

Convert Measurement Units



Real-World Link



Animals The table shows the approximate weights in tons of several large land animals. One ton is equivalent to 2,000 pounds. You can use a ratio table to convert each weight from tons to pounds.

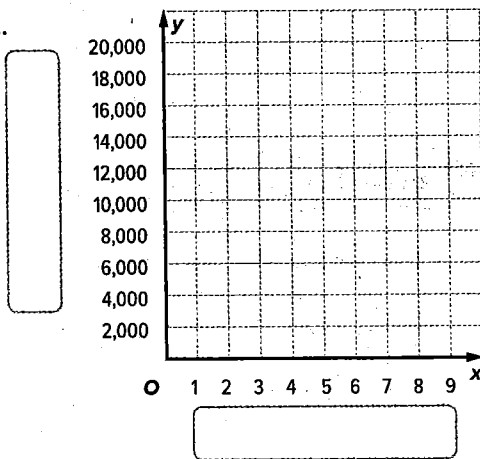
| Animal | Weight (T) |
|------------------|------------|
| Grizzly bear | 1 |
| White rhinoceros | 4 |
| Hippopotamus | 5 |
| African elephant | 8 |

- Complete the ratio table. The first two ratios are done for you. To produce equivalent ratios, multiply the quantities in each row by the same number.

| Tons | 1 | 4 | 5 | 8 |
|--------|-------|-------|---|---|
| Pounds | 2,000 | 8,000 | | |

- Use the coordinate plane shown.

- Graph the ordered pairs (tons, pounds) from the table on the coordinate plane.
- Label the horizontal axis *Weight in Tons*.
- Label the vertical axis *Weight in Pounds*.
- Connect the points and describe the graph.



Essential Question

WHAT does it mean to multiply and divide fractions?

Vocab



Vocabulary

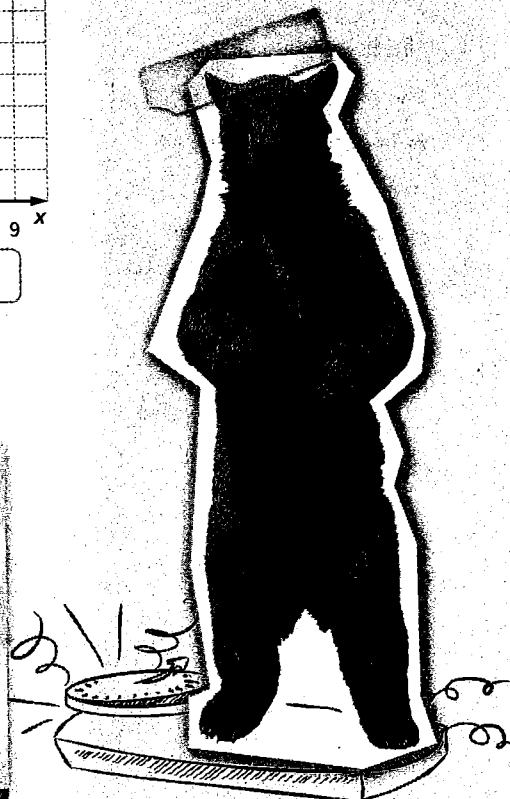
unit ratio
dimensional analysis



Common Core State Standards

Content Standards
6.RP.3, 6.RP.3d

MP Mathematical Practices
1, 3, 4, 6



Which **MP** Mathematical Practices did you use?

Shade the circle(s) that applies.

- | | |
|--|---|
| <input type="checkbox"/> 1 Persevere with Problems | <input type="checkbox"/> 5 Use Math Tools |
| <input type="checkbox"/> 2 Reason Abstractly | <input type="checkbox"/> 6 Attend to Precision |
| <input type="checkbox"/> 3 Construct an Argument | <input type="checkbox"/> 7 Make Use of Structure |
| <input type="checkbox"/> 4 Model with Mathematics | <input type="checkbox"/> 8 Use Repeated Reasoning |

Convert Larger Units to Smaller Units

Each relationship in the table can be written as a ratio. For example, you know that 1 yard = 3 feet. You can use the ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ to convert from yards to feet.

| Type of Measure | Larger Unit | → | Smaller Unit |
|-----------------|----------------|---|------------------------|
| Length | 1 foot (ft) | = | 12 inches (in.) |
| | 1 yard (yd) | = | 3 feet |
| | 1 mile (mi) | = | 5,280 feet |
| Weight | 1 pound (lb) | = | 16 ounces (oz) |
| | 1 ton (T) | = | 2,000 pounds |
| Capacity | 1 cup (c) | = | 8 fluid ounces (fl oz) |
| | 1 pint (pt) | = | 2 cups |
| | 1 quart (qt) | = | 2 pints |
| | 1 gallon (gal) | = | 4 quarts |

Like a unit rate, a **unit ratio** is one in which the denominator is 1 unit. So, the ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ is a unit ratio.

Dimensional analysis is the process of including units of measurement as factors when you compute.

Multiplying by 1

The ratio $\frac{3 \text{ ft}}{1 \text{ yd}}$ is equivalent to 1 because the numerator and the denominator represent the same amount.

Show your work.

a. _____

b. _____

c. _____

Example



1. Convert 20 feet to inches.

Since 1 foot = 12 inches, the unit ratio is $\frac{12 \text{ in.}}{1 \text{ ft}}$.

$$\begin{aligned}
 20 \text{ ft} &= 20 \text{ ft} \times \frac{12 \text{ in.}}{1 \text{ ft}} && \text{Multiply by } \frac{12 \text{ in.}}{1 \text{ ft}} \\
 &= 20 \cancel{\text{ft}} \times \frac{12 \text{ in.}}{1 \cancel{\text{ft}}} && \text{Divide out common units, leaving the desired unit, inches.} \\
 &= 20 \times 12 \text{ in.} && \text{Multiply.} \\
 &= 240 \text{ in.}
 \end{aligned}$$

So, 20 feet = 240 inches.

Got it? Do these problems to find out.

Complete.

a. 36 yd = ■ ft

b. $\frac{3}{4}$ T = ■ lb

c. $1\frac{1}{2}$ qt = ■ pt



Example



2. Marco mixes $\frac{1}{4}$ cup of fertilizer with soil before planting each bulb. How many fluid ounces of fertilizer does he use per bulb?

$$\begin{aligned} \frac{1}{4} \text{ c} &= \frac{1}{4} \cancel{\text{c}} \times \frac{8 \text{ fl oz}}{1 \cancel{\text{c}}} && \text{Since } 1 \text{ cup} = 8 \text{ fluid ounces, multiply by } \frac{8 \text{ fl oz}}{1 \text{ c}}. \\ &= \frac{1}{4} \times 8 \text{ fl oz} && \text{Then, divide out common units.} \\ &= 2 \text{ fl oz} && \text{Multiply.} \end{aligned}$$

So, 2 fluid ounces of fertilizer are used per bulb.

Got it? Do this problem to find out.

d. Jen runs $\frac{1}{8}$ of a mile before tennis practice. How many feet does she run before practice?

Show your work.

d.

Convert Smaller Units to Larger Units

Remember that the ratios $\frac{1 \text{ yd}}{3 \text{ ft}}$ and $\frac{3 \text{ ft}}{1 \text{ yd}}$ are equivalent. To convert from smaller units to larger units, choose the ratio that allows you to divide out the common units.

Example: $12 \text{ ft} \times \frac{1 \text{ yd}}{3 \text{ ft}} \checkmark$

~~$12 \text{ ft} \times \frac{3 \text{ ft}}{1 \text{ yd}}$~~

Example



3. Convert 15 quarts to gallons.

Since 1 gallon = 4 quarts, and quarts are smaller units than gallons, use the ratio $\frac{1 \text{ gal}}{4 \text{ qt}}$.

$$\begin{aligned} 15 \text{ qt} &= 15 \text{ qt} \times \frac{1 \text{ gal}}{4 \text{ qt}} && \text{Multiply by } \frac{1 \text{ gal}}{4 \text{ qt}}. \\ &= 15 \cancel{\text{qt}} \times \frac{1 \text{ gal}}{4 \cancel{\text{qt}}} && \text{Divide out common units, leaving the desired unit, gallons.} \\ &= 15 \times \frac{1}{4} \text{ gal} && \text{Multiplying 15 by } \frac{1}{4} \text{ is the same as dividing 15 by 4.} \\ &= 3.75 \text{ gal} \end{aligned}$$

Got it? Do these problems to find out.

e. 2,640 ft = mi

f. 100 oz = lb

g. 3 c = pt

e.

f.

g.



4. Umeka needs $4\frac{1}{2}$ feet of fabric to make a costume for a play. How many yards of fabric does she need?

$$4\frac{1}{2} \text{ ft} = 4\frac{1}{2} \cancel{\text{ft}} \times \frac{1 \text{ yd}}{3 \cancel{\text{ft}}}$$

Since 1 yard = 3 feet, multiply by $\frac{1 \text{ yd}}{3 \text{ ft}}$.
Then, divide out common units.

$$= \frac{3}{2} \times \frac{1}{3} \text{ yd}$$

Write $4\frac{1}{2}$ as an improper fraction.
Then divide out common factors.

$$= \frac{3}{2} \text{ yd or } 1\frac{1}{2} \text{ yd}$$

Multiply.

So, Umeka needs $1\frac{1}{2}$ yards of fabric.

Guided Practice



Complete. (Examples 1 and 3)

1. $5\frac{1}{3} \text{ yd} = \underline{\hspace{2cm}} \text{ ft}$

2. $4\frac{1}{2} \text{ pt} = \underline{\hspace{2cm}} \text{ c}$

3. $12 \text{ qt} = \underline{\hspace{2cm}} \text{ gal}$

4. $28 \text{ in.} = \underline{\hspace{2cm}} \text{ ft}$

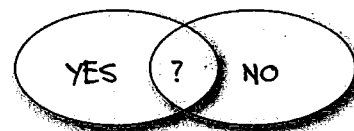
Show your work. →

5. A large grouper can weigh $\frac{1}{3}$ ton. How much does a large grouper weigh to the nearest pound? (Example 2) _____
6. The world's narrowest electric vehicle is about 35 inches wide. How wide is this vehicle to the nearest foot? (Example 4) _____

7. **Building on the Essential Question** How can you use ratios to convert units of measurement?

Rate Yourself!

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



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



Independent Practice

Go online for Step-by-Step Solutions



Complete. (Examples 1 and 3)

1. 18 ft = _____ yd

Show your work.

2. 2 lb = _____ oz

3. 6.5 c = _____ fl oz

4. 2 mi = _____ ft

5. 5,000 lb = _____ T

6. $2\frac{3}{4}$ qt = _____ pt

7. One of the largest pumpkins ever grown weighed about $\frac{3}{4}$ ton. How many pounds did the pumpkin weigh? (Example 2)

Show your work.

8. A 40-foot power boat is for sale by owner. How long is the boat to the nearest yard? (Example 4)

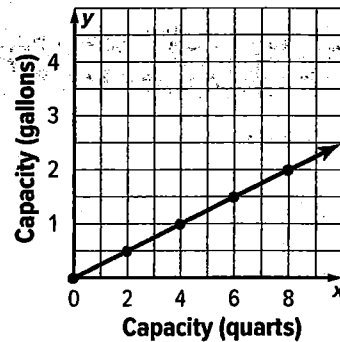
9. A 3-pound pork loin can be cut into 10 pork chops of equal weight. How many ounces is each pork chop? _____

10. **MP Model with Mathematics** Will a 2-quart pitcher hold the entire recipe of citrus punch given at the right? Explain your reasoning.

| Citrus Punch Drink | |
|--------------------|-----------------------|
| 2 | cups orange juice |
| 2 | cups grapefruit juice |
| $\frac{1}{4}$ | cup apricot nectar |
| $\frac{1}{3}$ | cup pineapple juice |
| 4 | cups ginger ale |



11. **MP Multiple Representations** Use the graph at the right.



a. **Numbers** What does an ordered pair from this graph

represent? _____

b. **Measurement** Use the graph to find the capacity in quarts of a 2.5-gallon container. Explain your reasoning.

c. **Unit Rate** What is the unit rate that converts gallons to quarts?

d. **Expressions** Write an expression you could use to convert 2.5 gallons to quarts.

H.O.T. Problems Higher Order Thinking

12. **MP Model with Mathematics** Write a real-world problem in which you would need to convert pints to cups. _____

MP Persevere with Problems Fill in each \bigcirc with $<$, $>$, or $=$ to make a true sentence. Justify your answers.

13. $16 \text{ in.} \bigcirc 1\frac{1}{2} \text{ ft}$

14. $8\frac{3}{4} \text{ gal} \bigcirc 32 \text{ qt}$

15. **MP Persevere with Problems** Give two different measurements that are equivalent to $2\frac{1}{2}$ quarts. _____

16. **MP Model with Mathematics** Write a real-world problem that can be represented by the graph. _____

