

LESSON

5-3

Problem Solving***Dimensional Analysis***

Use the following: 1 mile = 1.609 km; 1 kg = 2.2046 lb. Round to the nearest tenth.

- | | |
|---|---|
| 1. Worker bees travel up to 14 km to find pollen and nectar. How far will a worker bee travel in miles? | 2. Worker bees can travel at 24 km/h. How fast can the worker bee travel in miles per hour? |
| _____ | _____ |
| 3. The average hippopotamus weighs 1800 kg. How many pounds does the average hippopotamus weigh? | 4. At the age of 45, an elephant grows teeth, each weighing 4 kg. How many pounds do these teeth weigh? |
| _____ | _____ |

Paraceratherium was the biggest land mammal there has ever been. It lived about 35 million years ago and was 8 m tall and 11 m long. It looked like a gigantic rhinoceros but had a long neck like a giraffe. 1 foot = 0.3048 meters. Round to the nearest tenth.

- | | |
|--|--|
| 5. How tall was the paraceratherium in feet? | 6. How long was the paraceratherium in feet? |
| _____ | _____ |

Round to the nearest tenth. Choose the letter for the best answer.

- | | |
|--|--|
| 7. The fastest sporting animal is the racing pigeon that flies up to 110 mi an hour. How fast is the racing pigeon in feet each second?
A 75.0 ft/s C 543.2 ft/s
B 161.3 ft/s D 9,680 ft/s | 8. The longest gloved fight between two Americans lasted for more than seven hours before being declared a draw. How many seconds did the fight last?
F 127 s H 420 s
G 385 s J 25,200 s |
| 9. The average person falls asleep in seven minutes. How many seconds does it take the average person to fall asleep?
A 127 s C 420 s
B 385 s D 25,200 s | 10. The brain of an average adult male weighs 55 oz. How many pounds does the average male brain weigh?
F 3.4 lb H 13.8 lb
G 5.8 lb J 880 lb |

LESSON Reteach

5-3 Dimensional Analysis (continued)

When rates are involved, two conversions may be needed.

Convert 55 miles per hour to feet per second. $\frac{55 \text{ mi}}{1 \text{ hr}}$

First, change miles to feet.

Use 1 mile = 5280 feet to write a fraction of value 1.

Miles, the unit to be changed, is in the numerator of the given rate.

So, put *miles* in the denominator of the fraction of value 1. $\frac{5280 \text{ ft}}{1 \text{ mi}}$

$$\frac{55 \text{ mi}}{1 \text{ hr}} \times \frac{5280 \text{ ft}}{1 \text{ mi}} = \frac{(55 \times 5280) \text{ ft}}{1 \text{ hr}} = \frac{290,400 \text{ ft}}{1 \text{ hr}}$$

Now, change hours to seconds.

Use 1 hour = 3600 seconds to write a fraction of value 1.

Hours, the unit to be changed, is in the denominator of the given rate.

So, put *hours* in the numerator of the fraction of value 1. $\frac{1 \text{ hr}}{3600 \text{ s}}$

$$\frac{290,400 \text{ ft}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = \frac{290,400 \text{ ft}}{3600 \text{ s}} \approx 80.7 \frac{\text{ft}}{\text{s}}$$

Complete to convert the units of the given rate.

8. Convert 60 miles per hour to yards per minute.

In ratio form the rate is: $\frac{60 \text{ mi}}{1 \text{ hr}}$

The conversion relation between miles and yards is: 1 mi = 1760 yd

The unit *miles* is in the numerator of the given rate.

What place will *miles* take in the fraction of value 1? denominator

To convert from miles to yards: $\frac{60 \text{ mi}}{1 \text{ hr}} \times \frac{1760 \text{ yd}}{1 \text{ mi}} = \frac{105,600 \text{ yd}}{1 \text{ hr}}$

The conversion relation between hours and minutes is: 1 hr = 60 min

The unit *hours* is in the denominator of the given rate.

What place will *hours* take in the fraction of value 1? numerator

To convert from hours to minutes:

$$\frac{105,600 \text{ yd}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = \frac{1760 \text{ yd}}{\text{min}}$$

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LESSON Challenge

5-3 Water, Water, Everywhere

Next time you are in a supermarket, pick up a gallon of water to verify what you will now determine.

How many pounds does a gallon of water weigh?

The amount of space between particles of a substance is what determines its **density**.

Lead is more dense than wood, which is more dense than foam rubber.

Density *d* is equal to the mass (weight) *m* of a substance divided by its volume *V*. $d = \frac{m}{V}$

Water was used as the basis for establishing the metric unit of mass.

The density of water is 1 gram per milliliter: $\frac{1 \text{ g}}{1 \text{ mL}}$.

1. Use the conversion relation 1 mL = 1 cm³ to write the density of water in terms of grams per cubic centimeter.

density of water = $\frac{1 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} = \frac{1 \text{ g}}{1 \text{ cm}^3}$

2. Since 1 m = 100 cm, how many cubic centimeters are there in 1 cubic meter?

1 m³ = 1,000,000 cm³

3. Use your results from Exercises 1 and 2, and the conversion relation 1 kg = 1000 g to write the density of water in terms of kilograms per cubic meters. Round your answer to the nearest hundredth.

density of water = $\frac{1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1,000,000 \text{ cm}^3}{1 \text{ m}^3} = \frac{1000 \text{ kg}}{1 \text{ m}^3}$

4. Use your result from Exercise 3 and these conversion relations to write the density of water as a unit rate in terms of pounds per gallon:

1 kg = 2.205 lb and 1 m³ = 264.2 gal

density of water = $\frac{1000 \text{ kg}}{1 \text{ m}^3} \times \frac{2.205 \text{ lb}}{1 \text{ kg}} \times \frac{1 \text{ m}^3}{264.2 \text{ gal}} \approx \frac{8.35 \text{ lb}}{1 \text{ gal}}$

5. So, a gallon of water weighs about 8.35 pounds.

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LESSON Problem Solving

5-3 Dimensional Analysis

Use the following: 1 mile = 1.609 km; 1 kg = 2.2046 lb. Round to the nearest tenth.

1. Worker bees travel up to 14 km to find pollen and nectar. How far will a worker bee travel in miles?

8.7 mi

2. Worker bees can travel at 24 km/h. How fast can the worker bee travel in miles per hour?

14.9 miles an hour

3. The average hippopotamus weighs 1800 kg. How many pounds does the average hippopotamus weigh?

3,968.3 lb

4. At the age of 45, an elephant grows teeth, each weighing 4 kg. How many pounds do these teeth weigh?

8.8 lb

Paraceratherium was the biggest land mammal there has ever been. It lived about 35 million years ago and was 8 m tall and 11 m long. It looked like a gigantic rhinoceros but had a long neck like a giraffe. 1 foot = 0.3048 meters. Round to the nearest tenth.

5. How tall was the paraceratherium in feet?

26.2 ft

6. How long was the paraceratherium in feet?

36.1 ft

Round to the nearest tenth. Choose the letter for the best answer.

7. The fastest sporting animal is the racing pigeon that flies up to 110 mi an hour. How fast is the racing pigeon in feet each second?

A 75.0 ft/s C 543.2 ft/s
B 161.3 ft/s D 9,680 ft/s

8. The longest gloved fight between two Americans lasted for more than seven hours before being declared a draw. How many seconds did the fight last?

F 127 s H 420 s
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LESSON Reading Strategies

5-3 Choose Relevant Information

Here are some common measurement units and their equivalents.

- 16 ounces in 1 pound
- 12 inches in 1 foot
- 8 ounces in 1 cup
- 60 minutes in 1 hour
- 3 feet in 1 yard
- 4 quarts in 1 gallon

You can change a measurement from one unit to another if you know the equivalent measure.

If a larger unit, such as gallons, is changed into a smaller one, such as quarts, you will have a greater number of units. If a smaller unit, such as inches, is changed into a larger unit, such as feet, you will have a smaller number of units.

Write *larger* or *smaller* to show whether your answer will be a larger or smaller number of units.

1. changing ounces into pounds

smaller

2. changing yards into feet

larger

3. changing gallons into quarts

larger

To change eight feet into inches, use the following steps.

4. Will the numeric portion of your answer be smaller or larger? Explain.

The answer will be larger. You are changing from a larger unit of measure to a smaller one.

5. How many inches are in a foot?

12

6. How many feet are being changed into inches?

8

Multiply the numbers in Exercises 5 and 6 together to get the number of inches in 8 feet.

7. How many inches are in 8 feet?

96 inches

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