

Working with Unit Rates

A **unit rate** is a special kind of ratio that compares a quantity to one unit. Unit rates are usually expressed with the word *per*.

Examples: An employee earns \$9 per hour. The speed limit is 55 miles per hour.

To find a unit rate:

1. Use the information in the problem to write a ratio in fraction form.
2. Divide the top number by the bottom number. Express the remainder as either a fraction or a decimal.
3. Write the quotient from Step 2 as the top number of the unit rate over 1.

► Use your knowledge of unit rates to calculate gas mileage.

Example: Since her last fill-up, Lynn has driven 192 miles. When she stops for gas, it takes 12 gallons to fill up her gas tank. How many miles per gallon did she get on her last tank of gasoline?

- | | |
|--------|--------|
| (1) 12 | (4) 17 |
| (2) 15 | (5) 19 |
| (3) 16 | |

You're right if you chose **(3) 16**. Lynn drove 192 miles on 12 gallons of gas. The ratio is $\frac{192}{12}$, which equals a rate of $\frac{16}{1}$. Lynn's car averaged 16 miles per 1 gallon of gasoline.

SKILL PRACTICE

Solve each problem. Reduce ratios to lowest terms. Remember: Do not change a ratio to a whole or mixed number.

1. For a special showing of *The Wizard of Oz*, a movie theater sold 75 tickets to adults and 125 tickets to children. Write the following ratios:
 - a. adults to children in the audience
 - b. adult tickets sold to total tickets sold
2. Brett took a test on ratios in his math class. Of the 48 items on the test, he missed 4. Write the following ratios:
 - a. correct answers to total test items
 - b. incorrect answers to total test items
 - c. correct to incorrect answers
3. During a 6-hour sale, a bookstore manager counted 246 customers. Of the total customers, 82 spent more than \$20.
 - a. Write the ratio of total customers to those spending more than \$20.
 - b. Find the rate of customers per hour.
4. Chris earned \$855 for a temporary job. She worked 36 hours the first week and 40 hours the second week. Which expression shows how much she earned per hour?
 - (1) $\frac{\$855}{36}$
 - (2) $\frac{\$855}{40}$
 - (3) $\frac{\$855}{2}$
 - (4) $\frac{(36+40)}{\$855}$
 - (5) $\frac{\$855}{(36+40)}$

Both ratios compare pounds to dollars.
An x is used for the missing term.

$$\frac{\text{pounds}}{\text{dollars}} \quad \frac{4}{5} = \frac{10}{x}$$

First: Cross multiply.

$$5 \times 10 = 50$$

Next: Divide the cross product by the remaining term.

$$50 \div 4 = 12.5, \text{ or } \$12.50$$

Answer: The company will charge **\$12.50** for a 10-pound shipment. *Check:* Substitute and cross multiply. The proportion is true.

$$\frac{4}{5} \times \frac{10}{12.50} \quad \begin{array}{l} 5 \times 10 = 50 \\ 4 \times 12.5 = 50 \end{array}$$

You could also set up the ratios using dollars over pounds. Try it. The answer is the same.



A calculator is very useful for solving proportion problems, especially when the numbers are large. Enter the operations one after the other. You don't have to write down and re-enter the first cross product.

Calculator: 5 × 10 ÷ 4 = 12.5

On the GED Math Test, you will sometimes be asked to choose how a proportion problem could be set up. The expression will show both the multiplication and the division step. Remember, the fraction bar means division.

A correct set-up for the example above is:

$$\frac{5 \times 10}{4}$$

SKILL PRACTICE

Solve each problem.

1. Marti has created a logo for a T-shirt. Her sample design measures 6 inches wide and 10 inches long. If she uses a photocopier to enlarge the design to a 10-inch width, what will its length be to the nearest whole inch?

(1) 10	(4) 26
(2) 16	(5) 60
(3) 17	

2. A bread recipe calls for 6 cups of flour and 3 tablespoons of butter. If John makes a smaller batch using only 4 cups of flour, how many tablespoons of butter will he need?

(1) 2	(4) 5
(2) 3	(5) 6
(3) 4	

3. Ken earned \$218.75 for 25 hours of work. At the same rate, how much would he earn for 40 hours of work?

(1) \$136.72	(4) \$350.00
(2) \$258.75	(5) \$781.25
(3) \$283.75	

4. For every \$50 that Max earns, he saves \$5. Which expression could be used to find the amount he will save if he earns \$300?

(1) $\frac{50 \times 5}{300}$	(4) $\frac{300 + 5}{5}$
(2) $\frac{300 \times 50}{5}$	(5) $\frac{300 \times 5}{50}$
(3) $\frac{300 \div 5}{50}$	

5. Jonisa spent \$34.14 for 3 gallons of paint. Which expressions could be used to find the cost of 7 gallons of the same paint?

(1) $\frac{34.14 \times 7}{3}$	(4) $\frac{34.14 + 7}{3}$
(2) $\frac{34.14 \times 3}{7}$	(5) $\frac{7 \times 3}{34.14}$
(3) $\frac{34.14 \div 3}{7}$	

Answers and explanations start on page 315.

Solving Two-Part Proportion Problems

For some word problems, you may have to use information in the problem to calculate one of the terms before you can write a proportion.

Example: David is helping children paint a mural. The pink color used in the mural is made by mixing red and white paint in a 2:7 ratio. If David needs 36 quarts of pink paint, how many quarts of red paint will he use?

David needs to know how much red paint is needed to mix with white to get 36 quarts of pink paint. Set up a proportion using two ratios that compare the amount of red paint to the total amount of paint (pink). Use the ratio you are given to find a total (pink). Add: $2 + 7 = 9$. There are 2 quarts of red paint in 9 quarts of pink. Write the other ratio comparing the unknown amount of red to the total: $\frac{x}{36}$.

Write the proportion and solve: $\frac{2 \text{ red}}{9 \text{ pink}} = \frac{x \text{ red}}{36 \text{ pink}} \quad \frac{2 \times 36}{9} = 8 \text{ red}$

Answer: David will need **8 quarts** of red paint.

Check: Substitute and find the cross products: $2 \times 36 = 72$ and $9 \times 8 = 72$.

SKILL PRACTICE

Solve each problem.

- The distance from Kent to Leeds is 175 km. On a map with a scale of 1 cm = 25 km, how many centimeters apart are Kent and Leeds?
- The scale on a map of Oregon is 1 inch = 36 miles. Ontario and Burns are $5\frac{1}{2}$ inches apart on the map. What is the actual distance between the cities?
- The ratio of children to adults on a camping trip is 5:2. If there are 56 people on the camping trip, how many are children?
- Paul makes 1 sale in his shop for every 8 sales he makes over the telephone. If he averages 180 sales per week, how many are made in his shop?

SOCIAL STUDIES Connection



One strategy when solving a proportion problem on the GED test is to use **labels**.

Labels will help you to always keep the ratios in the same order.

Example: In North Dakota, there are approximately 10 square miles of water for every 400 square miles of land. If the land area of North Dakota is nearly 69,000 square miles, how many of the state's square miles are water?

Write the labels in the order you want the numbers to appear. Then write the numbers.

$$\frac{\text{water sq mi}}{\text{land sq mi}} = \frac{10}{400} = \frac{x}{69,000}$$

Solve the proportion. **In North Dakota about how many square miles are covered in water?**

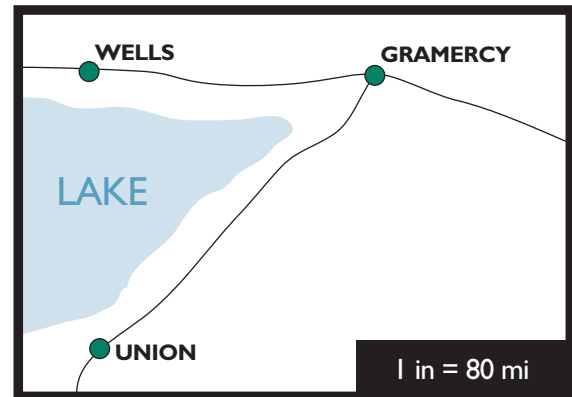
GED PRACTICE



PART ONE DIRECTIONS: Choose the one best answer to each of the following problems. Use a calculator wherever necessary.

- Sebastian spent \$38.94 for 3 CDs. Which expression could be used to find the cost of 8 CDs at the same price?
 - $\frac{38.94 + 8}{3}$
 - $\frac{38.94 \times 8}{3}$
 - $\frac{38.94 \times 3}{8}$
 - $\frac{3 \times 8}{38.94}$
 - $\frac{38.94 \div 8}{3}$
- Marla recently got a job selling carpet; she works 8 hours a day, 3 days a week. Marla just made her first sale of \$840. She is to receive 6% commission for this sale. What will her commission be?
 - \$600.00
 - \$504.00
 - \$100.80
 - \$50.40
 - \$35.00
- Cindy is a sculptor who mixes a sculpting compound composed of 60% sand, 25% alumina cement, and 15% plaster. How many ounces of sand will Cindy need of the sculpting compound for 2 sculptures?
 - 6
 - 12
 - 15
 - 60
 - Not enough information is given.

Questions 5 and 6 are based on the following map.



Question 3 is based on the following drawing.



- A poster is 8 inches wide by 14 inches long. A smaller poster of the same proportions is 6 inches wide. How many inches long is the smaller poster?
 - 21
 - $11\frac{1}{2}$
 - $10\frac{1}{2}$
 - $10\frac{1}{4}$
 - 10
- On the map the road from Wells to Gramercy is 1.5 inches, and the road from Gramercy to Union is 2 inches. What is the driving distance in miles from Wells to Union?
 - 3.5
 - 40
 - 80
 - 120
 - 280
- The actual distance from a proposed shopping mall to Union is 300 miles. Which expression could be used to find how many inches would represent 300 miles on the map?
 - $\frac{300 \times 80}{1}$
 - $\frac{1 + 300}{80}$
 - $\frac{1 \times 80}{300}$
 - $\frac{1 \times 300}{80}$
 - $\frac{1 + 80}{300}$

7. Eva makes \$12 an hour. Last year, she made 25% less per hour. Which expression could be used to find how many fewer dollars per hour Eva made last year?
- (1) $\$12 \div 4$
 - (2) $\$12 \div \frac{1}{4}$
 - (3) $\$12 \times \frac{1}{25}$
 - (4) $25\% \times \frac{1}{4}$
 - (5) $\$12 \div 25$

Questions 8 and 9 are based on the following information.

Mail-Order Linens
SEPTEMBER CATALOG



Twin Bed Quilt	\$30.00
Full-Size Quilt.....	\$40.00
Queen-Size Quilt.....	\$60.00
King-Size Quilt.....	\$80.00
Pillow Sham (All Sizes)	\$15.00

8. From the September catalog, Miko orders a queen-size quilt and two pillow shams. If there is a 5% shipping charge, how much will Miko pay for the order?
- (1) \$78.75
 - (2) \$90.00
 - (3) \$94.50
 - (4) \$95.00
 - (5) \$99.00
9. In the October catalog, the price for a king-size quilt is marked down 20%. In November, it is reduced another 10%. What is the advertised price in November for a king-size quilt?
- (1) \$78.40
 - (2) \$68.00
 - (3) \$57.60
 - (4) \$56.00
 - (5) \$50.00

10. At a family reunion, Kay counts 30 of her cousins in a room of 70 relatives. To the nearest whole percent, what percent of relatives in the room are Kay's cousins?
- (1) 3%
 - (2) 23%
 - (3) 33%
 - (4) 43%
 - (5) 57%

11. For one day only, Factory Warehouse, an appliance store, will sell their merchandise for an amount 15% lower than any advertised price from another store. Tami brings in an ad for a microwave priced at \$345. How much will the item cost at Factory Warehouse?

- (1) \$15.00
- (2) \$51.75
- (3) \$290.25
- (4) \$293.25
- (5) \$330.00

12. Alberto earns \$142.60 for 15.5 hours of work. At the same rate, how much would Alberto earn for 40 hours of work?

- (1) \$368.00
- (2) \$368.75
- (3) \$400.00
- (4) \$468.22
- (5) Not enough information is given.

13. Which proportion expression could you write to calculate how many days there are in 390 hours?

- (1) $\frac{60}{1} = \frac{390}{x}$
- (2) $\frac{1}{24} = \frac{390}{x}$
- (3) $\frac{24}{1} = \frac{390}{x}$
- (4) $\frac{390 \times 24}{x}$
- (5) $\frac{24}{1} = \frac{x}{390}$

14. **(4) 18** To obtain the lowest common denominator, think of the multiples of the denominators 6, 3, 9, and 2, and choose the lowest common multiple.
15. **(4) $19\frac{1}{2}$** Multiply: $3\frac{1}{4} \times 6 = \frac{13}{4} \times \frac{6}{1} = \frac{78}{4} = 19\frac{1}{2}$
16. **(1) a pedicure** Find the amount of time needed to complete 1 permanent and 2 haircuts: $1\frac{1}{4} + \frac{1}{2} + \frac{1}{2} = 2\frac{1}{4}$. Subtract from 3 hours: $3 - 2\frac{1}{4} = \frac{3}{4}$. Evaluate each of the choices to see which will take $\frac{3}{4}$ hour (45 minutes) or less. Choice (1) will take $\frac{2}{3}$ of an hour, or 40 minutes.
17. **(3) 1:10 P.M.** There are several ways to approach the problem, but whatever method you use, you will eventually have to change the fractions of an hour to minutes.
Method 1: Add the times from the chart: $\frac{1}{4} + 1\frac{1}{4} + \frac{2}{3} = 1\frac{7}{6} = 2\frac{1}{6}$ hour. Since there are 60 minutes in an hour, $\frac{1}{6}$ hour = 10 minutes. The work takes 2 hours 10 minutes. Since Tracy began at 11:00 A.M., she is finished at 1:10 P.M.
Method 2: Change the times to minutes from the start: $\frac{1}{4}$ hour = 15 minutes, $1\frac{1}{4}$ hour = 1 hour 15 minutes, $\frac{2}{3}$ hour = 40 minutes. Add the amount of time: 15 min + 1 hr 15 min + 40 min = 1 hr 70 min = 2 hr 10 min. Tracy is finished at 1:10 P.M.
18. **(2) $\frac{15}{6} - \frac{2}{6}$** Subtract the whipped cream used for the topping from the total whipped cream by converting the unlike fractions into like fractions with the lowest common denominator of 6.
19. **(4) $\frac{2}{5}$** The artisans have already woven 45 out of 75 rugs, which means they have 30 left to weave. $\frac{30}{75}$ reduces to $\frac{2}{5}$.
20. **(1) 5** You need to divide 42 by $7\frac{1}{2}$ inches. You can use either decimals or fractions.
Using decimals: Divide: $42 \div 7.5 = 5.6$. Ignore the decimal remainder, since the situation calls for whole lengths of the pipe.
Using fractions: Divide: $42 \div 7\frac{1}{2} = 42 \div \frac{15}{2} = 42 \times \frac{2}{15} = \frac{84}{15} = 5\frac{9}{15} = 5\frac{3}{5}$. Again, ignore the fraction.
21. **(3) \$0.97** Remember that a dollar has 100 parts, and think in terms of fractions of a hundred. Convert the fractions to decimals, then add: $\frac{1}{4} + \frac{3}{10} + \frac{2}{5} + \frac{1}{50} = \$0.25 + \$0.30 + \$0.40 + \$0.02 = \0.97 .
2. **a. 11:12** He missed 4 items, so he got 44 correct. $44:48 = 11:12$
b. 1:12 Reduce 4:48.
c. 11:1 Reduce 44:4.
3. **a. 3:1** Reduce 246:82.
b. 41 $246 \text{ customers} / 6 \text{ hours} = 41 \text{ customers per hour}$
4. **(5) $\frac{\$855}{(36+40)}$** Divide the amount of money earned by the total hours.

Working with Proportions

Skill Practice, page 115

1. **(3) 17** $\frac{\text{width}}{\text{length}} = \frac{6}{10} = \frac{10}{x}$ $10 \times 10 \div 6 = 16\frac{2}{3}$
2. **(1) 2** $\frac{\text{flour}}{\text{butter}} = \frac{6}{3} = \frac{4}{x}$ $3 \times 4 \div 6 = 2$
3. **(4) \$350.00** $\frac{\text{dollars}}{\text{hours}} = \frac{218.75}{25} = \frac{x}{40}$
 $218.75 \times 40 \div 25 = 350$
4. **(5) $\frac{300 \times 5}{50}$** $\frac{\text{savings}}{\text{earnings}} = \frac{5}{50} = \frac{x}{300}$
5. **(1) $\frac{34.14 \times 7}{3}$** $\frac{\text{cost}}{\text{gallon}} = \frac{\$34.14}{3} = \frac{x}{7}$

Skill Practice, page 117

1. **7 cm** $\frac{\text{cm}}{\text{km}} = \frac{1}{25} = \frac{x}{175}$
2. **198 miles** $\frac{\text{inch}}{\text{miles}} = \frac{1}{36} = \frac{5\frac{1}{2}}{x}$
3. **40 children** $\frac{\text{children}}{\text{people}} = \frac{5}{(5+2)} = \frac{x}{56}$
4. **20 shop sales** $\frac{\text{shop sales}}{\text{total sales}} = \frac{1}{(1+8)} = \frac{x}{180}$

Geography Connection, page 117

Water covers about 1,725 square miles in North Dakota. Cross multiply, then divide: $69,000 \times 10 \div 400 = 1,725$.

Working with Percent

Skill Practice, page 119

1. 252
 2. 315
 3. \$88.20
 4. 80%
 5. 90%
 6. 75%
 7. 64 children
 8. 30%
 9. **(4) $\frac{25 \times 272}{100}$**

Skill Practice, page 121

1. **8 hours** Solve for the whole: $\frac{2}{0.25} = 8$.
2. **15%** Solve for the percent:
 $\frac{1.2}{8} = .15 = 15\%$.
3. **(1) 6×0.2** Solve for the part using the percent formula: Whole \times Rate = Part. Use 0.2 for 20%.
4. **(3) $\frac{16}{40}$** Solve for the rate using the percent formula: Part \div Whole = Rate.
5. **(2) $\frac{26.4 \times 100}{55}$** Set up a proportion to solve for the whole: $\frac{55}{100} = \frac{26.4}{x}$.

PROGRAM 32: RATIO, PROPORTION, AND PERCENT

Working with Ratios

Skill Practice, page 113

1. **a. 3:5** Reduce $\frac{75}{125}$.
b. 3:8 Reduce $\frac{75}{(75+125)}$.