6.5 Exercise Set

FOR EXTRA HELP

Concept Reinforcement *Find each rate.*

1. If Sandy can decorate a cake in 2 hr, what is her rate? $\frac{1}{2}$ cake per hour
2. If Eric can decorate a cake in 3 hr, what is his rate? $\frac{1}{3}$ cake per hour
3. If Sandy can decorate a cake in 2 hr and Eric can decorate the same cake in 3 hr, what is their rate, working together? $\frac{5}{6}$ cake per hour
4. If Lisa and Mark can mow a lawn together in 1 hr, what is their rate? 1 lawn per hour
5. If Lisa can mow a lawn by herself in 3 hr, what is her rate? $\frac{1}{3}$ lawn per hour
6. If Lisa and Mark can mow a lawn together in 1 hr, and Lisa can mow the same lawn by herself in 3 hr, what is Mark's rate, working alone? $\frac{2}{3}$ lawn per hour

7. *Home Restoration.* Trey can refinish the floor of an apartment in 8 hr. Matt can refinish the floor in 6 hr. How long will it take them, working together, to refinish the floor? $3\frac{3}{7}$ hr
8. *Custom Embroidery.* Chandra can embroider logos on a team's sweatshirts in 6 hr. Traci, a new employee, needs 9 hr to complete the same job. Working together, how long will it take them to do the job? $3\frac{3}{5}$ hr
9. *Filling a Pool.* The San Paulo community swimming pool can be filled in 12 hr if water enters through a pipe alone or in 30 hr if water enters through a hose alone. If water is entering through both the pipe and the hose, how long will it take to fill the pool? $8\frac{4}{7}$ hr
10. *Filling a Tank.* A community water tank can be filled in 18 hr by the town office well alone and in 22 hr by the high school well alone. How long will it take to fill the tank if both wells are working? $9\frac{9}{10}$ hr
11. *Pumping Water.* A $\frac{1}{4}$ HP Simer 2905 Mark I sump pump can remove water from Martha's flooded basement in 70 min. The $\frac{1}{3}$ HP Wayne SPV 500 sump pump can complete the same job in 30 min. How long would it take the two pumps together to pump out the basement? 21 min
    Source: Based on data from manufacturers' Web sites
12. *Hotel Management.* The Honeywell 17000 air cleaner can clean the air in a conference room in 12 min. The Allerair 4000 can clean the air in a room of the same size in 10 min. How long would it take the two machines together to clean the air in such a room? $5\frac{5}{11}$ min
    Source: Based on data from manufacturers' Web sites
13. *Copiers.* The Aficio MP C2500 takes three times as long as the MP C7500 to copy Ragheda's grant proposal. If working together the two machines can complete the job in 1.5 min, how long would it take each machine, working alone, to copy the proposal?
    Source: Ricol-usa.com MP C2500: 6 min; MP C7500: 2 min
14. *Computer Printers.* The HP Laser Jet P2035 works twice as fast as the Laser Jet P1005. If the machines work together, a university can produce all its staff manuals in 15 hr. Find the time it would take each machine, working alone, to complete the same job.
    Source: www.shopping.hp.com Laser Jet P2035: $22\frac{1}{2}$ hr; Laser Jet P1005: 45 hr
15. *Hotel Management.* The Airgle 750 can purify the air in a conference hall in 20 fewer minutes than it takes the Austin Healthmate 400 to do the same job. Together the two machines can purify the air in the conference hall in 10.5 min. How long would it take each machine, working alone, to purify the air in the room?
    Source: Based on information from manufacturers' Web sites
    Airgle: 15 min; Austin: 35 min
16. *Photo Printing.* It takes the Canon PIXMA iP6310D 15 min longer to print a set of photo proofs than it takes the HP Officejet H470b Mobile Printer. Together it would take them $\frac{180}{7}$, or $25\frac{5}{7}$ min to print the photos. How long would it take each machine, working alone, to print the photos? Canon: 60 min; HP: 45 min
    Sources: www.shopping.hp.com; www.staples.com
17. *Forest Fires.* The Erickson Air-Crane helicopter can douse a certain forest fire four times as fast as an S-58T helicopter. Working together, the two helicopters can douse the fire in 8 hr. How long would it take each helicopter, working alone, to douse the fire?
    Sources: Based on information from www.emergency.com and www.arishelicopters.com
    Erickson Air-Crane: 10 hr; S-58T: 40 hr
18. *Newspaper Delivery.* Jared can deliver papers three times as fast as Kevin can. If they work together, it takes them 1 hr. How long would it take each to deliver the papers alone? Jared: $1\frac{1}{3}$ hr; Kevin: 4 hr
19. *Sorting Recyclables.* Together, it takes Dawn and Deb 2 hr 55 min to sort recyclables. Alone, Dawn would require 2 more hours than Deb. How long would it take Deb to do the job alone? (*Hint*: Convert minutes to hours or hours to minutes.) 300 min, or 5 hr
20. *Paving.* Together, Travis and Nick require 4 hr 48 min to pave a driveway. Alone, Travis would require 4 hr longer than Nick. How long would it take Nick to do the job alone? (*Hint*: Convert minutes to hours.) 8 hr

21. *Train Speeds.* A B&M freight train is traveling 14 km/h slower than an AMTRAK passenger train. The B&M train travels 330 km in the same time that it takes the AMTRAK train to travel 400 km. Find their speeds. Complete the following table as part of the familiarization. AMTRAK: 80 km/h; B&M: 66 km/h

Distance = Rate · Time

	Distance (in km)	Speed (in km/h)	Time (in hours)
B&M	330	$r - 14$	$\frac{330}{r - 14}$
AMTRAK	400	r	$\frac{400}{r}$

22. *Speed of Travel.* A loaded Roadway truck is moving 40 mph faster than a New York Railways freight train. In the time that it takes the train to travel 150 mi, the truck travels 350 mi. Find their speeds. Complete the following table as part of the familiarization. Truck: 70 mph; train: 30 mph

Distance = Rate · Time

	Distance (in miles)	Speed (in miles per hour)	Time (in hours)
Truck	350	r	$\frac{350}{r}$
Train	150	$r - 40$	$\frac{150}{r - 40}$

23. *Kayaking.* The speed of the current in Catamount Creek is 3 mph. Cory can kayak 4 mi upstream in the same time that it takes him to kayak 10 mi downstream. What is the speed of Cory's kayak in still water? 7 mph

24. *Boating.* The current in the Lazy River moves at a rate of 4 mph. Heather's dinghy motors 6 mi upstream in the same time that it takes to motor 12 mi downstream. What is the speed of the dinghy in still water? 12 mph

Aha! **25.** *Bus Travel.* A local bus travels 7 mph slower than the express. The express travels 45 mi in the time that it takes the local to travel 38 mi. Find the speed of each bus. Express: 45 mph; local: 38 mph

26. *Walking.* Nicole walks 2 mph slower than Simone. In the time that it takes Simone to walk 8 mi, Nicole walks 5 mi. Find the speed of each person. Nicole: $3\frac{1}{3}$ mph; Simone: $5\frac{1}{3}$ mph

27. *Moving Sidewalks.* Newark Airport's moving sidewalk moves at a speed of 1.7 ft/sec. Walking on the moving sidewalk, Kaitlyn can travel 120 ft forward in the same time that it takes to travel 52 ft in the opposite direction. How fast would Kaitlyn be walking on a nonmoving sidewalk? 4.3 ft/sec

28. *Moving Sidewalks.* The moving sidewalk at O'Hare Airport in Chicago moves 1.8 ft/sec. Walking on the moving sidewalk, Cameron travels 105 ft forward in the same time that it takes to travel 51 ft in the opposite direction. How fast would Cameron be walking on a nonmoving sidewalk? 5.2 ft/sec

Aha! **29.** *Tractor Speed.* Manley's tractor is just as fast as Caledonia's. It takes Manley 1 hr more than it takes Caledonia to drive to town. If Manley is 20 mi from town and Caledonia is 15 mi from town, how long does it take Caledonia to drive to town? 3 hr

30. *Boat Speed.* Tory and Emilio's motorboats travel at the same speed. Tory pilots her boat 40 km before docking. Emilio continues for another 2 hr, traveling a total of 100 km before docking. How long did it take Tory to navigate the 40 km? 1 hr 20 min

31. *Boating.* Destinee's Mercruiser travels 15 km/h in still water. She motors 140 km downstream in the same time that it takes to travel 35 km upstream. What is the speed of the river? 9 km/h

32. *Boating.* Sierra's paddleboat travels 2 km/h in still water. The boat is paddled 4 km downstream in the same time that it takes to go 1 km upstream. What is the speed of the river? $1\frac{1}{5}$ km/h

33. *Shipping.* A barge moves 7 km/h in still water. It travels 45 km upriver and 45 km downriver in a total time of 14 hr. What is the speed of the current? 2 km/h

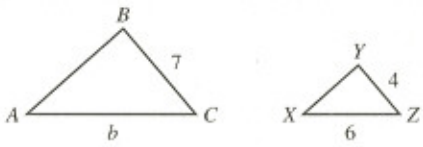
34. *Aviation.* A Citation II Jet travels 350 mph in still air and flies 487.5 mi into the wind and 487.5 mi with the wind in a total of 2.8 hr. Find the wind speed. Source: Eastern Air Charter 25 mph

35. *Train Travel.* A freight train covered 120 mi at a certain speed. Had the train been able to travel 10 mph faster, the trip would have been 2 hr shorter. How fast did the train go? 20 mph

36. *Moped Speed.* Julio's moped travels 8 km/h faster than Ellia's. Julio travels 69 km in the same time that Ellia travels 45 km. Find the speed of each person's moped. Julio: 23 km/h; Ellia: 15 km/h

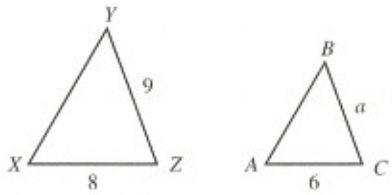
Geometry. *For each pair of similar triangles, find the value of the indicated letter.*

37. b



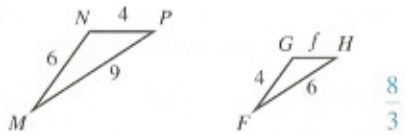
10.5

38. a



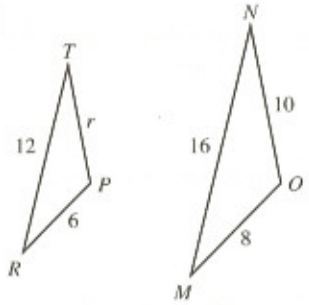
6.75

39. f



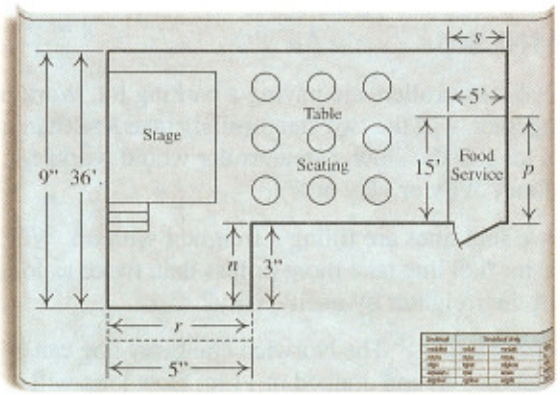
$\frac{8}{3}$

40. r



7.5

Architecture. *Use the blueprint below to find the indicated length.*



41. p, in inches on blueprint $3\frac{3}{4}$ in.

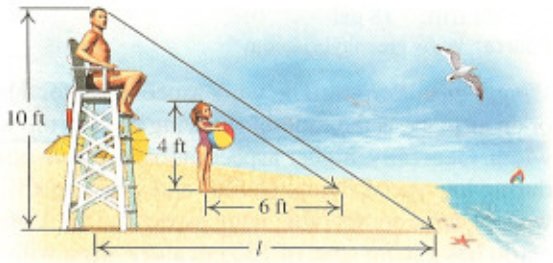
42. s, in inches on blueprint $1\frac{1}{4}$ in.

43. r, in feet on actual building 20 ft

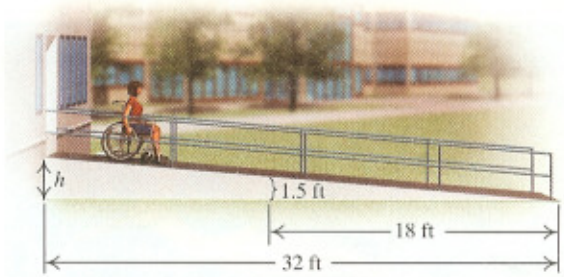
44. n, in feet on actual building 12 ft

Construction. *Find the indicated length.*

45. l 15 ft

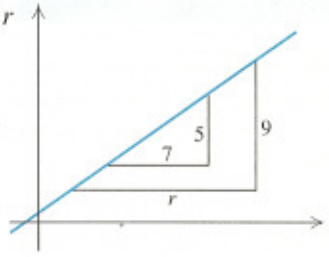


46. h $2\frac{2}{3}$ ft



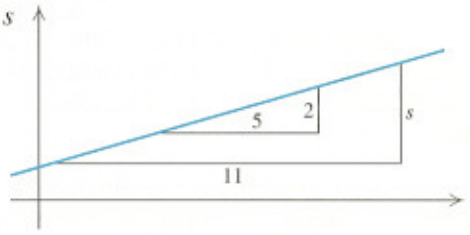
Graphing. *Find the indicated length.*

47. r



12.6

48. s



4.4

49. *Text Messaging.* Brett sent or received 384 text messages in 8 days. At this rate, how many text messages would he send or receive in 30 days? 1440 messages

50. *Burning Calories.* The average 140-lb adult burns about 160 calories playing touch football for 20 min. How long should the average 140-lb adult play touch football in order to burn 200 calories? 25 min
Source: changingshape.com

Aha! **51.** *Photography.* Rema snapped 234 photos over a period of 14 days. At this rate, how many would she take in 42 days? 702 photos

52. *Mileage.* The Honda Civic Hybrid is a gasoline–electric car that travels approximately 180 mi on 4 gal of gas. Find the amount of gas required for an 810-mi trip. 18 gal
Source: www.greenhybrid.com

53. *Wing Aspect Ratio.* The wing aspect ratio for a bird or an airplane is the ratio of the wing span to the wing width. Generally, higher aspect ratios are more efficient during low speed flying. Herons and storks, both waders, have comparable wing aspect ratios. A grey heron has a wing span of 180 cm and a wing width of 24 cm. A white stork has a wing span of 200 cm. What is the wing width of a stork? $26\frac{2}{3}$ cm
Source: birds.ecoport.org

Aha! **54.** *Money.* The ratio of the weight of copper to the weight of zinc in a U.S. penny is $\frac{1}{39}$. If 50 kg of zinc is being turned into pennies, how much copper is needed?
Source: United States Mint $1\frac{11}{39}$ kg

55. *Flash Drives.* A sample of 150 flash drives contained 7 defective drives. How many defective flash drives would you expect in a batch of 2700 flash drives? 126 flash drives

56. *Light Bulbs.* A sample of 184 compact fluorescent light bulbs contained 6 defective bulbs. How many defective bulbs would you expect in a sample of 1288 bulbs? 42 bulbs

57. *Veterinary Science.* The amount of water needed by a small dog depends on its weight. A moderately active 8-lb Shih Tzu needs approximately 12 oz of water per day. How much water does a moderately active 5-lb Bolognese require each day? $7\frac{1}{2}$ oz
Source: www.smalldogsparadise.com

58. *Miles Driven.* Carlos is allowed to drive his leased car for 45,000 mi in 4 years without penalty. In the first $1\frac{1}{2}$ years, Carlos has driven 16,000 mi. At this rate will he exceed the mileage allowed for 4 years? No

59. *Environmental Science.* To determine the number of humpback whales in a pod, a marine biologist, using tail markings, identifies 27 members of the pod. Several weeks later, 40 whales from the pod are randomly sighted. Of the 40 sighted, 12 are from the 27 originally identified. Estimate the number of whales in the pod. 90 whales

60. *Fox Population.* To determine the number of foxes in King County, a naturalist catches, tags, and then releases 25 foxes. Later, 36 foxes are caught; 4 of them have tags. Estimate the fox population of the county. 225 foxes

61. *Weight on the Moon.* The ratio of the weight of an object on the moon to the weight of that object on Earth is 0.16 to 1.

a) How much would a 12-T rocket weigh on the moon? 1.92 T

b) How much would a 180-lb astronaut weigh on the moon? 28.8 lb

62. *Weight on Mars.* The ratio of the weight of an object on Mars to the weight of that object on Earth is 0.4 to 1.

a) How much would a 12-T rocket weigh on Mars? 4.8 T

b) How much would a 120-lb astronaut weigh on Mars? 48 lb

TW **63.** Is it correct to assume that two workers will complete a task twice as quickly as one person working alone? Why or why not?

TW **64.** If two triangles are exactly the same shape and size, are they similar? Why or why not?

SKILL REVIEW

To prepare for Section 6.6, review solving a formula for a variable (Section 1.6).

Solve. [1.6]

65. $a = \dfrac{b}{c}$, for b $b = ac$

66. $a = \dfrac{b}{c}$, for c $c = \dfrac{b}{a}$

67. $2x - 5y = 10$, for y $y = \frac{2}{5}x - 2$

68. $12 + 6y = 2x$, for y $y = \frac{1}{3}x - 2$

69. $an + b = a$, for a $a = \dfrac{b}{1 - n}$

70. $xy + xz = 1$, for x $x = \dfrac{1}{y + z}$

SYNTHESIS

TW **71.** Two steamrollers are paving a parking lot. Working together, will the two steamrollers take less than half as long as the slower steamroller would working alone? Why or why not?

TW **72.** Two fuel lines are filling a freighter with oil. Will the faster fuel line take more or less than twice as long to fill the freighter by itself? Why?

73. *Filling a Bog.* The Norwich cranberry bog can be filled in 9 hr and drained in 11 hr. How long will it take to fill the bog if the drainage gate is left open? $49\frac{1}{2}$ hr

74. *Filling a Tub.* Kayla's hot tub can be filled in 10 min and drained in 8 min. How long will it take to empty a full tub if the water is left on? 40 min

75. *Grading.* Julia can grade a batch of placement exams in 3 hr. Tristan can grade a batch in 4 hr. If they work together to grade a batch of exams, what percentage of the exams will have been graded by Julia? About 57%

76. According to the U.S. Census Bureau, Population Division, in October 2009, there was one birth every 7 sec, one death every 13 sec, and one new international migrant every 36 sec. How many seconds does it take for a net gain of one person? About 10.7 sec

77. *Escalators.* Together, a 100-cm wide escalator and a 60-cm wide escalator can empty a 1575-person auditorium in 14 min. The wider escalator moves twice as many people as the narrower one. How many people per hour does the 60-cm wide escalator move? Source: *McGraw-Hill Encyclopedia of Science and Technology* 10,125 people per hour

78. *Aviation.* A Coast Guard plane has enough fuel to fly for 6 hr, and its speed in still air is 240 mph. The plane departs with a 40-mph tailwind and returns to the same airport flying into the same wind. How far from the airport can the plane travel under these conditions? (Assume that the plane can use all its fuel.) 700 mi from the airport

79. *Boating.* Shoreline Travel operates a 3-hr paddleboat cruise on the Missouri River. If the speed of the boat in still water is 12 mph, how far upriver can the pilot travel against a 5-mph current before it is time to turn around? $14\frac{7}{8}$ mi

80. *Travel by Car.* Melissa drives to work at 50 mph and arrives 1 min late. She drives to work at 60 mph and arrives 5 min early. How far does Melissa live from work? 30 mi

81. *Photocopying.* The printer in an admissions office can print a 500-page document in 50 min, while the printer in the business office can print the same document in 40 min. If the two printers work together to print the document, with the faster machine starting on page 1 and the slower machine working backwards from page 500, at what page will the two machines meet to complete the job? Page 278

82. At what time after 4:00 will the minute hand and the hour hand of a clock first be in the same position? $21\frac{9}{11}$ min after 4:00

83. At what time after 10:30 will the hands of a clock first be perpendicular? $8\frac{2}{11}$ min after 10:30

Average speed is defined as total distance divided by total time.

84. Paloma drove 200 km. For the first 100 km of the trip, she drove at a speed of 40 km/h. For the second half of the trip, she traveled at a speed of 60 km/h. What was the average speed of the entire trip? (It was *not* 50 km/h.) 48 km/h

85. For the first 50 mi of a 100-mi trip, Liam drove 40 mph. What speed would he have to travel for the last half of the trip so that the average speed for the entire trip would be 45 mph? $51\frac{3}{7}$ mph

Try Exercise Answers: Section 6.5

7. $3\frac{3}{7}$ hr **15.** Airgle: 15 min; Austin: 35 min **21.** B&M speed: $r - 14$; B&M time: $\frac{330}{r-14}$; AMTRAK: 80 km/h; B&M: 66 km/h **31.** 9 km/h **37.** 10.5 **41.** $3\frac{3}{4}$ in. **59.** 90 whales

6.6 Division of Polynomials

- Dividing by a Monomial
- Dividing by a Binomial

A rational expression indicates division. We will find that polynomial division is similar to division in arithmetic.

DIVIDING BY A MONOMIAL

We first consider division by a monomial. When dividing a monomial by a monomial, we use the quotient rule of Section 1.4 to subtract exponents when bases are the same. For example,

$$\frac{15x^{10}}{3x^4} = 5x^{10-4}$$
$$= 5x^6$$

CAUTION! The coefficients are divided but the exponents are subtracted.