

METRIC SYSTEM OF MEASUREMENT

The metric system of measurement is used in the world of science and medicine. 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.

The metric units of measurement have the same prefixes for different types of units. For example: millimeter is a length unit, milligram is a weight unit, and milliliter is a unit of capacity. They all begin with the prefix, “milli”. We will examine the metric system prefixes and then the metric system conversion tables to see how the metric units are connected.

To measure short lengths in the metric system, we use a metric ruler with millimeter and centimeter divisions. We will review measuring with a metric ruler.

We will convert larger metric units into smaller metric units through multiplication and the metric steps followed by expressing smaller metric units into larger metric units through division and the metric steps. The metric steps show the units in order from largest to smallest, with each unit on a higher step being equivalent to 10 times the smaller unit on the next lower step.

We will look at large metric units of area such as the hectare and small metric units of volume such as the cubic centimeter.

Metric Units

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

Length

Kilometer (km)

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

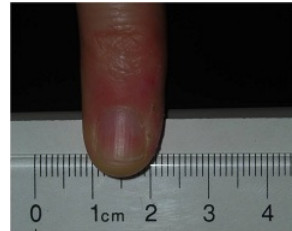


Meter (m)

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

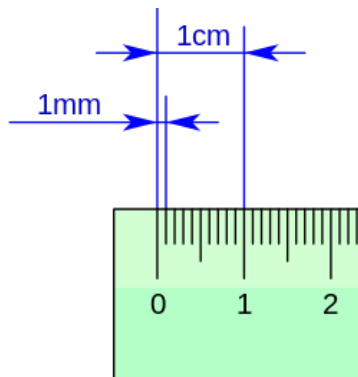
Centimeter (cm)

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.



Weight

Kilogram (kg)

A pair of shoes could weigh a kilogram.



Gram (g)

The weight of a cherry is close to a gram.

Milligram (mg)

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



Capacity



Liter (l)

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

Milliliter (ml)

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



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.

hecto means 100 times the base unit.

hecto + meter means 100 meters.
Thus a hectometer = 100 meters.

hecto + liter means 100 liters.
Thus a hectoliter = 100 liters.

deca + meter means 10 meters.

deca + meter means 10 meters.
Thus a decameter = 10 meters.

deca + gram means 10 grams.
Thus a decagram = 10 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 $\frac{1}{1,000}$ th of the base.

milli + meter means $\frac{1}{1,000}$ of a meter.

Thus, a millimeter is $\frac{1}{1,000}$ of a meter or 1 meter = 1000 millimeters.

milli + gram means $\frac{1}{1,000}$ of a gram

1 gram = 1000 milligrams

milli + liter means $\frac{1}{1,000}$ of a liter

1 liter = 1000 milliliters

Metric System Conversion Tables

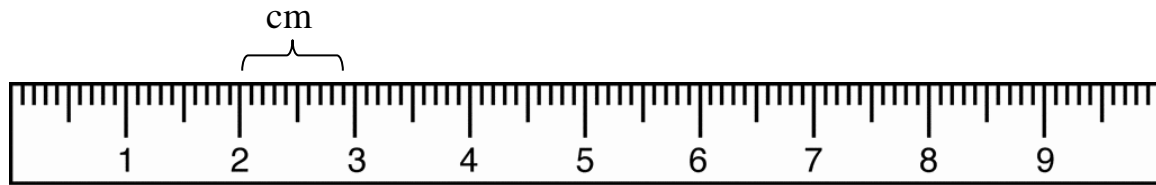
Length	
kilometer (km)	1,000 meters
hectometer (hm)	100 meters
dekameter (dkm)	10 meters
1 decimeter (dm)	$\frac{1}{10}$ m
1 centimeter (cm)	$\frac{1}{100}$ m
1 millimeter (mm)	$\frac{1}{1,000}$ m

Weight	
kilogram (kg)	1000 grams
hectogram (hg)	100 grams
dekagram (dkg)	10 grams
1 decigram (dg)	$\frac{1}{10}$ g
1 centigram (cg)	$\frac{1}{100}$ g
1 milligram (mg)	$\frac{1}{1,000}$ g

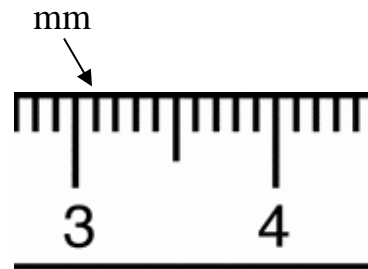
Capacity	
kiloliter (kl)	1000 liters
hectoliter (hl)	100 liters
dekaliter (dkl)	10 liters
1 deciliter (dl)	$\frac{1}{10}$ l
1 centiliter (cl)	$\frac{1}{100}$ l
1 milliliter (ml)	$\frac{1}{1,000}$ l

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. 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.



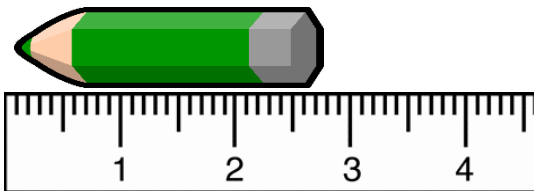
centimeters



1 cm = 10 mm

not actual size

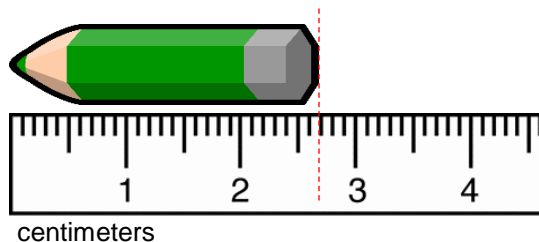
Using the ruler, determine approximately how long the pencil is in **centimeters**.



centimeters

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

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



centimeters

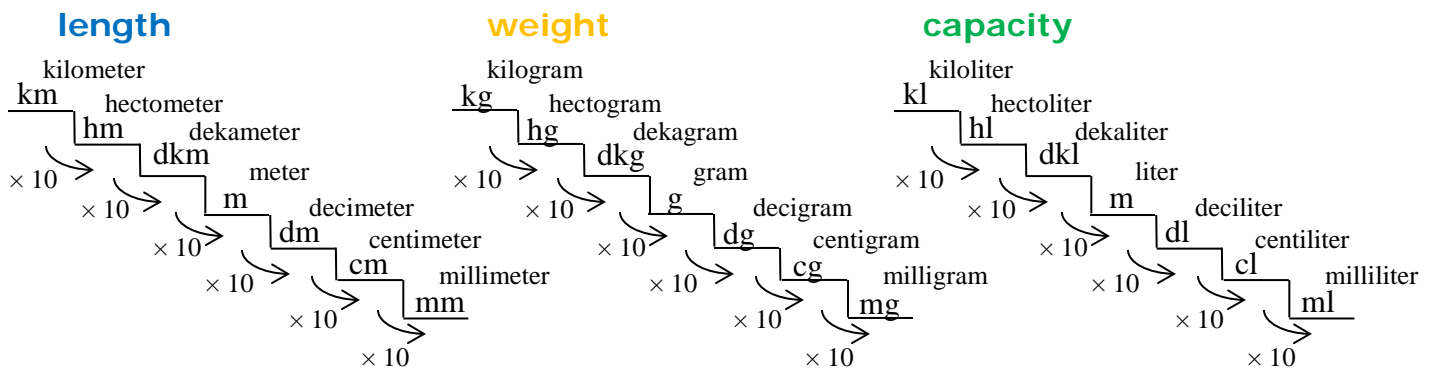
Since 1 centimeter equals 10 millimeters, count 10, 20 up to 2 centimeters, then count in ones. The pencil is approximately **27 mm (millimeters)** long. Zoom in to view a more precise measurement.

Converting Metric Units 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 unit on the top step to smallest unit on the bottom step. The conversion factor is beside the arrow.



Solve: 7 km = _____ m

Using the steps,
 multiply $7 \times 10 \times 10 \times 10$
 (three steps down)
 or
 multiply 7×1000

7 km = 7000 m

Solve: 4.8 g = _____ cg

Using the steps,
 multiply $4.8 \times 10 \times 10$
 (two steps down)
 or
 multiply 4.8×100

4.8 g = 480 cg

Solve: 5 dkl = _____ l

Using the steps, multiply 5×10

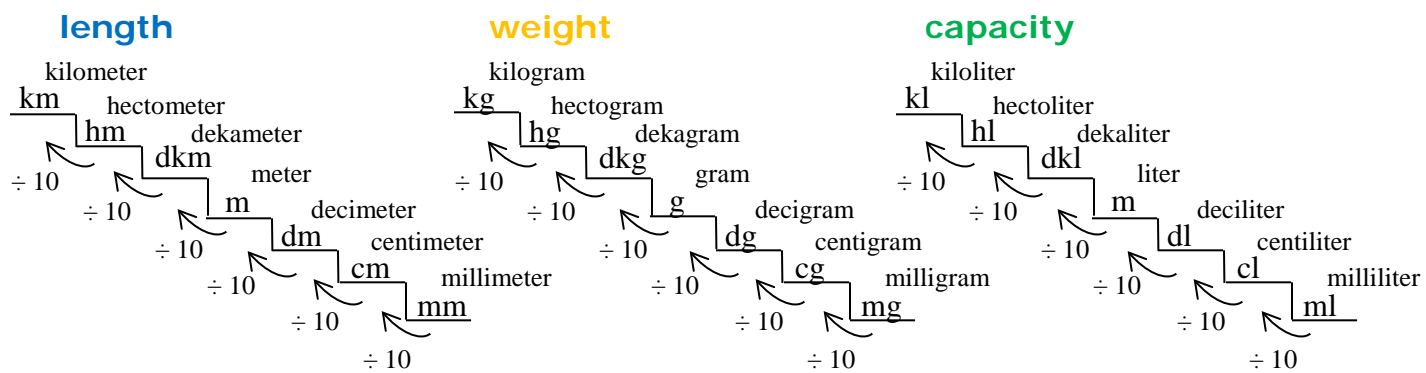
5 dkl = 50 l

Converting Metric Units 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 on the bottom step to largest unit on the top step. The conversion factor is beside the arrow.



Solve: 700 cm = _____ m

Using the steps,
 compute $700 \div 10 \div 10$
 (two steps up)
or
 compute $700 \div 100$

700 cm = 7 m

Solve: 80 mg = _____ cg

Using the steps, divide 80 by 10

80 mg = 8 cg

Solve: 4500 ml = _____ l

Using the steps,
 compute $4500 \div 10 \div 10 \div 10$
 (three steps up)
or
 compute $4500 \div 1000$

4500 ml = 4.5 l

Metric Units of Area

Use the table of metric units of area to find equivalent areas in solving the problems below.

Unit	Abbreviation	Equivalence
square kilometer	sq km or km ²	1 sq km = 1,000,000 square meters
hectare	ha	1 ha = 10,000 square meters
square centimeter	sq cm or cm ²	1 sq cm = 0.0001 square meters

Solve.

2000 square centimeters = _____ square meters

$$\frac{1}{0.0001} = \frac{2,000}{n}$$

Cross multiply.

$$n = 0.2 \text{ square meter}$$

Following the conversion chart, we state square centimeters to square meters on both sides of the proportion.
On the left, we compare 1 sq cm to 1 sq m.
On the right, we compare 2,000 sq cm to “*n*” sq m.
We then cross multiply and divide to solve.

Metric Units of Volume

Unit	Abbreviation	Number of Cubic meters
cubic meter	cu m or m ³	1 cubic meter = 1,000,000 cubic centimeters
cubic centimeter	cu cm or cm ³	1 cubic centimeter = 0.000001 cubic meter

Solve.

500 cubic meters = _____ cubic centimeters

$$\frac{1}{1,000,000} = \frac{500}{n}$$

Cross multiply.

$$n = 500,000,000 \text{ cu cm}$$

Following the conversion chart, we state cubic meters to cubic centimeters on both sides of the proportion.

On the left, we compare 1 cu m to 1,000,000 cu cm.

On the right, we compare 500 cu m to “*n*” cu cm.

We then cross multiply and divide to solve.