functions below represent pricing plans for car rentals, where d is number of days and C is cost. Which plan is least expensive for a long-term rental? Explain your reasoning.

Subcompact: Total cost is \$30 plus \$25 per day.

Compact: $C = 28d + 10$

16. **Challenge** Which of the following functions has the greatest rate of change? Explain your reasoning.

K: $2x + 3y = 9$

L: $3x + 2y = 4$

M: $x + y = 11$

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Test Prep and Mixed Review **Practice**

Multiple Choice

17. Which of the linear functions has the greatest rate of change?

(A) The line that passes through (2, 7) and (5, 22)

(C) $y = 6x - 4$

(B)

x	5	8	12	13
y	12	18	26	28

(D) The function that models Kayla's daily income. Kayla earns \$30 plus \$8 for every pet she walks.

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For Exercises	See Lesson
18-19	2-2

Simplify each expression.

18. $5x + 3y - 18 + 2.5x - 4.8y$

19. $3(x - 4) + 8x + 3.5(x + 17)$