English and Metric Measurements

NGLISH MEASURES are more complicated than metric measures. The English system has 12 inches in a foot; three feet in a yard; 5,280 feet in a mile; and 16 ounces in a pound. In the less complex metric system, all metric units are based on a decimal system. Distance, area, volume, and mass are denoted by factors of 10, with



a standard set of prefixes in powers of 10 used with meters, liters, and grams. There are 1,000 millimeters (10³mm) in a meter; 1,000 meters (10³m) in a kilometer; 1,000 grams $(10^{3}g)$ in a kilogram; and 1,000 milligrams $(10^{3}mg)$ in a gram.

Objectives:

- 1. Explain English and metric linear measurement.
- 2. Explain English and metric area measurement.
- Explain English and metric volume measurement.
- 4. Explain English and metric weight measurement.

Key Terms:

metric system unit equations

Understanding English and Metric Linear Measurement

What is the difference between English and metric linear measurement, and how are they used? They are two customary systems of measurement used in our country. The **metric system** is a decimal system. The equivalents used to make conversions within each system are **unit equations**. You use equations to make conversions by arranging the unit equation as a fraction. The given units will cancel, and the desired units will remain.



Example: Change 28 miles/gallon to kilometers/liter [1 gallon = 3.785 liters; 1 mile = 1.6093 kilometers].

 $\frac{28 \text{ miles}}{\text{gallon}} \times \frac{(1 \text{ gallon})}{3.785 \text{ liters}} \times \frac{(1.6093 \text{ kilometers})}{1 \text{ mile}}$

By canceling out the terms gallons and miles, the answer will be in kilometers/liters

 $\frac{28 \times (1.6093 \text{ kilometers})}{3.785 \text{ liters}} = 11.91 \text{ kilometers/liter}$

ENGLISH LINEAR UNITS

12 inches (in.) = 1 foot (ft.) 3 ft. = 1 yard (yd.) 16.5 ft. = 1 rod (rd.) 5.5 yd. = 1 rd. 320 rd. = 1 mile (mi.) 5,280 ft. = 1 mi. 1,720 yd. = 1 mi. 1 furlong (fur.) = ¹/₈ mi. 1 fur. = 660 ft.

METRIC LINEAR UNITS

1 kilometer (km) = 1,000 meters (m) 1 hectometer (hm) = 100 m 1 decameter (dam) = 10 m 1 decimeter (dm) = 0.1 m 1 centimeter (cm) = 0.01 m 1 millimeter (mm) = 0.001 m 1 m = 10 dm = 100 cm = 1,000 mm





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1 rd. = 5.029 m 1 mi. = 1.6093 km 1 fur. = 201.168 m 1 mm = 0.03937 in. 1 cm = 0.3937 in. 1 m = 3.281 ft. 1 km = 0.6214 mi.

Calculating Area with English and Metric Measurements

Many occasions in personal and business affairs require you to know how to convert English and metric measurements to determine area.

ENGLISH AREA UNITS

144 square inches (sq. in.) = 1 square foot (sq. ft.) 9 sq. ft. = 1 square yard (sq. yd.) 30.25 sq. yd. = 1 square rod (sq. rd.) 160 sq. rd. = 1 acre (A) 43,560 sq. ft. = 1 A 640 A = 1 square mile (sq. mi.) 36 sq. mi. = 1 township (twp.)

METRIC AREA UNITS

1 square centimeter $(cm^2) = 100$ square millimeters (mm^2) 1 square decimeter $(dm^2) = 100$ cm² 1 square meter $(m^2) = 100$ dm² 10,000 m² = 1 hectare (ha) 1m² = 10,000 cm² 100m² = 1are(a) 100 a = 1 ha

ENGLISH-METRIC CONVERSION UNITS

1 sq. in. = 6.452 cm² 1 sq. ft. = 0.0929 cm² t1 sq. yd. = 0.8361 m² 1 sq. mi. = 259 ha



1 sq. mi. = 2.589 square kilometers (km²) 1 sq. rd. = 25.293 m² 1 A = 40.47 a 1 A = 0.4047 ha 1 cm² = 0.1549 sq. in. 1 m² = 1549 sq. in. 1 m² = 10.76 sq. ft 1 m² = 1.196 sq. yd. 1 ha = 2.471 A 1 a = 119.6 sq. yd.

English and Metric Volume Measurement

Several English and metric conversion measurements are needed to perform metric calculations. English volume units are used to measure liquid, dry, and household products.

LIQUID MEASUREMENTS

1 pint (pt.) = 16 ounces (oz.) 2 pt. = 1 quart (qt.) 4 qt. = 1 gallon (gal.) 31.5 gal. = 1 barrel (bbl.) 7.48 gal. = 1 cubic foot (cu. ft.)

DRY MEASUREMENTS

2 pt. = 1 qt. 8 qt. = 1 peck (pk.) 4 pk. = 1 bushel (bu.) 1 bu. = 1.25 cu. ft.

HOUSEHOLD MEASUREMENTS

1 teaspoon (tsp.) = $\frac{1}{6}$ fluid ounce (fl. oz.) 3 tsp. = 1 tablespoon (tbs.) 1 tbs. = $\frac{1}{2}$ fl. oz. 1 cup (c.) = 8 fl. oz. 2 c. = 1 pt.



METRIC VOLUME UNITS

Metric volume units involve solid and liquid measurements.

Solid Volume

1 cubic centimeter (cm³) = 1,000 cubic millimeter (mm³) 1 cubic meter (m³) = 1,000,000 cm³ 1,000 cm³ = 1 cubic decimeter (dm³) 1,000 cm³ = 1 liter (L) 1 cm³ = 1 milliliter (ml)

Liquid Volume

- 1 ml = 0.001 L
- 1 centiliter (cl) = 0.01 L
- 1 deciliter (dl) = 0.1 L
- 1 decaliter (dal) = 10 L
- 1 hectoliter (hl) = 100 L
- 1 kiloliter (kl) = 1,000 L

DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Metric System Versus English System

Ninety-five percent of the world uses the metric system. The standard set of base units and prefixes in powers of 10 are more suitable for science and engineering than the English system. Distance, area, volume, and mass are more easily determined with metric calculations, which facilitate figuring quantitative analysis and understanding in science. Because calculations are easier to perform in the metric system, there are fewer mistakes and less confusion. This makes it easier to understand scientific principles and concepts.

In 1586, Flemish mathematician Simon Stevin introduced decimal fractions in Europe, and the concept of multiples and sub-multiples of units figured on a decimal pattern. The debate to replace English measurement with metrics was waged by the mathematician Augustus de Morgan in 1854 at Britain's Decimal Association. He said: "In the simple rules of arithmetic, we practice a pure decimal system, nowhere interrupted by the entrance of any other system: from column to column, we never carry anything but tens." In 1790, the simplicity of the metric system replaced awkward traditional systems where one-third of a foot equals a foot, and 16 ounces equals one pound.

The metric system was officially sanctioned for use in the United States in 1866, but it is generally used only in science and mathematics, not having been adopted as the official system of measurement.

Universally, however, time is reckoned in the English system with 60 seconds in a minute, 60 minutes in an hour, and 24 hours in a day.



English–Metric Volume Conversion Units

1 pt. = 0.4732 L 1 qt. = 0.9463 L 1 L = 1.0567 qt. 1 gal. = 3.7853 L 1 L = 0.264 gal. 1 grain (gr.) = 0.0648 gram (g) 1 oz. = 28.35 g 1 pound (lb.) = 453.6 g 1 lb. = 0.4536 kilogram (kg) 1 g = 15.432 gr. 1 g = 0.03528 oz. 1 kg = 2.204 lb. 1 metric ton (MT) = 1.1023 ton (T)—short ton

TABLE 1. Comparing English and Metric Units

Metric to English Conversions	Metric Units in Plain English
1 meter = 3.26 feet	A meter is about 3 feet (1 yard).
1 kilometer = 0.62 miles	A kilometer is about $1/2$ mile.
1 liter = 0.26 gallons	A liter is about 1 quart ($1/_4$ gallon).
1 kilogram = 2.20 pounds	A kilo is about 2 pounds.
0 degrees $C = 32$ degrees F	0 degrees C is cold.
10 degrees $C = 50$ degrees F	10 degrees C is cool.
20 degrees $C = 68$ degrees F	20 degrees C is warm.
30 degrees C = 86 degrees F	30 degrees C is hot.

Calculating Weight Using English and Metric Measurement

Several conversion factors are needed to understand English and metric weight measurement.

ENGLISH WEIGHT UNITS

437.5 gr. = 1 oz.



7,000 gr. = 1 lb. 16 oz. = 1 lb. 100 lb. = 1 hundredweight (cwt.) 2,000 lb. = 1 T 2,240 lb. = 1 long ton

METRIC WEIGHT UNITS

- 1 milligram (mg) = 0.0001 g
- 1 centigram (cg) = 0.01 g
- 1 decigram (dg) = 0.1 g
- 1 decagram (dag) = 10 g
- 1 hectogram (hg) = 100 g
- 1 kg = 1,000 g1 MT = 1,000 kg

ENGLISH-METRIC WEIGHT CONVERSION UNITS

1 gr. = 0.0648 g 1 oz. = 28.35 g 1 lb. = 453.6 g 1 lb. = 0.4536 kg 1 T = 0.9072 MT

Summary:



English and metric linear measurements are two customary systems of measurement used in our country. The metric system, based on the decimal system, is less complicated. The equivalents used to make conversions within each system are unit equations. Fractions are used to convert English to metric measurements and metrics into English equivalents.

English linear units are measured in inches, feet, yards, rods, furlongs, and miles. Metric linear units are measured in kilometers, hectometers, decameters, centimeters, millimeter, and meters. You can perform English and metric conversions for area, volume, and weight.

Checking Your Knowledge:



- 1. Why is the metric system less complicated than the English system?
- 2. Define unit equations.



- 3. Explain the fractional function of canceling and remaining.
- 4. What are English measurements for linear measures?
- 5. What is the function of prefixes in denoting metric measurements?

Expanding Your Knowledge:

To change 28 miles/gallon to kilometers/liter [1 gallon = 3.785 liters; 1 mile = 1.6093 kilometers], the following fraction is created and computed.

 $\frac{28 \text{ miles}}{\text{gallon}} \times \frac{(1 \text{ gallon})}{3.785 \text{ liters}} \times \frac{(1.6093 \text{ kilometers})}{1 \text{ mile}}$

By canceling out the gallons and miles, the answer will be in kilometers/liters

 $\frac{28 \times (1.6093 \text{ kilometers})}{3.785 \text{ liters}} = 11.91 \text{ kilometers/liter}.$

Create fractions changing:

- 12 meters into feet
- 25 liters into gallons
- 10 kilometers into miles
- 6 kilos into pounds
- 10 degrees Celsius into degrees Fahrenheit

Web Links:



Metric System

http://www2.seminolestate.edu/rrapalje/Tech-Prep-Math/ Metric%20System.htm

The Metric System and the English System

http://wiki.answers.com/Q/What_are_the_differences_between_the_metric_ system_and_the_English_system_of_measurement

English System vs. Metric System

http://www.ehow.com/facts_7688529_english-system-vs-metric-system.html

Converting Between Systems

http://www.regentsprep.org/Regents/math/ALGEBRA/AM2/MetEng.htm

