

2.8.4: The Metric System



You will NOT need a calculator for this module.

The metric system was first implemented following the French Revolution; if we're overthrowing the monarchy, why should we use a unit of a "foot" that is based on the length of a king's foot?

The metric system was designed to be based on the natural world, and different units are related to each other by powers of 10 instead of weird numbers like 3, 12, 16, and 5, 280... This makes converting between metric units incredibly simple.

kilo- (k)	hecta- (h)	deka- (da)	[base unit]	deci- (d)	centi- (c)	milli- (m)
1, 000	100	10	1	0.1	0.01	0.001
1, 000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1,000}$
10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}

Notice that because deka- and deci- both start with d, the abbreviation for deka- is da.

Metric System: Measurements of Length

The base unit of length is the meter, which is a bit longer than a yard (three feet). Because the prefix kilo- means one thousand, 1 kilometer is 1, 000 meters. (One kilometer is around six tenths of a mile.) Similarly, because the prefix centi- means one hundredth, 1 centimeter is $\frac{1}{100}$ of a meter, or 1 meter is 100 centimeters. (One centimeter is roughly the thickness of a pen.) And because the prefix milli- means one thousandth, 1 millimeter is $\frac{1}{1,000}$ of a meter, or 1 meter is 1, 000 millimeters. (One millimeter is roughly the thickness of a credit card.)

? Exercises 2.8.4.1

From each of the four choices, choose the most reasonable measure.

- The length of a car:
5 kilometers, 5 meters, 5 centimeters, 5 millimeters
- The height of a notebook:
28 kilometers, 28 meters, 28 centimeters, 28 millimeters
- The distance to the next town:
3.8 kilometers, 3.8 meters, 3.8 centimeters, 3.8 millimeters
- An adult woman's height:
1.6 kilometers, 1.6 meters, 1.6 centimeters, 1.6 millimeters
- An adult woman's height:
160 kilometers, 160 meters, 160 centimeters, 160 millimeters

6. The thickness of a pane of glass:
3 kilometers, 3 meters, 3 centimeters, 3 millimeters

Answer

1. 5 m
2. 28 cm
3. 3.8 km
4. 1.6 m
5. 160 cm
6. 3 mm

kilo- (km)	hecta- (hm)	deka- (dam)	meter (m)	deci- (dm)	centi- (cm)	milli- (mm)
1,000	100	10	1	0.1	0.01	0.001
1,000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1,000}$
10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}

To convert metric units, you can simply move the decimal point left or right the number of places indicated in the table above. No calculator required!

? Exercises 2.8.4.1

7. Convert 3.7 meters to centimeters.
8. Convert 3.7 meters to millimeters.
9. Convert 2.45 kilometers to meters.
10. Convert 2.45 kilometers to centimeters.
11. Convert 342 millimeters to meters.
12. Convert 342 millimeters to centimeters.
13. Convert 528 meters to kilometers.
14. Convert 45 centimeters to meters.

Answer

7. 370 cm
8. 3,700 mm
9. 2,450 m
10. 245,000 cm
11. 0.342 m
12. 34.2 cm
13. 0.528 km
14. 0.45 m

Metric System: Measurements of Weight or Mass

The base unit for mass is the gram, which is approximately the mass of a paper clip. A kilogram is 1,000 grams; as we'll see in the next module, this is around 2.2 pounds. The active ingredients in medicines may be measured using the milligram, or possibly the microgram, which we will come back to in a future module. For now, we will focus on the prefixes between kilo- and milli-.

? Exercises 2.8.4.1

From each of the three choices, choose the most reasonable measure.

15. The mass of an apple:
100 kilograms, 100 grams, 100 milligrams
16. The mass of an adult man:
80 kilograms, 80 grams, 80 milligrams
17. The amount of active ingredient in a pain relief pill:
500 kilograms, 500 grams, 500 milligrams
18. The base vehicle weight of a GMC Sierra 1500:
2,000 kilograms, 2,000 grams, 2,000 milligrams

Answer

15. 100 g
16. 80 kg
17. 500 mg
18. 2,000 kg

kilo- (kg)	hecta- (hg)	deka- (dag)	gram (g)	deci- (dg)	centi- (cg)	milli- (mg)
1,000	100	10	1	0.1	0.01	0.001
1,000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1,000}$
10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}

This table is identical to the previous table; the only difference is that the base unit “meter” has been replaced by “gram”. This means that converting metric units of mass is exactly the same process as converting metric units of length; just move the decimal point!

? Exercises 2.8.4.1

19. Convert 0.813 grams to centigrams.
20. Convert 0.813 grams to milligrams.
21. Convert 1.25 kilograms to grams.
22. Convert 1.25 kilograms to milligrams.
23. Convert 960 milligrams to grams.
24. Convert 960 milligrams to centigrams.
25. Convert 1,350 grams to dekagrams.
26. Convert 7.5 centigrams to grams.

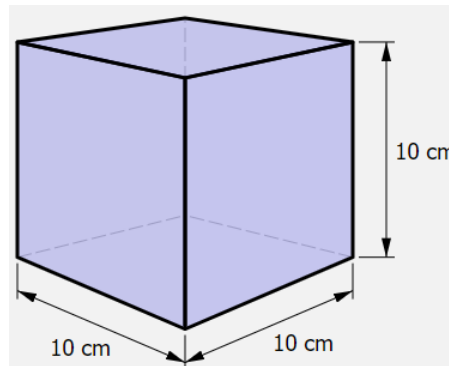
Answer

19. 81.3cg

- 20. 813g
- 21. 1,250g
- 22. 1,250,000mg
- 23. 0.96g
- 24. 96 cg
- 25. 135 dag
- 26. 0.075g

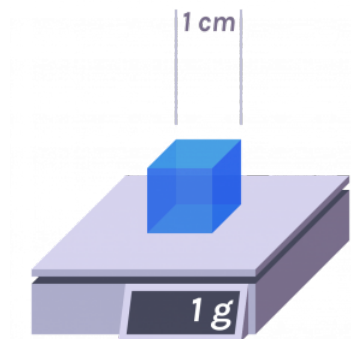
Metric System: Measurements of Volume or Capacity

The base unit of volume is the liter, which is slightly larger than one quart. The milliliter is also commonly used; of course, there are 1,000 milliliters in 1 liter.



1 liter is equivalent to a cube with sides of 10 centimeters.

In case you were wondering, the units of volume, length, and mass are all connected; one cubic centimeter (a cube with each side equal to 1 cm) has the same volume as one milliliter, and one milliliter of water has a mass of one gram.



? Exercises 2.8.4.1

From each of the two choices, choose the more reasonable measure.

- 27. The capacity of a car's gas tank: 50 liters, 50 milliliters
- 28. A dosage of liquid cough medicine: 30 liters, 30 milliliters

Answer

- 27. 50 L
- 28. 30 mL

kilo- (kL)	hecta- (hL)	deka- (daL)	liter (L)	deci- (dL)	centi- (cL)	milli- (mL)
1, 000	100	10	1	0.1	0.01	0.001
1, 000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1,000}$
10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}

Again, this table is identical to the previous tables; just move the decimal point left or right to convert the units.

? Exercises 2.8.4.1

29. Convert 2.8 liters to milliliters.
30. Convert 2.8 liters to deciliters.
31. Convert 15 dekaliters to liters.
32. Convert 0.75 deciliters to milliliters.
33. Convert 600 milliliters to centiliters.
34. Convert 600 milliliters to liters.
35. Convert 4.5 deciliters to liters.
36. Convert 550 centiliters to liters.
37. Flying on IcelandAir, you happen to notice that one mini bottle of booze is labeled 50 mL, but another mini bottle is labeled 5 cL. How do the two bottles compare in size?
38. How many 500-milliliter bottles of Coke^[1] are equivalent to one 2-liter bottle?
39. The engine displacement of a Yamaha Majesty scooter is 125 cc (cubic centimeters), and the engine displacement of a Chevrolet Spark automobile is 1.4 L (liters). What is the approximate ratio of these engine displacements?

Answer

29. 2,800mL
30. 28 dL
31. 150L
32. 75 mL
33. 60 cL
34. 0.6L
35. 0.45L
36. 5.5 L
37. they are equal in size
38. 4 bottles
39. about 11 to 1

1. (Fun fact: in Spanish, a 500-milliliter bottle is called a *medio litro*.) ↩

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