Conversion Fractions

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The table below shows some of the most commonly encountered metric conversions that you may need for your science courses.

Prefix & Effect on Base Unit	Distance	Mass	Volume
mega- (M) = 10^6 × base unit			
kilo- (k) = 10^3 × base unit	1 km = 10^3 m	1 kg = 10^3 g	
BASE UNIT = 1 × base unit	m	g	L
centi- (c) = 10^{-2} × base unit	1 cm = 10^{-2} m		
milli- (m) = 10^{-3} × base unit	1 mm = 10^{-3} m	1 mg = 10^{-3} g	1 mL = 10^{-3} L
micro- (µ) = 10^{-6} × base unit		1 µg = 10^{-6} g	
nano- (n) = 10^{-9} × base unit	1 nm = 10^{-9} m		

NOTE : Each prefix multiplies the base unit by a power of 10.

　　　1 MJ = 10^6 joules, since "mega-" means "× 10^6"

CONVERSION FRACTIONS

Conversion fractions can be used in many contexts to convert one unit to another, such as metric conversions or finding atomic masses.

Example 1: Convert 23.5 m to cm.

Solution: We set up a conversion factor to translate between the unit we have and the unit we want to have.

We _have_ metres. We must set up a conversion fraction with metres and centimetres so that "metres" cancels. The conversion equation is 1 m = 100 cm. Since we want "metres" to cancel, it needs to be on the bottom of the fraction:

$$23.5\,\text{m} \times \frac{100\,\text{cm}}{1\,\text{m}} = 2350\ \text{cm}$$

With the conversion fraction, we'll never forget whether we need to multiply or divide: if a number is in the numerator of the conversion fraction, we multiply, and if it is in the denominator, we divide.

Example 2: Convert 16.4 cm² to m².

Solution: We don't have a direct conversion from cm² to m², but we can still use the same conversion fraction as in the previous question.

$$16.4\,\text{cm}^2 \times \left(\frac{1\,\text{m}}{100\,\text{cm}}\right)^2 = 16.4\,\text{m}^2 \div 100^2 = 1.64 \times 10^{-3}\ \text{m}^2$$

Authored by Gordon Wong

Example 3: There are 5280 feet in a mile, 12 inches in a foot, and according to US law, an inch is exactly 2.54 cm. Convert 12.9 km to miles.

Solution: While we don't have a single way of converting kilometres to miles, we can use multiple conversion fractions to get the job done. Remember that we must cancel any unit that we don't want in the end.

$$12.9 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} = \frac{12.9 \times 1000 \times 100}{2.54 \times 12 \times 5280} \text{ mi} = 8.02 \text{ mi}$$

EXERCISES
A. Convert from one metric unit to another:
1) 1.15 km → m

2) 255 m → km

3) 15 mm → m

4) 45 cm → m

5) 458.3 g → kg

6) 2.34 kg → g

7) 50.0 mL → L

8) 1.5 L → mL

9) 55 mm → cm

10) 70 cm → mm

11) 2.55×10^6 m → km

12) 1500 mm → cm

13) 0.007 m → cm

14) 0.0078 g → kg

15) 15 km → m

16) 25 g → kg

17) 1992 mL → L

18) 1.45×10^{-4} km → m

B. Convert, using the conversion factors provided and proper significant figures:
1) 5.0 yd → cm (3 ft = 1 yd)

2) 34.7 g → lb. (1 kg ≈ 2.204 lb.)

3) 0.72 m³ → L (1 cm³ = 1 mL)

4) 0.50 lb. gold → mL (19.3 g Au ≈ 1 cm³ Au)

5) 3.00 tr.oz. Au → lb. Au (1 tr.oz. ≈ 31.103 g)

6) 2.91 mm³ Au → $ ($1225.54 = 1 tr.oz. Au)

7) €300. → in³ Au ($1 = €0.6287)

8) 2.00 mol Au → $ (1 mol Au ≈ 196.97 g Au)

SOLUTIONS
A. (1) 1150 m   (2) 0.255 km   (3) 0.015 m   (4) 0.45 m   (5) 0.4583 kg   (6) 2340 g
   (7) 0.0500 L   (8) 1500 mL   (9) 5.5 cm   (10) 7.0×10^2 mm   (11) 2.55×10^3 km
   (12) 150.0 cm   (13) 0.7 cm   (14) 7.8×10^{-6} kg   (15) 15 000 m *or* 1.5×10^4 m
   (16) 0.025 kg   (17) 1.992 L   (18) 0.145 m
B. (1) 4.6×10^2 cm [457.2]   (2) 0.0764 lb.   (3) 720 L   (4) 12 mL [11.754417…]
   (5) 0.205 lb.   (6) $2.21   (7) 3.82×10^{-3} in³ Au   (8) $15 500 [$15 522.272…]