$$\frac{210}{r}-\frac{210}{3r}=4 \qquad \text{The difference between their times is 4 hours.}$$

$$\frac{210}{r}-\frac{70}{r}=4$$

$$\frac{210}{r}\cdot r-\frac{70}{r}\cdot r=4\cdot r$$

$$210-70=4r$$

$$140=4r$$

$$35=r \qquad \text{Speed of the freight train.}$$

$$105=3r \qquad \text{Speed of the passenger train.}$$

Check

Time for freight train $=\frac{210}{35}=6$ hours

Time for passenger train $=\frac{210}{105}=2$ hours

$6-2=4$ hours difference in time

The freight train travels 35 mph, and the passenger train travels 105 mph.

Now work margin exercise 6.

Margin Exercise Answers

1. $\frac{5}{8}$ **2.** $\frac{36}{5}$ hours or $7\frac{1}{5}$ hours **3.** It takes the mom $\frac{9}{2}$ hours, or $4\frac{1}{2}$ hours, and her son takes 9 hours. **4.** The pool will drain in $\frac{20}{3}$ hours, or $6\frac{2}{3}$ hours. **5.** 2 mph

6. Commercial airplane: 360 mph; Private airplane: 180 mph

12.7 Exercises

Concept Check

Fill-in-the-Blank. Complete each sentence using information found in this section.

1. For problems involving work, you should represent what part of the work is done in one _____ of _____.
2. To solve any word problem, begin by _____ the problem carefully, possibly even several times.
3. Once a potential solution for a word problem has been found, _____ the solution with the original problem to make sure it makes sense.
4. The formula that relates distance, rate, and time is $d = rt$. This formula can be manipulated to represent the formula for rate, which is _____.
5. When solving word problems, it may be helpful to draw a/an _____ or set up a/an _____ as a visual aid.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

6. The first step in solving application problems is to assign a variable to the unknown value.

7. If the total amount of work took 5 hours to do, then $\frac{1}{5}$ of the work can be done in one hour.

8. If you know the distance and rate, you can use the formula $t = d - r$ to represent time.

Applications

Solve.

1. The sum of two numbers is 117, and they are in the ratio of 8 to 5. Find the two numbers.

2. If 4 is subtracted from a certain number and the difference is divided by 2, the result is 1 more than $\frac{1}{5}$ of the original number. Find the original number.

3. What number must be added to both the numerator and denominator of $\frac{16}{21}$ to make the resulting fraction equal to $\frac{5}{6}$?

4. Find the number that can be subtracted from both the numerator and denominator of the fraction $\frac{69}{102}$ so that the result is $\frac{5}{8}$.

5. The denominator of a fraction exceeds the numerator by 7. If the numerator is increased by 3 and the denominator is increased by 5, the resulting fraction is equal to $\frac{1}{2}$. Find the original fraction.

6. The numerator of a fraction exceeds the denominator by 5. If the numerator is decreased by 4 and the denominator is increased by 3, the resulting fraction is equal to $\frac{4}{5}$. Find the original fraction.

7. One number is $\frac{3}{4}$ of another number. Their sum is 63. Find the numbers.

8. The sum of two numbers is 24. If $\frac{2}{5}$ of the larger number is equal to $\frac{2}{3}$ of the smaller number, find the numbers.

9. One number exceeds another by 5. The sum of their reciprocals is equal to 19 divided by the product of the two numbers. Find the numbers.

10. One number is 3 less than another. The sum of their reciprocals is equal to 7 divided by the product of the two numbers. Find the numbers.

Solve the following word problems. Remember to check each solution with the wording of the original problem to make sure it is reasonable.

11. It takes Rosa, traveling at 30 mph, 30 minutes longer to go a certain distance than it takes Melody traveling at 50 mph. Find the distance traveled.

12.  It takes a plane, flying at 450 mph, 25 minutes longer to travel a certain distance than it takes a second plane to fly the same distance at 500 mph. Find the distance.

13. Kira needs 4 hours to complete the yard work. Her husband, Zackary, needs 6 hours to do the work. How long will the job take if they work together?

14. In 1921, automated wrapping machines were used to aid in the wrapping of Hershey Kisses® in the Hershey chocolate factory. The machine could wrap the candies 100 times faster than a person could. Together the machine and the person could wrap a crate full of Hershey Kisses® in 5 minutes. How long would it take each of them working alone?

15. Ben's secretary can address the weekly newsletters in $4\frac{1}{2}$ hours. Charlie's secretary needs only 3 hours. How long will it take if they both work on the job?

16. Working together, Greg and Cindy can clean the snow from the driveway in 20 minutes. It would have taken Cindy 36 minutes working alone. How long would it have taken Greg alone?

17. A carpenter and his partner can put up a patio cover in $3\frac{3}{7}$ hours. If the partner needs 8 hours to complete the patio alone, how long would it take the carpenter working alone?

18. Beth can travel 208 miles in the same length of time it takes Anna to travel 192 miles. If Beth's speed is 4 mph greater than Anna's, find both rates.

19. Charles can bike 32 miles in the same amount of time that his twin brother Chase can bike 24 miles. If Charles bikes 2 mph faster than Chase, how fast does each man bike?

20. A commercial airliner can travel 750 miles in the same amount of time that it takes a private plane to travel 300 miles. The speed of the airliner is 60 mph more than twice the speed of the private plane. Find the speed of each aircraft.

21. Gabriela drives her car 350 miles and has an average of a certain speed. If the average speed had been 9 mph less, she could have traveled only 300 miles in the same length of time. What was her average speed?

22. A family travels 18 miles down river and returns. It takes 8 hours to make the round trip. Their rate in still water is twice the rate of the river's current. How long will the return trip take?

23. Cruise ships travel 5 times faster than sailboats (in optimal wind conditions). If it takes 16 hours longer for a sailboat (with optimal wind conditions) to travel 100 miles from Charleston, SC, to Savannah, GA, what is the speed of each boat?

24. An airplane can fly 650 mph in still air. If it can travel 2800 miles with the wind in the same time it can travel 2400 miles against the wind, find the wind speed.

25. A one-engine plane can fly 120 mph in still air. If it can fly 490 miles with a tailwind in the same time that it can fly 350 miles against a headwind, what is the speed of the wind? (**Note:** A tailwind increases the speed of the plane and a headwind decreases the speed of the plane.)

26. Using a small inlet pipe, it takes 9 hours to fill a pool. Using a large inlet pipe, it only takes 3 hours. If both are used simultaneously, how long will it take to fill the pool?

27. An inlet pipe on a swimming pool can be used to fill a pool in 36 hours. The drain pipe can be used to empty the pool in 40 hours. If the pool is $\frac{2}{3}$ filled using the inlet pipe and then the drain pipe is accidentally opened, how long from that time will it take to fill the pool?

28. A contractor hires two bulldozers to clear the trees from a 20-acre tract of land. One works twice as fast as the other. It takes them 3 days to clear the tract working together. How long would it take each of them alone?

29. John, Raul, and Denny, working together, can clean their bait and tackle store in 6 hours. Working alone, Raul takes twice as long to clean the store as John does. Denny needs three times as long as John does. How long would it take each man working alone?

30. Francois rode his jet ski 36 miles downstream and then 36 miles back. The round trip took $5\frac{1}{4}$ hours. Find the speed of the jet ski in still water and the speed of the current if the speed of the current is $\frac{1}{7}$ the speed of the jet ski.

31. Momence, IL, is 12 miles upstream on the same side of the river from Kankakee, IL, on the Kankakee River. A motorboat that can travel 8 mph in still water leaves Momence and travels downstream toward Kankakee. At the same time, another boat that can travel 10 mph leaves Kankakee and travels upstream toward Momence. Each boat completes the trip in the same amount of time. Find the rate of the current.

32. Samantha rides the ski lift to the top of Blue Mountain, a distance of $1\frac{3}{4}$ kilometers (a little more than 1 mile). She then skis directly down the slope. If she skis five times as fast as the lift travels and the total trip takes 45 minutes, find the rate at which she skis.

33. A local print shop has a big order of pamphlets to print, so they decide to use two of their printers for the one job. The newest printer can print the pamphlets four times as fast as the old printer. Working together the printers can complete the job in 4 hours. How many hours would it take each printer to print all of the pamphlets by itself?

a. Use the table to set up a rational equation to describe the situation. Use the variable x to represent the time it takes the newest printer to complete the job.

Printer	Time of Work (in Hours)	Part of Work Done in 1 Hour
Newest		
Old		
Together		

b. Solve the equation from part a. for x.

c. Use the solution from part b. to answer the question in the problem statement.

34. The Winston family is moving to another state. The family is driving to their new house in a car and all of their belongings are in a moving truck. The car is traveling at speed that is 9 miles per hour faster than the speed of the truck. After a certain amount of time, the family's car traveled 350 miles and the moving truck traveled 300 miles. What are the speeds of the car and the truck? Use the table to set up a rational equation to describe the situation. Use the variable x to represent the rate of the truck.

	Distance (d)	÷	**Rate (r)**	=	**Time** $\left(t = \frac{d}{r}\right)$
Car					
Truck					

a. Solve the equation from part a. for x.

b. Use the solution from part b. to answer the question in the problem statement.

c. If the Winston family's new home is 378 miles away, how long will it take the car and the truck to make the trip?

Writing & Thinking

35. If n is any integer, then $2n$ is an even integer and $2n + 1$ is an odd integer. Use these ideas to solve the following problems.

a. Find two consecutive odd integers such that the sum of their reciprocals is $\frac{12}{35}$.

b. Find two consecutive even integers such that the sum of the first and the reciprocal of the second is $\frac{9}{4}$.