

1.4: Conversion Between the Metric and US Customary Systems of Measurement

Learning Objectives

1. Estimate equivalence between metric units and US customary units.
2. Convert metric units to US customary units.
3. Convert US customary units to metric units.

Estimate equivalence between the Metric Units and US Customary Units

Before converting metric units to US customary units and vice versa, you need to familiarize the approximate metric equivalents of common customary units. The table below summarizes the commonly used metric and US customary units and their approximate equivalence. The notations enclosed are the abbreviations of each unit.

Metric Units	US Customary Units
Lengths	
1 meter (m)	3.28 feet (ft or ')
1 meter (m)	39.4 inches (in)
1 kilometer (km)	0.62 mile (mi)
2.54 centimeter (cm)	1 inch (in)
0.9144 meter (m)	1 yard (yd)
Weight	
1 kilogram (kg)	2.2 pounds (lb)
28.3 grams (g)	1 ounce (oz)
Fluid Capacity	
1 milliliter (ml)	0.203 teaspoon (tsp)
29.57 milliliters (ml)	1 fluid ounce (fl oz)
1 liter (l)	4.23 cups (c)
3.79 liters (l)	1 gallon (gal)
473.176 milliliters (ml)	1 pint (pt)
0.95 liters (l)	1 quart (qt)

Additional Common Conversions

Metric Units	US Customary Units
Area	
6.45 square centimeters (cm ²)	1 square inch (in ²)
1 square meter (m ²)	1.196 square yard (yd ²)
4046.873 square meters (m ²)	1 acre (ac)
Volume and Capacity	
16.39 milliliter (ml)	1 cubic inch (in ³)
28.32 liters (l)	1 cubic foot (ft ³)
764.55 liters (l)	1 cubic yard (yd ³)

Convert Metric Units to US Customary Units

You have familiarized the commonly used equivalence between metric and US customary units. At this point, you will learn to convert metric units to US customary units.

To convert metric units to US customary units, use their estimate equivalence as the conversion factor in dimensional analysis. Write the equivalence as a fraction, and multiply it to the given measurement (in metric) to convert. Be sure that the units of measure to convert cancels out. For instance, to convert liters to gallons, be sure to cancel out liters and retain gallons as the final unit.

Now, let us consider some examples.

✓ Example 1.4.1

The official regulators of a shipment company classify a parcel weighing more than 51 pounds (lb) as a heavy shipment. Andrea packed 24 terracotta plant containers to be shipped to her customers. If each plant container weighs 1.3 kilograms (kg), will her package be classified as a heavy shipment?

Solution

To determine whether the parcel is a heavy shipment or not, you need to convert the total weight of the plant containers to pounds.

Compute for the total weight.

$$\text{Total Weight} = 24 \times 1.3 \text{ kg} = 31.2 \text{ kg}$$

Convert the total weight to pounds. Use the metric to US customary units' equivalence: 1 kg = 2.2 lbs.

$$31.2 \cancel{\text{ kg}} \cdot \frac{2.2 \text{ lb}}{1 \cancel{\text{ kg}}} = 68.64 \text{ lb}$$

Since the total weight is more than 51 lb, the shipment is considered heavy.

Try It 1.4.1

Angelica who lives in Las Vegas, Nevada, visited her friend in Canada. She knows that Canada uses the metric system, so their speed limits are posted in kilometers per hour. On her way, she sees a road sign that says, "max 60 km/h". She knows the sign means "a maximum speed of 60 kilometers per hour" but she is unsure if this is higher than the speed limit in Las Vegas, Nevada, which is 65 miles per hour (mph). How can Angelica convert 60 km/h to miles per hour? Use the metric to US customary units' equivalence: 1 kilometer (km) = 0.62 mile.

Answer

$$\frac{60 \cancel{\text{ km}}}{1 \text{ hr}} \cdot \frac{0.62 \text{ mi}}{1 \cancel{\text{ km}}} = 37.2 \text{ mi / hr}$$

In Las Vegas, the limit is 65 miles per hour (mph). Since 37.2 mph is below this limit, 60km/h is not over the speed limit.

✓ Example 1.4.2

Half of a meter of ribbon is required for wrapping presents enclosed in a rectangular box. How many presents using the same box size can be wrapped with 10 yards of ribbon?

Solution

Convert half a meter (0.5 m) to yards. Use the metric to US customary units' equivalence: 1 yard = 0.9144 meter.

$$0.5 \cancel{\text{ m}} \cdot \frac{1 \text{ yd}}{0.9144 \cancel{\text{ m}}} = 0.5468 \text{ yd}$$

The result means that one present requires 0.5468 yards of ribbon. Calculate the number of presents by dividing 10 yards by 0.5468 yards.

$$10 \text{ yd} \div \frac{0.5468 \text{ yd}}{1 \text{ present}} = 10 \text{ yd} \times \frac{1 \text{ present}}{0.5468 \text{ yd}} = 18.29 \text{ presents}$$

Approximately, 18 presents can be wrapped with 10 yards of ribbons.

Try It 1.4.2

Crystal and her friends are planning for a road trip, which they have determined to be 2000 kilometers (km) long. They want to rent a van that can travel 100 km using 9 liters of gas. Suppose the gas price is \$3.74 a gallon (gal), how many gallons of gas they will need? How much money will the group of friends need to save for gas? Use the metric to US customary units' equivalence: 3.79 liters (l) = 1 gallon (gal).

Answer

$$\text{They will need } \frac{2000 \cancel{\text{ km}}}{1} \cdot \frac{9 \text{ l}}{100 \cancel{\text{ km}}} = 180 \text{ liters of gas.}$$

$$\text{Converting to gallons: } \frac{180 \cancel{\text{ l}}}{1} \cdot \frac{1 \text{ gal}}{3.79 \cancel{\text{ l}}} = 47.5 \text{ gallons of gas}$$

$$\text{Calculating the price: } 47.5 \times \$3.74 = \$177.63$$

The team needs 47.5 gallons of gas for the trip, which will cost them \$177.63.

Try It 1.4.3

Christine plans to put up a short-course swimming pool at her house. A short-course swimming pool usually measures 22.86 meters in length, at least 18.29 meters in width, and 2.5 meters in depth. Convert the dimensions of the pool to inches. Use the metric to US customary units' equivalence: 1 centimeter (cm) = 0.39 inch (in.) and 1 centimeter (cm) = 0.01 meter (m).

Answer

$$\text{Length: } \frac{22.86 \cancel{\text{ m}}}{1} \cdot \frac{1 \cancel{\text{ cm}}}{0.01 \cancel{\text{ m}}} \cdot \frac{0.39 \text{ in}}{1 \cancel{\text{ cm}}} = 891.54 \text{ inches}$$

$$\text{Width: } \frac{18.29 \cancel{\text{ m}}}{1} \cdot \frac{1 \cancel{\text{ cm}}}{0.01 \cancel{\text{ m}}} \cdot \frac{0.39 \text{ in}}{1 \cancel{\text{ cm}}} = 713.31 \text{ inches}$$

$$\text{Depth: } \frac{2.5 \cancel{\text{ m}}}{1} \cdot \frac{1 \cancel{\text{ cm}}}{0.01 \cancel{\text{ m}}} \cdot \frac{0.39 \text{ in}}{1 \cancel{\text{ cm}}} = 97.5 \text{ inches}$$

Approximately, the pool measures 891.54 in by 713.31 in by 97.5 in.

Convert US Customary Units to Metric Units

You have learned how to convert metric units to US customary units. Now, you will learn to convert US customary units to metric units.

Example 1.4.3

Daniel drove 40 miles in two hours. What distance (in meters) did he cover in one minute? Use the US customary to metric units' equivalence: 0.62 mile (mi) = 1 kilometer (km), 1 km is equal to 1000 meters (m), and 1 hour = 60 minutes.

Solution

Convert 40 miles in two hours to kilometers per hour.

$$\frac{40 \cancel{\text{ mi}}}{2 \text{ hrs}} \cdot \frac{1 \text{ km}}{0.62 \cancel{\text{ mi}}} = 32.2581 \text{ km/hr}$$

Convert 32.2581 kilometers per hour to meters per hour.

$$\frac{32.2581 \cancel{\text{ km}}}{1 \text{ hr}} \cdot \frac{1000 \text{ m}}{1 \cancel{\text{ km}}} = 32,258.1 \text{ m/hr}$$

Convert 32,258.1 meters per hour to meters per minute.

$$\frac{32,258.1 \text{ m}}{1 \cancel{\text{ hr}}} \cdot \frac{1 \cancel{\text{ hr}}}{60 \text{ min}} = 537.635 \text{ m/min}$$

Daniel has covered 537.635 meters in one minute.

Try It 1.4.4

A supermarket has a car parking spot that is 9 feet wide and 18 feet long. Its ground-level parking has 50 parallel parking spots (side by side) of the same sizes. What is the area of the parking lot in square centimeters? Use the US customary units' equivalence: 1 foot (ft) = 12 inches (in) and 1 square inch (in²) = 6.45 square centimeters (cm²). (Hint: You will need to use the formula to find the area of a rectangle)

Answer

$$\text{Convert 9 feet to inches: } \frac{9 \cancel{\text{ ft}}}{1} \cdot \frac{12 \text{ in}}{1 \cancel{\text{ ft}}} = 108 \text{ in}$$

$$\text{Convert 18 feet to inches: } \frac{18 \cancel{\text{ ft}}}{1} \cdot \frac{12 \text{ in}}{1 \cancel{\text{ ft}}} = 216 \text{ in}$$

$$\text{Find the area of one parking spot: } 108 \text{ in} \times 216 \text{ in} = 23,328 \text{ in}^2$$

$$\text{Find the area of the whole parking lot: } 23,328 \text{ in}^2 \times 50 = 1,166,400 \text{ in}^2$$

$$\text{Convert to cm}^2: \frac{1,166,400 \cancel{\text{ in}^2}}{1} \cdot \frac{6.45 \text{ cm}^2}{1 \cancel{\text{ in}^2}} = 7,523,280 \text{ cm}^2$$

The area of the parking lot is 7,523,280 square centimeters.

Example 1.4.4

Melody's garage is 45 feet long while David's garage is 10 yards and 10 feet long. Which house has a longer garage? How much is the difference (in meters)? Use the US customary to metric equivalence: 3.28 feet (ft) = 1 meter (m) and 1 foot (ft) = 0.3333 yard (yd)

Solution

$$\text{Convert 10 yards to feet: } \frac{10 \cancel{\text{ yd}}}{1} \cdot \frac{1 \text{ ft}}{0.3333 \cancel{\text{ yd}}} = 30 \text{ ft}$$

David's garage is 30 ft + 10 ft = 40 ft long. His garage is 5 feet shorter than Melody's garage.

$$\text{Convert 5 feet to meters: } \frac{5 \cancel{\text{ ft}}}{1} \cdot \frac{1 \text{ m}}{3.28 \cancel{\text{ ft}}} = 1.52 \text{ m}$$

Melody's garage is longer by 1.52 meters.

Try It 1.4.5

How many liters of water are needed to fill an Olympic swimming pool with a total volume of 3300 cubic yards? Assume that the water level is as deep as the pool. Use the US customary to metric units' equivalence: 1 cubic yard (yd³) = 746.56 liters (l).

Answer

Convert cubic yards to liters: $\frac{3300 \cancel{\text{yd}^3}}{1} \cdot \frac{746.56 \text{ l}}{1 \cancel{\text{yd}^3}} = 2,463,648 \text{ liters}$

At most 2,463,648 liters of water are needed to fill the swimming pool.

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