

METRIC SYSTEM - UNITS OF LENGTH, WEIGHT, AND CAPACITY

In the world of science and medicine, the metric system of measurement is used. Also, many European countries use the metric system rather than the customary measurement system. We will study units of length based on the meter, units of weight based on gram, and units of capacity based on the liter. We will refer to the metric system conversion tables for connections between the metric units used not often.

First we'll start with examining the meanings of the metric prefixes. They are used in the three types of measurement: length, weight, and capacity.

For length, we study kilometer, meter, centimeter, and millimeter. There are also other metric units of length like hectometer, decameter, and decimeter.

A centimeter ruler can be used to measure centimeters and millimeters. Often times rulers in the U.S. have centimeters marked on one edge with inches marked on the opposite edge. One centimeter equals 10 millimeters. We will practice measuring with metric units of length.

Sometimes we need to convert from one metric unit to another metric unit. First we will look at converting metric units of length using multiplication, where we convert a measurement given as a large unit into the same measurement but expressed in a smaller unit. Then we will look at converting metric units of length using division, where we convert a measurement given as a small unit into the same measurement but expressed in a larger unit.

For weight we study kilogram, gram, and milligram. There are also other metric units of weight like hectogram, decagram, decigram, and centigram.

For capacity we study liter and milliliter. There are other metric units of capacity like kiloliter, hectoliter, decaliter, deciliter, and centiliter.

Metric System Conversion Tables

Length	
kilometer (km)	1000 meters
1 meter (m)	100 centimeters
1 centimeter (cm)	10 millimeters (mm)

Weight	
kilogram (kg)	1000 grams
1 gram (g)	1000 milligrams (mg)

Capacity	
liter (l)	1000 milliliters (ml)

Metric System Prefixes

Metric prefixes have meaning.

kilo means 1000 times the base unit.

kilo + meter means 1000 meters.
Thus a kilometer = 1000 meters.

kilo + gram means 1000 grams.
Thus a kilogram = 1000 grams.

deci means $\frac{1}{10}$ th of the base.

deci + meter means $\frac{1}{10}$ of a meter.

Thus, a decimeter is $\frac{1}{10}$ of a meter or 1 meter = 10 decimeters.

centi means $\frac{1}{100}$ th of the base.

centi + meter means $\frac{1}{100}$ of a meter.

Thus, a centimeter is $\frac{1}{100}$ of a meter or 1 meter = 100 centimeters.

milli means $\frac{1}{1000}$ th of the base.

milli + meter means $\frac{1}{1000}$ of a meter.

Thus, a millimeter is $\frac{1}{1000}$ of a meter or 1 meter = 1000 millimeters.

milli + gram means $\frac{1}{1000}$ of a gram.
1 gram = 1000 milligrams

milli + liter means $\frac{1}{1000}$ of a liter.

1 liter = 1000 milliliters

Metric Units of Length

The metric system of measurement is used by scientists, doctors, and people of many other countries.

Kilometer (km)

A kilometer is a distance that is about 7 blocks long.
Kilometers are used to measure long distances.



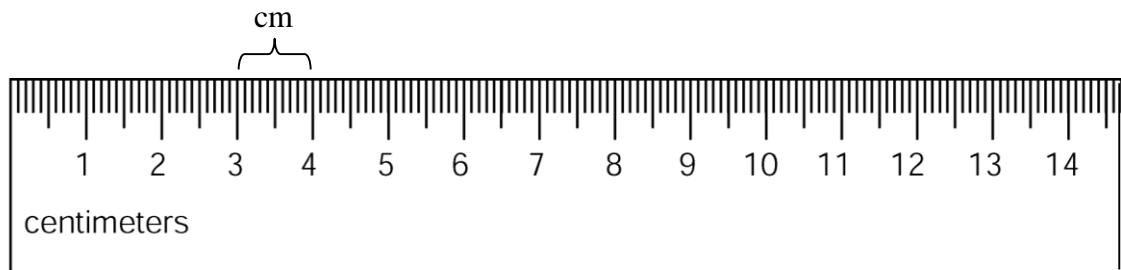
Meter (m)

A meter is about as long as a baseball bat.
A meter stick could be used to measure the length of a room.



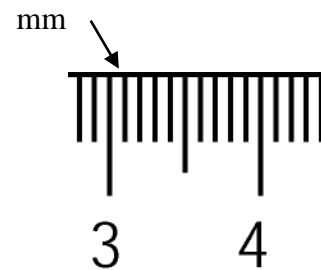
Centimeter (cm)

A centimeter is about the width of the pinky finger.
A centimeter is a little less than half an inch long.



Millimeter (mm)

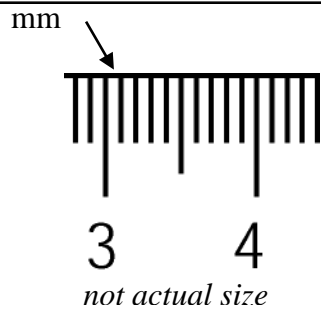
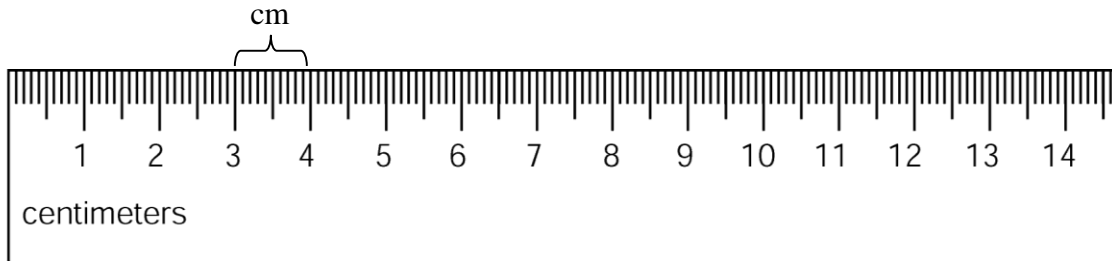
A millimeter is about as long as the thickness of the wire in a paper clip.
The thickness of a dime is about 2 millimeters.



not actual size

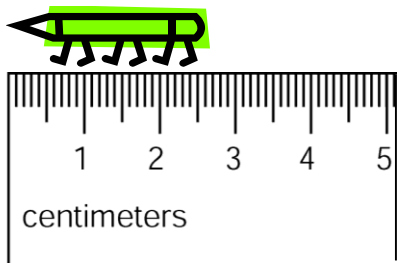
Measuring with Metric Units of Length

Look closely at the rulers below to view centimeters and millimeters. A centimeter is the length from one number's notch to the next number's notch. One section of the ruler is enlarged to show millimeters. Count the spaces between the 3 notch and the 4 notch and note that there are 10 millimeters in a centimeter.



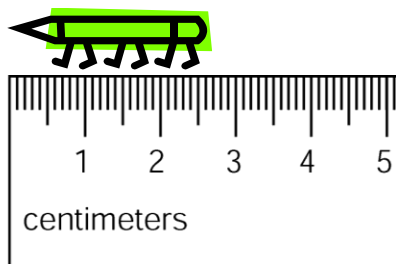
$$1 \text{ cm} = 10 \text{ mm}$$

Using the ruler, determine approximately how long the pencil is in *centimeters*.



Since the major unit shown is centimeters, read the closest whole number. The pencil measures approximately **3 cm (centimeters)**.

Using the ruler, determine approximately how long the pencil is in *millimeters*.



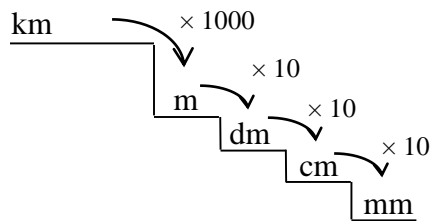
Since 1 centimeter equals 10 millimeters, count 10, 20 up to 2 centimeters, then count in ones. The pencil is approximately **27 mm (millimeters)** long. Zoom in to view a more precise measurement.

Converting Metric Units of Length Using Multiplication

Large Units to Small Units

To express a **larger unit as a smaller unit**, **multiply** by the conversion factor.

The metric units are arranged on the steps in order from largest to smallest.
The conversion factor is beside the arrow.



Solve: $7 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

Using the steps, multiply 7×1000 .

$$7 \text{ km} = 7000 \text{ m}$$

Solve: $5 \text{ cm} = \underline{\hspace{2cm}} \text{ mm}$

Using the steps, multiply 5×10 .

$$5 \text{ cm} = 50 \text{ mm}$$

Solve: $4 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

Using the steps,
multiply $4 \times 10 \times 10$.
(two steps down)

or
multiply 4×100

$$4 \text{ m} = 400 \text{ cm}$$

Solve:
 $9.3 \text{ m} = \underline{\hspace{2cm}} \text{ mm}$

Using the steps,
multiply $9.3 \times 10 \times 10 \times 10$.
(three steps down)

or
multiply 9.3×1000

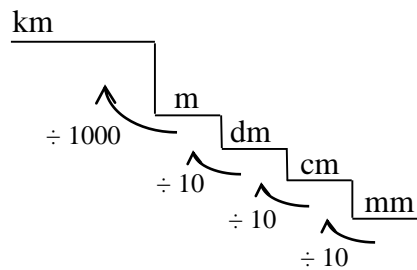
$$9.3 \text{ m} = 9300 \text{ mm}$$

Converting Metric Units of Length Using Division

Small Units to Large Units

To express a **smaller unit as a larger unit**, **divide** by the conversion factor.

The metric units are arranged on the steps in order from smallest unit to largest.
The conversion factor is beside the arrow.



Solve: $9000 \text{ m} = \underline{\hspace{2cm}} \text{ km}$

Using the steps, divide 9000 by 1000.

$$9000 \text{ m} = 9 \text{ km}$$

Solve: $80 \text{ mm} = \underline{\hspace{2cm}} \text{ cm}$

Using the steps, divide 80 by 10.

$$80 \text{ mm} = 8 \text{ cm}$$

Solve: $700 \text{ cm} = \underline{\hspace{2cm}} \text{ m}$

Using the steps,
compute $700 \div 10 \div 10$
(two steps up)

or
compute $700 \div 100$

$$700 \text{ cm} = 7 \text{ m}$$

Solve: $4500 \text{ mm} = \underline{\hspace{2cm}} \text{ m}$

Using the steps,
Compute $4500 \div 10 \div 10 \div 10$.
(three steps up)

or
compute $4500 \div 1000$

$$4500 \text{ mm} = 4.5 \text{ m}$$

Converting Metric Units of Weight

A pair of shoes could weigh a kilogram.

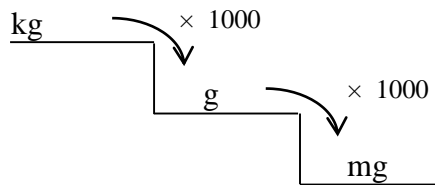


The weight of a cherry is close to a gram.

The weight of a grain of sand is close to a milligram.



To express a **larger unit as a smaller unit**, **multiply** by the conversion factor.



Solve: 3.28 kg = _____ g

Using the steps, multiply 3.28 x 1000.

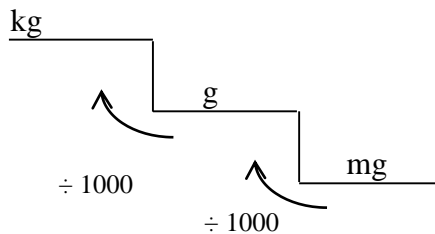
$$3.28 \text{ kg} = 3280 \text{ g}$$

Solve: 6 g = _____ mg

Using the steps, multiply 6 x 1000.

$$6 \text{ g} = 6000 \text{ mg}$$

To express a **smaller unit as a larger unit**, **divide** by the conversion factor.



Solve: 15,000 g = _____ kg

Using the steps, divide 15,000 by 1000.

$$15,000 \text{ g} = 15 \text{ kg}$$

Solve: 500mg = _____ g

Using the steps, divide 500 by 1000.

$$500 \text{ mg} = 0.5 \text{ g}$$

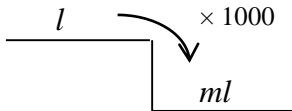
Converting Metric Units of Capacity

A liter is a little more than a quart of milk.



The amount of medicine that is held in a dropper is about one milliliter.

To express a **larger unit as a smaller unit**, **multiply** by the conversion factor.

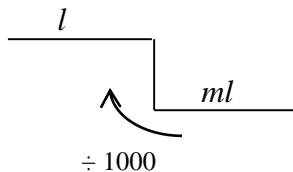


Solve: $5\text{ l} = \underline{\hspace{2cm}}\text{ ml}$

Using the steps, multiply 5×1000 .

$$5\text{ l} = 5000\text{ ml}$$

To express a **smaller unit as a larger unit**, **divide** by the conversion factor.



Solve: $350\text{ ml} = \underline{\hspace{2cm}}\text{ l}$

Using the steps, divide 350 by 1000.

$$350\text{ ml} = 0.35\text{ l}$$