Chapter 5

Chapter 5 Opener

Try It Yourself (p. 161)

1. $\frac{12}{144} = \frac{12 \div 12}{144 \div 12} = \frac{1}{12}$

2. $\frac{15}{45} = \frac{15 \div 15}{45 \div 15} = \frac{1}{3}$

3. $\frac{75}{100} = \frac{75 \div 25}{100 \div 25} = \frac{3}{4}$

4. $\frac{16}{24} = \frac{16 \div 8}{24 \div 8} = \frac{2}{3}$

5. $\frac{15}{60} = \frac{15 \div 15}{60 \div 15} = \frac{1}{4}$

So, $\frac{15}{60}$ is *not* equivalent to $\frac{3}{4}$.

6. $\frac{24}{144} = \frac{24 \div 24}{144 \div 24} = \frac{1}{6}$

So, $\frac{2}{5}$ is *not* equivalent to $\frac{24}{144}$.

7. $\frac{15}{20} = \frac{15 \div 5}{20 \div 5} = \frac{3}{4}$

So, $\frac{15}{20}$ is *not* equivalent to $\frac{3}{5}$.

8. $\frac{2}{8} = \frac{2 \div 2}{8 \div 2} = \frac{1}{4}$

$\frac{16}{64} = \frac{16 \div 16}{64 \div 16} = \frac{1}{4}$

So, $\frac{2}{8}$ is equivalent to $\frac{16}{64}$.

9. $\frac{y}{-5} = 3$

$-5 \bullet \frac{y}{-5} = -5 \bullet 3$

$y = -15$

Check: $\frac{y}{-5} = 3$

$\frac{-15}{-5} \stackrel{?}{=} 3$

$3 = 3 \checkmark$

The solution is $y = -15$.

10. $0.6 = 0.2a$

$\frac{0.6}{0.2} = \frac{0.2a}{0.2}$

$3 = a$

Check: $0.6 = 0.2a$

$0.6 \stackrel{?}{=} 0.2(3)$

$0.6 = 0.6 \checkmark$

The solution is $a = 3$.

11. $-2w = -9$

$\frac{-2w}{-2} = \frac{-9}{-2}$

$w = \frac{9}{2}$

Check: $-2w = -9$

$-2\left(\frac{9}{2}\right) \stackrel{?}{=} -9$

$-9 = -9 \checkmark$

The solution is $w = \frac{9}{2}$.

12. $\frac{1}{7}n = -4$

$7 \bullet \frac{1}{7}n = 7 \bullet (-4)$

$n = -28$

Check: $\frac{1}{7}n = -4$

$\frac{1}{7}(-28) \stackrel{?}{=} -4$

$-4 = -4 \checkmark$

The solution is $n = -28$.

Section 5.1

5.1 Activity (pp. 162–163)

1. Your running rate in a 100-meter dash can be represented by meters per second: $\frac{\square \text{ m}}{\text{sec}}$.

Sample answer: A reasonable rate is $\frac{8 \text{ m}}{\text{sec}}$ and an unreasonable rate is $\frac{50 \text{ m}}{\text{sec}}$.

The fertilization rate for an apple orchard can be represented by pounds per acre: $\frac{\square \text{ lb}}{\text{acre}}$.

Sample answer: A reasonable rate is $\frac{150 \text{ lb}}{\text{acre}}$ and an unreasonable rate is $\frac{50{,}000 \text{ lb}}{\text{acre}}$.

The average pay rate for a professional athlete can be represented by dollars per year: $\frac{\$\square}{\text{yr}}$.

Sample answer: A reasonable rate is $\frac{\$4.5 \text{ million}}{\text{yr}}$ and an unreasonable rate is $\frac{\$10{,}000}{\text{yr}}$.

The average rainfall rate in a rainforest can be represented by inches per year: $\frac{\square \text{ in.}}{\text{yr}}$.

Sample answer: A reasonable rate is $\frac{100 \text{ in.}}{\text{yr}}$ and an unreasonable rate is $\frac{5 \text{ in.}}{\text{yr}}$.

2. a. *Sample answer:* ingredients in a drink mixture;

$\frac{1}{2} \div 4 = \frac{1}{2} \bullet \frac{1}{4} = \frac{1}{8}$ cup per fluid ounce

b. *Sample answer:* speed of a bug;

$2 \div \frac{3}{4} = 2 \bullet \frac{4}{3} = \frac{8}{3}$, or $2\frac{2}{3}$ inches per second

c. *Sample answer*: ingredients in a cookie recipe;

$\frac{3}{8} \div \frac{3}{5} = \frac{3}{8} \bullet \frac{5}{3} = \frac{5}{8}$ cup of sugar for every cup of flour

d. *Sample answer*: draining an aquarium;

$\frac{5}{6} \div \frac{2}{3} = \frac{5}{6} \bullet \frac{3}{2} = \frac{5}{4}$, or $1\frac{1}{4}$ gallons per second

3. a. The rate is $\frac{18 \text{ mi}}{4 \text{ sec}}$.

b.

Time (seconds)	4	8	12	16	20
Distance (miles)	18	36	54	72	90

c. 1 minute = 60 seconds; Multiply 4 times 15 and multiply 18 times 15.

Time (seconds)	4	60
Distance (miles)	18	270

60 minutes = 1 hour; Multiply 1 times 60 and 270 times 60.

Time (seconds)	1	60
Distance (miles)	270	16,200

The satellite travels 270 miles per minute and 16,200 miles per hour.

d. (1) Ratio table: Divide 4 by 4 and divide 18 by 4.

Time (seconds)	4	1
Distance (miles)	18	4.5

(2) Quotient: $\frac{18 \text{ mi}}{4 \text{ sec}} = 4.5 \text{ mi/sec}$

The satellite can travel 4.5 mi/sec.

e. Use a ratio table: Divide 1 by 2 and 4.5 by 2.

Time (seconds)	1	$\frac{1}{2}$
Distance (miles)	4.5	2.25

So, the satellite can travel 2.25 miles in $\frac{1}{2}$ sec.

4. a. *Sample answer*: distance a vehicle travels using 10 gallons of gasoline when it gets 22 miles per gallon; $10 \text{ gal} \times \frac{22 \text{ mi}}{\text{gal}} = 220 \text{ mi}$

b. *Sample answer:* a deli cheese costs \$3 for every $\frac{1}{2}$ pound and you want to find the cost of $\frac{7}{2}$ pounds;

$$\frac{7}{2} \text{ lb} \times \frac{\$3}{\frac{1}{2} \text{ lb}} = \$21$$

c. *Sample answer*: an oil spill is spreading at a rate of 30 square feet per second and you want to know how much it spreads every $\frac{1}{2}$ second;

$$\frac{1}{2} \text{ sec} \times \frac{30 \text{ ft}^2}{\text{sec}} = 15 \text{ ft}^2$$

5. Rates represent ratios of two real-life quantities with different units. *Sample answer:* An example of a rate is driving rate during a car trip and another example is your pay rate for babysitting.

6. a. A person normally works 40 hours per week for 52 weeks per year. You can estimate the total hours worked in 1 year by finding the product 40×50, which is 2000. Then, to find the annual salary, multiply 2000 by the pay rate per hour.

b. $$\begin{aligned} \text{Annual salary} &= 8 \times 2 \times 100 \\ &= 16 \times 1000 \\ &= 16{,}000 \end{aligned}$$

The annual salary for an hourly pay rate of \$8 per hour is about \$16,000.

c. Annual salary $= 1{,}000{,}000 \times 12 = 12{,}000{,}000$

Your salary is \$12 million per year.

d. The cartoon is funny because the person who applied for the job does not understand that \$8 an hour is much less than \$1 million a month.

5.1 On Your Own (pp. 165–166)

1. $\frac{\text{females}}{\text{males}} = \frac{60}{45} = \frac{60 \div 15}{45 \div 15} = \frac{4}{3}$

The ratio of females to males is $\frac{4}{3}$.

2. $\frac{\text{females}}{\text{total passengers}} = \frac{60}{60 + 45} = \frac{60}{105} = \frac{60 \div 15}{105 \div 15} = \frac{4}{7}$

The ratio of females to total passengers is $\frac{4}{7}$.

3.

+ 3 + 3 + 3

Time (seconds)	3	6	9	12
Distance (miles)	14.4	28.8	43.2	57.6

+ 14.4 + 14.4 + 14.4

$\frac{\text{change in distance}}{\text{change in time}} = \frac{14.4 \text{ mi}}{3 \text{ sec}} = \frac{14.4 \div 3}{3 \div 3} = \frac{4.8 \text{ mi}}{1 \text{ sec}}$

The speed is 4.8 miles per second.

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4. no; The unit rate is still $\frac{1}{2}$ mile per minute because the rates represented by points on the graph are equivalent.

5. Yellow to green: $\frac{2}{5} \bullet 20 = 8$ cups of yellow paint

   Blue to green: $\frac{3}{5} \bullet 20 = 12$ cups of blue paint

5.1 Exercises (pp. 167–169)

Vocabulary and Concept Check

1. A rate is a unit rate if its denominator is 1.

2. *Sample answer:* Rates are usually written as unit rates because unit rates are easier to compare.

3. *Answer should include, but is not limited to:* Students will describe a rate that applies to them.

4. $\frac{\$74.75}{5\text{ gal}} \approx \frac{\$75}{5\text{ gal}} = \frac{75 \div 5}{5 \div 5} = \frac{\$15}{1\text{ gal}}$

   The unit rate is approximately \$15 per gallon.

5. $\frac{\$1.19}{12\text{ fl oz}} \approx \frac{\$1.20}{12\text{ fl oz}} = \frac{1.20 \div 12}{12 \div 12} = \frac{\$0.10}{1\text{ fl oz}}$

   The unit rate is approximately \$0.10 per fluid ounce.

6. $\frac{\$2.35}{12\text{ eggs}} \approx \frac{\$2.40}{12\text{ eggs}} = \frac{2.40 \div 12}{12 \div 12} = \frac{\$0.20}{1\text{ egg}}$

   The unit rate is approximately \$0.20 per egg.

Practice and Problem Solving

7. $8\text{ h} \times \frac{\$9}{\text{h}} = 8\cancel{\text{h}} \times \frac{\$9}{\cancel{\text{h}}} = \$72$

8. $8\text{ lb} \times \frac{\$3.50}{\text{lb}} = 8\cancel{\text{lb}} \times \frac{\$3.50}{\cancel{\text{lb}}} = \$28$

9. $\frac{29}{2}\text{ sec} \times \frac{60\text{ MB}}{\text{sec}} = \frac{29}{\cancelto{1}{2}}\cancel{\text{sec}} \times \frac{\cancelto{30}{60}\text{ MB}}{\cancel{\text{sec}}} = 870\text{ MB}$

10. $\frac{3}{4}\text{ h} \times \frac{19\text{ mi}}{\frac{1}{4}\text{ h}} = \frac{3}{4}\cancel{\text{h}} \times \frac{19\text{ mi}}{\frac{1}{4}\cancel{\text{h}}}$

    $= \frac{3}{\cancelto{1}{4}} \times 19\text{ mi} \times \frac{\cancelto{1}{4}}{1}$

    $= 57\text{ mi}$

11. $\frac{25}{45} = \frac{25 \div 5}{45 \div 5} = \frac{5}{9}$

    The ratio in simplest form is $\frac{5}{9}$.

12. $\frac{63}{28} = \frac{63 \div 7}{28 \div 7} = \frac{9}{4}$

    The ratio in simplest form is $\frac{9}{4}$.

13. $\frac{35\text{ girls}}{15\text{ boys}} = \frac{35 \div 5}{15 \div 5} = \frac{7\text{ girls}}{3\text{ boys}}$

    The ratio of girls to boys is $\frac{7}{3}$.

14. $\frac{51\text{ correct}}{9\text{ incorrect}} = \frac{51 \div 3}{9 \div 3} = \frac{17\text{ correct}}{3\text{ incorrect}}$

    The ratio of correct to incorrect is $\frac{17}{3}$.

15. $\frac{16\text{ dogs}}{12\text{ cats}} = \frac{16 \div 4}{12 \div 4} = \frac{4\text{ dogs}}{3\text{ cats}}$

    The ratio of dogs to cats is $\frac{4}{3}$.

16. $\frac{2\frac{1}{3}\text{ feet}}{4\frac{1}{2}\text{ feet}} = \frac{2\frac{1}{3} \div 2\frac{1}{3}}{4\frac{1}{2} \div 2\frac{1}{3}}$

    $= \frac{1}{\frac{9}{2} \div \frac{7}{3}}$

    $= \frac{1}{\frac{9}{2} \times \frac{3}{7}}$

    $= \frac{1}{\frac{27}{14}}$

    $= 1 \times \frac{14}{27}$

    $= \frac{14\text{ feet}}{27\text{ feet}}$

    The ratio of feet to feet is $\frac{14}{27}$.

17. $\frac{180\text{ miles}}{3\text{ hours}} = \frac{180 \div 3}{3 \div 3} = \frac{60\text{ miles}}{1\text{ hour}}$

    The unit rate is 60 miles per hour.

18. $\frac{256\text{ miles}}{8\text{ gallons}} = \frac{256 \div 8}{8 \div 8} = \frac{32\text{ miles}}{1\text{ gallon}}$

    The unit rate is 32 miles per gallon.

19. $\frac{\$9.60}{4\text{ pounds}} = \frac{9.60 \div 4}{4 \div 4} = \frac{\$2.40}{1\text{ pound}}$

    The unit rate is \$2.40 per pound.

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20. $\dfrac{\$4.80}{6 \text{ cans}} = \dfrac{4.80 \div 6}{6 \div 6} = \dfrac{\$0.80}{1 \text{ can}}$

The unit rate is \$0.80 per can.

21. $\dfrac{297 \text{ words}}{5.5 \text{ minutes}} = \dfrac{297 \div 5.5}{5.5 \div 5.5} = \dfrac{54 \text{ words}}{1 \text{ minute}}$

The unit rate is 54 words per minute.

22.
$$\dfrac{21\frac{3}{4} \text{ meters}}{2\frac{1}{2} \text{ hours}} = \dfrac{21\frac{3}{4} \div 2\frac{1}{2}}{2\frac{1}{2} \div 2\frac{1}{2}}$$
$$= \dfrac{\frac{87}{4} \div \frac{5}{2}}{1}$$
$$= \dfrac{\frac{87}{\cancel{4}_{2}} \times \frac{\cancel{2}^{1}}{5}}{1}$$
$$= \dfrac{\frac{87}{10}}{1}$$
$$= \dfrac{8\frac{7}{10} \text{ meters}}{1 \text{ hour}}$$

The unit rate is $8\frac{7}{10}$ meters per hour.

23.

$+3 \quad +3 \quad +3$

Packages	3	6	9	12
Servings	13.5	27	40.5	54

$+13.5 \quad +13.5 \quad +13.5$

$$\dfrac{\text{change in servings}}{\text{change in packages}} = \dfrac{13.5 \text{ servings}}{3 \text{ packages}}$$
$$= \dfrac{13.5 \div 3}{3 \div 3}$$
$$= \dfrac{4.5 \text{ servings}}{1 \text{ package}}$$

The unit rate is 4.5 servings per package.

24.

$+4 \quad +4 \quad +4$

Years	2	6	10	14
Feet	7.2	21.6	36	50.4

$+14.4 \quad +14.4 \quad +14.4$

$$\dfrac{\text{change in feet}}{\text{change in years}} = \dfrac{14.4 \text{ feet}}{4 \text{ years}} = \dfrac{14.4 \div 4}{4 \div 4} = \dfrac{3.6 \text{ feet}}{1 \text{ year}}$$

The unit rate is 3.6 feet per year.

25.
$$\dfrac{\text{change in megabytes}}{\text{change in minutes}} = \dfrac{96 - 24}{15 - 0}$$
$$= \dfrac{72 \text{ megabytes}}{15 \text{ minutes}}$$
$$= \dfrac{72 \div 15}{15 \div 15}$$
$$= \dfrac{4.8 \text{ megabytes}}{1 \text{ minute}}$$

The download rate is 4.8 megabytes per minute.

26.
$$\dfrac{\text{change in population}}{\text{change in years}} = \dfrac{314 - 302}{2012 - 2007}$$
$$= \dfrac{12}{5}$$
$$= \dfrac{12 \text{ million}}{5 \text{ years}}$$
$$= \dfrac{12 \div 5}{5 \div 5}$$
$$= \dfrac{2.4 \text{ million}}{1 \text{ year}}$$

The rate of population change per year is 2.4 million per year.

27.
$$\dfrac{350 \text{ square feet}}{1.25 \text{ hours}} = \dfrac{350 \div 1.25}{1.25 \div 1.25}$$
$$= \dfrac{280 \text{ square feet}}{1 \text{ hour}}$$

The painting rate is 280 square feet per hour.

28. a. The point $(4, 122)$ represents that it costs \$122 for 4 tickets.

b. $\dfrac{\text{cost}}{\text{tickets}} = \dfrac{\$122}{4 \text{ tickets}} = \dfrac{122 \div 4}{4 \div 4} = \dfrac{\$30.50}{1 \text{ ticket}}$

The unit rate is \$30.50 per ticket.

c. cost of 10 tickets = cost per ticket • number of tickets
= 30.50 • 10
= 305

The cost of buying 10 tickets is \$305.

29. no; The ratio of boys to girls as a fraction is $\frac{2}{3}$. The ratio of girls to boys as a fraction is $\frac{3}{2}$. Because $\frac{2}{3} \neq \frac{3}{2}$, the ratios are not equivalent.

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30. 4-pack: $\dfrac{\$11.49}{4 \text{ containers}} = \dfrac{11.49 \div 4}{4 \div 4} \approx \dfrac{\$2.87}{1 \text{ container}}$

6-pack: $\dfrac{\$16.79}{6 \text{ containers}} = \dfrac{16.79 \div 6}{6 \div 6} \approx \dfrac{\$2.80}{1 \text{ container}}$

9-pack: $\dfrac{\$22.99}{9 \text{ containers}} = \dfrac{22.99 \div 9}{9 \div 9} \approx \dfrac{\$2.55}{1 \text{ container}}$

The 9-pack has the lowest unit rate, so it is the best buy.

31. Unit rate: $\dfrac{\$68}{16 \text{ square feet}} = \dfrac{68 \div 16}{16 \div 16}$

$= \dfrac{\$4.25}{1 \text{ square foot}}$

$\$4.25 \times 12 = \$51$

The flooring costs \$51.

32. Unit rate: $\dfrac{25 \text{ square meters}}{\frac{1}{6} \text{ hour}} = \dfrac{25 \div \frac{1}{6}}{\frac{1}{6} \div \frac{1}{6}}$

$= \dfrac{150 \text{ square meters}}{1 \text{ hour}}$

$150 \times 2 = 300$

The oil spill covers an area of 300 square meters in 2 hours.

33. Juice concentrate to water: $\dfrac{\frac{1}{4}}{\frac{1}{4} + 2} = \dfrac{\frac{1}{4}}{\frac{1}{4} + \frac{8}{4}}$

$= \dfrac{\frac{1}{4}}{\frac{9}{4}}$

$= \dfrac{1}{4} \bullet \dfrac{4}{9}$

$= \dfrac{1}{9}$

$\dfrac{1}{9} \bullet 18 = 2$

Water to juice concentrate: $\dfrac{2}{\frac{1}{4} + 2} = \dfrac{2}{\frac{1}{4} + \frac{8}{4}}$

$= \dfrac{2}{\frac{9}{4}}$

$= 2 \bullet \dfrac{4}{9}$

$= \dfrac{8}{9}$

$\dfrac{8}{9} \bullet 18 = 16$

So, you need 2 cups of juice concentrate and 16 cups of water.

34. Mulch to gravel: $\dfrac{2\frac{1}{4}}{2\frac{1}{4} + 1\frac{1}{3}} = \dfrac{\frac{9}{4}}{\frac{9}{4} + \frac{4}{3}}$

$= \dfrac{\frac{9}{4}}{\frac{27}{12} + \frac{16}{12}}$

$= \dfrac{9}{4} \bullet \dfrac{12}{43}$

$= \dfrac{27}{43}$

$\dfrac{27}{43} \bullet 172 = 108$

Gravel to mulch: $\dfrac{1\frac{1}{3}}{2\frac{1}{4} + 1\frac{1}{3}} = \dfrac{\frac{4}{3}}{\frac{9}{4} + \frac{4}{3}}$

$= \dfrac{\frac{4}{3}}{\frac{27}{12} + \frac{16}{12}}$

$= \dfrac{4}{3} \bullet \dfrac{12}{43}$

$= \dfrac{16}{43}$

$\dfrac{16}{43} \bullet 172 = 64$

So, the supplier sells 108 pounds of mulch and 64 pounds of gravel.

35. a. At rest: $15 \text{ seconds} \times \dfrac{1 \text{ minute}}{60 \text{ seconds}} = \dfrac{1}{4} \text{ minute}$

$\dfrac{18 \text{ beats}}{\frac{1}{4} \text{ minute}} = \dfrac{18 \div \frac{1}{4}}{\frac{1}{4} \div \frac{1}{4}} = 72 \text{ beats/minute}$

Running: $10 \text{ seconds} \times \dfrac{1 \text{ minute}}{60 \text{ seconds}} = \dfrac{1}{6} \text{ minute}$

$\dfrac{25 \text{ beats}}{\frac{1}{6} \text{ minute}} = \dfrac{25 \div \frac{1}{6}}{\frac{1}{6} \div \frac{1}{6}} = 150 \text{ beats/minute}$

So, your friend's heart beat per minute at rest is 72 beats/minute and running is 150 beats/minute.

b. At rest: $72 \bullet 3 = 216$; Running: $150 \bullet 3 = 450$;
The difference is $450 - 216 = 234$.

So, your friend's heart beats 234 more times while running than while at rest.

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36. a. Whole milk:

$$1 \text{ cup} = 1 \cancel{\text{cup}} \times \frac{8 \text{ fluid ounces}}{1 \cancel{\text{cup}}} = 8 \text{ fluid ounces}$$

$$\frac{146 \text{ calories}}{8 \text{ fluid ounces}} = \frac{146 \div 8}{8 \div 8} = \frac{18.25 \text{ calories}}{1 \text{ fluid ounce}}$$

Orange juice:

$$1 \text{ pint} = 1 \cancel{\text{pint}} \times \frac{16 \text{ fluid ounces}}{1 \cancel{\text{pint}}} = 16 \text{ fluid ounces}$$

$$\frac{210 \text{ calories}}{16 \text{ fluid ounces}} = \frac{210 \div 16}{16 \div 16} = \frac{13.125 \text{ calories}}{1 \text{ fluid ounce}}$$

Apple juice:

$$\frac{351 \text{ calories}}{24 \text{ fluid ounces}} = \frac{351 \div 24}{24 \div 24} = \frac{14.625 \text{ calories}}{1 \text{ fluid ounce}}$$

Whole milk has the greatest unit rate, so whole milk has the most calories per fluid ounce.

b. Whole milk:

$$\frac{98 \text{ milligrams}}{8 \text{ fluid ounces}} = \frac{98 \div 8}{8 \div 8} = \frac{12.25 \text{ milligrams}}{1 \text{ fluid ounce}}$$

Orange juice:

$$\frac{10 \text{ milligrams}}{16 \text{ fluid ounces}} = \frac{10 \div 16}{16 \div 16} = \frac{0.625 \text{ milligram}}{1 \text{ fluid ounce}}$$

Apple juice:

$$\frac{21 \text{ milligrams}}{24 \text{ fluid ounces}} = \frac{21 \div 24}{24 \div 24} = \frac{0.875 \text{ milligram}}{1 \text{ fluid ounce}}$$

Orange juice has the lowest unit rate, so orange juice has the least sodium per fluid ounce.

37. a. *Answer should include, but is not limited to:* Students will use the Internet to determine the ranges of the rates for each color fire hydrant.

b. *Answer should include, but is not limited to:* Students will research and then explain why a firefighter needs to know the rate at which water comes out of the hydrant.

38. a. $1\frac{5}{8} \text{ gallons} \times \frac{16 \text{ cups}}{1 \text{ gallon}} = 26 \text{ cups}$

Red paint:
$$\frac{\frac{2}{5}}{\frac{2}{5} + \frac{1}{4}} = \frac{\frac{2}{5}}{\frac{8}{20} + \frac{5}{20}} = \frac{\frac{2}{5}}{\frac{13}{20}} = \frac{2}{5} \bullet \frac{20}{13} = \frac{8}{13}$$

$$\frac{8}{13} \bullet 26 = 16$$

Blue paint:
$$\frac{\frac{1}{4}}{\frac{2}{5} + \frac{1}{4}} = \frac{\frac{1}{4}}{\frac{8}{20} + \frac{5}{20}} = \frac{\frac{1}{4}}{\frac{13}{20}} = \frac{1}{4} \bullet \frac{20}{13} = \frac{5}{13}$$

$$\frac{5}{13} \bullet 26 = 10$$

So, you will need 16 cups of red paint and 10 cups of blue paint.

b. $\frac{3}{8}$ gallons $\times \frac{16 \text{ cups}}{1 \text{ gallon}} = 6$ cups

Red: $\dfrac{\frac{2}{5}}{\frac{2}{5}+\frac{1}{4}+\frac{1}{10}} = \dfrac{\frac{2}{5}}{\frac{8}{20}+\frac{5}{20}+\frac{2}{20}} = \dfrac{\frac{2}{5}}{\frac{15}{20}} = \frac{2}{5} \bullet \frac{20}{15} = \frac{8}{15}$

$\frac{8}{15} \bullet 6 = 3\frac{1}{5}$

Blue: $\dfrac{\frac{1}{4}}{\frac{2}{5}+\frac{1}{4}+\frac{1}{10}} = \dfrac{\frac{1}{4}}{\frac{8}{20}+\frac{5}{20}+\frac{2}{20}} = \dfrac{\frac{1}{4}}{\frac{15}{20}} = \frac{1}{4} \bullet \frac{20}{15} = \frac{1}{3}$

$\frac{1}{3} \bullet 6 = 2$

White: $\dfrac{\frac{1}{10}}{\frac{2}{5}+\frac{1}{4}+\frac{1}{10}} = \dfrac{\frac{1}{10}}{\frac{8}{20}+\frac{5}{20}+\frac{2}{20}} = \dfrac{\frac{1}{10}}{\frac{15}{20}} = \frac{1}{10} \bullet \frac{20}{15} = \frac{2}{15}$

$\frac{2}{15} \bullet 6 = \frac{4}{5}$

So, you will need $3\frac{1}{5}$ cups of red paint, 2 cups of blue paint, and $\frac{4}{5}$ cups of white paint.

39. a. You:

$$\dfrac{\frac{2}{3} \text{ miles}}{\frac{1}{4} \text{ hour}} = \dfrac{\frac{2}{3} \div \frac{1}{4}}{\frac{1}{4} \div \frac{1}{4}} = \dfrac{\frac{2}{3} \bullet 4}{1} = 2\frac{2}{3} \text{ miles per hour}$$

You hike faster because $2\frac{2}{3} > 2\frac{1}{3}$. You hike $2\frac{2}{3} - 2\frac{1}{3} = \frac{1}{3}$ mile per hour faster than your friend.

b. You and your friend walk at a total rate of $2\frac{2}{3} + 2\frac{1}{3} = 5$ miles per hour.

$17.5 \text{ miles} \div \frac{5 \text{ miles}}{\text{hour}} = 17.5 \bullet \frac{1}{5} = 3\frac{1}{2}$ hours

You will meet after $3\frac{1}{2}$ hours.

c. You: $2\frac{2}{3}$ miles per hour $\bullet\ 3\frac{1}{2}$ hours $= \frac{8}{3} \bullet \frac{7}{2} = \frac{56}{6}$, or $9\frac{1}{3}$

You hike a total of $9\frac{1}{3}$ miles.

Your friend:

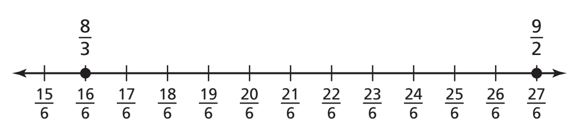
$2\frac{1}{3}$ miles per hour $\bullet\ 3\frac{1}{2}$ hours $= \frac{7}{3} \bullet \frac{7}{2} = \frac{49}{6}$, or $8\frac{1}{6}$

Your friend hikes a total of $8\frac{1}{6}$ miles.

You hike further. You hike $9\frac{1}{3} - 8\frac{1}{6} = 9\frac{2}{6} - 8\frac{1}{6} = 1\frac{1}{6}$ miles further.

Fair Game Review

40. $\frac{9}{2} = \frac{27}{6}$; $\frac{8}{3} = \frac{16}{6}$



Because $\frac{9}{2}$ is to the right of $\frac{8}{3}$, $\frac{9}{2} > \frac{8}{3}$.

41. Any positive number is greater than any negative number. So, $-\frac{8}{15} < \frac{10}{18}$.

42. $-\frac{6}{24} = -\frac{1}{4}$; $-\frac{2}{8} = -\frac{1}{4}$

So, $-\frac{6}{24} = -\frac{2}{8}$.

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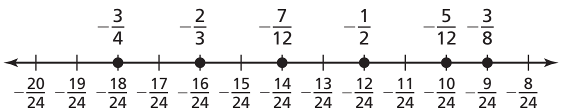
43. B; $-\frac{2}{3} = -\frac{16}{24}$; $-\frac{1}{2} = -\frac{12}{24}$; $-\frac{3}{4} = -\frac{18}{24}$;

$-\frac{7}{12} = -\frac{14}{24}$; $-\frac{5}{12} = -\frac{10}{24}$; $-\frac{3}{8} = -\frac{9}{24}$



From the number line, you can see that $-\frac{7}{12}$ is the only fraction greater than $-\frac{2}{3}$ and less than $-\frac{1}{2}$.

Section 5.2

5.2 Activity (pp. 170–171)

1. a. $\frac{\$5.00}{2\text{ boxes}} \stackrel{?}{=} \frac{\$7.50}{3\text{ boxes}}$

$\frac{\$2.50}{1\text{ box}} = \frac{\$2.50}{1\text{ box}}$ ✓

So, the two ratios are equivalent.

b. $\frac{3\frac{1}{2}\text{ h}}{175\text{ mi}} \stackrel{?}{=} \frac{5\text{ h}}{200\text{ mi}}$

$\frac{0.02\text{ h}}{1\text{ mi}} \neq \frac{0.025\text{ h}}{1\text{ mi}}$ ✗

So, the two ratios are *not* equivalent.

Sample answer:

The unit rate for the first day is $\frac{175\text{ miles}}{3\frac{1}{2}\text{ hours}} = \frac{50\text{ miles}}{1\text{ hour}}$.

Multiply the next day's hours by this rate:

$5\text{ hours} \bullet \frac{50\text{ miles}}{1\text{ hour}} = 250\text{ miles}$.

So, the next day's ratio should be 250 miles in 5 hours.

c. $\frac{4\text{ mi}}{300\text{ cal}} \stackrel{?}{=} \frac{3\frac{1}{3}\text{ mi}}{250\text{ cal}}$

$\frac{0.01\overline{3}\text{ mi}}{1\text{ cal}} = \frac{0.01\overline{3}\text{ mi}}{1\text{ cal}}$ ✓

So, the two ratios are equivalent.

d. $\frac{150\text{ ft}^2}{2\frac{1}{2}\text{ h}} \stackrel{?}{=} \frac{200\text{ ft}^2}{4\text{ h}}$

$\frac{60\text{ ft}^2}{1\text{ h}} \neq \frac{50\text{ ft}^2}{1\text{ h}}$ ✗

So, the two ratios are *not* equivalent.

Sample answer:

The unit rate for the first day is $\frac{150\text{ ft}^2}{2\frac{1}{2}\text{ h}} = \frac{60\text{ ft}^2}{1\text{ h}}$.

Multiply the next day's hours by this rate:

$4\text{ h} \bullet \frac{60\text{ ft}^2}{1\text{ h}} = 240\text{ ft}^2$.

So, the next day's ratio should be 240 square feet in 4 hours.

2. a. yes; Simplifying the ratio on the right, you get

$\frac{15}{105} = \frac{15 \div 15}{105 \div 15} = \frac{1}{7}$.

b. Because 1 dog year is equivalent to 7 human years, divide the 98 human points by 7 to find the dog points.

$98 \div 7 = 14$

So, Newton actually has 14 points.

3. a. $\frac{\$184}{2\text{ tickets}} \stackrel{?}{=} \frac{\$266}{3\text{ tickets}}$

$\frac{\$92}{1\text{ ticket}} \neq \frac{\$88.67}{1\text{ ticket}}$ ✗

It is *not* fair because the unit rates are *not* equal.

b. $\frac{75\text{ points}}{15\text{ questions}} \stackrel{?}{=} \frac{70\text{ points}}{14\text{ questions}}$

$\frac{5\text{ points}}{1\text{ question}} = \frac{5\text{ points}}{1\text{ question}}$

It is fair because the unit rates are equal.

c. $\frac{24\text{ football cards}}{15\text{ baseball cards}} \stackrel{?}{=} \frac{20\text{ football cards}}{32\text{ baseball cards}}$

$\frac{1.6\text{ football cards}}{1\text{ baseball card}} \neq \frac{0.625\text{ football card}}{1\text{ baseball card}}$ ✗

It is *not* fair because the unit rates are *not* equal.

Chapter 5

4. *Answer should include, but is not limited to:* Students will find a recipe for something they like to eat. Students will choose two of the ingredient amounts and find the amounts when the recipe is doubled and tripled. They will then show that the amounts are proportional to the original amounts.

5. By simplifying two ratios and comparing the results, you can decide when things are fair.

Sample answer: You pay \$36 for 2 T-shirts and your friend pays \$72 for 4 T-shirts. Compare the ratios.

$$\frac{\$36}{\$72} \stackrel{?}{=} \frac{2 \text{ T-shirts}}{4 \text{ T-shirts}}$$

$$\frac{1}{2} = \frac{1}{2} \checkmark$$

The ratios are equivalent, so it is fair.

5.2 On Your Own (pp. 172–173)

1. $\frac{1}{2}$ is in simplest form.

$$\frac{5}{10} = \frac{5 \div 5}{10 \div 5} = \frac{1}{2}$$

The ratios are equivalent. So, $\frac{1}{2}$ and $\frac{5}{10}$ form a proportion.

2. $$\frac{4}{6} = \frac{4 \div 2}{6 \div 2} = \frac{2}{3}$$

$$\frac{18}{24} = \frac{18 \div 6}{24 \div 6} = \frac{3}{4}$$

The ratios are *not* equivalent. So, $\frac{4}{6}$ and $\frac{18}{24}$ do *not* form a proportion.

3. $\frac{10}{3}$ is in simplest form. $\frac{5}{6}$ is in simplest form. The ratios are *not* equivalent. So, $\frac{10}{3}$ and $\frac{5}{6}$ do *not* form a proportion.

4. $$\frac{25}{20} = \frac{25 \div 5}{20 \div 5} = \frac{5}{4}$$

$$\frac{15}{12} = \frac{15 \div 3}{12 \div 3} = \frac{5}{4}$$

The ratios are equivalent. So, $\frac{25}{20}$ and $\frac{15}{12}$ form a proportion.

5. $\frac{1}{12}$; $\frac{2}{24} = \frac{1}{12}$; $\frac{4}{48} = \frac{1}{12}$; $\frac{6}{72} = \frac{1}{12}$

So, x and y are proportional because all the ratios are equivalent.

6. $$\frac{20 \text{ pages}}{25 \text{ min}} \stackrel{?}{=} \frac{36 \text{ pages}}{45 \text{ min}}$$

$$20 \bullet 45 \stackrel{?}{=} 25 \bullet 36$$

$$900 = 900 \checkmark$$

So, the number of pages read is proportional to your time.

5.2 Exercises (pp. 174–175)

Vocabulary and Concept Check

1. Two ratios form a proportion if the two ratios are equivalent.

2. You can tell that two ratios form a proportion by comparing the ratios in simplest form or by using the Cross Products Property.

3. *Sample answer:* $\frac{3}{5} = \frac{3 \times 2}{5 \times 2} = \frac{6}{10}$

$\frac{3}{5} = \frac{3 \times 3}{5 \times 3} = \frac{9}{15}$

Two ratios equivalent to $\frac{3}{5}$ are $\frac{6}{10}$ and $\frac{9}{15}$.

4. $$\frac{4}{10} = \frac{4 \div 2}{10 \div 2} = \frac{2}{5}$$

$\frac{2}{5}$ is in simplest form.

$\frac{3}{5}$ is in simplest form.

$$\frac{6}{15} = \frac{6 \div 3}{15 \div 3} = \frac{2}{5}$$

$\frac{3}{5}$ does *not* belong because the other three ratios are equivalent to $\frac{2}{5}$.

Practice and Problem Solving

5. $\frac{1}{3}$ is in simplest form.

$$\frac{7}{21} = \frac{7 \div 7}{21 \div 7} = \frac{1}{3}$$

The ratios are equivalent. So, $\frac{1}{3}$ and $\frac{7}{21}$ form a proportion.

6. $\frac{1}{5}$ is in simplest form.

$$\frac{6}{30} = \frac{6 \div 6}{30 \div 6} = \frac{1}{5}$$

The ratios are equivalent. So, $\frac{1}{5}$ and $\frac{6}{30}$ form a proportion.

7. $\frac{3}{4}$ is in simplest form.

$$\frac{24}{18} = \frac{24 \div 6}{18 \div 6} = \frac{4}{3}$$

The ratios are *not* equivalent. So, $\frac{3}{4}$ and $\frac{24}{18}$ do *not* form a proportion.

8. $\frac{2}{5}$ is in simplest form.

$$\frac{40}{16} = \frac{40 \div 8}{16 \div 8} = \frac{5}{2}$$

The ratios are *not* equivalent. So, $\frac{2}{5}$ and $\frac{40}{16}$ do *not* form a proportion.

9. $\frac{16}{3}$ is in simplest form.

$$\frac{48}{9} = \frac{48 \div 3}{9 \div 3} = \frac{16}{3}$$

The ratios are equivalent. So, $\frac{48}{9}$ and $\frac{16}{3}$ form a proportion.

10. $\frac{18}{27} = \frac{18 \div 9}{27 \div 9} = \frac{2}{3}$

$$\frac{33}{44} = \frac{33 \div 11}{44 \div 11} = \frac{3}{4}$$

The ratios are *not* equivalent. So, $\frac{18}{27}$ and $\frac{33}{44}$ do *not* form a proportion.

11. $\frac{7}{2}$ is in simplest form.

$$\frac{16}{6} = \frac{16 \div 2}{6 \div 2} = \frac{8}{3}$$

The ratios are *not* equivalent. So, $\frac{7}{2}$ and $\frac{16}{6}$ do *not* form a proportion.

12. $\frac{12}{10} = \frac{12 \div 2}{10 \div 2} = \frac{6}{5}$

$$\frac{14}{12} = \frac{14 \div 2}{12 \div 2} = \frac{7}{6}$$

The ratios are *not* equivalent. So, $\frac{12}{10}$ and $\frac{14}{12}$ do *not* form a proportion.

13. $\frac{1}{7}$; $\frac{2}{8} = \frac{1}{4}$; $\frac{3}{9} = \frac{1}{3}$; $\frac{4}{10} = \frac{2}{5}$

So, x and y are *not* proportional because the ratios are *not* equivalent.

14. $\frac{2}{5}$; $\frac{4}{10} = \frac{2}{5}$; $\frac{6}{15} = \frac{2}{5}$; $\frac{8}{20} = \frac{2}{5}$

So, x and y are proportional because the ratios are equivalent.

15. $\frac{7\text{ in.}}{9\text{ h}} \stackrel{?}{=} \frac{42\text{ in.}}{54\text{ h}}$

$$7 \bullet 54 \stackrel{?}{=} 9 \bullet 42$$
$$378 = 378 \checkmark$$

The cross products are equal. So, the two rates form a proportion.

16. $\frac{12\text{ players}}{21\text{ teams}} \stackrel{?}{=} \frac{15\text{ players}}{24\text{ teams}}$

$$12 \bullet 24 \stackrel{?}{=} 21 \bullet 15$$
$$288 \neq 315 \times$$

The cross products are *not* equal. So, the two rates do *not* form a proportion.

17. $\frac{440\text{ calories}}{4\text{ servings}} \stackrel{?}{=} \frac{300\text{ calories}}{3\text{ servings}}$

$$440 \bullet 3 \stackrel{?}{=} 4 \bullet 300$$
$$1320 \neq 1200 \times$$

The cross products are *not* equal. So, the two rates do *not* form a proportion.

18. $\frac{120\text{ units}}{5\text{ days}} \stackrel{?}{=} \frac{88\text{ units}}{4\text{ days}}$

$$120 \bullet 4 \stackrel{?}{=} 5 \bullet 88$$
$$480 \neq 440 \times$$

The cross products are *not* equal. So, the two rates do *not* form a proportion.

19. $\frac{66\text{ wins}}{82\text{ games}} \stackrel{?}{=} \frac{99\text{ wins}}{123\text{ games}}$

$$66 \bullet 123 \stackrel{?}{=} 82 \bullet 99$$
$$8118 = 8118 \checkmark$$

The cross products are equal. So, the two rates form a proportion.

20. $\frac{68\text{ hits}}{172\text{ at bats}} \stackrel{?}{=} \frac{43\text{ hits}}{123\text{ at bats}}$

$$68 \bullet 123 \stackrel{?}{=} 172 \bullet 43$$
$$8364 \neq 7396 \times$$

The cross products are *not* equal. So, the two rates do *not* form a proportion.

Chapter 5

21. $\dfrac{90 \text{ sit-ups}}{2 \text{ min}} \stackrel{?}{=} \dfrac{135 \text{ sit-ups}}{3 \text{ min}}$

$$90 \bullet 3 \stackrel{?}{=} 2 \bullet 135$$
$$270 = 270 \checkmark$$

The cross products are equal. So, the rates are proportional.

22. You: $\dfrac{22 \text{ heartbeats}}{20 \text{ seconds}} = \dfrac{22 \div 20}{20 \div 20} = \dfrac{1.1 \text{ heartbeats}}{1 \text{ second}}$

Your friend: $\dfrac{18 \text{ heartbeats}}{15 \text{ seconds}} = \dfrac{18 \div 15}{15 \div 15} = \dfrac{1.2 \text{ heartbeats}}{1 \text{ second}}$

The unit rates are *not* equivalent. So, the rates do *not* form a proportion.

23. $\dfrac{2.5}{4} \stackrel{?}{=} \dfrac{7}{11.2}$

$$2.5 \bullet 11.2 \stackrel{?}{=} 4 \bullet 7$$
$$28 = 28 \checkmark$$

The cross products are equal. So, $\dfrac{2.5}{4}$ and $\dfrac{7}{11.2}$ form a proportion.

24. $\dfrac{2}{4} \stackrel{?}{=} \dfrac{11}{\frac{11}{2}}$

$$2 \bullet \frac{11}{2} \stackrel{?}{=} 4 \bullet 11$$
$$11 \neq 44 \times$$

The cross products are *not* equal. So, 2 to 4 and 11 to $\dfrac{11}{2}$ do *not* form a proportion.

25. $\dfrac{2}{\frac{4}{5}} \stackrel{?}{=} \dfrac{\frac{3}{4}}{\frac{3}{10}}$

$$2 \bullet \frac{3}{10} \stackrel{?}{=} \frac{4}{5} \bullet \frac{3}{4}$$
$$\frac{3}{5} = \frac{3}{5} \checkmark$$

The cross products are equal. So, $2 : \dfrac{4}{5}$ and $\dfrac{3}{4} : \dfrac{3}{10}$ form a proportion.

26. **a.** $\dfrac{\$56}{8 \text{ h}} = \dfrac{56 \div 8}{8 \div 8} = \dfrac{\$7}{1 \text{ h}}$

Your pay rate is \$7 per hour.

b. $\dfrac{\$36}{4 \text{ h}} = \dfrac{36 \div 4}{4 \div 4} = \dfrac{\$9}{1 \text{ h}}$

Your friend's pay rate is \$9 per hour.

c. The unit rates are *not* equivalent. So, the pay rates are *not* equivalent.

27. First triangle: $\dfrac{h}{b} = \dfrac{12 \text{ cm}}{15 \text{ cm}} = \dfrac{12 \div 3}{15 \div 3} = \dfrac{4}{5}$

Second triangle: $\dfrac{h}{b} = \dfrac{8 \text{ cm}}{10 \text{ cm}} = \dfrac{8 \div 2}{10 \div 2} = \dfrac{4}{5}$

The ratios are equivalent. So, the ratios are proportional.

28. **a.** Session number x and pitches y are proportional.

$\dfrac{1}{10}$; $\dfrac{2}{20} = \dfrac{1}{10}$; $\dfrac{3}{30} = \dfrac{1}{10}$; $\dfrac{4}{40} = \dfrac{1}{10}$

Session number x and curveballs z are proportional.

$\dfrac{1}{4}$; $\dfrac{2}{8} = \dfrac{1}{4}$; $\dfrac{3}{12} = \dfrac{1}{4}$; $\dfrac{4}{16} = \dfrac{1}{4}$

Pitches y and curveballs z are proportional.

$\dfrac{10}{4} = \dfrac{5}{2}$; $\dfrac{20}{8} = \dfrac{5}{2}$; $\dfrac{30}{12} = \dfrac{5}{2}$; $\dfrac{40}{16} = \dfrac{5}{2}$

b. First, find the number of pitches thrown in Session 5.

$$\frac{1}{10} = \frac{5}{y}$$
$$y = 50 \text{ pitches}$$

Then find the number of curveballs thrown.

$$\frac{5}{2} = \frac{50}{z}$$
$$z = 20 \text{ curveballs}$$

So, the pitcher will throw $50 - 20 = 30$ pitches that are not curveballs.

29. Given mixture: $\dfrac{35 \text{ quarts red}}{8 \text{ quarts yellow}}$ Desired mixture: $\dfrac{7 \text{ quarts red}}{2 \text{ quarts yellow}}$

You need to add yellow to the given mixture to form a ratio that is equivalent to $\dfrac{7}{2}$.

$$\frac{35}{?} \xrightarrow{\div 5} \frac{7}{2}$$

If the numerator of the given mixture is divided by 5, it simplifies to the desired mixture. So, what number divided by 5 simplifies to 2?

$10 \div 5 = 2$, which means you want 10 quarts yellow.

The given mixture already contains 8 quarts yellow.

So, you should add $10 - 8 = 2$ quarts yellow to the given mixture.

30. **a.** no

b. *Sample answer:* Suppose 2 quarters and 2 dimes are added to the collection.

The new ratio is $7 : 5$, which is *not* equivalent to the original ratio $5 : 3$. The ratio changes.

Chapter 5

31. No, your age is *not* proportional to your cousin's age because $\frac{13}{19} \neq \frac{14}{20} \neq \frac{15}{21}$, etc.

32. yes; Because B is equivalent to both A and C, then A must be equivalent to C.

Fair Game Review

33. $-28 + 15 = -13$

34. $-6 + (-11) = -17$

35. $-10 - 8 = -18$

36. $-17 - (-14) = -17 + 14 = -3$

37. D; $\frac{2}{6} = \frac{2 \div 2}{6 \div 2} = \frac{1}{3}$; $\frac{12}{36} = \frac{12 \div 12}{36 \div 12} = \frac{1}{3}$;

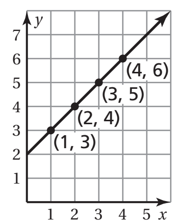
$\frac{4}{12} = \frac{4 \div 4}{12 \div 4} = \frac{1}{3}$; $\frac{6}{9} = \frac{6 \div 3}{9 \div 3} = \frac{2}{3}$

So, $\frac{6}{9}$ is *not* equivalent to $\frac{2}{6}$.

5.2 Extension (pp. 176–177)

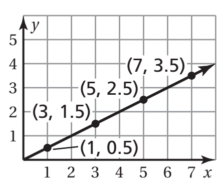
Practice

1.



The graph is a line that does *not* pass through the origin. So, x and y are *not* in a proportional relationship.

2.



The graph is a line that passes through the origin. So, x and y are in a proportional relationship.

3. $(0, 0)$: You earn \$0 for working 0 hours.

$(1, 15)$: You earn \$15 for working 1 hour. This point represents the unit rate, $\frac{\$15}{1\text{ h}}$, or \$15 per hour.

$(4, 60)$: You earn \$60 for working 4 hours. Because the relationship is proportional, you can also use this point to find the unit rate.

$\frac{\$60}{4\text{ h}} = \frac{\$15}{1\text{ h}}$, or \$15 per hour

4. $(0, 0)$: The balloon rises 0 feet in 0 seconds.

$(1, 5)$: The balloon rises 5 feet in 1 second. This point represents the unit rate, $\frac{5\text{ ft}}{1\text{ sec}}$, or 5 feet per second.

$(6, 30)$: The balloon rises 30 feet in 6 seconds. Because the relationship is proportional, you can also use this point to find the unit rate

$\frac{30\text{ ft}}{6\text{ sec}} = \frac{5\text{ ft}}{1\text{ sec}}$, or 5 feet per second.

5. x and y are in a proportional relationship.

Unit rate is $\frac{5\text{ ft}}{1\text{ h}}$.

6.

***x* (hours)**	0.5	1	1.5	2
***y* (temperature)**	58°	56°	54°	50°

$\frac{0.5}{58} \neq \frac{1}{56} \neq \frac{1.5}{54}$, etc. So, x and y are *not* in a proportional relationship.

7. $\frac{12}{16} = \frac{1}{y}$

$12y = 16$

$\frac{12y}{12} = \frac{16}{12}$

$y = \frac{4}{3}$

So, $y = \frac{4}{3}$.

8. a. You:

Days	1	2	3	4	5
Cost (\$)	1.50	2	2.50	3	3.50

Friend:

Days	1	2	3	4	5
Cost (\$)	1.25	2.50	3.75	5	6.25

b. You: $\frac{1}{1.50}$; $\frac{2}{2} = 1$; $\frac{3}{2.50} = \frac{6}{5}$; $\frac{4}{3}$; $\frac{5}{3.50} = \frac{10}{7}$

Friend: $\frac{1}{1.25} = \frac{4}{5}$; $\frac{2}{2.5} = \frac{4}{5}$; $\frac{3}{3.75} = \frac{4}{5}$; $\frac{4}{5}$;

$\frac{5}{6.25} = \frac{4}{5}$

Your friend pays a proportional amount.

Chapter 5

Section 5.3

5.3 Activity (pp. 178–179)

1. Write ratios of bat height to batter's height. Let x be the bat height.

   a. $\frac{x}{58} = \frac{1}{2}$

   One-half of 58 is 29. So, the bat length is 29 inches.

   b. $\frac{x}{60} = \frac{1}{2}$

   One-half of 60 is 30. So, the bat length is 30 inches.

   c. $\frac{x}{64} = \frac{1}{2}$

   One-half of 64 is 32. So, the bat length is 32 inches.

2. Because there are no decimals or fractions in the table, you only need to consider heights that are divisible by 2. In other words, only even numbers. In each height range, check to see if the number that is $\frac{1}{2}$ the height appears as a bat length somewhere in the column under that height range.

   The batters' heights for which the rough rule in this activity is exact are 60 inches, 62 inches, 64 inches, and 66 inches.

3. **a.** $$\text{Batting average} = \frac{H}{A}$$
   $$\frac{200}{1000} = \frac{H}{50}$$
   $$50 \bullet \frac{200}{1000} = 50 \bullet \frac{H}{50}$$
   $$10 = H$$

   The player needs 10 hits.

   b. $$\text{Batting average} = \frac{H}{A}$$
   $$\frac{250}{1000} = \frac{H}{84}$$
   $$84 \bullet \frac{250}{1000} = 84 \bullet \frac{H}{84}$$
   $$21 = H$$

   The player needs 21 hits.

   c. $$\text{Batting average} = \frac{H}{A}$$
   $$\frac{350}{1000} = \frac{H}{80}$$
   $$80 \bullet \frac{350}{1000} = 80 \bullet \frac{H}{80}$$
   $$28 = H$$

   The player needs 28 hits.

   d. $$\text{Batting average} = \frac{H}{A}$$
   $$\frac{1000}{1000} = \frac{H}{1}$$
   $$1 \bullet \frac{1000}{1000} = 1 \bullet \frac{H}{1}$$
   $$1 = H$$

   The player needs 1 hit.

4. *Sample answer:* Use the ratios from the real-life problem to write a proportion. Then use the Multiplication Property of Equality or mental math to solve for the missing quantity.

5. **a.** Player 1 gets 4 hits in the next 5 at bats. Add 4 to the number of hits and 5 to the number of at bats to find the new batting average.

   $$\begin{aligned}\text{Batting average} &= \frac{\text{Hits}}{\text{At bats}}\\ &= \frac{45 + 4}{132 + 5}\\ &= \frac{49}{137}\\ &\approx 0.358\end{aligned}$$

   Player 1's new batting average is 0.358.

   Player 2 gets 3 hits in the next 3 at bats. Add 3 to the number of hits and 3 to the number of at bats to find the new batting average.

   $$\begin{aligned}\text{Batting average} &= \frac{\text{Hits}}{\text{At bats}}\\ &= \frac{45 + 3}{132 + 3}\\ &= \frac{48}{135}\\ &\approx 0.356\end{aligned}$$

   Player 2's new batting average is 0.356. So, Player 1 has the higher batting average.

   b. *Sample answer:* no; Player 2 did not fail to get a hit in any of his 3 at bats.

5.3 On Your Own (pp. 180–181)

1. Example 1 used columns to write the proportion. Use rows to write a proportion.

   $$\frac{1.5 \text{ cups beans}}{6 \text{ cups beans}} = \frac{1 \text{ tomato}}{x \text{ tomatoes}}$$

2.

	Original Recipe	New Recipe
Black Beans	1.5 cups	6 cups
Water	2 cups	y cups

   Sample answer: $\frac{1.5 \text{ cups beans}}{2 \text{ cups water}} = \frac{6 \text{ cups beans}}{y \text{ cups water}}$

Chapter 5

3. $\dfrac{5}{8} = \dfrac{20}{d}$

Because the product of 5 and 4 is 20, multiply the denominator by 4 to find *d*.

$$5 \times 4 = 20$$

$$\frac{5}{8} = \frac{20}{d}$$

$$8 \times 4 = 32$$

The solution is $d = 32$.

4. $\dfrac{7}{z} = \dfrac{14}{10}$

Because the product of 14 and $\dfrac{1}{2}$ is 7, multiply the denominator by $\dfrac{1}{2}$ to find *z*.

$$14 \times \frac{1}{2} = 7$$

$$\frac{7}{z} = \frac{14}{10}$$

$$10 \times \frac{1}{2} = 5$$

The solution is $z = 5$.

5. $\dfrac{21}{24} = \dfrac{x}{8}$

Because the product of 24 and $\dfrac{1}{3}$ is 8, multiply the numerator by $\dfrac{1}{3}$ to find *x*.

$$21 \times \frac{1}{3} = 7$$

$$\frac{21}{24} = \frac{x}{8}$$

$$24 \times \frac{1}{3} = 8$$

The solution is $x = 7$.

6. $\dfrac{\text{Female students}}{\text{All students}} = \dfrac{48}{95} = \dfrac{f}{950}$

Because the product of 95 and 10 is 950, multiply the numerator by 10 to find *f*.

$$48 \times 10 = 480$$

$$\frac{48}{95} = \frac{f}{950}$$

$$95 \times 10 = 950$$

There are 480 female students.

5.3 Exercises (pp. 182–183)

Vocabulary and Concept Check

1. You can use the columns or the rows of the table to write a proportion.

2. The first step in solving $\dfrac{x}{15} = \dfrac{3}{5}$ is to find the number that when multiplied by 5 is 15.

3. *Sample answer:* $\dfrac{x}{12} = \dfrac{5}{6}$

Because the product of 6 and 2 is 12, multiply the numerator by 2 to find *x*.

$$5 \times 2 = 10$$

$$\frac{x}{12} = \frac{5}{6}$$

$$6 \times 2 = 12$$

The solution is $x = 10$.

Practice and Problem Solving

4. Test score $= \dfrac{\text{Points scored}}{\text{Total points}}$

$$0.40 = \frac{x}{50}$$

$$\frac{40}{100} = \frac{x}{50}$$

5. Test score $= \dfrac{\text{Points scored}}{\text{Total points}}$

$$0.78 = \frac{x}{50}$$

$$\frac{78}{100} = \frac{x}{50}$$

Chapter 5

6. Test score $= \dfrac{\text{Points scored}}{\text{Total points}}$

$$0.80 = \frac{x}{80}$$

$$\frac{80}{100} = \frac{x}{80}$$

7. Test score $= \dfrac{\text{Points scored}}{\text{Total points}}$

$$0.96 = \frac{x}{150}$$

$$\frac{96}{100} = \frac{x}{150}$$

8. *Sample answer:* A proportion is $\dfrac{12 \text{ points}}{14 \text{ shots}} = \dfrac{18 \text{ points}}{w \text{ shots}}$.

9. *Sample answer:* A proportion is

$$\frac{n \text{ winners}}{85 \text{ entries}} = \frac{34 \text{ winners}}{170 \text{ entries}}.$$

10. *Sample answer:* A proportion is $\dfrac{15 \text{ miles}}{2.5 \text{ hours}} = \dfrac{m \text{ miles}}{4 \text{ hours}}$.

11. *Sample answer:* A proportion is

$$\frac{100 \text{ meters}}{x \text{ seconds}} = \frac{200 \text{ meters}}{22.4 \text{ seconds}}.$$

12. When using a table to write a proportion, you cannot mix rows and columns.

Sample answer: A proportion is $\dfrac{\$2.08}{8 \text{ ounces}} = \dfrac{d}{16 \text{ ounces}}$.

13. *Sample answer:*

T-shirts	3	7
Cost	\$24	c

A proportion is $\dfrac{3 \text{ T-shirts}}{7 \text{ T-shirts}} = \dfrac{\$24}{c}$.

14. *Sample answer:*

Computers	2	c
Students	5	145

A proportion is $\dfrac{2 \text{ computers}}{5 \text{ students}} = \dfrac{c \text{ computers}}{145 \text{ students}}$.

15. *Sample answer:*

7th-grade swimmers	s	5
All swimmers	80	16

A proportion is

$$\frac{s \text{ 7th-grade swimmers}}{80 \text{ swimmers}} = \frac{5 \text{ 7th-grade swimmers}}{16 \text{ swimmers}}.$$

16. $\dfrac{1}{4} = \dfrac{z}{20}$

Because the product of 4 and 5 is 20, multiply the numerator by 5 to find z.

$$1 \times 5 = 5$$

$$\frac{1}{4} = \frac{z}{20}$$

$$4 \times 5 = 20$$

The solution is $z = 5$.

17. $\dfrac{3}{4} = \dfrac{12}{y}$

Because the product of 3 and 4 is 12, multiply the denominator by 4 to find y.

$$3 \times 4 = 12$$

$$\frac{3}{4} = \frac{12}{y}$$

$$4 \times 4 = 16$$

The solution is $y = 16$.

18. $\dfrac{35}{k} = \dfrac{7}{3}$

Because the product of 7 and 5 is 35, multiply the denominator by 5 to find k.

$$7 \times 5 = 35$$

$$\frac{35}{k} = \frac{7}{3}$$

$$3 \times 5 = 15$$

The solution is $k = 15$.

Chapter 5

19. $\dfrac{15}{8} = \dfrac{45}{c}$

Because the product of 15 and 3 is 45, multiply the denominator by 3 to find c.

$15 \times 3 = 45$

$\dfrac{15}{8} = \dfrac{45}{c}$

$8 \times 3 = 24$

The solution is $c = 24$.

20. $\dfrac{b}{36} = \dfrac{5}{9}$

Because the product of 9 and 4 is 36, multiply the numerator by 4 to find b.

$5 \times 4 = 20$

$\dfrac{b}{36} = \dfrac{5}{9}$

$9 \times 4 = 36$

The solution is $b = 20$.

21. $\dfrac{1.4}{2.5} = \dfrac{g}{25}$

Because the product of 2.5 and 10 is 25, multiply the numerator by 10 to find g.

$1.4 \times 10 = 14$

$\dfrac{1.4}{2.5} = \dfrac{y}{25}$

$2.5 \times 10 = 25$

The solution is $g = 14$.

22. a. *Sample answer:*

Trombones	1	t
Violas	3	9

A proportion is $\dfrac{1 \text{ trombone}}{3 \text{ violas}} = \dfrac{t \text{ trombones}}{9 \text{ violas}}$.

b. $\dfrac{1}{3} = \dfrac{t}{9}$

Because the product of 3 and 3 is 9, multiply the numerator by 3 to find t.

$1 \times 3 = 3$

$\dfrac{1}{3} = \dfrac{t}{9}$

$3 \times 3 = 9$

So, $t = 3$. There are 3 trombones in the orchestra.

23.

	Scale	**Length**
Model dimension	1	19.5 cm
Actual dimension	200	x cm

A proportion is $\dfrac{1}{200} = \dfrac{19.5}{x}$.

24. Your friend is incorrect. To solve the proportion $\dfrac{6}{x} = \dfrac{12}{48}$, think 12 times what number is 6? Because the product of 12 and $\dfrac{1}{2}$ is 6, multiply the denominator by $\dfrac{1}{2}$ to find x.

$12 \times \dfrac{1}{2} = 6$

$\dfrac{6}{x} = \dfrac{12}{48}$

$48 \times \dfrac{1}{2} = 24$

The solution is $x = 24$.

25. $\dfrac{180 \text{ white lockers}}{x \text{ blue lockers}} = \dfrac{3 \text{ white lockers}}{5 \text{ blue lockers}}$

$\dfrac{180}{x} = \dfrac{3}{5}$

Because the product of 3 and 60 is 180, multiply the denominator by 60 to find x.

$3 \times 60 = 180$

$\dfrac{180}{x} = \dfrac{3}{5}$

$5 \times 60 = 300$

There are 300 blue lockers. So, there are $300 + 180 = 480$ lockers in the school.

Fair Game Review

26. $\dfrac{x}{6} = 25$

$6 \bullet \dfrac{x}{6} = 6 \bullet 25$

$x = 150$

The solution is $x = 150$.

27. $8x = 72$

$\dfrac{8x}{8} = \dfrac{72}{8}$

$x = 9$

The solution is $x = 9$.

Chapter 5

28. $150 = 2x$

$$\frac{150}{2} = \frac{2x}{2}$$

$$75 = x$$

The solution is $x = 75$.

29. $$35 = \frac{x}{4}$$

$$4 \bullet 35 = 4 \bullet \frac{x}{4}$$

$$140 = x$$

The solution is $x = 140$.

30. C; $$-\frac{9}{4} + \left|-\frac{8}{5}\right| - 2\frac{1}{2} = -\frac{9}{4} + \frac{8}{5} - \frac{5}{2}$$
$$= -\frac{45}{20} + \frac{32}{20} - \frac{50}{20}$$
$$= -\frac{63}{20}, \text{ or } -3\frac{3}{20}$$

Study Help

Available at *BigIdeasMath.com*.

Quiz 5.1–5.3

1. $$\frac{18 \text{ red buttons}}{12 \text{ blue buttons}} = \frac{18 \div 6}{12 \div 6} = \frac{3 \text{ red buttons}}{2 \text{ blue buttons}}$$

The ratio of red buttons to blue buttons is $\frac{3}{2}$.

2. $$\frac{\frac{5}{4} \text{ inches}}{\frac{2}{3} \text{ inches}} = \frac{\frac{5}{4} \div \frac{2}{3}}{\frac{2}{3} \div \frac{2}{3}} = \frac{\frac{5}{4} \bullet \frac{3}{2}}{1 \text{ inch}} = \frac{\frac{15}{8} \text{ inches}}{1 \text{ inch}}$$

The ratio of inches to inches is $\frac{15}{8}$.

3.

+ 2 + 2 + 2

Songs	0	2	4	6
Cost	\$0	\$1.98	\$3.96	\$5.94

+ 1.98 + 1.98 + 1.98

$$\frac{\text{change in cost}}{\text{change in songs}} = \frac{\$1.98}{2 \text{ songs}}$$
$$= \frac{1.98 \div 2}{2 \div 2}$$
$$= \frac{\$0.99}{1 \text{ song}}$$

The unit rate is \$0.99 per song.

4.

+ 3 + 3 + 3

Hour	3	6	9	12
Gallons	10.5	21	31.5	42

+ 10.5 + 10.5 + 10.5

$$\frac{\text{change in gallons}}{\text{change in hour}} = \frac{10.5 \text{ gal}}{3 \text{ h}}$$
$$= \frac{10.5 \div 3}{3 \div 3}$$
$$= \frac{3.5 \text{ gal}}{1 \text{ h}}$$

The unit rate is 3.5 gallons per hour.

5. $\frac{1}{8}$ is in simplest form.

$$\frac{4}{32} = \frac{4 \div 4}{32 \div 4} = \frac{1}{8}$$

The ratios are equivalent. So, $\frac{1}{8}$ and $\frac{4}{32}$ form a proportion.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{3}{2}$$

6. $\frac{2}{3}$ is in simplest form.

$$\frac{10}{30} = \frac{10 \div 10}{30 \div 10} = \frac{1}{3}$$

The ratios are *not* equivalent. So, $\frac{2}{3}$ and $\frac{10}{30}$ do *not* form a proportion.

7. $\frac{7}{4}$ is in simplest form.

$$\frac{28}{16} = \frac{28 \div 4}{16 \div 4} = \frac{7}{4}$$

The ratios are equivalent. So, $\frac{7}{4}$ and $\frac{28}{16}$ form a proportion.

8. $$\frac{75 \text{ mi}}{3 \text{ h}} \stackrel{?}{=} \frac{140 \text{ mi}}{4 \text{ h}}$$

$$75 \bullet 4 \stackrel{?}{=} 3 \bullet 140$$

$$300 \neq 420 \ ✗$$

The cross products are *not* equal. So, the two rates do *not* form a proportion.

9. $\dfrac{12 \text{ gal}}{4 \text{ min}} \stackrel{?}{=} \dfrac{21 \text{ gal}}{7 \text{ min}}$

$12 \bullet 7 \stackrel{?}{=} 4 \bullet 21$

$84 = 84$ ✓

The cross products are equal. So, the two rates form a proportion.

10. $\dfrac{150 \text{ steps}}{50 \text{ ft}} \stackrel{?}{=} \dfrac{72 \text{ steps}}{24 \text{ ft}}$

$150 \bullet 24 \stackrel{?}{=} 50 \bullet 72$

$3600 = 3600$ ✓

The cross products are equal. So, the two rates form a proportion.

11. $\dfrac{3 \text{ rotations}}{675 \text{ days}} \stackrel{?}{=} \dfrac{2 \text{ rotations}}{730 \text{ days}}$

$3 \bullet 730 \stackrel{?}{=} 675 \bullet 2$

$2190 \neq 1350$ ✗

The cross products are *not* equal. So, the two rates do *not* form a proportion.

12. *Sample answer:* A proportion is $\dfrac{42 \text{ dollars}}{6 \text{ hours}} = \dfrac{56 \text{ dollars}}{h \text{ hours}}$.

13. *Sample answer:* A proportion is $\dfrac{g \text{ games}}{6 \text{ games}} = \dfrac{4 \text{ wins}}{3 \text{ wins}}$.

14.

+6 +6 +6

Seconds	6	12	18	24
Megabytes	2	4	6	8

+2 +2 +2

$$\frac{\text{change in megabytes}}{\text{change in seconds}} = \frac{2 \text{ megabytes}}{6 \text{ seconds}} = \frac{2 \div 6}{6 \div 6} = \frac{\frac{1}{3} \text{ megabyte}}{1 \text{ second}}$$

The unit rate is $\frac{1}{3}$ megabyte per second.

15. (0, 0): Sound travels through steel 0 kilometers in 0 seconds; (2, 12): Sound travels through steel 12 kilometers in 2 seconds; (4, 24): Sound travels through steel 24 kilometers in 4 seconds.

So, sound travels through steel 6 kilometers per second.

16. $\dfrac{3 \text{ levels}}{15 \text{ minutes}} \stackrel{?}{=} \dfrac{5 \text{ levels}}{20 \text{ minutes}}$

$3 \bullet 20 \stackrel{?}{=} 15 \bullet 5$

$60 \neq 75$ ✗

The cross products are *not* equal. So, the rates are *not* proportional.

17. $\dfrac{150 \text{ minutes}}{x \text{ minutes}} = \dfrac{3 \text{ classes}}{5 \text{ classes}}$

Because the product of 3 and 50 is 150, multiply the denominator by 50 to find x.

$3 \times 50 = 150$

$$\frac{150}{x} = \frac{3}{5}$$

$5 \times 50 = 250$

You spend 250 minutes in 5 classes.

Section 5.4

5.4 Activity (pp. 186–187)

1. a. *Sample answer*: $\dfrac{1 \text{ L}}{3 \text{ L}} = \dfrac{250 \text{ g}}{x \text{ g}}$

$1 \bullet x = 250 \bullet 3$

$x = 750$

There are 750 grams of salt in the 3-liter solution.

b. $\dfrac{\frac{1}{2} \text{ c}}{1 \text{ c}} = \dfrac{\frac{1}{2} \text{ c}}{x \text{ c}}$ or $\dfrac{\frac{1}{2} \text{ c}}{\frac{1}{2} \text{ c}} = \dfrac{1 \text{ c}}{x \text{ c}}$

$\frac{1}{2} \bullet x = 1 \bullet \frac{1}{2}$

$x = \frac{1}{2} \bullet 2$

$x = 1$

There is 1 cup of white glue in the solution.

c. $\dfrac{1 \text{ tsp}}{2 \text{ tsp}} = \dfrac{1 \text{ c}}{x \text{ c}}$ or $\dfrac{1 \text{ tsp}}{1 \text{ c}} = \dfrac{2 \text{ tsp}}{x \text{ c}}$

$1 \bullet x = 1 \bullet 2$

$x = 2$

There are 2 cups of borax in the solution.

d. In the recipe, $\frac{1}{2}$ cup water and $\frac{1}{2}$ cup white glue are combined to make 1 cup white glue solution. Then, 1 cup borax solution is combined with 1 cup white glue solution. So, $x = 1$. To find y:

$$\frac{1\text{ c}}{\frac{1}{2}\text{ c}} = \frac{1\text{ c}}{y\text{ c}}$$

$$1 \bullet y = \frac{1}{2} \bullet 1$$

$$y = \frac{1}{2}$$

So, there is $\frac{1}{2}$ cup of white glue when you use $\frac{1}{2}$ cup of the borax solution.

2. *Answer should include, but is not limited to:* Students will prepare for the game following the provided instructions. Students will then play the game following the provided instructions. Students will use their knowledge of proportions throughout game play.

3. *Sample answer:* Set up a ratio table, and then use the table to write a proportion involving an unknown quantity. Then use cross products to solve the proportion to determine the unknown quantity.

Salt Water	1 L	4 L
Salt	250 g	x g

$$\frac{4\text{L}}{1\text{L}} = \frac{x\text{ g}}{250\text{g}}$$

$$4 \bullet 250 = 1 \bullet x$$

$$1000 = x$$

So, there are 1000 grams of salt in the 4-liter solution.

4. *Sample answer:* $\frac{1}{2} = \frac{5}{10}, \frac{15}{20} = \frac{3}{4}, \frac{12}{16} = \frac{6}{8}$

5.4 On Your Own (pp. 188–189)

1.
$$\frac{w}{6} = \frac{6}{9}$$
$$6 \bullet \frac{w}{6} = 6 \bullet \frac{6}{9}$$
$$w = 4$$

The solution is $w = 4$.

2.
$$\frac{12}{10} = \frac{a}{15}$$
$$15 \bullet \frac{12}{10} = 15 \bullet \frac{a}{15}$$
$$18 = a$$

The solution is $a = 18$.

3.
$$\frac{y}{6} = \frac{2}{4}$$
$$6 \bullet \frac{y}{6} = 6 \bullet \frac{2}{4}$$
$$y = 3$$

The solution is $y = 3$.

4.
$$\frac{2}{7} = \frac{x}{28}$$
$$2 \bullet 28 = 7 \bullet x$$
$$56 = 7x$$
$$\frac{56}{7} = \frac{7x}{7}$$
$$8 = x$$

The solution is $x = 8$.

5.
$$\frac{12}{5} = \frac{6}{y}$$
$$12 \bullet y = 5 \bullet 6$$
$$12y = 30$$
$$\frac{12y}{12} = \frac{30}{12}$$
$$y = 2.5$$

The solution is $y = 2.5$.

6.
$$\frac{40}{z+1} = \frac{15}{6}$$
$$40 \bullet 6 = 15 \bullet (z + 1)$$
$$240 = 15 \bullet z + 15 \bullet 1$$
$$240 = 15z + 15$$
$$\underline{-15} \qquad \underline{-15}$$
$$225 = 15z$$
$$\frac{225}{15} = \frac{15z}{15}$$
$$15 = z$$

The solution is $z = 15$.

7. Let x be the number of centimeters equivalent to 7.5 inches. Use the relationship 1 inch $\approx$ 2.54 centimeters to write a proportion.

$$\frac{1\text{ in.}}{2.54\text{ cm}} = \frac{7.5\text{ in.}}{x\text{ cm}}$$
$$\frac{1}{2.54} = \frac{7.5}{x}$$
$$1 \bullet x = 2.54 \bullet 7.5$$
$$x = 19.05$$

So, 7.5 inches is about 19.05 centimeters.

8. Let x be the number of ounces equivalent to 100 grams. Use the relationship 1 g $\approx$ 0.035 oz to write a proportion.

$$\frac{100\text{ g}}{x\text{ oz}} = \frac{1\text{ g}}{0.035\text{ oz}}$$
$$\frac{100}{x} = \frac{1}{0.035}$$
$$100 \bullet 0.035 = x \bullet 1$$
$$3.5 = x$$

So, 100 grams is about 3.5 ounces.

9. Let x be the number of quarts equivalent to 2 liters. Use the relationship $1 \text{ liter} \approx 1.06$ quarts to write a proportion.

$$\frac{2\text{ L}}{x\text{ qt}} = \frac{1\text{ L}}{1.06\text{ qt}}$$
$$\frac{2}{x} = \frac{1}{1.06}$$
$$2 \bullet 1.06 = x \bullet 1$$
$$2.12 = x$$

So, 2 liters is about 2.12 quarts.

10. Let x be the number of feet equivalent to 4 meters. Use the relationship $1 \text{ meter} \approx 3.28 \text{ feet}$ to write a proportion.

$$\frac{4\text{ m}}{x\text{ ft}} = \frac{1\text{ m}}{3.28\text{ ft}}$$
$$\frac{4}{x} = \frac{1}{3.28}$$
$$4 \bullet 3.28 = x \bullet 1$$
$$13.12 = x$$

So, 4 meters is about 13.12 feet.

5.4 Exercises (pp. 190–191)

Vocabulary and Concept Check

1. You can solve a proportion using mental math, the Multiplication Property of Equality, or the Cross Products Property.

2. *Sample answer:* mental math; Because $3 \bullet 2 = 6,$ the product of x and 2 is 14. So, $x = 7.$

3. Yes, because you obtain the same cross products.

$$\frac{x}{4} = \frac{15}{3} \qquad \frac{x}{15} = \frac{4}{3}$$
$$x \bullet 3 = 4 \bullet 15 \qquad x \bullet 3 = 15 \bullet 4$$
$$3x = 60 \qquad 3x = 60$$

Practice and Problem Solving

4. $$\frac{9}{5} = \frac{z}{20}$$
$$20 \bullet \frac{9}{5} = 20 \bullet \frac{z}{20}$$
$$36 = z$$

The solution is $z = 36$.

5. $$\frac{h}{15} = \frac{16}{3}$$
$$15 \bullet \frac{h}{15} = 15 \bullet \frac{16}{3}$$
$$h = 80$$

The solution is $h = 80$.

6. $$\frac{w}{4} = \frac{42}{24}$$
$$4 \bullet \frac{w}{4} = 4 \bullet \frac{42}{24}$$
$$w = 7$$

The solution is $w = 7$.

7. $$\frac{35}{28} = \frac{n}{12}$$
$$12 \bullet \frac{35}{28} = 12 \bullet \frac{n}{12}$$
$$15 = n$$

The solution is $n = 15$.

8. $$\frac{7}{16} = \frac{x}{4}$$
$$4 \bullet \frac{7}{16} = 4 \bullet \frac{x}{4}$$
$$\frac{7}{4} = x$$
$$1\frac{3}{4} = x$$

The solution is $x = 1\frac{3}{4}$.

9. $$\frac{y}{9} = \frac{44}{54}$$
$$9 \bullet \frac{y}{9} = 9 \bullet \frac{44}{54}$$
$$y = \frac{22}{3}$$
$$y = 7\frac{1}{3}$$

The solution is $y = 7\frac{1}{3}$.

10. $$\frac{a}{6} = \frac{15}{2}$$
$$a \bullet 2 = 6 \bullet 15$$
$$2a = 90$$
$$\frac{2a}{2} = \frac{90}{2}$$
$$a = 45$$

The solution is $a = 45$.

11. $$\frac{10}{7} = \frac{8}{k}$$
$$10 \bullet k = 7 \bullet 8$$
$$10k = 56$$
$$\frac{10k}{10} = \frac{56}{10}$$
$$k = 5.6$$

The solution is $k = 5.6$.

12. $$\frac{3}{4} = \frac{v}{14}$$
$$3 \bullet 14 = 4 \bullet v$$
$$42 = 4v$$
$$\frac{42}{4} = \frac{4v}{4}$$
$$10.5 = v$$

The solution is $v = 10.5$.

13. $$\frac{5}{n} = \frac{16}{32}$$
$$5 \bullet 32 = n \bullet 16$$
$$160 = 16n$$
$$\frac{160}{16} = \frac{16n}{16}$$
$$10 = n$$

The solution is $n = 10$.

14. $$\frac{36}{42} = \frac{24}{r}$$
$$36 \bullet r = 42 \bullet 24$$
$$36r = 1008$$
$$\frac{36r}{36} = \frac{1008}{36}$$
$$r = 28$$

The solution is $r = 28$.

15. $$\frac{9}{10} = \frac{d}{6.4}$$
$$9 \bullet 6.4 = 10 \bullet d$$
$$57.6 = 10d$$
$$\frac{57.6}{10} = \frac{10d}{10}$$
$$5.76 = d$$

The solution is $d = 5.76$.

16. $$\frac{x}{8} = \frac{3}{12}$$
$$x \bullet 12 = 8 \bullet 3$$
$$12x = 24$$
$$\frac{12x}{12} = \frac{24}{12}$$
$$x = 2$$

The solution is $x = 2$.

17. $$\frac{8}{m} = \frac{6}{15}$$
$$8 \bullet 15 = m \bullet 6$$
$$120 = 6m$$
$$\frac{120}{6} = \frac{6m}{6}$$
$$20 = m$$

The solution is $m = 20$.

Chapter 5

18. $$\frac{4}{24} = \frac{c}{36}$$
$$4 \bullet 36 = 24 \bullet c$$
$$144 = 24c$$
$$\frac{144}{24} = \frac{24c}{24}$$
$$6 = c$$

The solution is $c = 6$.

19. $$\frac{20}{16} = \frac{d}{12}$$
$$20 \bullet 12 = 16 \bullet d$$
$$240 = 16d$$
$$\frac{240}{16} = \frac{16d}{16}$$
$$15 = d$$

The solution is $d = 15$.

20. $$\frac{30}{20} = \frac{w}{14}$$
$$30 \bullet 14 = 20 \bullet w$$
$$420 = 20w$$
$$\frac{420}{20} = \frac{20w}{20}$$
$$21 = w$$

The solution is $w = 21$.

21. $$\frac{2.4}{1.8} = \frac{7.2}{k}$$
$$2.4 \bullet k = 1.8 \bullet 7.2$$
$$2.4k = 12.96$$
$$\frac{2.4k}{2.4} = \frac{12.96}{2.4}$$
$$k = 5.4$$

The solution is $k = 5.4$.

22. The Cross Products Property was not used correctly.
$$\frac{m}{8} = \frac{15}{24}$$
$$m \bullet 24 = 8 \bullet 15$$
$$24m = 120$$
$$\frac{24m}{24} = \frac{120}{24}$$
$$m = 5$$

The solution is $m = 5$.

23. $$\frac{48 \text{ pens}}{4 \text{ boxes}} = \frac{x \text{ pens}}{9 \text{ boxes}}$$
$$48 \bullet 9 = 4 \bullet x$$
$$432 = 4x$$
$$\frac{432}{4} = \frac{4x}{4}$$
$$108 = x$$

There are 108 pens in 9 boxes.

24. $$\frac{3 \text{ pizzas}}{\$10.50} = \frac{10 \text{ pizzas}}{\$x}$$
$$3 \bullet x = 10.50 \bullet 10$$
$$3x = 105$$
$$\frac{3x}{3} = \frac{105}{3}$$
$$x = 35$$

It costs \$35 for 10 pizzas.

25. $$\frac{2x}{5} = \frac{9}{15}$$
$$5 \bullet \frac{2x}{5} = 5 \bullet \frac{9}{15}$$
$$2x = 3$$
$$\frac{2x}{2} = \frac{3}{2}$$
$$x = 1.5$$

The solution is $x = 1.5$.

26. $$\frac{5}{2} = \frac{d-2}{4}$$
$$4 \bullet \frac{5}{2} = 4 \bullet \frac{d-2}{4}$$
$$10 = d - 2$$
$$\underline{+2} \qquad \underline{+2}$$
$$12 = d$$

The solution is $d = 12$.

27. $$\frac{4}{k+3} = \frac{8}{14}$$
$$4 \bullet 14 = 8 \bullet (k+3)$$
$$56 = 8 \bullet k + 8 \bullet 3$$
$$56 = 8k + 24$$
$$\underline{-24} \qquad \underline{-24}$$
$$32 = 8k$$
$$\frac{32}{8} = \frac{8k}{8}$$
$$4 = k$$

The solution is $k = 4$.

28. Let x be the number of miles equivalent to 6 kilometers. Use the relationship $1 \text{ kilometer} \approx 0.62 \text{ mile}$ to write a proportion.
$$\frac{6 \text{ km}}{x \text{ mi}} = \frac{1 \text{ km}}{0.62 \text{ mi}}$$
$$\frac{6}{x} = \frac{1}{0.62}$$
$$6 \bullet 0.62 = x \bullet 1$$
$$3.72 = x$$

So, 6 kilometers is about 3.72 miles.

Chapter 5

29. Let x be the number of gallons equivalent to 2.5 liters. Use the relationship $1 \text{ liter} \approx 0.26$ gallon to write a proportion.

$$\frac{2.5 \text{ L}}{x \text{ gal}} = \frac{1 \text{ L}}{0.26 \text{ gal}}$$
$$\frac{2.5}{x} = \frac{1}{0.26}$$
$$2.5 \bullet 0.26 = x \bullet 1$$
$$0.65 = x$$

So, 2.5 liters is about 0.65 gallon.

30. Let x be the number of kilograms equivalent to 90 pounds. Use the relationship $1 \text{ pound} \approx 0.45$ kilogram to write a proportion.

$$\frac{90 \text{ lb}}{x \text{ kg}} = \frac{1 \text{ lb}}{0.45 \text{ kg}}$$
$$\frac{90}{x} = \frac{1}{0.45}$$
$$90 \bullet 0.45 = x \bullet 1$$
$$40.5 = x$$

So, 90 pounds is about 40.5 kilograms.

31. true; The cross products of each proportion are equivalent.

$$\frac{a}{b} = \frac{2}{3} \qquad \frac{3}{2} = \frac{b}{a}$$
$$a \bullet 3 = b \bullet 2 \qquad 3 \bullet a = 2 \bullet b$$
$$3a = 2b \qquad 3a = 2b$$

32. $$\frac{\$95}{20 \text{ students}} = \frac{\$x}{162 \text{ students}}$$
$$95 \bullet 162 = 20 \bullet x$$
$$15{,}390 = 20x$$
$$\frac{15{,}390}{20} = \frac{20x}{20}$$
$$769.50 = x$$

It costs \$769.50 for 162 students to attend the aquarium.

33. $$\frac{120 \text{ pounds on Earth}}{20 \text{ pounds on moon}} = \frac{93 \text{ pounds on Earth}}{x \text{ pounds on moon}}$$
$$120 \bullet x = 20 \bullet 93$$
$$120x = 1860$$
$$\frac{120x}{120} = \frac{1860}{120}$$
$$x = 15.5$$

A 93-pound person weighs 15.5 pounds on the moon.

34. a. Using the graph, you know that the hair length after 6 months is 3 inches. Let x be the number of centimeters equivalent to 3 inches. Use the relationship $1 \text{ inch} \approx 2.54$ centimeters to write a proportion to find the hair length in centimeters after 6 months.

$$\frac{3 \text{ in.}}{x \text{ cm}} = \frac{1 \text{ in.}}{2.54 \text{ cm}}$$
$$\frac{3}{x} = \frac{1}{2.54}$$
$$3 \bullet 2.54 = x \bullet 1$$
$$7.62 = x$$

So, after 6 months the hair length is about 7.62 centimeters.

b. $$\frac{x \text{ mo}}{8 \text{ in.}} = \frac{6 \text{ mo}}{3 \text{ in.}}$$
$$8 \bullet \frac{x}{8} = \frac{6}{3} \bullet 8$$
$$x = 16$$

It takes 16 months for hair to grow 8 inches.

c. $$\frac{8 \text{ in.}}{16 \text{ mo}} = \frac{20 \text{ in.}}{x \text{ mo}}$$
$$8 \bullet x = 16 \bullet 20$$
$$8x = 320$$
$$\frac{8x}{8} = \frac{320}{8}$$
$$x = 40$$

It takes 40 months for hair to grow 20 inches.

35. *Sample answer:* No, the relationship is not proportional. It should take more people less time to build the swing set.

36. The ratio of adults to children is $5 : 3$, so the ratio of total audience to adults is $(5 + 3) : 5$, which is 8 : 5.

$$\frac{8 \text{ total audience members}}{5 \text{ adults}} = \frac{144 \text{ total audience members}}{x \text{ adults}}$$
$$8 \bullet x = 5 \bullet 144$$
$$8x = 720$$
$$\frac{8x}{8} = \frac{720}{8}$$
$$x = 90$$

There are 90 adults.

37. $$\frac{3 \text{ pounds}}{1800 \text{ square feet}} = \frac{x \text{ pounds}}{8400 \text{ square feet}}$$
$$3 \bullet 8400 = 1800 \bullet x$$
$$25{,}200 = 1800x$$
$$\frac{25{,}200}{1800} = \frac{1800x}{1800}$$
$$14 = x$$

14 pounds are needed, and $14 \div 4 = 3.5$ bags.

So, 4 bags are needed.

38. Solve for m: $\frac{m}{n} = \frac{1}{2}$
$$2m = 1n$$
$$m = \frac{n}{2}$$

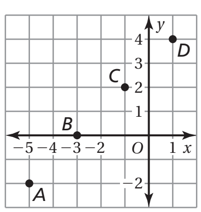
Solve for k: $\frac{n}{k} = \frac{2}{5}$
$$2k = 5n$$
$$k = \frac{5n}{2}$$

$$\frac{m}{k} = \frac{\frac{n}{2}}{\frac{5n}{2}} = \frac{n}{2} \bullet \frac{2}{5n} = \frac{1}{5}$$

The ratio $\frac{m}{k}$ is $\frac{1}{5}$.

Fair Game Review

39–42.



43. D; $(3w - 8) - 4(2w + 3) = 3w - 8 - 8w - 12$
$$= 3w - 8w - 8 - 12$$
$$= -5w - 20$$

Section 5.5

5.5 Activity (pp. 192–193)

1. a. Antelope:

$$\frac{61.0 \text{ mi}}{\text{h}} = \frac{61.0 \cancel{\text{mi}}}{1 \cancel{\text{h}}} \bullet \frac{5280 \text{ ft}}{1 \cancel{\text{mi}}} \bullet \frac{1 \cancel{\text{h}}}{60 \cancel{\text{min}}} \bullet \frac{1 \cancel{\text{min}}}{60 \text{ sec}} \approx \frac{89.5 \text{ ft}}{\text{sec}}$$

Black mamba snake:

$$\frac{29.3 \text{ ft}}{\text{sec}} = \frac{29.3 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} \approx \frac{20.0 \text{ mi}}{\text{h}}$$

Cheetah:

$$\frac{102.6 \text{ ft}}{\text{sec}} = \frac{102.6 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} \approx \frac{70.0 \text{ mi}}{\text{h}}$$

Chicken:

$$\frac{13.2 \text{ ft}}{\text{sec}} = \frac{13.2 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} = \frac{9 \text{ mi}}{\text{h}}$$

Coyote:

$$\frac{43.0 \text{ mi}}{\text{h}} = \frac{43.0 \cancel{\text{mi}}}{1 \cancel{\text{h}}} \bullet \frac{5280 \text{ ft}}{1 \cancel{\text{mi}}} \bullet \frac{1 \cancel{\text{h}}}{60 \cancel{\text{min}}} \bullet \frac{1 \cancel{\text{min}}}{60 \text{ sec}} \approx \frac{63.1 \text{ ft}}{\text{sec}}$$

Domestic pig:

$$\frac{16.0 \text{ ft}}{\text{sec}} = \frac{16.0 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} \approx \frac{10.9 \text{ mi}}{\text{h}}$$

Elephant:

$$\frac{36.6 \text{ ft}}{\text{sec}} = \frac{36.6 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} \approx \frac{25.0 \text{ mi}}{\text{h}}$$

Elk:

$$\frac{66.0 \text{ ft}}{\text{sec}} = \frac{66.0 \cancel{\text{ft}}}{1 \cancel{\text{sec}}} \bullet \frac{1 \text{ mi}}{5280 \cancel{\text{ft}}} \bullet \frac{60 \cancel{\text{sec}}}{1 \cancel{\text{min}}} \bullet \frac{60 \cancel{\text{min}}}{1 \text{ h}} = \frac{45.0 \text{ mi}}{\text{h}}$$

Giant tortoise:

$$\frac{0.2\text{ mi}}{\text{h}} = \frac{0.2\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{0.3\text{ ft}}{\text{sec}}$$

Giraffe:

$$\frac{32.0\text{ mi}}{\text{h}} = \frac{32.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{46.9\text{ ft}}{\text{sec}}$$

Gray fox:

$$\frac{61.6\text{ ft}}{\text{sec}} = \frac{61.6\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} = \frac{42.0\text{ mi}}{\text{h}}$$

Greyhound:

$$\frac{39.4\text{ mi}}{\text{h}} = \frac{39.4\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{57.8\text{ ft}}{\text{sec}}$$

Grizzly bear:

$$\frac{44.0\text{ ft}}{\text{sec}} = \frac{44.0\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} = \frac{30.0\text{ mi}}{\text{h}}$$

Human:

$$\frac{41.0\text{ ft}}{\text{sec}} = \frac{41.0\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} \approx \frac{28.0\text{ mi}}{\text{h}}$$

Hyena:

$$\frac{40.0\text{ mi}}{\text{h}} = \frac{40.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{58.7\text{ ft}}{\text{sec}}$$

Jackal:

$$\frac{35.0\text{ mi}}{\text{h}} = \frac{35.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{51.3\text{ ft}}{\text{sec}}$$

Lion:

$$\frac{73.3\text{ ft}}{\text{sec}} = \frac{73.3\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} \approx \frac{50.0\text{ mi}}{\text{h}}$$

Peregrine falcon:

$$\frac{200.0\text{ mi}}{\text{h}} = \frac{200.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{293.3\text{ ft}}{\text{sec}}$$

Quarter horse:

$$\frac{47.5\text{ mi}}{\text{h}} = \frac{47.5\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{69.7\text{ ft}}{\text{sec}}$$

Spider:

$$\frac{1.76\text{ ft}}{\text{sec}} = \frac{1.76\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} = \frac{1.2\text{ mi}}{\text{h}}$$

Squirrel:

$$\frac{12.0\text{ mi}}{\text{h}} = \frac{12.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{17.6\text{ ft}}{\text{sec}}$$

Thomson’s gazelle:

$$\frac{50.0\text{ mi}}{\text{h}} = \frac{50.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{73.3\text{ ft}}{\text{sec}}$$

Three-toed sloth:

$$\frac{0.2\text{ ft}}{\text{sec}} = \frac{0.2\ \cancel{\text{ft}}}{1\ \cancel{\text{sec}}} \bullet \frac{1\text{ mi}}{5280\ \cancel{\text{ft}}} \bullet \frac{60\ \cancel{\text{sec}}}{1\ \cancel{\text{min}}} \bullet \frac{60\ \cancel{\text{min}}}{1\text{ h}} \approx \frac{0.1\text{ mi}}{\text{h}}$$

Tuna:

$$\frac{47.0\text{ mi}}{\text{h}} = \frac{47.0\ \cancel{\text{mi}}}{1\ \cancel{\text{h}}} \bullet \frac{5280\text{ ft}}{1\ \cancel{\text{mi}}} \bullet \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \bullet \frac{1\ \cancel{\text{min}}}{60\text{ sec}} \approx \frac{68.9\text{ ft}}{\text{sec}}$$

b. The peregrine falcon is the fastest animal and the three-toed sloth is the slowest.

c. To convert miles per hour to feet per second, multiply by the ratios $\frac{5280\text{ ft}}{1\text{ mi}} \bullet \frac{1\text{ h}}{60\text{ min}} \bullet \frac{1\text{ min}}{60\text{ sec}}$. To convert feet per second to miles per hour, multiply by the ratios $\frac{1\text{ mi}}{5280\text{ ft}} \bullet \frac{60\text{ sec}}{1\text{ min}} \bullet \frac{60\text{ min}}{1\text{ h}}$.

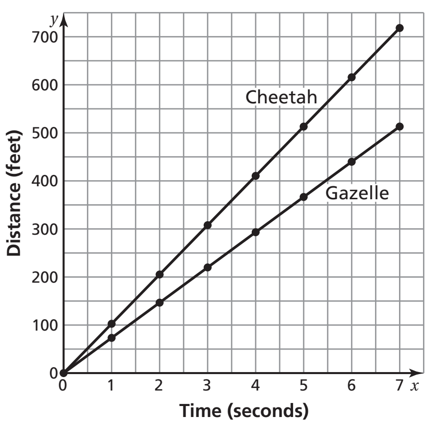
Chapter 5

2. a. Use the unit rate in feet per second multiplied by the number of seconds.

	Cheetah	Gazelle
Time (seconds)	**Distance (feet)**	**Distance (feet)**
0	0	0
1	$102.6(1) = 102.6$	$73.3(1) = 73.3$
2	$102.6(2) = 205.2$	$73.3(2) = 146.6$
3	$102.6(3) = 307.8$	$73.3(3) = 219.9$
4	$102.6(4) = 410.4$	$73.3(4) = 293.2$
5	$102.6(5) = 513.0$	$73.3(5) = 366.5$
6	$102.6(6) = 615.6$	$73.3(6) = 439.8$
7	$102.6(7) = 718.2$	$73.3(7) = 513.1$

b. Ordered pairs of the Cheetah:
(0, 0), (1, 102.6), (2, 205.2),
(3, 307.8), (4, 410.4), (5, 513),
(6, 615.6), (7, 718.2)

Ordered pairs of the Gazelle:
(0, 0), (1, 73.3), (2, 146.6),
(3, 219.9), (4, 293.2), (5, 366.5),
(6, 439.8), (7, 513.1)



Sample answer: The graphs are lines that pass through the origin.

c. The graph for the cheetah is steeper. The speed of the cheetah is greater.

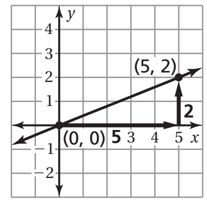
3. To compare two rates graphically, graph lines representing the rates and then compare the steepness of each line. The steeper line represents the higher rate.

Sample answer: In the same amount of time, a cheetah will run farther than a gazelle and its line is steeper.

4. *Answer should include, but is not limited to:* Students will choose 10 animals from Activity 1 and then repeat Activity 2 for these animals. Students will then write a conclusion of performing the activity.

5.5 On Your Own (pp. 194–195)

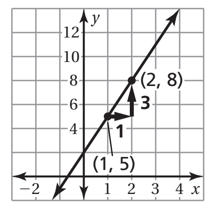
1.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{2}{5}$$

The slope of the line is $\frac{2}{5}$.

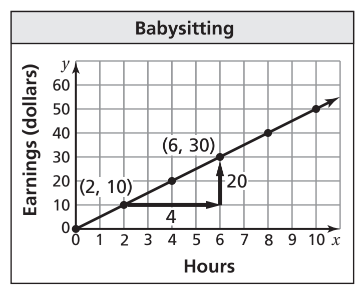
2.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{3}{1} = 3$$

The slope of the line is 3.

3. *Sample answer:*



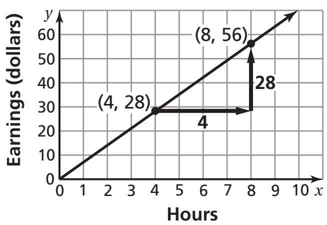
$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{20}{4} = 5$$

The slope of the line is 5. The slope does not change.

Chapter 5

4. **a.** Your friend's line is steeper, which means your friend's earnings per hour is greater than yours.

   b.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{28}{4} = 7$$

The slope of the line is 7. So, your friend earns \$7 per hour babysitting.

5.5 Exercises (pp. 196–197)

Vocabulary and Concept Check

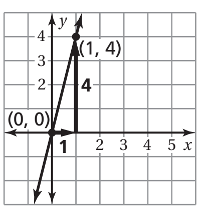
1. yes; Slope is the rate of change between any two points on a line.

2. Line A is the steepest. So, it has the greatest slope.

3. It is more difficult to run up a ramp with a slope of 5 because it is steeper than a ramp with a slope of $\frac{1}{5}$.

Practice and Problem Solving

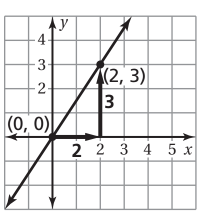
4.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4}{1} = 4$$

The slope of the line is 4.

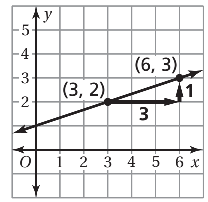
5.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{3}{2}$$

The slope of the line is $\frac{3}{2}$.

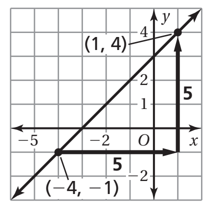
6.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{1}{3}$$

The slope of the line is $\frac{1}{3}$.

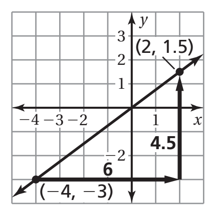
7.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{5}{5} = 1$$

The slope of the line is 1.

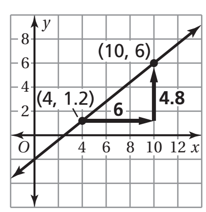
8.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4.5}{6} = \frac{3}{4}$$

The slope of the line is $\frac{3}{4}$.

9.

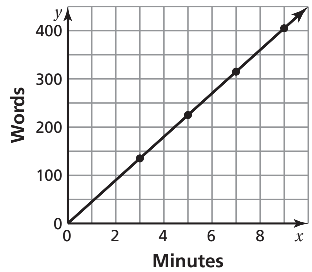


$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4.8}{6} = \frac{4}{5}$$

The slope of the line is $\frac{4}{5}$.

Chapter 5

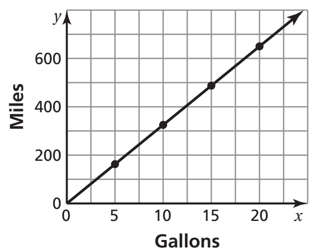
10.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{90}{2} = 45$$

The slope of the line is 45. You can type 45 words per minute.

11.



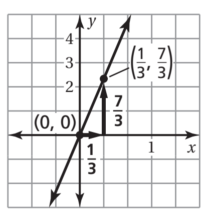
$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{325}{10} = \frac{65}{2} = 32.5$$

The slope of the line is 32.5. You can travel 32.5 miles per gallon.

12. The change in y should be in the numerator and the change in x should be in the denominator.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{5}{4}$$

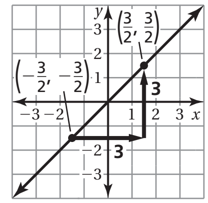
13.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{\frac{7}{3}}{\frac{1}{3}} = \frac{7}{3} \bullet \frac{3}{1} = 7$$

The slope of the line is 7.

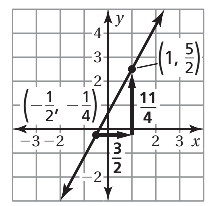
14.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{3}{3} = 1$$

The slope of the line is 1.

15.

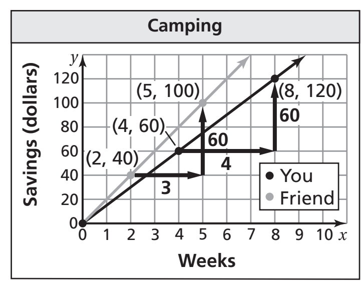


$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{\frac{11}{4}}{\frac{3}{2}} = \frac{11}{4} \bullet \frac{2}{3} = \frac{11}{6}$$

The slope of the line is $\frac{11}{6}$.

16. a. Your friend's line is steeper, which means your friend is saving more per week than you.

b.



$$\text{slope of your friend's line} = \frac{\text{change in } y}{\text{change in } x} = \frac{60}{3} = 20$$

The slope of your friend's line is 20.

$$\text{slope of your line} = \frac{\text{change in } y}{\text{change in } x} = \frac{60}{4} = 15$$

The slope of your line is 15.

c. Your friend saves $\$20 - \$15 = \$5$ more each week.

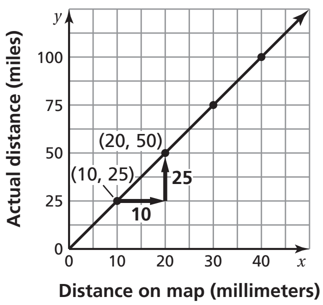
d. Number of weeks = cost ÷ saving rate

= 165 ÷ 15

= 11

It will take you 11 weeks to save enough money.

17. a–b.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{25}{10} = \frac{5}{2} = 2.5$$

The slope of the line is 2.5. Every millimeter on the map represents 2.5 miles.

c. Actual distance = map distance • slope

$$= 48\ \cancel{\text{mm}} \bullet \frac{2.5 \text{ mi}}{1\ \cancel{\text{mm}}}$$

$$= 120 \text{ miles}$$

The actual distance between Toledo and Columbus is 120 miles.

d. Map distance = actual distance ÷ slope

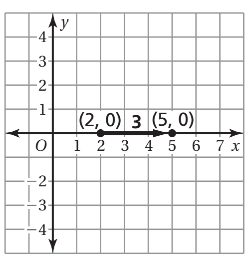
$$= 225 \text{ mi} \div \frac{2.5 \text{ mi}}{1 \text{ mm}}$$

$$= 225\ \cancel{\text{mi}} \bullet \frac{1 \text{ mm}}{2.5\ \cancel{\text{mi}}}$$

$$= 90 \text{ mm}$$

The distance on the map between Cincinnati and Cleveland is 90 millimeters.

18.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{0}{3} = 0$$

The slope is 0 because there is no change in y.

19. Plot the point $(1, 2)$. You know the x-coordinate of the point, and you know the change in x is 2. Because the slope is positive, the change in y is positive. So, from $(3, 2)$ on the graph, you will move up. Use the formula for slope to find the change in y.

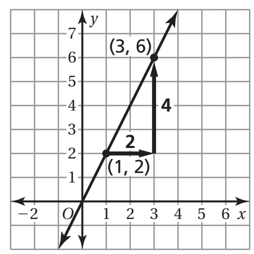
$$\text{slope} = \frac{\text{change in } y}{\text{change in } x}$$

$$2 = \frac{\text{change in } y}{2}$$

$$2 \bullet 2 = 2 \bullet \frac{\text{change in } y}{2}$$

$$4 = \text{change in } y$$

Move 4 units up from $(3, 2)$ to the point $(3, 6)$. So, the value of y is 6.



Fair Game Review

20. $-\frac{3}{5} \times \frac{8}{6} = -\frac{3 \times 8}{5 \times 6} = -\frac{\cancelto{1}{3} \times \cancelto{4}{8}}{5 \times \cancelto{1}{6}} = -\frac{4}{5}$

21. $1\frac{1}{2} \times \left(-\frac{6}{15}\right) = \frac{3}{2} \times \left(-\frac{6}{15}\right)$

$$= \frac{3 \times (-6)}{2 \times 15}$$

$$= \frac{\cancelto{1}{3} \times (\cancelto{-3}{-6})}{\cancelto{1}{2} \times \cancelto{5}{15}}$$

$$= -\frac{3}{5}$$

22. $-2\frac{1}{4} \times \left(-1\frac{1}{3}\right) = -\frac{9}{4} \times \left(-\frac{4}{3}\right)$

$$= \frac{-9 \times (-4)}{4 \times 3}$$

$$= \frac{\cancelto{-3}{-9} \times (\cancelto{-1}{-4})}{\cancelto{1}{4} \times \cancelto{1}{3}}$$

$$= 3$$

Chapter 5

23. C; Words: $\frac{3}{8}$ of your collection equals the number of stamps from Mexico.

Variable: Let x be the number of stamps in your collection.

Equation: $\frac{3}{8} \bullet x = 18$

$$\frac{3}{8}x = 18$$

$$\frac{8}{3} \bullet \frac{3}{8}x = \frac{8}{3} \bullet 18$$

$$x = 48$$

So, there are $48 - 18 = 30$ stamps from the United States.

Section 5.6

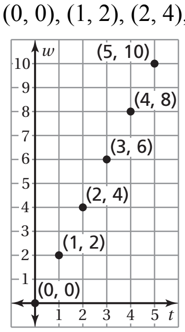
5.6 Activity (pp.198–199)

1.

Thumb, t	Wrist, w	Neck, n	Waist, x
0 in.	0 in.	$2(0) = 0$ in.	$2(0) = 0$ in.
1 in.	2 in.	$2(2) = 4$ in.	$2(4) = 8$ in.
2 in.	4 in.	$2(4) = 8$ in.	$2(8) = 16$ in.
3 in.	6 in.	$2(6) = 12$ in.	$2(12) = 24$ in.
4 in.	8 in.	$2(8) = 16$ in.	$2(16) = 32$ in.
5 in.	10 in.	$2(10) = 20$ in.	$2(20) = 40$ in.

2. a. *Sample answer*: w is two times t.

b. (0, 0), (1, 2), (2, 4), (3, 6), (4, 8), (5, 10)



c. *Sample answers*: All the points lie on a line and the line passes through the origin.

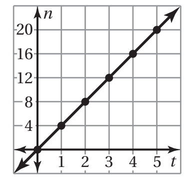
d. Ordered pairs: (0, 0) and (1, 2)

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{2}{1} = 2$$

The slope of the line is 2.

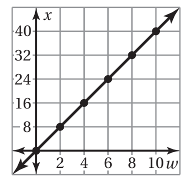
e. $w = 2t$

3. a.



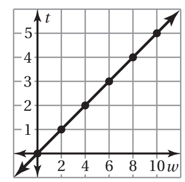
An equation that describes the relationship between t and n is $n = 4t$.

b.



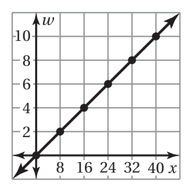
An equation that describes the relationship between w and x is $x = 4w$.

c.



An equation that describes the relationship between w and t is $t = \frac{1}{2}w$.

d.



An equation that describes the relationship between x and w is $w = \frac{1}{4}x$.

4. If the points of the graph lie on a line and the line passes through the origin, then the variables vary directly. An equation that shows two variables vary directly is a linear equation with a y-intercept of 0.

5. All the points in each graph lie on a line and all the lines pass through the origin.

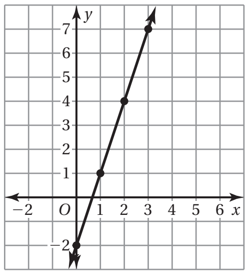
6. *Sample answer:* The relationship between the number of cars x you wash and the amount you earn y varies directly.

7. *Answer should include, but is not limited to:* Students will measure their thumb, wrist, and neck with a piece of string. They will then compare their measurements with what the tailor said and determine the accuracy of the tailor.

Chapter 5

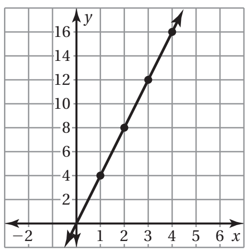
5.6 On Your Own (p. 201)

1.



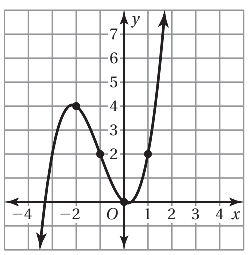
The line does *not* pass through the origin. So, x and y do *not* show direct variation.

2.



The line passes through the origin. So, x and y show direct variation.

3.



The graph is *not* a line. So, x and y do *not* show direct variation.

4. $xy = 3$

$$y = \frac{3}{x}$$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

5. $x = \frac{1}{3}y$

$3x = y$

The equation can be written as $y = kx$. So, x and y show direct variation.

6. $y + 1 = x$

$y = x - 1$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

7. No, x and y do *not* show direct variation because there is *not* a constant rate of change.

5.6 Exercises (pp. 202–203)

Vocabulary and Concept Check

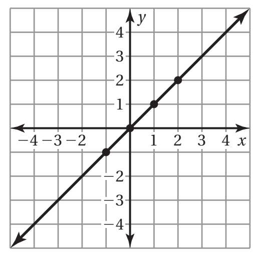
1. $y = kx$, where k is a number and $k \neq 0$.

2. The point $(0, 0)$ is on the graph of every direct variation equation.

3. "Is the graph of the relationship a line?" is different. The answer to this questions is yes. The answer to the other three questions is no, because the line does not pass through the origin.

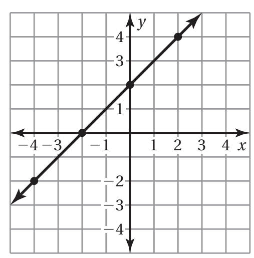
Practice and Problem Solving

4.



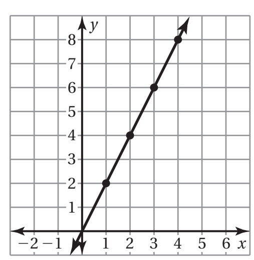
Yes, the graph shows that the quantities vary directly because all the points are on a line and the line passes through the origin.

5.



No, the graph does *not* show that the quantities vary directly because the line does *not* pass through the origin.

6.

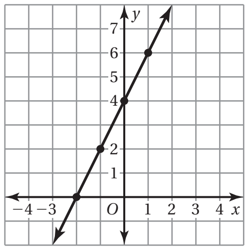


The line passes through the origin. So, x and y show direct variation.

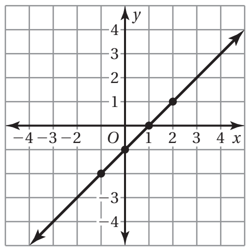
$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{2}{1} = 2$$

So, $k = 2$.

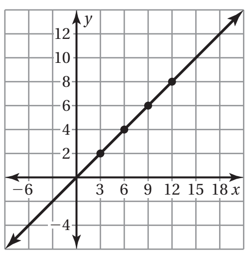
Chapter 5

7. 

The line does *not* pass through the origin. So, x and y do *not* show direct variation.

8. 

The line does *not* pass through the origin. So, x and y do *not* show direct variation.

9. 

The graph passes through the origin. So, x and y show direct variation.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{2}{3}$$

So, $k = \frac{2}{3}$.

10. $y - x = 4$

$y = x + 4$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

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

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

The equation can be written as $y = kx$. So, x and y show direct variation and $k = \frac{5}{2}$.

12. $y + 3 = x + 6$

$y = x + 3$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

13. $y - 5 = 2x$

$y = 2x + 5$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

14. $x - y = 0$

$x = y$

The equation can be written as $y = kx$. So, x and y show direct variation and $k = 1$.

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

$x = 2y$

$\frac{1}{2}x = y$

The equation can be written as $y = kx$. So, x and y show direct variation and $k = \frac{1}{2}$.

16. $8 = xy$

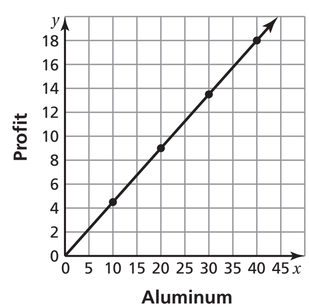
$\frac{8}{x} = y$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

17. $x^2 = y$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

18. Although the graph is a line, it does *not* pass through the origin. So, it does *not* show direct variation.

19. 

The line passes through the origin. So, x and y show direct variation.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4.5}{10} = 0.45$$

$y = kx$, so $y = 0.45x$.

Chapter 5

20. $y = kx$

$72 = k \bullet 3$

$24 = k$

An equation that relates x and y is $y = 24x$.

21. $y = kx$

$20 = k \bullet 12$

$\frac{5}{3} = k$

An equation that relates x and y is $y = \frac{5}{3}x$.

22. $y = kx$

$45 = k \bullet 40$

$\frac{9}{8} = k$

An equation that relates x and y is $y = \frac{9}{8}x$.

23. 1 inch is about 2.54 centimeters. So, $x = 1$ and $y = 2.54$.

$y = kx$

$2.54 = k \bullet 1$

$2.54 = k$

A direct variation equation that relates x inches to y centimeters is $y = 2.54x$.

24. *Answer should include, but is not limited to:* Students will design a jet ski ramp. They will include a drawing like the one given. Students will then use direct variation to plan the heights of the vertical supports. From what they learned about direct variation, they know the ramp should start at (0, 0). Then the vertical supports increase in length by the same amount k. Students will label the dimensions and vertical support lengths on their drawing.

25. Because when $x = 0$, $y = 0$. So, the graph of a proportional relationship always passes through the origin.

26. Yes, the graph shows direct variation.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{39}{3} = 13$$

So, $k = 13$, which means that the cost of one ticket is \$13.

$y = kx$

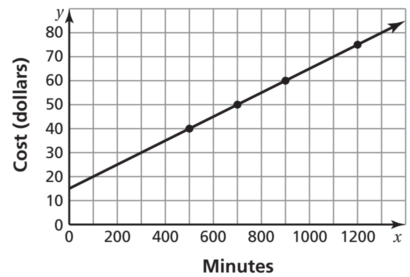
$y = 13x$

$y = 13(14)$

$y = 182$

So, the cost of 14 tickets is \$182.

27.



The line does *not* pass through the origin. So, x and y do *not* show direct variation.

28. Let y be the amount of chlorine (in milligrams) in the pool and x be the volume of water (in liters).

$y = kx$

$2.5 = k \bullet 1$

$2.5 = k$

An equation relating the volume of water x and the amount of chlorine y is $y = 2.5x$.

$$8000\ \cancel{\text{gal}} \times \frac{4\ \cancel{\text{qt}}}{1\ \cancel{\text{gal}}} \times \frac{0.95\text{ L}}{1\ \cancel{\text{qt}}} = \frac{8000 \bullet 4 \bullet 0.95\text{ L}}{1 \bullet 1}$$

$$= 30{,}400\text{ L}$$

The volume of the pool is 30,400 liters.

$y = 2.5x = 2.5(30{,}400) = 76{,}000$

There is 76,000 milligrams of chlorine in the pool.

29. The graph of every direct variation equation is a line because the equation is of the form $y = kx$, which is a line with a y-intercept of 0. Every line does not represent a direct variation equation. To represent direct variation, the line must pass through the origin, that is, it must have a y-intercept of 0.

Fair Game Review

30.

$$\begin{array}{r} 0.65 \\ 20\overline{)\ 13.00} \\ -\ 12\,0 \\ \hline 1\,00 \\ -\ 1\,00 \\ \hline 0 \end{array}$$

So, $\frac{13}{20} = 0.65$.

31.

$$\begin{array}{r} 0.5625 \\ 16\overline{)9.0000} \\ -\ 8\,0 \\ \hline 1\,00 \\ -\ 96 \\ \hline 40 \\ -\ 32 \\ \hline 80 \\ -\ 80 \\ \hline 0 \end{array}$$

So, $\frac{9}{16} = 0.5625$.

Chapter 5

32.
$$\begin{array}{r} 0.525 \\ 40\overline{)21.000} \\ -\underline{20\,0} \\ 1\,00 \\ -\underline{80} \\ 200 \\ -\underline{200} \\ 0 \end{array}$$

So, $\frac{21}{40} = 0.525$.

33.
$$\begin{array}{r} 0.96 \\ 25\overline{)24.00} \\ -\underline{22\,5} \\ 150 \\ -\underline{150} \\ 0 \end{array}$$

So, $\frac{24}{25} = 0.96$.

34. D; $\frac{180 \text{ ft}}{8 \text{ sec}} = \frac{180 \div 8}{8 \div 8} = \frac{22.5 \text{ ft}}{1 \text{ sec}}$

$\frac{225 \text{ ft}}{10 \text{ sec}} = \frac{225 \div 10}{10 \div 10} = \frac{22.5 \text{ ft}}{1 \text{ sec}}$

$\frac{45 \text{ ft}}{2 \text{ sec}} = \frac{45 \div 2}{2 \div 2} = \frac{22.5 \text{ ft}}{1 \text{ sec}}$

$\frac{135 \text{ ft}}{6 \text{ sec}} = \frac{135 \div 6}{6 \div 6} = \frac{22.5 \text{ ft}}{1 \text{ sec}}$

Answer choices A–C have a unit rate of $\frac{22.5 \text{ ft}}{1 \text{ sec}}$, which is the unit rate for $\frac{180 \text{ ft}}{8 \text{ sec}}$. The unit rate for Choice D is $\frac{180 \text{ ft}}{1 \text{ sec}}$, which is not equivalent to $\frac{22.5 \text{ ft}}{1 \text{ sec}}$.

Quiz 5.4–5.6

1.
$$\begin{aligned} \frac{7}{n} &= \frac{42}{48} \\ 7 \bullet 48 &= n \bullet 42 \\ 336 &= 42n \\ \frac{336}{42} &= \frac{42n}{42} \\ 8 &= n \end{aligned}$$

The solution is $n = 8$.

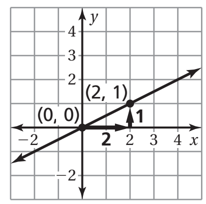
2.
$$\begin{aligned} \frac{x}{2} &= \frac{40}{16} \\ 2 \bullet \frac{x}{2} &= 2 \bullet \frac{40}{16} \\ x &= 5 \end{aligned}$$

The solution is $x = 5$.

3.
$$\begin{aligned} \frac{3}{11} &= \frac{27}{z} \\ 3 \bullet z &= 11 \bullet 27 \\ 3z &= 297 \\ \frac{3z}{3} &= \frac{297}{3} \\ z &= 99 \end{aligned}$$

The solution is $z = 99$.

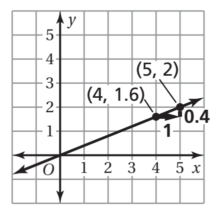
4.



$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{1}{2}$

The slope of the line is $\frac{1}{2}$.

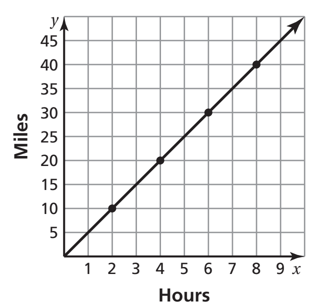
5.



$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{0.4}{1} = 0.4 = \frac{2}{5}$

The slope of the line is $\frac{2}{5}$.

6.



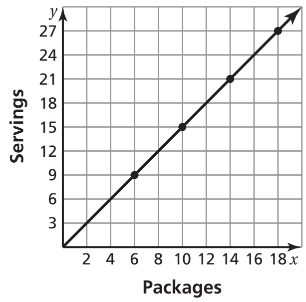
$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{10}{2} = 5$

The slope of the line is 5.

You are traveling 5 miles per hour.

Chapter 5

7.



$$\text{slope} = \frac{\text{change in } x}{\text{change in } y} = \frac{6}{4} = \frac{3}{2}$$

The slope of the line is $\frac{3}{2}$.

There are $1\frac{1}{2}$ servings per package.

8. $y - 9 = 6 + x$

$y = 15 + x$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

9. $x = \frac{5}{8}y$

$\frac{8}{5}x = y$

The equation can be written as $y = kx$. So, x and y show direct variation.

10. $\frac{3 \text{ performers}}{8 \text{ hours}} = \frac{4 \text{ performers}}{x \text{ hours}}$

$3 \bullet x = 8 \bullet 4$

$3x = 32$

$\frac{3x}{3} = \frac{32}{3}$

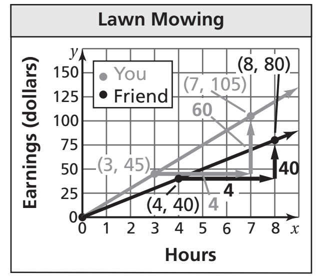
$x = 10\frac{2}{3}$ hours

$$\frac{2}{3}\,\cancel{\text{hour}} \times \frac{60 \text{ minutes}}{1\,\cancel{\text{hour}}} = 40 \text{ minutes}$$

A concert with 4 performers lasts $10\frac{2}{3}$ hours, or 10 hours and 40 minutes.

11. a. Your line is steeper, which means you earn more per hour than your friend.

b.



$$\text{slope of your line} = \frac{\text{change in } y}{\text{change in } x} = \frac{60}{4} = 15$$

The slope of your line is 15.

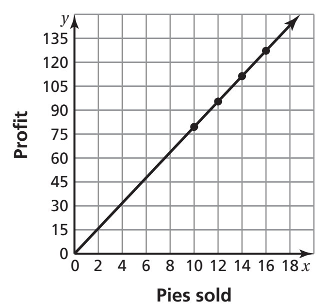
$$\text{slope of your friend's line} = \frac{\text{change in } y}{\text{change in } x} = \frac{40}{4} = 10$$

The slope of your friend's line is 10.

So, you earn \$15 per hour and your friend earns \$10 per hour.

c. You earn $\$15 - \$10 = \$5$ more per hour.

12.



The line passes through the origin. So, x and y show direct variation.

$y = kx$

$79.50 = k \bullet 10$

$7.95 = k$

So, a direct variation equation is $y = 7.95x$.

Chapter 5 Review

1. $$\frac{289 \text{ miles}}{10 \text{ gallons}} = \frac{289 \div 10}{10 \div 10} = \frac{28.9 \text{ miles}}{1 \text{ gallon}}$$

The unit rate is 28.9 miles per gallon.

2. $$\frac{6\frac{2}{5} \text{ revolutions}}{2\frac{2}{3} \text{ minutes}} = \frac{6\frac{2}{5} \div 2\frac{2}{3}}{2\frac{2}{3} \div 2\frac{2}{3}} = \frac{2\frac{2}{5} \text{ revolutions}}{1 \text{ minute}}$$

The unit rate is $2\frac{2}{5}$ revolutions per minute.

Chapter 5

3.

$$\begin{array}{c|c|c|c|c} & \overset{}{} & \xrightarrow{+2} & \xrightarrow{+2} & \xrightarrow{+2} \end{array}$$

Servings	2	4	6	8
Calories	240	480	720	960

$$+240 \quad +240 \quad +240$$

$$\frac{\text{change in calories}}{\text{change in servings}} = \frac{240 \text{ calories}}{2 \text{ servings}}$$
$$= \frac{240 \div 2}{2 \div 2}$$
$$= \frac{120 \text{ calories}}{1 \text{ serving}}$$

The unit rate is 120 calories per serving.

4. $\frac{4}{9}$ and $\frac{2}{3}$ are in simplest form. The ratios are *not* equivalent. So, $\frac{4}{9}$ and $\frac{2}{3}$ do *not* form a proportion.

5. $\frac{12}{22} = \frac{12 \div 2}{22 \div 2} = \frac{6}{11}$

$\frac{18}{33} = \frac{18 \div 3}{33 \div 3} = \frac{6}{11}$

The ratios are equivalent. So, $\frac{12}{22}$ and $\frac{18}{33}$ form a proportion.

6. $\frac{8}{50} = \frac{8 \div 2}{50 \div 2} = \frac{4}{25}$

$\frac{4}{10} = \frac{4 \div 2}{10 \div 2} = \frac{2}{5}$

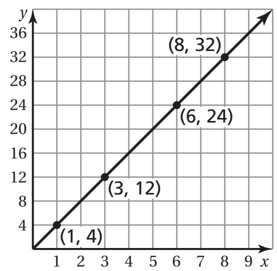
The ratios are *not* equivalent. So, $\frac{8}{50}$ and $\frac{4}{10}$ do *not* form a proportion.

7. $\frac{32}{40} = \frac{32 \div 8}{40 \div 8} = \frac{4}{5}$

$\frac{12}{15} = \frac{12 \div 3}{15 \div 3} = \frac{4}{5}$

The ratios are equivalent. So, $\frac{32}{40}$ and $\frac{12}{15}$ form a proportion.

8.



The graph is a line that passes through the origin. So, x and y are in a proportional relationship.

9. *Sample answer:*

A proportion is $\frac{6 \text{ penalties}}{16 \text{ minutes}} = \frac{8 \text{ penalties}}{m \text{ minutes}}$.

10. *Sample answer:* A proportion is $\frac{15 \text{ songs}}{18 \text{ songs}} = \frac{2.5 \text{ hours}}{h \text{ hours}}$.

11.
$$\frac{x}{4} = \frac{2}{5}$$
$$4 \bullet \frac{x}{4} = 4 \bullet \frac{2}{5}$$
$$x = 1.6$$

The solution is $x = 1.6$.

12.
$$\frac{5}{12} = \frac{y}{15}$$
$$5 \bullet 15 = 12 \bullet y$$
$$75 = 12y$$
$$\frac{75}{12} = \frac{12y}{12}$$
$$6.25 = y$$

The solution is $y = 6.25$.

13.
$$\frac{8}{20} = \frac{6}{w}$$
$$8 \bullet w = 20 \bullet 6$$
$$8w = 120$$
$$\frac{8w}{8} = \frac{120}{8}$$
$$w = 15$$

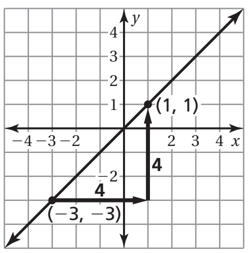
The solution is $w = 15$.

Chapter 5

14. $$\begin{aligned} \frac{s+1}{4} &= \frac{4}{8} \\ (s+1) \bullet 8 &= 4 \bullet 4 \\ 8 \bullet s + 8 \bullet 1 &= 16 \\ 8s + 8 &= 16 \\ -8 \quad & \quad -8 \\ 8s &= 8 \\ \frac{8s}{8} &= \frac{8}{8} \\ s &= 1 \end{aligned}$$

The solution is $s = 1$.

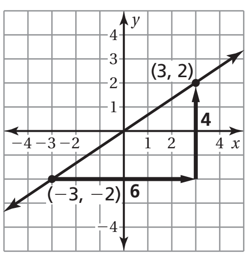
15.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4}{4} = 1$$

The slope of the line is 1.

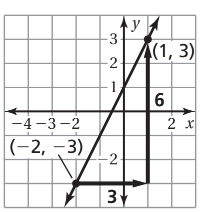
16.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{4}{6} = \frac{2}{3}$$

The slope of the line is $\frac{2}{3}$.

17.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{6}{3} = 2$$

The slope of the line is 2.

18. $$\begin{aligned} x + y &= 6 \\ y &= 6 - x \end{aligned}$$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

19. $$\begin{aligned} y - x &= 0 \\ y &= x \end{aligned}$$

The equation can be written as $y = kx$. So, x and y show direct variation.

20. $$\begin{aligned} \frac{x}{y} &= 20 \\ x &= 20y \\ \frac{1}{20}x &= y \end{aligned}$$

The equation can be written as $y = kx$. So, x and y show direct variation.

21. $$\begin{aligned} x &= y + 2 \\ x - 2 &= y \end{aligned}$$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

Chapter 5 Test

1. $$\frac{84 \text{ miles}}{12 \text{ days}} = \frac{84 \div 12}{12 \div 12} = \frac{7 \text{ miles}}{1 \text{ day}}$$

The unit rate is 7 miles per day.

2. $$\frac{2\frac{2}{5} \text{ kilometer}}{3\frac{3}{4} \text{ minutes}} = \frac{2\frac{2}{5} \div 3\frac{3}{4}}{3\frac{3}{4} \div 3\frac{3}{4}} = \frac{\frac{16}{25} \text{ kilometer}}{1 \text{ minute}}$$

The unit rate is $\frac{16}{25}$ kilometer per minute.

3. $\frac{1}{9}$ is in simplest form.

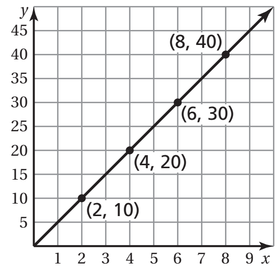
$$\frac{6}{54} = \frac{6 \div 6}{54 \div 6} = \frac{1}{9}$$

The ratios are equivalent. So, $\frac{1}{9}$ and $\frac{6}{54}$ form a proportion.

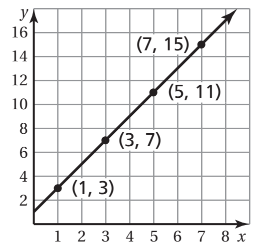
4. $$\begin{aligned} \frac{9}{12} &= \frac{9 \div 3}{12 \div 3} = \frac{3}{4} \\ \frac{8}{72} &= \frac{8 \div 8}{72 \div 8} = \frac{1}{9} \end{aligned}$$

The ratios are *not* equivalent. So, $\frac{9}{12}$ and $\frac{8}{72}$ do *not* form a proportion.

Chapter 5

5. 

The graph is a line that passes through the origin. So, x and y are in a proportional relationship.

6. 

The graph is a line that does *not* pass through the origin. So, x and y are *not* in a proportional relationship.

7. *Sample answer:* A proportion is $\dfrac{m \text{ miles}}{180 \text{ miles}} = \dfrac{8 \text{ gallons}}{6 \text{ gallons}}$.

8. *Sample answer:* A proportion is $\dfrac{6 \text{ classes}}{8 \text{ hours}} = \dfrac{c \text{ classes}}{4 \text{ hours}}$.

9.

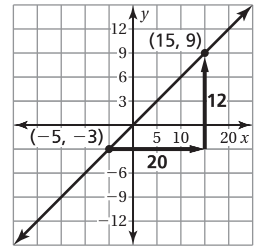
$$\frac{x}{8} = \frac{9}{4}$$
$$8 \bullet \frac{x}{8} = 8 \bullet \frac{9}{4}$$
$$x = 18$$

The solution is $x = 18$.

10.

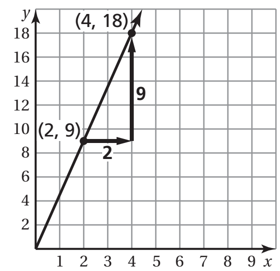
$$\frac{17}{3} = \frac{y}{6}$$
$$17 \bullet 6 = 3 \bullet y$$
$$102 = 3y$$
$$\frac{102}{3} = \frac{3y}{3}$$
$$34 = y$$

The solution is $y = 34$.

11. 

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{12}{20} = \frac{3}{5}$$

The slope of line is $\dfrac{3}{5}$.

12. 

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{9}{2}$$

The slope of the line is $\dfrac{9}{2}$.

13.

$$xy - 11 = 5$$
$$xy = 16$$
$$y = \frac{16}{x}$$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

14.

$$x = \frac{3}{y}$$
$$xy = 3$$
$$y = \frac{3}{x}$$

The equation *cannot* be written as $y = kx$. So, x and y do *not* show direct variation.

15.

$$\frac{y}{x} = 8$$
$$y = 8x$$

The equation can be written as $y = kx$. So, x and y show direct variation.

Chapter 5

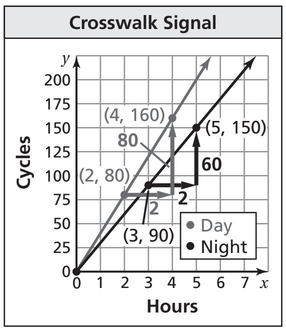
16. $\dfrac{5 \text{ tickets}}{\$36.25} = \dfrac{8 \text{ tickets}}{x \text{ dollars}}$

$$5 \bullet x = 36.25 \bullet 8$$
$$5x = 290$$
$$\frac{5x}{5} = \frac{290}{5}$$
$$x = 58$$

The cost of eight movie tickets is \$58.

17. a. The Day line is steeper, which means that there are more cycles of the crosswalk signal per hour during the day than during the night.

b.



slope of Day line $= \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{80}{2} = 40$

The slope of the Day line is 40.

slope of the Night line $= \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{60}{2} = 30$

The slope of the Night line is 30.

The crosswalk signal cycles 40 times per hour during the day and 30 times per hour during the night.

18. The ratio for the green glaze is 5 parts blue to 3 parts yellow. Write a ratio equivalent to $\dfrac{5}{3}$.

Given mixture: Desired mixture:

$\dfrac{25}{9}$ $\dfrac{5}{3}$

$$\overset{\times 5}{}$$
$$\frac{25}{?} = \frac{5}{3}$$
$$\underset{\times 5}{}$$

$3 \times 5 = 15$

The mixture needs 15 total quarts of yellow. So, you should add $15 - 9 = 6$ quarts of yellow to the mixture.

Chapter 5 Standards Assessment

1. A; $\dfrac{\$0.80}{4 \text{ pencils}} = \dfrac{0.8 \div 4}{4 \div 4} = \dfrac{0.2}{1}$

The unit price is $\$0.20$.

2. F; I. $2 + (-1) = 1$

II. $2 - (-1) = 3$

III. $-3 \times (-1) = 3$

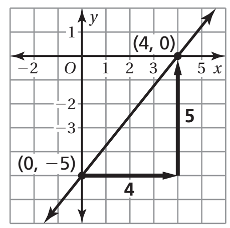
IV. $-3 \div (-1) = 3$

Expression I does not have a value of 3.

3. 29; $-4 \times (-6) - (-5) = 24 - (-5)$
$= 29$

The value of the expression is 29.

4. B;



slope $= \dfrac{\text{change in } y}{\text{change in } x} = \dfrac{5}{4}$

The slope of the line is $\dfrac{5}{4}$.

5. H;

F.
$$\begin{aligned} -3 - 6x &< -27 \\ \underline{+3} \qquad &\quad \underline{+3} \\ -6x &< -24 \\ \frac{-6x}{-6} &> \frac{-24}{-6} \\ x &> 4 \end{aligned}$$

G.
$$\begin{aligned} 2x + 6 &\geq 14 \\ \underline{-6} \quad &\quad \underline{-6} \\ 2x &\geq 8 \\ \frac{2x}{2} &\geq \frac{8}{2} \\ x &\geq 4 \end{aligned}$$

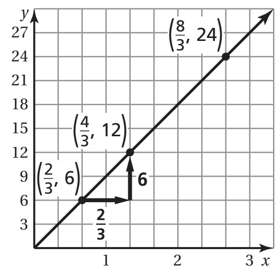
H.
$$\begin{aligned} 5 - 3x &> -7 \\ \underline{-5} \qquad &\quad \underline{-5} \\ -3x &> -12 \\ \frac{-3x}{-3} &< \frac{-12}{-3} \\ x &< 4 \end{aligned}$$

Chapter 5

I.
$$\begin{aligned} 2x + 3 &\le 11 \\ -3 \quad & \quad -3 \\ 2x &\le 8 \\ \frac{2x}{2} &\le \frac{8}{2} \\ x &\le 4 \end{aligned}$$

The graph represents $x < 4$, which is equivalent to $5 - 3x > -7$.

6. C;



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{6}{\frac{2}{3}} = 9$$

$$\begin{aligned} y &= kx \\ &= 9x \\ &= 9(5) \\ &= 45 \end{aligned}$$

So, the missing value is 45.

7. G;

Words:	Cost of tomatoes	times	number of pounds	plus	amount earned today
	equals	total amount earned			

Variable: Let x be the number of pounds of tomatoes.

Equation:

$$\begin{aligned} 4 \bullet x + 16 &= 60 \\ 4x + 16 &= 60 \\ -16 \quad & \quad -16 \\ 4x &= 44 \\ \frac{4x}{4} &= \frac{44}{4} \\ x &= 11 \end{aligned}$$

You need to sell an additional 11 pounds.

8. C; After 4 hours, the train is still traveling 200 kilometers per hour.

9. G; Regina took the reciprocal of both fractions. When dividing by a fraction, change the second number to a reciprocal.

$$\begin{aligned} -\frac{3}{2} \div \left(-\frac{8}{7}\right) &= -\frac{3}{2} \times \left(-\frac{7}{8}\right) \\ &= \frac{3 \times 7}{2 \times 8} \\ &= \frac{21}{16} \end{aligned}$$

10. 3;

$$\begin{aligned} 3 - 6t &\le -15 \\ -3 \quad & \quad -3 \\ -6t &\le -18 \\ \frac{-6t}{-6} &\ge \frac{-18}{-6} \\ t &\ge 3 \end{aligned}$$

The least value of t for which the inequality is true is 3.

11. *Part A:*

Sample answer: $\dfrac{800 \text{ square feet}}{15 \text{ minutes}} = \dfrac{6000 \text{ square feet}}{m \text{ minutes}}$

Part B:

$$\begin{aligned} 800 \bullet m &= 6000 \bullet 15 \\ 800m &= 90{,}000 \\ \frac{800m}{800} &= \frac{90{,}000}{800} \\ m &= 112.5 \end{aligned}$$

It takes 112.5 minutes to mow 6000 square feet.

12. D;

$$\begin{aligned} 6 - 2p &= -48 \\ -6 \quad & \quad -6 \\ -2p &= -54 \\ \frac{-2p}{-2} &= \frac{-54}{-2} \\ p &= 27 \end{aligned}$$

The value of p is 27.