**Lesson 4**

**Solve Problems with Unit Rate**

**Name:**

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**Prerequisite: Equivalent Ratios**

Study the example problem showing how to find equivalent ratios. Then solve problems 1–6.

**Example**

Ramon needs 12 oranges to make 3 glasses of juice. How many oranges does he need to make 5 glasses? How many oranges does he need to make 8 glasses?

You can make a table to show ratios of the number of oranges to the number of glasses of juice.

<table>
<thead>
<tr>
<th>Number of Oranges</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Glasses</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

Ramon needs 20 oranges to make 5 glasses of juice. Ramon needs 32 oranges to make 8 glasses of juice.

**B 1** What ratio is given in the problem for the number of oranges to the number of glasses of juice?

12 to 3

**B 2** What is the unit rate? Explain what it means in this situation.

4 oranges are needed for 1 glass of juice.

**M 3** Explain how you can write equivalent ratios.

Possible explanation: I can identify the relationship between the quantities in a given ratio. Then I can multiply or divide the quantities in a given ratio by the same number to find other quantities with the same relationship.

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**Vocabulary**

**equivalent ratios** Two or more ratios that are equal to one another. 24 : 2, 36 : 3, 48 : 4

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**C 5** Students are knitting scarves for a fundraiser. Elaine can knit 4 scarves in 20 days. Mario can knit 2 more scarves than Elaine can in 40 days.

What is the difference in the time it takes each of them to knit a scarf? Explain your answers.

**Show your work.**

**Possible work:**

<table>
<thead>
<tr>
<th>Elaine</th>
<th>Number of Days</th>
<th>5</th>
<th>20</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Days</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Number of Scarves</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Elaine’s unit rate is 20 ÷ 4 = 5. It takes her 5 days to knit 1 scarf. Mario will knit 8 + 2 = 10 scarves in 40 days. So his unit rate is 40 ÷ 10 = 4. It takes Mario 4 days to knit 1 scarf. 5 − 4 = 1, so it takes Elaine 1 more day than Mario to knit a scarf.

**Solution:** It takes Elaine 1 more day than Mario to knit a scarf.

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**M 4** Nathan does push-ups for the same amount of time every day. He does 9 minutes of push-ups in 3 days. How many minutes of push-ups does Nathan do in 7 days? Make a table to show the relationship between the number of minutes and the number of days.

**Show your work.**

**Possible work:**

<table>
<thead>
<tr>
<th>Number of Minutes</th>
<th>24</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>16</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Days</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Solution: Nathan does 21 minutes of push-ups in 7 days.

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**M 5** There are 24 total customers seated at 4 tables in a restaurant. Each table has the same number of customers. Tell whether each statement is True or False.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Multiply 24 by 4 to find the number of customers per table.</td>
<td>☑ True ☒ False</td>
</tr>
<tr>
<td>b.</td>
<td>The unit rate for the number of customers per table is 6.</td>
<td>☒ True ☑ False</td>
</tr>
<tr>
<td>c.</td>
<td>The ratio of customers to tables is 24 : 4.</td>
<td>☑ True ☒ False</td>
</tr>
<tr>
<td>d.</td>
<td>If all the tables are the same size, a maximum of 30 customers can sit at 6 tables.</td>
<td>☒ True ☑ False</td>
</tr>
</tbody>
</table>

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**Key**

<table>
<thead>
<tr>
<th></th>
<th>B Basic</th>
<th>M Medium</th>
<th>C Challenge</th>
</tr>
</thead>
</table>

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Lesson 4

Study the example problem showing how to solve a problem about unit price. Then solve problems 1–7.

Example

All the comic books in a store are the same price. Vera buys 3 comic books for $7.50. How much do 5 comic books cost? How much do 8 comic books cost?

Divide 7.50 by 3 to find the unit price.

7.50 ÷ 3 = 2.50

The price per book is $2.50. You can use the unit price to make a table of equivalent ratios.

<table>
<thead>
<tr>
<th>Cost ($)</th>
<th>2.50</th>
<th>5.00</th>
<th>7.50</th>
<th>10.00</th>
<th>12.50</th>
<th>15.00</th>
<th>17.50</th>
<th>20.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comic Books</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

The cost of 5 comic books is $12.50.

The cost of 8 comic books is $20.00.

**B 1** How can you use multiplication to find the cost of 5 comic books?

Multiply the unit price by 5: $2.50 • 5 = $12.50.

**B 2** How can you use addition to find the cost of 8 comic books?

Possible answer: Add the unit price to the cost of 7 comic books: $17.50 + 2.50 = $20.00.

**M 3** Explain how to find the number of comic books you could buy with $25.00.

Possible explanation: Add $2.50 to the cost of 8 comic books and continue to add $2.50 to the cost until you reach $25.00. Then add the corresponding numbers of books. 8 comic books + 2 comic books = 10 comic books.

You can buy 10 comic books with $25.00.

**Problem Solving**

Solve the following situation to solve problems 4–7.

All of the used hardcover books at a yard sale are the same price. Hugo paid $4.50 for 6 books.

**M 4** Explain how to find the unit price of the books.

Divide $4.50 by 6. The unit price is $0.75.

**M 5** Hugo’s friends bought used books at the yard sale. Sonia paid $2.25, John paid $6.00, and Keisha paid $3.75. How many books did each friend buy?

Show your work.

<table>
<thead>
<tr>
<th>Cost ($)</th>
<th>0.75</th>
<th>1.50</th>
<th>2.25</th>
<th>3.00</th>
<th>3.75</th>
<th>4.50</th>
<th>5.25</th>
<th>6.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Books</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>


**M 6** Kim bought 10 used books at the yard sale. How much did she pay? Did you use addition or multiplication to solve this problem? Why?

$7.50; Possible explanation: I used multiplication. It was faster than extending the table.

**C 7** The price for the used paperback books at the yard sale was $0.25 less than for the hardcover books. How many more paperback books than hardcover books could someone buy with $3.00?

Show your work.

Possible work:

$0.75 − 0.25 = 0.50.

The paperback price is $0.50.

<table>
<thead>
<tr>
<th>Cost ($)</th>
<th>0.50</th>
<th>1.00</th>
<th>1.50</th>
<th>2.00</th>
<th>2.50</th>
<th>3.00</th>
<th>3.50</th>
<th>4.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Books</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

With $3.00, someone could buy 6 paperback books but only 4 hardcover books: 6 − 4 = 2.

Solution: Someone could buy 2 more paperback books than hardcover books with $3.00.
Lesson 4

Constant Speed

Study the example problem showing how to solve a problem about constant speed. Then solve problems 1–7.

Example

Kenja traveled 120 miles in 3 hours on a train. At this speed, how long will it take her to travel 200 miles?

The unit rate for miles per hour is \( \frac{120}{3} = 40 \) miles per hour. Use the unit rate to make a double number line.

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\text{Miles} & 0 & 40 & 80 & 120 & 160 & 200 & 240 & 280 & 320 \\
\text{Hours} & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9
\end{array}
\]

Divide 200 by 40.

\[200 \div 40 = 5\]

It will take Kenja 5 hours to travel 200 miles.

B 1 How many miles could Kenja travel in 1 hour? Is this the same number of hours it takes Kenja to travel 1 mile? Explain your answer.

40; no; Possible explanation: The unit rate for miles per hour is 40. To find out how many hours it takes to travel 1 mile you want the unit rate for hours per mile, which is \( \frac{1}{40} \).

B 2 Explain how to use the unit rate for miles per hour to find how many miles Kenja can travel in 8 hours.

Possible explanation: Multiply 8 by 40. Kenja can drive 320 miles in 8 hours.

B 3 Explain how to use the double number line to find how many hours it will take Kenja to travel 220 miles.

Possible explanation: 220 miles is halfway between 200 and 240 miles. So the number of hours is halfway between 5 and 6, which is 5.5 hours. It will take Kenja 5.5 hours to travel 220 miles.

Solve.

Use the following situation to solve problems 4–6.

Zachary exercises by jogging at a constant speed. During one week, he jogged 36 miles in 6 hours.

M 1 Complete the double number line to show the relationship between the number of miles and the hours that Zachary jogs.

M 2 Explain how you found the number of hours it takes Zachary to jog 18 miles.

Possible explanation: First I found that Zachary jogs at a speed of 6 miles per hour.

Then I divided 18 by that unit rate to find that it takes 3 hours for him to jog 18 miles.

M 3 How many miles does Zachary jog in 4.5 hours? Explain how to use the double number line to find the answer.

27 miles; Possible explanation: 4.5 hours is halfway between 4 and 5 hours. So the number of miles is halfway between 24 and 30, which is 27.

C 7 Alyssa and Caleb both drove 210 miles to the beach in separate cars. They left at the same time. They both drove at a constant speed. Alyssa drove 105 miles in 3.5 hours. Caleb drove 168 miles in 4 hours. Who arrived earlier? How much earlier?

Show your work.

Possible work:

Alyssa’s unit rate is \( \frac{105}{3.5} = 30 \) miles per hour. Caleb’s unit rate is \( \frac{168}{4} = 42 \) miles per hour.

Alyssa: \( \frac{210}{30} = 7 \) hours
Caleb: \( \frac{210}{42} = 5 \) hours
7 – 5 = 2 hours

Solution: Caleb arrived 2 hours before Alyssa.
Converting Measurement Units

Study the example problem showing how to solve a problem involving conversion of measurement units. Then solve problems 1–6.

Example
Hannah needs 78 inches of ribbon to make a picture frame. She knows that there are 60 inches in 5 feet. How many feet of ribbon are in 78 inches?

You can find the unit rate and make a double number line. There are 60 inches in 5 feet, so there are 60 ÷ 5 = 12 inches in 1 foot. The unit rate is 12.

![Double number line diagram]

Because the number of inches, 78, is halfway between 72 and 84, the number of feet must be halfway between 6 and 7 feet. There are 6 ½ feet of ribbon in 78 inches.

B 1 Explain how to use the unit rate without the number lines to find how many feet of ribbon are in 48 inches.

Possible explanation: Divide 48 inches by 12 inches per foot.

B 2 How many inches of ribbon are in 3 feet? Explain how to find the answer without using the number lines.

36 inches; Possible explanation: Multiply 3 feet by 12 inches per foot.

B 3 What is the difference between using the unit rate to find how many feet are in a given number of inches and using the unit rate to find how many inches are in a given number of feet?

Possible answer: To find how many feet are in a given number of inches, you divide by 12. To find how many inches are in a given number of feet, you multiply by 12.

Solve.
Use the following situation to solve problems 4–5.

Antonio measures items in his pocket. He knows there are 50 millimeters in 5 centimeters. His key chain is 3.5 centimeters long. His library card is 80 millimeters long.

M 4 How many centimeters long is his library card? Explain how to use the unit rate to find the answer.

8 centimeters; Possible explanation: There are 10 millimeters in each centimeter, so the unit rate is 10. Divide 80 by the unit rate, 10, to get 8 centimeters.

M 5 How many millimeters long is his key chain? Draw a double number line to find the answer.

Show your work.

Possible work:

<table>
<thead>
<tr>
<th>Centimeters</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millimeters</td>
<td>0</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

Solution: Antonio’s key chain is 35 millimeters long.

C 6 Claire is measuring ingredients for recipes. She knows that there are 12 cups in 6 pints. She also knows that 4 quarts equals 16 cups. Which has more cups, 5 pints or 3 quarts? How many more cups?

Show your work.

Possible work:

The unit rate of cups to pints is 2. The unit rate of cups to quarts is 4.

5 pints • 2 cups per pint = 10 cups
3 quarts • 4 cups per quart = 12 cups
12 − 10 = 2

Solution: There are 2 more cups in 3 quarts than in 5 pints.
Solve the problems.

1. The double number line shows the relationship between the number of minutes and the number of pages that a printer prints. How many pages does the printer print in 4 1/2 minutes?

2. A carpenter uses 65 shelves to make 13 bookcases. She uses the same number of shelves for each bookcase. Are 32 shelves enough to build 6 more bookcases?

3. The price of 6 pretzels is $5.10. Simon and Sofia bought 8 pretzels and shared the cost equally. How much did each person pay?

4. Michael drove 350 miles in 7 hours at a constant speed. Tell whether each statement is True or False.
   a. The unit rate for miles to hours is 50.  
   b. Michael drove 250 miles in 4 hours. 
   c. To find the number of miles Michael drove in 3 hours, multiply by 3 by 50.  
   d. To find the number of hours it took Michael to drive 300 miles, divide 300 by 50.

5. Jorge says there are 198 inches in 5.5 yards. Is he correct? Explain your answer.

6. At Teen Tops, a package of 5 T-shirts costs $38. At Bargain City, a package of 4 T-shirts costs $34. Which statement is the most accurate?
   A. Bargain City is the better buy because it sells T-shirts at $8.50 per T-shirt.
   B. Teen Tops is the better buy because the package has more T-shirts.
   C. Bargain City is the better buy because $34 is less than $38.
   D. Teen Tops is the better buy because it sells T-shirts at $7.60 per T-shirt.