1. Express the relationship between the number of prints she made and the total cost for each situation as a rate in fraction form.

$\frac{10 \text{ prints}}{\$2}$ and $\frac{30 \text{ prints}}{\$6}$

2. Compare the relationship between the numerators of each rate in Exercise 1. Compare the relationship between the denominators of these rates.

Sample answer: The numerator in the second rate is 3 times the numerator in the first rate. The denominator in the second rate is 3 times the denominator in the first rate.

3. What is the unit rate for 10 prints? $\frac{10 \text{ prints}}{\$2} \div \frac{2}{2} = \frac{5 \text{ prints}}{\$1}$

4. What is the unit rate for 30 prints? $\frac{30 \text{ prints}}{\$6} \div \frac{6}{6} = \frac{5 \text{ prints}}{\$1}$

5. Are the rates in Exercise 1 equivalent? Explain.

Yes; Sample answer: They have the same unit rate of 5 prints for $1.

Which MP Mathemat

**Unit Rates**

The unit rate in Example 2, $\frac{\$7}{1\text{ T-shirt}}$, is called the unit price since it gives the cost per unit.

a. No; Since the unit rates $\frac{12\text{ T-shirts}}{1\text{ box}}$ and $\frac{10\text{ T-shirts}}{1\text{ box}}$ are not the same, the rates are not equivalent.

Show your work.

b. Yes; Since both unit rates are, $\frac{6\text{ flowers}}{1\text{ vase}}$, the rates are equivalent.

÷5 ÷9

Since the rates do not have the same unit rate, they are not equivalent.

**2.** **3 T-shirts for $21; 5 T-shirts for $35**

$$\frac{\$21}{3\text{ T-shirts}} \overset{\div 3}{=} \frac{\$7}{1\text{ T-shirt}} \qquad \frac{\$35}{5\text{ T-shirts}} \overset{\div 5}{=} \frac{\$7}{1\text{ T-shirt}}$$

Since the rates have the same unit rate, they are equivalent.

**Got it?** **Do these problems to find out.**

**Determine if each pair of rates is equivalent. Explain your reasoning.**

**a.** 36 T-shirts in 3 boxes; 60 T-shirts in 6 boxes

**b.** 42 flowers in 7 vases; 54 flowers in 9 vases

**3.** **Felisa read the first 60 pages of a book in 3 days. She read the last 90 pages in 6 days. Are these reading rates equivalent? Explain your reasoning.**

$$\frac{60 \text{ pages}}{3 \text{ days}} \overset{\div 3}{=} \frac{20 \text{ pages}}{1 \text{ day}} \qquad \frac{90 \text{ pages}}{6 \text{ days}} \overset{\div 6}{=} \frac{15 \text{ pages}}{1 \text{ day}}$$

Since the rates do not have the same unit rate, they are not equivalent. So, Felisa's reading rates are not equivalent.

**Got it?** **Do these problems to find out.**

**c.** Marcia made 10 bracelets for 5 friends. Jen made 12 bracelets for 4 friends. Are these rates equivalent? Explain your reasoning.

**d.** Club A raised $168 by washing 42 cars. Club B raised $152 by washing 38 cars. Are these fundraising rates equivalent? Explain your reasoning.

**Proportion**

A proportion is an equation stating that two ratios or rates are equivalent.

c. No; Since the unit rates, $\frac{2 \text{ bracelets}}{1 \text{ friend}}$ and $\frac{3 \text{ bracelets}}{1 \text{ friend}}$, are not the same, the rates are not equivalent.

Show your work.

d. Yes; Since the unit rates are the same, $\frac{\$4}{1 \text{ car}}$, the rates are equivalent.

Use Equivalent Fractions

**Got it?** Do this problem to find out.

e. Mrs. Jeffries has 12 girls out of 16 students on the Student Council. The Earth Day Committee has 4 girls out of 8 students. Are the ratios equivalent? Explain your reasoning.

Show your work.

e. No; since $\frac{12 \text{ girls}}{16 \text{ students}} \neq \frac{4 \text{ girls}}{8 \text{ students}}$, the ratios are not equivalent.

## Guided Practice

Check

**Determine if each pair of ratios or rates is equivalent. Explain your reasoning.**

1. $24 saved after 3 weeks; $52 saved after 7 weeks (Examples 1 and 2)

Show your work.

No; Since the unit rates, $\frac{\$8}{1 \text{ week}}$ and $\frac{\$7.43}{1 \text{ week}}$, are not the same, the rates are not equivalent.

2. 270 Calories in 3 servings; 450 Calories in 5 servings (Examples 1 and 2)

Yes; Since the unit rates are the same, $\frac{90 \text{ Calories}}{1 \text{ serving}}$, the rates are equivalent; $\frac{270 \text{ Calories}}{3 \text{ servings}} = \frac{450 \text{ Calories}}{5 \text{ servings}}$.

3. Micah can do 75 push-ups in 3 minutes. Eduardo can do 130 push-ups in 5 minutes. Are these rates equivalent? Explain. (Example 3)

No; Micah's unit rate is $\frac{25 \text{ push-ups}}{1 \text{ minute}}$ and Eduardo's unit rate is $\frac{26 \text{ push-ups}}{1 \text{ minute}}$.

4. A human adult takes about 16 breaths/ ... ready to move on?

**Rate Yourself!**

equivalent.

$\frac{270 \text{ Calories}}{3 \text{ servings}} = \frac{450 \text{ Calories}}{5 \text{ servings}}$.

**3.** Micah can do 75 push-ups in 3 minutes. Eduardo can do 130 push-ups in 5 minutes. Are these rates equivalent? Explain. (Example 3) No; Micah's unit rate is $\frac{25 \text{ push-ups}}{1 \text{ minute}}$ and Eduardo's unit rate is $\frac{26 \text{ push-ups}}{1 \text{ minute}}$.

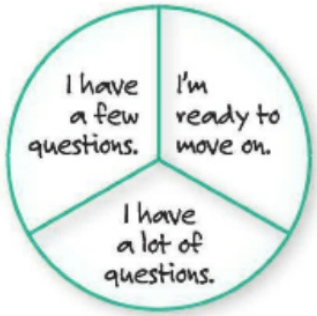
**4.** A human adult takes about 16 breaths in 60 seconds. A puppy takes about 8 breaths in 15 seconds. Are these rates equivalent? Explain your reasoning. (Examples 4 and 5) No; Since $\frac{16 \text{ breaths}}{60 \text{ seconds}} \neq \frac{8 \text{ breaths}}{15 \text{ seconds}}$, the rates are not equivalent.

**5.** **Building on the Essential Question** How can you determine if two ratios are equivalent?

Sample answer: You can find the unit rate of each ratio and compare them.

## Rate Yourself!

Are you ready to move on? Shade the section that applies.




For more help, go online to access a Personal Tutor. Tutor

FOLDABLES Time to update your Foldable!

# Independent Practice

Go online for Step-by-Step Solutions

eHelp

**Determine if each pair of ratios or rates is equivalent. Explain your reasoning.** (Examples 1–2, 4–5)

**1** $3 for 6 bagels; $9 for 24 bagels

No; Since the unit rates, $\frac{\$0.50}{1 \text{ bagel}}$ and $\frac{\$0.38}{1 \text{ bagel}}$, are not the same, the rates are not equivalent.

**2.** $12 for 3 paperback books; $28 for 7 paperback books

Yes; Since the unit rates are the same, $\frac{\$4}{1 \text{ book}}$, the rates are equivalent; $\frac{\$12}{3 \text{ books}} = \frac{\$28}{7 \text{ books}}$.

**3** 3 hours worked for $12; 9 hours worked for $36

Yes; Since $\frac{3 \text{ h} \times 3}{\$12 \times 3} = \frac{9 \text{ h}}{\$36}$, the fractions are equivalent; $\frac{3 \text{ h}}{\$12} = \frac{9 \text{ h}}{\$36}$.

**4.** 12 minutes to drive 30 laps; 48 minutes to drive 120 laps

Yes; Since $\frac{12 \text{ min} \times 4}{30 \text{ laps} \times 4} = \frac{48 \text{ min}}{120 \text{ laps}}$, the fractions are equivalent; $\frac{12 \text{ min}}{30 \text{ laps}} = \frac{48 \text{ min}}{120 \text{ laps}}$.

**5.** Jenny is comparing the cos[illegible] package has

Yes; Since $\frac{3\text{ h} \times 3}{\$12 \times 3} = \frac{9\text{ h}}{\$36}$, the fractions are equivalent; $\frac{3\text{ h}}{\$12} = \frac{9\text{ h}}{\$36}$.

**4.** 12 minutes to drive 30 laps; 48 minutes to drive 120 laps

Yes; Since $\frac{12\text{ min} \times 4}{30\text{ laps} \times 4} = \frac{48\text{ min}}{120\text{ laps}}$, the fractions are equivalent; $\frac{12\text{ min}}{30\text{ laps}} = \frac{48\text{ min}}{120\text{ laps}}$.

**5.** Jenny is comparing the cost of two packages of socks. One package has 8 pairs of socks for $12. Another package has 3 pairs of socks for $6. Are the rates equivalent? Explain your reasoning.

No; Sample answer: since $\frac{8\text{ pairs}}{\$12} \neq \frac{3\text{ pairs}}{\$6}$, the ratios are not equivalent.

**6.** Jade enlarged the photograph at the right to a poster. The size of the poster is 60 inches by 100 inches. Is the ratio of the poster's length and width equivalent to the ratio of the photograph's length and width? Explain your reasoning. (Example 3)

Yes; The length to width ratio for the photograph and poster form equivalent fractions.


Jeremy Hoare/Life File/Getty Images

**7** MP **Justify Conclusions** inutes to do

Are the rates equivalent? Explain your reasoning.

No; Sample answer: since $\frac{8 \text{ pairs}}{\$12} \neq \frac{3 \text{ pairs}}{\$6}$, the ratios are not equivalent.

**6.** Jade enlarged the photograph at the right to a poster. The size of the poster is 60 inches by 100 inches. Is the ratio of the poster's length and width equivalent to the ratio of the photograph's length and width? Explain your reasoning. (Example 3)


Yes; The length to width ratio for the photograph and poster form equivalent fractions.

**7** MP **Justify Conclusions** On a math test, it took Kiera 30 minutes to do 6 problems. Heath finished 18 problems in 40 minutes. Did the students work at the same rate? Explain your reasoning.

No; Sample answer: Kiera did $\frac{6 \text{ problems}}{30 \text{ minutes}}$ or $\frac{1 \text{ problem}}{5 \text{ minutes}}$, and Heath did $\frac{18 \text{ problems}}{40 \text{ minutes}}$ or $\frac{9 \text{ problems}}{20 \text{ minutes}}$. So, the ratios are not equivalent.

**8.** MP **Be Precise** Refer to the graphic novel frame below for Exercises a–b.


**a.** What is the unit price for the cans of lemonade at each of the stores?

**Super Saver: $0.21 per can; Shop Smart: $0.19 per can;**

**Price Busters: $0.25 per can**

**b.** From which store should Mei, Pilar, and David purchase the cans of lemonade? Explain.

**They should purchase the cans of lemonade from Shop Smart. At Shop Smart, the cost per can is the least.**

## H.O.T. Problems Higher Order Thinking

9. MP **Which One Doesn't Belong?** Identify the rate that does not belong with the other three. Justify your response.

| 4.5 feet per second | 112.5 feet in 25 seconds | 86.4 feet in 18 seconds | 54 feet in 12 seconds |
|---|---|---|---|

**86.4 feet in 18 seconds; Sample answer: The other three are equivalent rates.**

10. MP **Identify Structure** Write two ratios that are equivalent to $\frac{5}{7}$.
**Sample answers: $\frac{10}{14}$ and $\frac{15}{21}$**

11. MP **Persevere with Problems** The ratio of girls to boys in the junior high band is 5 to 7. At the beginning of the year, there were 72 students in the band. By the end of the year, the ratio of girls to boys was 3 to 4. If there are now 48 boys in the band, how many girls joined the band during the school year? **6 girls**