6.3 Unit Rates

Unit Rate: A unit rate is a rate where the second quantity or the denominator is 1.

The following are examples of unit rates:

- 5 men to 1 car = 5 men per car = 5 men / car
- 30 miles to 1 gallon = 30 miles per gallon = 30 mpg
- $3.49 to 1 pound = $3.49 per pound

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<th>HOW TO DETERMINE A UNIT RATE</th>
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<td>Step 1: Write the rate as a fraction.</td>
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<td>Step 2: Make the denominator equal to 1 by dividing the quantity in the numerator and denominator by the quantity in the denominator.</td>
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**Example 1:** Given the rate 200 miles to 8 gallons, determine the unit rate.

\[
\frac{200 \text{ miles}}{8 \text{ gallons}} = \frac{200 \text{ miles} \div 8}{8 \text{ gallons} \div 8} = \frac{25 \text{ miles}}{1 \text{ gallon}}
\]

Simplify.

The unit rate is 25 miles per gallon.

**Practice 1:** Determine the unit rate for driving 288 miles on 8 gallons of gasoline.

**Watch It:** [http://youtu.be/fBDHWm_YLcg](http://youtu.be/fBDHWm_YLcg)  
**Answer:** 36 miles per gallon

**Example 2:** A typist can type 240 words in 4 minutes. Find the unit rate.

\[
\frac{240 \text{ words}}{4 \text{ minutes}} = \frac{240 \text{ words} \div 4}{4 \text{ minutes} \div 4} = \frac{60 \text{ words}}{1 \text{ minute}}
\]

Simplify.

The unit rate is 60 words per minute.
Practice 2: A typist can type 480 words in 6 minutes. Determine the unit rate.

Watch It: [http://youtu.be/QH8sTiv-4go](http://youtu.be/QH8sTiv-4go)  
Answer: 80 words per minute

Example 3: Find the unit rate for driving 135 miles on 4 gallons of gasoline.

\[
\frac{135 \text{ miles}}{4 \text{ gallons}} \quad \text{Write the rate as a fraction.}
\]

\[
= \frac{135 \text{ miles} \div 4}{4 \text{ gallons} \div 4} \quad \text{Divide the numerator and denominator by the denominator.}
\]

\[
= \frac{33.75 \text{ miles}}{1 \text{ gallon}} \quad \text{Simplify.}
\]

The unit rate is 33.75 miles per gallon.

Practice 3: Determine the unit rate for driving 850 miles on 20 gallons of gasoline.

Watch It: [http://youtu.be/dUYgAiB7hOI](http://youtu.be/dUYgAiB7hOI)  
Answer: 42.5 miles per gallon

Calling all shoppers! One very useful unit rate is called a unit price. It gives the price of a single part. For instance, it could be the price of one pound or the price of one liter or the price of one quart, or the price of one tile.

Example 4: Mina bought 2.5 kilograms of brown rice for $7.50. Determine the unit price.

\[
\frac{$7.50}{2.5 \text{ kilograms}} \quad \text{Write the rate as a fraction.}
\]

\[
= \frac{$7.50 \div 2.5}{2.5 \text{ kilograms} \div 2.5} \quad \text{Divide the numerator and denominator by the denominator.}
\]

\[
= \frac{$3}{1 \text{ kilogram}} \quad \text{Simplify.}
\]

The unit rate is $3.00 per kilogram.

Practice 4: George bought 2 kilograms of brown rice for $3.50. Determine the unit rate or unit price (of brown rice per kilogram).

Watch It: [http://youtu.be/RAdhsd0Pwbw](http://youtu.be/RAdhsd0Pwbw)  
Answer: $1.75 per kilogram
Example 5: The price of 8 pounds of apples is $10. What is the unit price?

\[
\frac{10}{8 \text{ pounds}} \quad \text{Write the rate as a fraction.}
\]

\[
= \frac{10 \div 8}{8 \text{ pounds} \div 8} \quad \text{Divide the numerator and denominator by the denominator.}
\]

\[
= \frac{1.25}{1 \text{ pound}} \quad \text{Simplify.}
\]

The unit rate is $1.25 per pound.

Practice 5: The price of 4 pounds of apples is $8. What is the unit rate (price of apples per one pound)?

Watch It: [http://youtu.be/Dnb0eYJ-ad0](http://youtu.be/Dnb0eYJ-ad0)  
Answer: $2 per pound

Example 6: A 20-ounce box of cereal costs $3.40. What is the unit price?

\[
\frac{3.40}{20 \text{ ounces}} \quad \text{Write the rate as a fraction.}
\]

\[
= \frac{3.40 \div 20}{20 \text{ ounces} \div 20} \quad \text{Divide the numerator and denominator by the denominator.}
\]

\[
= \frac{0.17}{1 \text{ ounce}} \quad \text{Simplify.}
\]

The unit rate is $0.17 per ounce (or 17¢ per ounce).

Practice 6: A 16-ounce box of cereal costs $2.40. What is the unit price?

Watch It: [http://youtu.be/idTuuWZV28k](http://youtu.be/idTuuWZV28k)  
Answer: $0.15 per ounce

Sometimes we will need to convert one of the units before we can determine the unit rate. This may happen in a problem if the rate given does not have the same units as the unit rate that we are asked to find. For instance, suppose we are given the rate 15 miles to 20 minutes. But we are asked to find the unit rate in miles per hour. To solve a problem like this we must first get the units to match, then we can proceed to find the unit rate.
Example 7: Given the rate 15 miles to 20 minutes, determine the unit rate in miles per hour.

Change minutes to hours:

\[
\frac{20 \text{ minutes}}{1} \cdot \frac{1 \text{ hour}}{60 \text{ minutes}} = \frac{20 \text{ hour}}{60} = \frac{20 \text{ hour}}{60 \div 20} = \frac{1}{3} \text{ hour}
\]

The given rate was 15 miles to 20 minutes, but now we can express this as 15 miles to \(\frac{1}{3}\) hour.

\[
\frac{15 \text{ miles}}{\frac{1}{3} \text{ hour}} \quad \text{Write the rate as a fraction.}
\]

\[
= 15 \div \frac{1}{3} \quad \text{Divide the numerator by the denominator.}
\]

\[
= \frac{15}{1} \times \frac{3}{1} \quad \text{Change division to multiplication of the reciprocal.}
\]

\[
= \frac{45}{1} \quad \text{Multiply.}
\]

The unit rate is 45 miles per hour or 45 mph.

Practice 7: Given the rate 35 miles in 40 minutes, determine the unit rate in miles per hour.

Watch It: [http://youtu.be/99kG6usX78Q](http://youtu.be/99kG6usX78Q)  
Answer: 52.5 miles per hour

Watch All: [http://youtu.be/r2cYOj8Oc](http://youtu.be/r2cYOj8Oc)
6.3 Unit Rate Exercises

Determine the unit rate.

1. 784 calories per 4 servings of pie
2. 550 miles in 11 hours
3. 345 miles per 12 gallons
4. $15.20 per 3 hours
5. 34 grams per 17 milliliters
6. 120 pages in 6 hours
7. 28 meters per 8 seconds
8. $8.25 per 3 boxes
9. $45.35 per 5 hours
10. 8700 calories per 15 servings

Solve each problem.

11. An international call costs $9.35 for 32 minutes. What is the cost per minute?
12. At a warehouse store, 10 cans of soup cost $8.22. What is the price per can of soup?
13. A secretary can type 2435 words in 20 minutes. What is the secretary’s unit rate in words per minute?
14. A 12 ounce can of beans costs $0.88. What is the unit price per ounce?
15. A car traveled 120 miles in 2 hours. What was the unit rate in miles per hour?
16. Ann babysat for 6 hours and was paid $36. What is her pay per hour?
17. Four cookies have 125 calories. What is the number of calories per cookie?
18. Sue bought 5 apples for $1.50. What is the price per apple?
19. Bill got his phone bill and was charged $4.25 for a 20 minute call. How much was he charged per minute?
20. Caleb rode his bicycle 5 miles in 30 minutes. What is the rate of miles per hour?
6.3 Unit Rates Exercises Answers

1. 196 calories per serving
2. 50 miles per hour
3. 28.75 miles per gallon
4. $5.07 per hour (rounded to the nearest cent)
5. 2 grams per millimeter
6. 20 pages per hour
7. 3.5 meters per second
8. $2.75 per box
9. $9.07 per hour
10. 580 calories per serving
11. $0.29 per minute (rounded to the nearest cent)
12. $0.82 per can (rounded to the nearest cent)
13. 121.75 words per minute
14. $0.07 per ounce (rounded to the nearest cent)
15. 60 miles per hour
16. $6 per hour
17. 31.25 calories per cookie
18. $0.30 per apple
19. $0.21 per minute (rounded to the nearest cent)
20. 10 miles per hour
Mid-Chapter Review

Write each ratio in two other ways.

1. 5 to 8
2. 7 to 3
3. 14:15
4. 9:11
5. \( \frac{18}{53} \)
6. \( \frac{99}{100} \)

Write each ratio or rate in simplest form.

7. 51 to 48
8. 74 to 32
9. 36 to 18
10. \( \frac{65}{75} \)
11. \( \frac{36}{60} \)
12. 18:52
13. 77:99
14. 250 pounds to 300 pounds
15. 36 male students to 24 female students
16. 30 cars to 45 trucks
17. 482 words per 4 minutes
18. 55 meters per 15 seconds
19. 65 calories per 4 bags

20. A group consists of 27 females and 12 males. What is the ratio of females to males?
21. Juliet paid $6 for lunch and $36 for dinner while traveling for work. What is the ratio of the cost of lunch to the cost of dinner?
22. A cabinet at school has 18 boxes of yellow chalk and 21 boxes of white chalk. What is the ratio of boxes of white chalk to all the boxes of chalk in the cabinet?

Find the unit rate.

23. 300 miles per 8 gallons of gas
24. $54.40 for 16 pounds
25. $49.56 for 14 gallons
26. $2496 for 15 people
27. 1200 books for 16 people
28. 450 gallons for 20 people
29. 255 miles in 5 hours
30. 114 calories for six cupcakes
Mid-Chapter 6 Review Answers

1. 5:8 ; \(\frac{5}{8}\)
2. 7:3 ; \(\frac{7}{3}\)
3. 14 to 15 ; \(\frac{14}{15}\)
4. 9 to 11 ; \(\frac{9}{11}\)
5. 18:53 ; 18 to 53
6. 99:100 ; 99 to 100
7. 17 to 16
8. 37 to 16
9. 2 to 1
10. \(\frac{13}{15}\)
11. \(\frac{3}{5}\)
12. 9:26
13. 7:9
14. \(\frac{5 \text{ pounds}}{6 \text{ pounds}}\)
15. \(\frac{3 \text{ male students}}{2 \text{ female students}}\)
16. \(\frac{2 \text{ cars}}{3 \text{ trucks}}\)
17. \(\frac{241 \text{ words}}{2 \text{ minutes}}\)
18. \(\frac{11 \text{ meters}}{3 \text{ seconds}}\)
19. \(\frac{65 \text{ calories}}{4 \text{ bags}}\)
20. \(\frac{9 \text{ females}}{4 \text{ males}}\)
21. \(\frac{\$1 \text{ lunch}}{\$6 \text{ dinner}}\)
22. \(\frac{7 \text{ boxes white chalk}}{13 \text{ boxes of chalk}}\)
23. 37.5 miles per chalk
24. \$3.40 per pound
25. \$3.54 per gallon
26. \$166.40 per person
27. 75 books per person
28. 22.5 gallons per person
29. 51 miles per hour
30. 19 calories per cupcake