

# Chemistry 11

## Notes on the Metric System

The most common Metric prefixes with their symbols and meanings that you will be responsible for are found in the following table;

Name of Prefix	Symbol	Meaning Exponential	Meaning Expanded
exa	E	$10^{18}$	1 000 000 000 000 000 000
peta	P	$10^{15}$	1 000 000 000 000 000
tera	T	$10^{12}$	1 000 000 000 000
* giga	G	$10^9$	1 000 000 000
* mega	M	$10^6$	1 000 000
* kilo	k	$10^3$	1 000
* hecto	h	$10^2$	100
* deca	da	$10^1$	10
* (NO PREFIX)		$10^0$	1
* deci	d	$10^{-1}$	0.1
* centi	c	$10^{-2}$	0.01
* milli	m	$10^{-3}$	0.001
* micro	$\mu$	$10^{-6}$	0.000 001
* nano	n	$10^{-9}$	0.000 000 001
* (Angstrom)	Å	$10^{-10}$ <u>metre</u>	0.000 000 000 1 metre) **
pico	p	$10^{-12}$	0.000 000 000 001
femto	f	$10^{-15}$	0.000 000 000 000 001
atto	a	$10^{-18}$	0.000 000 000 000 000 001

NOTE: You are responsible for each of the prefixes marked with \*.

\*\* NOTE: The Angstrom is an outdated Metric measurement of length. You may still see reference to this improper Metric unit because it is approximately the size of atoms which make it useful.

NOTE: Notice that for Metric prefixes from milli ( $10^{-3}$ ) to kilo ( $10^3$ ), each unit is 10 times bigger than the unit before it. Above kilo and below milli, the units jump in 1000 fold increments.

NOTE: In order to convert from one Metric unit to another, count how many exponential steps are required to get from one unit to another. If you move up the chart, move the decimal place the appropriate number of places to the LEFT. If you move down the chart, move the decimal place the appropriate number of places to the RIGHT.

For example: How many millimetres are there in 0.003 56 hectometres?

Solution: You are converting from "hecto" ( $10^2$ ) to "milli" ( $10^{-3}$ ). This is a difference of 5 exponential steps ( $2 - -3 = 5$ ). Because you are moving down the chart, you will shift the decimal place 5 places to the right. Therefore, the answer is; 0.003 56 hm = 356 mm.

*Some of the rules or standards for use of the Metric System are as follows*

1. Unit symbols are lower case letters (unless named after a person; e.g. °C and Pa named after Celsius and Pascal). An exception to this rule is L for litre, which was made an upper case symbol to distinguish the symbols from the number one (1). The full names of units are always in lower case letters with the only exceptions as mentioned above.
2. A period should not follow the unit symbol ( unless at the end of a sentence).
3. There is no difference between the unit symbol for singular or plural.
4. 1 mL = 1 cm<sup>3</sup> exactly.
5. Metre and litre are spelled with an re . ( Meter refers to a measuring instrument, not a length.)
6. Kilometre should be pronounced in the same manner as kilogram, kilolitre, and kilowatt. The prefix kilo should not be used by itself to refer to a kilogram.
7. The term mass replaces the term weight.
8. A specific temperature and a temperature change both have units of degrees Celsius (°C).
9. Use the unit symbol in preference to words for units; i.e. 10.0 g/mol not 10.0 grams/mole (ten grams per mole is right but not preferred). (Do not use unit symbols without a number; i.e. the # mol, #g, or #L is incorrect without a number.)
10. For values less than one, use a zero in front of the decimal point; i.e. 0.069 5 mol and not .069 5 mol.
11. Use a space (not a comma) to separate sets of three digits to the left and right of the decimal point. The practice is optional where there are only four digits to the left or right of the decimal point.
12. Use decimal fractions (0.5) rather than the common fraction ( $\frac{1}{2}$ ).

## UNITS OF MEASUREMENT

Metric system		
mm	millimeter	.001 m
cm	centimeter	.01 m
dm	decimeter	.1 m
m	meter	1 m
dam	decameter	10 m
hm	hectometer	100 m
km	kilometer	1000 m

Note: Prefixes also apply to l (liter) and g (gram). Canadian preferred spelling: metre, litre.

English system		
1 foot (ft)	= 12 inches (in)	1 tablespoon (T) = 3 teaspoons (t)
	1' = 12"	1 cup (c) = 16 tablespoons
1 yard (yd)	= 3 feet	1 pint (pt) = 2 cups
1 mile (mi)	= 1760 yards	1 quart (qt) = 2 pints
1 sq. foot	= 144 sq. inches	1 gallon (gal) = 4 quarts
1 sq. yard	= 9 sq. feet	16 ounces (oz) = 1 pound (lb)
1 acre	= 4840 sq. yards	1 ton = 2000 pounds
	= 43560 ft <sup>2</sup>	
1 sq. mile	= 640 acres	

## CONVERSIONS

LENGTH / AREA			
to go from	to	multiply by	to go from
cm	→	in	0.3937
m	→	ft	3.2808
km	→	mi	0.6214
m <sup>2</sup>	→	ft <sup>2</sup>	10.76
km <sup>2</sup>	→	mi <sup>2</sup>	0.3861
in	→	cm	2.54
ft	→	m	0.3048
mi	→	km	1.609
ft <sup>2</sup>	→	m <sup>2</sup>	0.0929
mi <sup>2</sup>	→	km <sup>2</sup>	2.59

WEIGHT / CAPACITY			
to go from	to	multiply by	to go from
g	→	oz	0.0353
kg	→	lb	2.2046
t	→	T	1.1023
ml	→	fl oz	0.0338
l	→	gal	0.2642
oz	→	g	28.35
lb	→	kg	0.4536
T	→	t	0.9072
fl oz	→	ml	29.575
gal	→	l	3.785

Temperature	°C → °F: n x 1.8; add 32	°F → °C: (n-32) x 0.555
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Common Units used with the International System					
UNITS OF MEAS.	ABBREV.	RELATION	UNITS OF MEAS.	ABBREV.	RELATION
meter	m	length	degree Celsius	°C	temperature
hectare	ha	area	kelvin	K	thermodynamic temp.
tonne	t	mass	pascal	Pa	pressure, stress
kilogram	kg	mass	joule	J	energy, work
nautical mile	M	distance (navigation)	newton	N	force
knot	kn	speed (navigation)	watt	W	power, radiant flux
liter	L	volume or capacity	ampere	A	electric current
second	s	time	volt	V	electric potential
hertz	Hz	frequency	ohm	Ω	electric resistance
candela	cd	luminous intensity	coulomb	C	electric charge

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## Worksheet for Metric Usage

Convert the following Metric unit into the indicated unit.

- 126 mg = \_\_\_\_\_ g
- 53.6 dag = \_\_\_\_\_ cg
- 1235 Å = \_\_\_\_\_ mm
- 48 Å = \_\_\_\_\_ nm
- 338 mL = \_\_\_\_\_ L
- 0.035 cg = \_\_\_\_\_ mg
- 0.45 L = \_\_\_\_\_ mL
- 86.634 m = \_\_\_\_\_ km
- 0.58 mg = \_\_\_\_\_ µg
- 268.48 nm = \_\_\_\_\_ mm

In each of the following statements, there is AT LEAST one error in Metric System usage. RE-WRITE the entire statement, correcting each of the errors. Refer to the notes sheet on Metric System usage.

11. The recipe called for 1.0 ML of vanilla and 100 c<sup>3</sup>c. of milk. Quick Note: "c.c." is an old term meaning "cubic centimetre".

12. Trevor's temperature dropped by .9 c° ( from 39.2 ° celsius to 38.3 degrees Centigrade in 12 hr.)

13. The car accelerated from rest to 100 Km. per hour in 10 sec.

14. The weight of 1 Ml of water is exactly 1 gm.

15. The package was marked as containing 500 gms of spaghetti.

16. The height of the precipitate in the test tube was  $2\frac{1}{2}$  c.m.

17. Cameron calculated that, if the molar weight of calcium carbonate was 100 g/mol, then the number of mol in 0.543 gms was .00543 mols.