Lesson 50 • Unit Multipliers and Unit Conversion

Power Up

- ***Facts***
- ***Mental Math***
- ***Problem Solving***

New Concepts

- ***Examples***
- ***Practice Set***

Facts Find the number that completes each proportion.

$\frac{3}{4} = \frac{a}{12}$ $a = 9$	$\frac{3}{4} = \frac{12}{b}$ $b = 16$	$\frac{c}{5} = \frac{12}{20}$ $c = 3$	$\frac{2}{d} = \frac{12}{24}$ $d = 4$	$\frac{8}{12} = \frac{4}{e}$ $e = 6$
$\frac{f}{10} = \frac{10}{5}$ $f = 20$	$\frac{5}{g} = \frac{25}{100}$ $g = 20$	$\frac{10}{100} = \frac{5}{h}$ $h = 50$	$\frac{8}{4} = \frac{j}{16}$ $j = 32$	$\frac{24}{k} = \frac{8}{6}$ $k = 18$
$\frac{9}{12} = \frac{36}{m}$ $m = 48$	$\frac{50}{100} = \frac{w}{30}$ $w = 15$	$\frac{3}{9} = \frac{5}{p}$ $p = 15$	$\frac{q}{60} = \frac{15}{20}$ $q = 45$	$\frac{2}{5} = \frac{r}{100}$ $r = 40$

problem solving

Alan wanted to form a triangle out of straws that were 5 cm, 7 cm, and 12 cm long. He threaded a piece of string through the three straws, pulled the string tight, and tied it. What was the area of the triangle formed by the three straws?

Example 1

Write two unit multipliers for these equivalent measures:

$$3 \text{ ft} = 1 \text{ yd}$$

Solution

We write one measure as the numerator and its equivalent as the denominator.

$$\frac{3 \text{ ft}}{1 \text{ yd}}$$

Example 2

Select unit multipliers from example 1 to convert

a. 240 yards to feet.

b. 240 feet to yards.

Solution

a. We are given a measure in yards. We want the answer in feet. So we write the following:

$$240 \text{ yd} \cdot \boxed{\begin{array}{c}\text{Unit} \\ \text{multiplier}\end{array}} = \quad \text{ft}$$

Solution *continued*

We know our answer is reasonable because feet are shorter units than yards, and therefore it takes more feet than yards to measure the same distance.

b. We are given the measure in feet, and we want the answer in yards. We choose the unit multiplier that has a numerator of yd.

$$240 \text{ ft} \cdot \frac{1 \text{ yd}}{3 \text{ ft}} =$$

Example 3

An Olympic event in track and field is the 100 meter dash. One hundred meters is about how many yards? (1 m ≈ 1.1 yd)

Solution

We can use unit multipliers to convert between the metric system and the U.S. Customary System.

$$100 \cancel{\text{m}} \cdot \frac{1.1 \text{ yd}}{1 \cancel{\text{m}}} \approx \square$$

Example 4

Tim can sprint 9 yards per second. Convert this rate to feet per second.

Solution

We write the rate as a ratio.

$$\frac{9 \text{ yd}}{1 \text{ sec}}$$

To convert yards to feet we multiply by a unit multiplier that has yards and feet and that cancels yards. Three feet equals 1 yard.

Practice Set

Write two unit multipliers for each pair of equivalent measures:

a. 1 yd = 36 in.

b. 100 cm = 1 m

c. 16 oz = 1 lb

Use unit multipliers to answer problems **d–f.**

d. Convert 10 yards to inches.

e. Twenty-four feet is how many yards (1 yd = 3 ft)?

f. *Conclude* Which is greater 20 inches or 50 centimeters (1 in. = 2.54 cm)?

20 in. ◯ 50 cm

Connect Use unit multipliers to convert the rates in **g** and **h.**

g. Convert 20 miles per gallon to miles per quart (1 gal = 4 qt).

h. When sleeping Diana's heart beats 60 times per minute. Convert 60 beats per minute to beats per hour.

Solutions

2. a. $\frac{\text{parts with 1}}{\text{total parts}} = \frac{4}{10} = \frac{2}{5}$

b. $\frac{3}{5} \times 100\% = \frac{300\%}{5} = \mathbf{60\%}$

c. $P(\text{number} > 2) = \frac{\text{numbers} > 2}{\text{total}}$

$= \frac{3}{10} = \mathbf{0.3}$

3. $\frac{\$1.44}{18 \text{ ounces}} = \frac{\$0.08}{1 \text{ ounce}}$

8¢ per ounce

4. $\frac{20 \text{ miles}}{2.5 \text{ hours}} = \mathbf{8 \frac{miles}{hour}}$

5. First hour costs \$2, 50¢ for each additional half hour or part thereof 3 hours 20 minutes 2 + hour = 2 hours 20 minutes → 5 half hours

$\$2 + \$0.50(5)$

$= \$2 + \$2.50 = \mathbf{\$4.50}$

6. $\frac{1 \text{ mile}}{\cancel{6} \text{ minutes}_{1}} \times \frac{\overset{10}{\cancel{60} \text{ minutes}}}{1 \text{ hour}} =$

10 miles per hour

7. a. $2(6 \text{ members})$

$= \mathbf{12 \text{ members}}$

b. $\frac{3}{5} \times 100\% = \frac{300\%}{5} = \mathbf{60\%}$

8. **B. 40%**

9. $6\overline{)5.0000\ldots}$ **3.8333**

48
20
18
20
18
20
18
2

10. $7{,}500{,}000$

$= 7{,}000{,}000 + 500{,}000$

$= \mathbf{(7 \times 10^6) + (5 \times 10^5)}$

11. a. $0.6 \times 100\% = \mathbf{60\%}$

b. $\frac{1}{6} \times 100\% = \frac{100\%}{6}$

$= \mathbf{16 \frac{2}{3}\%}$

c. $1\frac{1}{2} \times 100\% = \frac{3}{2} \times 100\%$

$= \frac{300\%}{2} = \mathbf{150\%}$

12. a. $30\% = \frac{30}{100} = \mathbf{\frac{3}{10}}$

b. $10\overline{)3.0}$ **0.3**

30
0

c. $250\% = \frac{250}{100} = \frac{25}{10} = \frac{5}{2} = \mathbf{2\frac{1}{2}}$

d. $250\% = 2\frac{1}{2} = \mathbf{2.5}$

e. **5 or $\frac{5}{1}$**

f. $5 \times 100\% = \mathbf{500\%}$

13. **97**

14. a. $\text{Area} = (8 \text{ cm})(12 \text{ cm})$

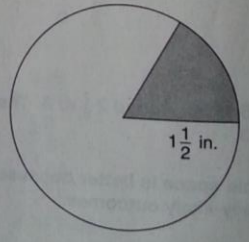
$= \mathbf{96 \text{ cm}^2}$

b. $\text{Area} = \frac{(6 \text{ cm})(8 \text{ cm})}{2} = \mathbf{24 \text{ cm}^2}$

c. $\text{Area} = 96 \text{ cm}^2 + 24 \text{ cm}^2$

$= \mathbf{120 \text{ cm}^2}$

15.



16. $\frac{10}{x} = \frac{7}{42}$

$7x = 10 \cdot 42$

$x = \frac{420}{7}$

$x = 60$

17. $\frac{1.5}{1} = \frac{w}{4}$

$1w = (1.5)4$

$w = \frac{6}{1}$

$w = 6$

18. $5.\overset{5}{\cancel{6}}\overset{1}{0}$

$-\ 3.5\ 6$

$2.0\ 4$

$y = 2.04$

19. $\frac{3}{20} = \frac{9}{60}$

$-\ \frac{1}{15} = \frac{4}{60}$

$\frac{5}{60} = \frac{1}{12}$

$w = \frac{1}{12}$

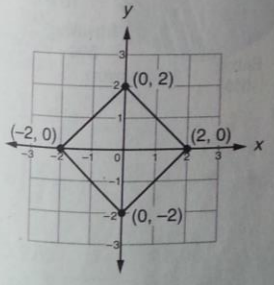
20. a. Distributive property

b. Commutative property of addition

c. Identity property of multiplication

21. B. 10^4

22.



a. (0, 2)

b. Area $= 4(1 \text{ sq. units}) + 8\left(\frac{1}{2} \text{ sq. units}\right)$

$= 4 \text{ sq. units} + 4 \text{ sq. units}$

$= 8 \text{ sq. units}$

23. $4\overline{)10}$ $2\frac{1}{2}$ muffins

$\frac{8}{2}$

24. a. $20 - 6 = 14$

b. 15

c. See student work.

25. $\frac{10 \text{ mm}}{1 \text{ cm}}, \frac{1 \text{ cm}}{10 \text{ mm}}$

$\overset{16}{\cancel{160 \text{ mm}}} \cdot \frac{1 \text{ cm}}{\underset{1}{\cancel{10 \text{ mm}}}} = 16 \text{ cm}$

26.

	4 yd	2 ft	7 in.
+	3 yd		5 in.
	7 yd	2 ft	12 in.

12 in. = 1 ft, 1 ft + 2 ft = 3 ft

3 ft = 1 yd, 7 yd + 1 yd = 8 yd

27. $1\frac{3}{4} \div 2\frac{1}{3} = \frac{7}{4} \div \frac{7}{3}$

$= \frac{\overset{1}{7}}{4} \times \frac{3}{\underset{1}{7}} = \frac{3}{4}$

$5\frac{1}{6} = 5\frac{2}{12} \longrightarrow 4\frac{14}{12}$

$-\ \frac{3}{4} = \frac{9}{12} \qquad -\ \frac{9}{12}$

$4\frac{5}{12}$

28. $3\frac{1}{8} \cdot 2\frac{2}{5} = \frac{\overset{5}{\cancel{25}}}{\underset{2}{8}} \cdot \frac{\overset{3}{\cancel{12}}}{\underset{1}{5}} = \frac{15}{2}$

$3\frac{5}{7} = 3\frac{10}{14}$

$+\ \frac{15}{2} = \frac{105}{14}$

$3\frac{115}{14} = 11\frac{3}{14}$

29. a. $m\angle BAC = m\angle CDB = 60°$

b. $m\angle BCA = 180° - (70° + 60°)$

$= 180° - 130° = 50°$

c. $m\angle CBD = m\angle BCA = 50°$

Solutions

30. a. $4(5 - 3)$ or $4(5 - 3)$

$4(2)$ $\quad 20 - 12$

$8 \quad 8$

b. Yes

c. Distributive property

Early Finishers Solutions

a. $\$31.50 \times 0.08 = \$2.52$

b. $\$31.50 + \$2.52 = \$34.02$

$\frac{\$34.02}{2} = \$17.01$