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**LESSON 8 Solving Problems with Unit Rates** CC.2.1.6.D.1

**1 Introduction**

A **unit rate** is a ratio that compares one quantity with one unit of another quantity. For example, \$8 per hour or 25 miles/gallon are unit rates. You can use unit rates to solve problems.

Latasha drove 160 miles in 2.5 hours. At this rate, how long would it take her to drive 320 miles?

First, write the rate as a fraction:  $\frac{160 \text{ mi}}{2.5 \text{ hr}}$

Convert the rate to a unit rate by dividing the numerator and denominator by the denominator.

$$\frac{160 \text{ mi} \div 2.5}{2.5 \text{ hr} \div 2.5} = \frac{64 \text{ mi}}{1 \text{ hr}}$$

Divide the total number of miles by the number of miles per hour to find the time it takes to drive this distance.

$$\frac{320 \text{ mi}}{64 \text{ mi}} = 5$$

It takes 5 hours for Latasha to drive 320 miles.

You can find unit rates to find the cost of items. The unit rate is known as a unit price when describing cost.

Billy bought 2 bottles of water for \$2.58. At this rate, how much will Billy pay for 5 bottles of water?

Write the rate as a fraction:  $\frac{\$2.58}{2 \text{ bottles}}$

Divide to find the cost per bottle:  $\frac{\$2.58 \div 2}{2 \text{ bottles} \div 2} = \frac{\$1.29}{1 \text{ bottle}}$

Multiply the cost of each bottle by the number of bottles to find the total cost:  $\$1.29 \times 5 = \$6.45$ .

Billy will pay \$6.45 for 5 bottles of water.

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## Objective

To use unit rates to solve real-life problems

## 1 Introduction

Discuss with students how unit rates can help them solve other problems. Brainstorm rates that students might encounter in their lives, e.g., 50 miles in 2 hours or 3 levels of a game completed in 30 minutes. Find the unit rates for these rates and show students how they can use the unit rates to solve other problems, e.g., how far they will travel in 3 hours and how many levels of the game they will complete in 1.5 hours.

**Think About It**

Explain how you know when to multiply and when to divide when using a unit rate to solve rate problems.

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**2 Focused Instruction**

You can find rates in tables and in graphs. Work with a partner to answer the questions below.

► Every summer, the Richards family rents an RV to go on vacation. The graph below shows the miles per gallon of gas the Richards family averaged on their most recent summer vacation.

**RICHARDS FAMILY TRIP**

In Lesson 6, you found rates using tables and graphs.

What does the x-axis represent? the number of gallons

What does the y-axis represent? the number of miles

Look at the point (2, 24). What does the ordered pair represent?  
They used 2 gallons of gas to drive 24 miles.

Write a rate based on the point (2, 24).  $\frac{24 \text{ mi}}{2 \text{ gal}}$

Find the unit rate, in miles per gallon, using the point (2, 24).  
12 mi per gallon

Miles per gallon is often abbreviated as "mpg."

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## Think About It

Students should explain that they multiply when the rate, or the numerator of the fraction, is not known and they divide to find the unit, or the denominator of the fraction.

## PA Core Standard

**CC.2.1.6.D.1** Understand ratio concepts and use ratio reasoning to solve problems.

## Eligible Content

**M06.A-R.1.1.4** Solve unit rate problems including those involving unit pricing and constant speed.

## Vocabulary

**unit rate:** a rate that compares a quantity to one unit; sometimes called "unit price"

**2 Focused Instruction**

First, students must use a graph of a situation to find the unit rate. Then they will answer questions to help them solve problems about the use of gasoline and the amount of travel.

Next, students must translate a rate into a unit rate and calculate distance and time for a train's journey.

Conclude the Focused Instruction section by having students answer two questions based on a grocery store scenario.

**3 Guided Practice**

Students should complete the Guided Practice section on their own. Offer assistance as needed, pointing out the reminder and hint boxes along the right side of the page.

**2 Focused Instruction** Lesson 8

Using the unit rate you found, how many gallons of gas will the Richards family use to travel 450 miles? 37.5

How far can the Richards family travel on 25 gallons? 300 miles

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► A train is traveling at a constant speed. After 7.25 hours, the train has traveled 450 miles.

What rate is described in this problem?  $\frac{450 \text{ mi}}{7.25 \text{ hr}}$

Calculate the unit rate. Round your answer to the nearest whole number. 62 miles per hour

How far will the train travel in 11.5 hours? 713 miles

How long will it take the train to travel 335 miles? Round your answer to the nearest tenth. 5.4 hours

**Use what you know about unit rates to answer these questions.**

A grocery store charges \$2.49 for 3 candy bars.

- At this rate, how many candy bars can be bought for \$13.00? Round your answer to the nearest whole number. 15
- How much will 20 candy bars cost? \$16.60

Should you multiply or divide to find the distance?

Should you multiply or divide to find the time?

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**Connections to Standards for Mathematical Practice**

- Make sense of problems and persevere in solving them.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

**Extension Activity**

Collect some literature from various cellphone companies on different plans. Have students work in groups to find the cost of different plans for different stretches of time or for different parts of the plan. For example, a 2-GB data plan costs \$30 per 30-day month and a 3-GB plan costs \$40 per 30-day month. How much will a person pay in all if he has the 2-GB plan for 6 months and 14 days and then upgrades to the 3-GB plan for 5 months and 16 days?

**3 Guided Practice** Lesson 8

Solve the following problems.

- The Fritjof family puts the same amount of money into a savings account each month. The table below shows their deposits.

Month	4	7	11	15
Amount (\$)	900	1,575	2,475	3,375

**Part A** Use the information in the table to find the amount of money the family deposits each month.

Answer \$ 225

**Part B** At this rate, how much money will the Fritjof family have deposited in their savings account after 32 months?

Answer \$ 7,200

**Part C** How long will it take the family to save \$9,000?

Answer 40 months

- A grocery store charges \$2.29 a pound for chicken. Fill in the missing numbers in the table below.

The unit rate is the cost per pound.

COST OF CHICKEN				
Number of Pounds	2	5	8	12.5
Total Price (\$)	<u>4.58</u>	<u>11.45</u>	18.32	28.63

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**4** Independent Practice

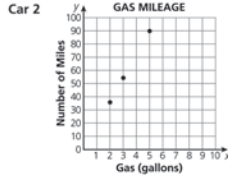
Lesson 8

Solve the following problems.

- 1 Jeanette is shopping for a car. She found three cars that she likes and plans to buy the car that gets the most miles per gallon of gas. The information about the three cars Jeanette likes is shown below. **DOK 2**  
**M06.A-R.1.1.4**

**Car 1**

Gas (gallons)	5	8	11
Miles	105	168	231



**Car 3**  
Great car! I was able to drive 350 miles on 16 gallons of gas! Call 717-555-1234 for more information.

**Part A** Complete the table below to show the number of miles per gallon of gas for each car.

Vehicle	Miles per Gallon
Car 1	21
Car 2	18
Car 3	$21\frac{7}{8}$

**Part B** Based on what Jeanette wants, which car should she buy?

Answer car 3

- 2 A grocery store charges \$3.00 for 4 two-liter bottles of lemonade. Amadou has \$12.00 in his wallet. Since Amadou is having a party, he puts 20 two-liter bottles in his grocery cart. Will Amadou have enough money? Explain how you arrived at your answer. **DOK 3**  
**M06.A-R.1.1.4**

Amadou will not have enough money because \$12 will buy only 16 bottles of lemonade:  
 $\frac{\$3.00}{4 \text{ bottles}} = \frac{\$0.75}{1 \text{ bottle}}; \frac{\$0.75}{1 \text{ bottle}} = \frac{\$12.00}{x \text{ bottles}}; 12 \div 0.75 = 16$

**4** Independent Practice

Lesson 8

- 3 A baseball pitcher can throw a ball 120 feet per second. At this rate, how long would it take the ball to travel 300 feet? **DOK 2**  
**M06.A-R.1.1.4**

- A 2 seconds  
 B 2.5 seconds  
 C 3 seconds  
 D 3.5 seconds

- 4 A bakery makes \$8 for every 5 loaves of bread sold. The bakery makes the same dollar amount for each loaf of bread. At this rate, what dollar amount would the bakery make by selling 30 loaves of bread? **DOK 2**  
**M06.A-R.1.1.4**

- A \$35  
 B \$43  
 C \$48  
 D \$70

- 5 Find the unit rate in each problem to solve for the missing number. Use the numbers in the boxes. Write the number next to the correct statement. **DOK 2**  
**M06.A-R.1.1.4**

2.15    $2\frac{1}{4}$     $4\frac{1}{2}$    12.3

Mr. Howard paid \$99 for 18 feet of chain. At this rate, he will pay \$67.65 for _____ feet of chain.	12.3
Caleb runs 3 miles every 32 minutes. At this rate, Caleb can run _____ miles in 48 minutes.	$4\frac{1}{2}$
A car traveled 70 miles in $1\frac{1}{4}$ hours. At this rate, it will take the car _____ hours to travel 126 miles.	$2\frac{1}{4}$
Xun sold 2 quarts of strawberries for a total of \$8.60. At this rate, it would cost \$_____ for $\frac{1}{2}$ quart of strawberries.	2.15

**4** Independent Practice Answer Rationales

1 **PARTS A AND B** Find the miles per gallon for each car by dividing the miles traveled by the gallons used. For car 1, divide:  $105 \div 5 = 21$  mpg. For car 2, find a point on the graph and divide the y-value by the x-value:  $90 \div 5 = 18$  mpg. For car 3, use the information in the advertisement. The person drove 350 miles on 16 gallons of gas:  $350 \div 16 = 21\frac{7}{8}$  mpg. So car 3 gets the most miles per gallon. Since this is the requirement that Jeanette has set, she should buy car 3.

2 First find the unit price by dividing the cost for 4 bottles by the number of bottles:  $\$3.00 \div 4 \text{ bottles} = \$0.75$  per bottle. Then multiply the unit price by the number of bottles:  $20 \times \$0.75 = \$15.00$ . Since \$15 is greater than \$12, Amadou does not have enough money. Students may also solve by finding the number of bottles Amadou can buy for \$12. Divide:  $\$12 \div \$0.75 = 16$ . He can only buy 16 bottles for \$12.

3 The unit rate is given: 120 feet per second. Divide to find the length of time for a ball to travel 300 feet:  $300 \div 120 = 2.5$  seconds. Choice B is correct.

4 Divide to find the unit price, the cost of one loaf of bread:  $\$8 \div 5 = \$1.60$ . Multiply to find the cost of 30 loaves:  $\$1.60 \times 30 = \$48$ . Choice C is correct.

5 Calculate the unit rate for each situation and use the unit rate to find the missing number. Then match the rate with the numbers given in the box. In the first situation, the unit rate is  $\$99 \div 18 = \$5.50$  per foot, so  $\$67.65 \div \$5.50 = 12.3$  feet. In the second situation, the unit rate is  $32 \text{ minutes} \div 3 \text{ miles} = 10\frac{2}{3} \text{ minutes per mile}$ . Divide:  $48 \text{ minutes} \div 10\frac{2}{3} = 4\frac{1}{2} \text{ miles}$ . In the third situation, the car is traveling  $70 \text{ miles} \div 1\frac{1}{4} \text{ hours} = 56 \text{ miles per hour}$ . So the car will need  $126 \div 56 = 2\frac{1}{4} \text{ hours}$  to travel 126 miles. In the fourth situation, a quart of strawberries costs  $\$8.60 \div 2 = \$4.30$ . So  $\frac{1}{2}$  quart will cost  $\frac{1}{2} \times \$4.30 = \$2.15$ .