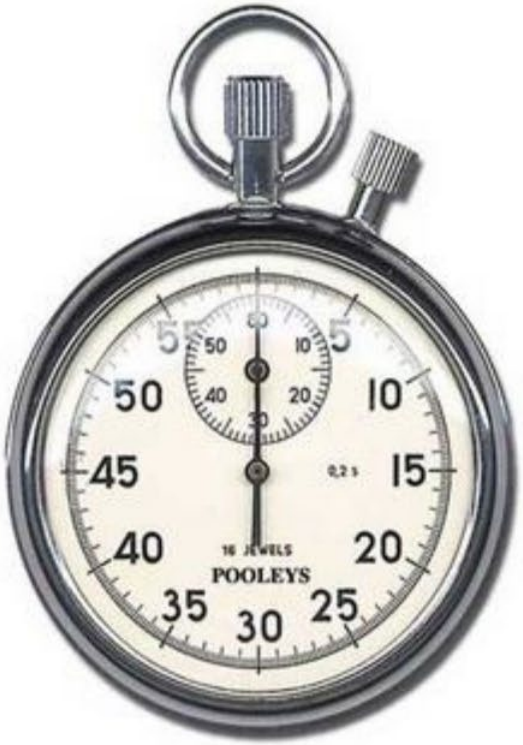
Science 10 Unit B - Physics

Measurement and Metric Prefixes / Scientific Notation, Sig. Digs



Measurement - The Metric System

The metric system was devised in the late 18th century by a group of french scientists lead by chemist Antoine Lavoissier.

Their hope was to create a standard set of units for scientific measurements.

The metric system spread to Canada in the mid 70's under Prime Minister Trudeau. It was a slow transition over from the British Imperial System and was more or less completed in 1984.

Most other countries also converted, with the exception of Liberia, Myanmar and the United States.

The metric system is comprised of 7 base units:

1. metre - (unit of length) Is the distance traveled by light in a vacuum during a time interval of 1/2997294858th of a second.

The original platinum-iridium alloy metre and kilogram.

2. kilogram - (unit of mass) A unit of mass equal to the mass of the international prototype kilogram in Sevres, France.

3. **second** - (unit of time) based on the decay of a cesium-133 atom.

4. **Ampere** - unit of electric current

5. **Kelvin** - unit of temperature

6. **Candela** - unit of luminous intensity

7. **Mole** - unit of amount of substance

For now, we will deal mostly with the metre, kilogram and second.

Prefixes

To express larger or smaller amounts of these base units, we use prefixes.

A System of Prefixes

Prefix	Symbol	Factor by Which Base Unit is Multiplied	
exa	E	1 000 000 000 000 000 000	$= 10^{18}$
peta	P	1 000 000 000 000 000	$= 10^{15}$
tera	T	1 000 000 000 000	$= 10^{12}$
giga	G	1 000 000 000	$= 10^{9}$
*mega	M	1 000 000	$= 10^{6}$
*kilo	k	1000	$= 10^{3}$
hecto	h	100	$= 10^{2}$
deca	da	10	$= 10^{1}$
deci	d	0.1	$= 10^{-1}$
centi	c	0.01	$= 10^{-2}$
*milli	m	0.001	$= 10^{-3}$
*micro	μ	0.000 001	$= 10^{-6}$
nano	n	0.000 000 001	$= 10^{-9}$
pico	p	0.000 000 000 001	$= 10^{-12}$
femto	f	0.000 000 000 000 001	$= 10^{-15}$
atto	a	0.000 000 000 000 000 001	$= 10^{-18}$

*most commonly used

Working with prefixes:

ex) Convert.

1.4 cm = _____ m

Step 1: Find the prefix on your conversion chart.

Prefix	Symbol	Factor by Which Base Unit is Multiplied
centi	c	0.01 $= 10^{-2}$

Step 2: When moving to the base unit, multiply by the factor shown on the chart.

Alternate Method: As the exponent is 2, move the decimal two places to the left.

ex) Convert.

12 m = _____ mm

Step 1: Find the prefix on your conversion chart.

Prefix	Symbol	Factor by Which Base Unit is Multiplied
*milli	m	0.001 $= 10^{-3}$

Step 2: When moving from the base unit, divide by the factor shown on the chart.

Alternate Method: As the exponent is 3, move the decimal three places to the right (as a mm is smaller than a m)

Practice: Convert.

1) 48 mm = _____ m

2) 10 cm = _____ hm

3) 1.2 GL = _____ L

4) 25 nm = _____ mm

5) 25000 mg = _____ kg

Derived Units

Derived units are made up from two or more base units.

ex) km/h ↗ **velocity**

m/s ↑ **velocity**

m/s^2 ↖ **acceleration**

The most common conversion here is between km/h and m/s:

To convert from m/s to km/h, multiply by 3.6.
To convert from km/h to m/s, divide by 3.6.

Question!

Why 3.6?

Well, think of 1 km/h:

$$\frac{1\text{ km}}{1\text{ hour}} = \frac{1000\text{ m}}{60\text{ min}} = \frac{1000\text{ m}}{3600\text{ s}} = \frac{1\text{ m}}{36\text{ s}}$$

oh, that's where it came from...

ex) Convert the following (from workbook)

a) 24Km = _____m

b) 3.5h = _____min

c) 126min = _____h

d) 4138m = _____Km

e) 2.25h = _____s

Scientific Notation

In physics, we often study very large or very small numbers. For simplicity, these numbers are often converted to scientific notation using fewer digits and an exponent.

In this course we will use the form

$$L \times 10^{d}$$

where: $1 \leq L < 10$

d is a whole number integer (+ive or -ive)

ex) 125000 = 1.25×10^{5}

standard form

scientific notation

ex) 0.0000421 = 4.21×10^{-5}

standard form

scientific notation

Moving the decimal to the left gives a positive exponent, moving to the right gives a negative exponent.

ex) The speed of light is ~300 000 000 m/s. What is this value in scientific notation (expressed with one digit)?

ex) The radius of the Earth is 6.37×10^6 m . Express this value in standard notation (in metres).

ex) Express the answer from the previous example in kilometres using scientific notation.