

# 8.1

## Linear Measures: American Units

### OBJECTIVES

- a Convert from one American unit of length to another.

Length, or distance, is one kind of measure. To find lengths, we start with some unit segment and assign to it a measure of 1.

### American Units of Length

- 12 inches (in.) = 1 foot (ft)
- 3 feet = 1 yard (yd)
- 36 inches = 1 yard
- 5280 feet = 1 mile (mi)

EXAMPLE A Complete: 8 yd = \_\_\_\_ in.

**Solution**

$$\begin{aligned} 8 \text{ yd} &= 8 \cdot 1 \text{ yd} \\ &= 8 \cdot 36 \text{ in.} \quad \text{Substituting 36 in. for 1 yd} \\ &= 288 \text{ in.} \end{aligned}$$

EXAMPLE B Complete: 60 in. = \_\_\_\_ ft.

**Solution**

$$\begin{aligned} 60 \text{ in.} &= \frac{60 \text{ in.}}{1} \times \frac{1 \text{ ft}}{12 \text{ in.}} \\ &= \frac{60 \text{ in.}}{12 \text{ in.}} \times 1 \text{ ft} \\ &= \frac{60}{12} \times \frac{\text{in.}}{\text{in.}} \times 1 \text{ ft} \quad \text{The in./in. acts like 1, so we can omit it.} \\ &= 5 \times 1 \text{ ft} \\ &= 5 \text{ ft.} \end{aligned}$$

EXAMPLE C Complete: 60 ft = \_\_\_\_ yd.

**Solution** To convert from "ft" to "yd," we choose a symbol for 1 with "yd" on the top and "ft" on the bottom.

EXAMPLE C Complete: 60 ft = \_\_\_\_ yd.

$$\begin{aligned} 60 \text{ ft.} &= 60 \text{ yd} \cdot \frac{1 \text{ yd}}{3 \text{ ft}} \\ &= \frac{60}{3} \times \frac{\text{ft}}{\text{ft}} \times 1 \text{ yd} \\ &= 20 \cdot 1 \text{ yd} \\ &= 20 \text{ yd} \end{aligned}$$

EXAMPLE D Complete: 35 yd = \_\_\_\_ ft.

**Solution**

Converting "yd" to "ft," we choose a symbol for 1 with "ft" on top and "yd" on the bottom:

$$\begin{aligned} 35 \text{ yd} &= 35 \text{ yd} \cdot \frac{3 \text{ ft}}{1 \text{ yd}} \\ &= 35 \cdot 3 \text{ ft} \\ &= 105 \text{ ft} \end{aligned}$$

# 8.2

## Linear Measures: The Metric System

### OBJECTIVES

- a Convert from one metric unit of length to another.

The metric system is used by most of the world, and the United States is now making greater use of it as well. Because it is based on powers of 10, the metric system allows for easy conversion between smaller and larger units.

The basic unit of length is the meter. It is just over 1 yard.


### Metric Units of Length

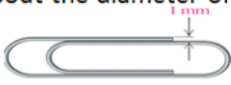
- 1 *kilometer* (km) = 1000 meters (m)
- 1 *hectometer* (hm) = 100 meters (m)
- 1 *dekameter* (dam) = 10 meters (m)
- 1 meter
- 1 *decimeter* (dm) =  $\frac{1}{10}$  meter (m)
- 1 *centimeter* (cm) =  $\frac{1}{100}$  meter (m)
- 1 *millimeter* (mm) =  $\frac{1}{1000}$  meter (m)

### Familiar Metric Units

1 kilometer (1000 meters) is a bit more than ½ mile

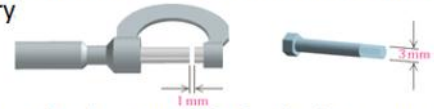
1 meter is just over a yard

1 centimeter (0.01 meter) is a little more than the width of a jumbo paperclip 

1 millimeter is about the diameter of a paperclip wire. 


**a** Convert from one metric unit of length to another.

Millimeters are used for small distances, especially in industry



Centimeters (cm) are used for body dimensions, clothing sizes, and household measurements.

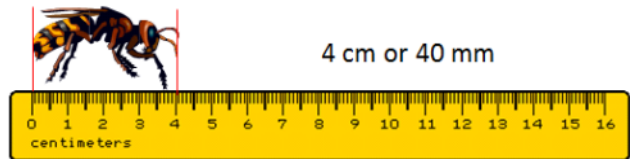


Meters (m) are used for expressing dimensions of larger objects—the length of a building or shorter distances—the length of a rug. 

Kilometers (km) are used for longer distances, mostly in cases where miles are now being used.

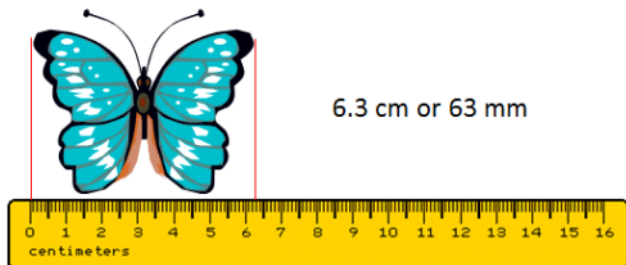
St. Louis  
30 mi  
48 km

What is the measure of each insect?



4 cm or 40 mm

What is the measure of each insect?



6.3 cm or 63 mm

**EXAMPLE A** Complete: 7 km = \_\_\_\_ m.

**Solution**

$$\begin{aligned}
 7 \text{ km} &= 7 \cdot 1 \text{ km} \\
 &= 7 \cdot 1000 \text{ m} \text{ Substituting } 1000 \text{ m for } 1 \text{ km} \\
 &= 7000 \text{ m}
 \end{aligned}$$

## Metric Conversions

$$1 \text{ m} = 10 \text{ dm}$$

$$1 \text{ m} = 100 \text{ cm} \quad \text{and}$$

$$1 \text{ m} = 1000 \text{ mm}$$

EXAMPLE C Complete: 3158 m = \_\_\_\_\_ km.

### Solution

We multiply by using  $\frac{1 \text{ km}}{1000 \text{ m}}$

$$\begin{aligned} 3158 \text{ m} &= 3158 \text{ m} \cdot \frac{1 \text{ km}}{1000 \text{ m}} \\ &= \frac{3158}{1000} \cdot 1 \text{ km} \\ &= 3.158 \text{ km} \end{aligned}$$

EXAMPLE D Complete: 42.9 mm = \_\_\_\_\_ cm.

### Solution

Think: To go from mm to cm in the table is a move of one place to the left. Thus, we move the decimal point one place to the left.

EXAMPLE E Complete: 1.245 km = \_\_\_\_\_ cm.

### Solution

Think: To go from km to cm is a move of five places to the right. Thus, we move the decimal point five places to the right.

EXAMPLE F Complete: 5 m = \_\_\_\_\_ cm.

### Solution

Think: To go from m to cm is a move of two places to the right.

EXAMPLE B Complete: 0.547 m = \_\_\_\_\_ mm.

### Solution

We are converting from "m" to "mm", so we choose a symbol for 1 with "mm" on the top and "m" on the bottom:

$$\begin{aligned} 0.547 \text{ m} &= 0.547 \text{ m} \cdot \frac{1000 \text{ mm}}{1 \text{ m}} \\ &= 0.547 \cdot 1000 \text{ mm} \\ &= 547 \text{ mm} \end{aligned}$$

## Mental Conversion

Changing from one unit to another in the metric system involves moving a decimal point. This occurs because the metric system is based on 10.

1000 m	100 m	10 m	1 m	0.1 m	0.01 m	0.001 m
1 km	1 hm	1 dam	1 m	1 dm	1 cm	1 mm

EXAMPLE D Complete: 42.9 mm = \_\_\_\_\_ cm.

1000 m	100 m	10 m	1 m	0.1 m	0.01 m	0.001 m
1 km	1 hm	1 dam	1 m	1 dm	1 cm	1 mm

1 place to the left

$$42.9 \quad 4.2.9 \quad 42.9 \text{ mm} = 4.29 \text{ cm}$$

EXAMPLE E Complete: 1.245 km = \_\_\_\_\_ cm.

1000 m	100 m	10 m	1 m	0.1 m	0.01 m	0.001 m
1 km	1 hm	1 dam	1 m	1 dm	1 cm	1 mm

5 places to the right

$$1.245 \quad 1.24500. \quad 1.245 \text{ km} = 124,500 \text{ cm}$$

EXAMPLE F Complete: 5 m = \_\_\_\_\_ cm.

1000 m	100 m	10 m	1 m	0.1 m	0.01 m	0.001 m
1 km	1 hm	1 dam	1 m	1 dm	1 cm	1 mm

2 places to the right

$$5 \quad 5.00. \quad 5 \text{ m} = 500 \text{ cm}$$

## 8.3

### Converting Between American Units and Metric Units

#### OBJECTIVES

- a Convert between American units of length and metric units of length.

- a Convert between American units of length and metric units of length.

We can make conversions between American and metric units by using the following table.

American	Metric
1 in.	2.540 cm
1 ft	0.305 m
1 yd	0.914 m
0.621 mi	1 km
1.094 yd	1 m
3.281 ft	1 m
39.370 in.	1 m

EXAMPLE B Complete: 3.5 m = \_\_\_\_ in.  
Solution

$$\begin{aligned} 3.5 \text{ m} &= 3.5 \cdot 1 \text{ m} \\ &= 3.5 \cdot 39.37 \text{ in. for } 1 \text{ m} \\ &= 137.795 \text{ in.} \end{aligned}$$

EXAMPLE D Complete: 180 cm = \_\_\_\_ in.  
Solution

$$\begin{aligned} 180 \text{ cm} &= 180 \cancel{\text{ cm}} \cdot \frac{1 \text{ in.}}{2.54 \cancel{\text{ cm}}} \\ &\approx 70.866 \text{ in.} \end{aligned}$$

EXAMPLE A Complete: 6.2 mi = \_\_\_\_ km.  
Solution

$$\begin{aligned} 6.2 \text{ mi} &= 6.2 \cdot 1 \text{ mi} \\ &= 6.2 \cdot 1.609 \text{ km} \\ &= 9.9758 \text{ km} \end{aligned}$$

EXAMPLE C Complete: 2158 km = \_\_\_\_ mi.  
Solution

$$\begin{aligned} 2158 \text{ km} &= 2158 \cdot 1 \text{ km} \\ &= 2158 \cdot 0.621 \text{ mi} \\ &= 1340.118 \text{ mi} \end{aligned}$$

## 8.4

### Weight and Mass; Medical Applications

#### OBJECTIVES

- a Convert from one American unit of weight to another.
- b Convert from one metric unit of mass to another.
- c Make conversions and solve applied problems concerning medical dosages.

#### American Units of Weight

1 lb = 16 ounces (oz)  
1 ton (t) = 2000 pounds (lb)

EXAMPLE A How many ounces are in 3 pounds?  
Solution

$$\begin{aligned} 3 \text{ lb} &= 3 \cdot 1 \text{ lb} \\ &= 3 \cdot 16 \text{ oz} \quad \text{Substituting } 16 \text{ oz for } 1 \text{ lb} \\ &= 48 \text{ oz} \end{aligned}$$

**EXAMPLE B** Complete: 17,258 lb = \_\_\_\_ T.

**Solution**

$$\begin{aligned}
 17,258 \text{ lb} &= 17,258 \cancel{\text{ lb}} \cdot \frac{1 \text{ T}}{2000 \cancel{\text{ lb}}} \\
 &= \frac{17,258}{2000} \text{ T} \\
 &= 8.629 \text{ T}
 \end{aligned}$$

The basic unit of mass is the gram (g), which is the mass of 1 cubic centimeter (1 cm<sup>3</sup> or 1 mL) of water.

### Metric Units of Mass

1 metric ton (t) = 1000 kilograms (kg)

1 kilogram (kg) = 1000 grams (g)

1 hectogram (hg) = 100 grams (g)

1 dekagram (dag) = 10 grams (g)

1 gram (g)

### Metric Units of Mass

1 decigram (dg) =  $\frac{1}{10}$  gram (g)

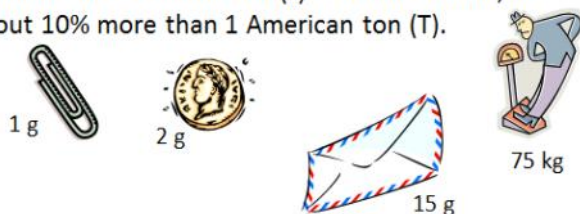
1 centigram (cg) =  $\frac{1}{100}$  gram (g)

1 milligram (mg) =  $\frac{1}{1000}$  gram (g)

**b** Convert from one metric unit of mass to another.

The mass of 1 raisin or 1 paperclip is approximately 1 gram (g).

Since 1 metric ton is 1000 kg and 1 kg is about 2.2 lb, it follows that 1 metric ton (t) is about 2200 lb, or about 10% more than 1 American ton (T).



**EXAMPLE C** Complete: 7 kg = \_\_\_\_ g.

1000 g	100 g	10 g	1 g	0.1 g	0.01 g	0.001 g
1 kg	1 hg	1 dag	1 g	1 dg	1 cg	1 mg

3 places to the right

$$7.0 \quad 7.000 \quad 7 \text{ kg} = 7000 \text{ g}$$

**EXAMPLE D** Complete: 8346 g = \_\_\_\_ kg.

1000 g	100 g	10 g	1 g	0.1 g	0.01 g	0.001 g
1 kg	1 hg	1 dag	1 g	1 dg	1 cg	1 mg

3 places to the left

$$8346.0 \quad 8.346.0 \quad 8346 \text{ g} = 8.346 \text{ kg}$$

**EXAMPLE C** Complete: 7 kg = \_\_\_\_ g.

**Solution** Think: To go from kg to g is a move of 3 places to the right. Thus we move the decimal point 3 places to the right.

**EXAMPLE D** Complete: 8346 g = \_\_\_\_ kg.

**Solution** To go from g to kg in the table is a move of 3 places to the left.

### Microgram

1 microgram = 1 mcg =  $\frac{1}{1,000,000}$  g = 0.000001 g

1,000,000 mcg = 1 g

EXAMPLE F Complete: 2 mg = \_\_\_\_ mcg.

**Solution** We convert to grams then to micrograms:

$$\begin{aligned} 2 \text{ mg} &= 0.002 \text{ g} \\ &= 0.002 \cdot 1 \text{ g} \\ &= 0.002 \cdot 1,000,000 \text{ mcg} \\ &= 2000 \text{ mcg} \end{aligned}$$

medical usages.

EXAMPLE F A physician prescribes 0.8-mg of a medication. How many micrograms are in each tablet?

**Solution** Complete 0.8 mg = \_\_\_\_ mcg

$$\begin{aligned} 0.8 \text{ mg} &= 0.8 \cdot 1 \text{ mg} && \text{From previous} \\ &= 0.8 \cdot 1000 \text{ mcg} && \text{example that} \\ &= 800 \text{ mcg} && 1000 \text{ mcg} = 1 \\ &&& \text{mg} \end{aligned}$$