Measurement and conversions

- Have fun.

SI units of measurement

- The International System of Units (SI)
- Standard of measurement used in science
- Revised version of the metric system
- Units based on 10
- Seven base units
- Derived units, such as volume, density etc.

Base units

- Gram - the measure of mass, the amount of matter (size of a small paperclip)
- Meter – the measure of length (one large step)
- Liter – the measure for volume, how much space something takes up

Prefixes that change the value

Prefix	Symbol	American Scale	Value(Powers of 10)	Value(Decimal)
tera	T	Trillion	10^12	1,000,000,000,000
giga	G	Billion	10^9	1,000,000,000
mega	M	Million	10^6	1,000,000
kilo	k	Thousand	10^3	1,000
hecto	h	Hundred	10^2	100
deca	da	Ten	10^1	10
(none)	(none)	One	10^0	1
deci	d	Tenth	10^-1	0.1
centi	c	Hundredth	10^-2	0.01
milli	m	Thousandth	10^-3	0.001
micro	μ	Millionth	10^-6	0.000001
nano	n	Billionth	10^-9	0.000000001
pico	p	Trillionth	10^-12	0.000000000001

KHDMDCM

- Kilo (k)- 1000
- Hecto (h)- 100
- Deka (da)- 10
- Meter, (g, l) (base) - 1
- Deci (d)– 0.10
- Centi (c) 0.01
- Milli – (m) 0.001

- King Henry Died Monday Drinking Chocolate Milk!

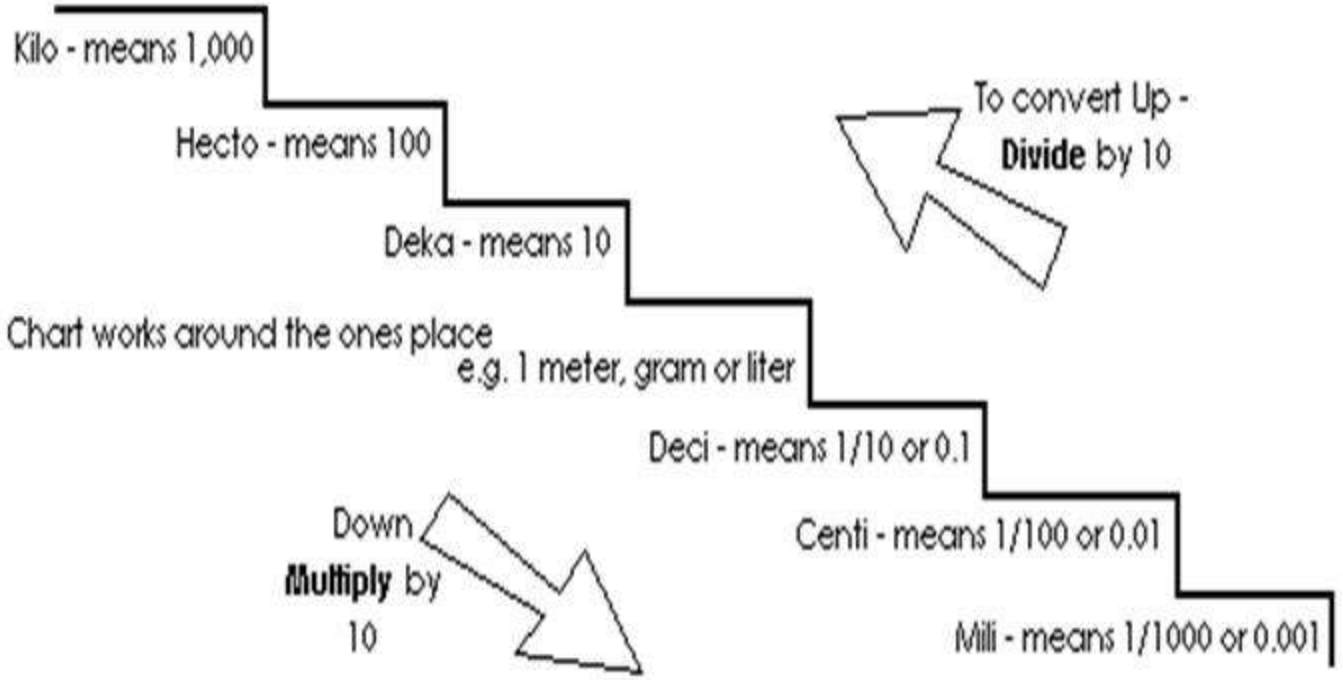
What unit would I use to measure:

- The length of your desk?
- The height of the ceiling?
- The amount of water in a swimming pool?
- The mass of a pushpin?
- The mass of a person?
- The amount of water in a fish tank?

Converting from one unit to another

- Makes huge numbers make more sense
- Makes extremely small numbers make more sense

Converting from one unit to another



Examples

- Convert 2 meters into centimeters
- Ask yourself, will my answer be a bigger or smaller number?
- KHDMDCM – this is our start point. We want to get to KHDMDCM. I need to move 2 spaces to the right. I therefore multiply by 10 2 times or just move the decimal place two spaces to the right.

Significant Figures in measurement

- In Science, measurement should be accurate and precise
- Accuracy – close to the accepted value or the target
- Precision – the closeness of repeated measurements. The more significant figures, the higher the precision, ex: 4.02, and 4.0231.

- High accuracy, low precision

- Low accuracy, high precision

Why is this important?

- Significant figures were created to help scientists determine how they should round off their answers. By using significant figures, scientists ensure that their results don't appear to have more precision than their measuring devices (ex: area of swimming pool)
- Precise measurement of time are also important in sports. Just ask Phelps and Cavic (50.58 to 50.59)
- Phelps-video

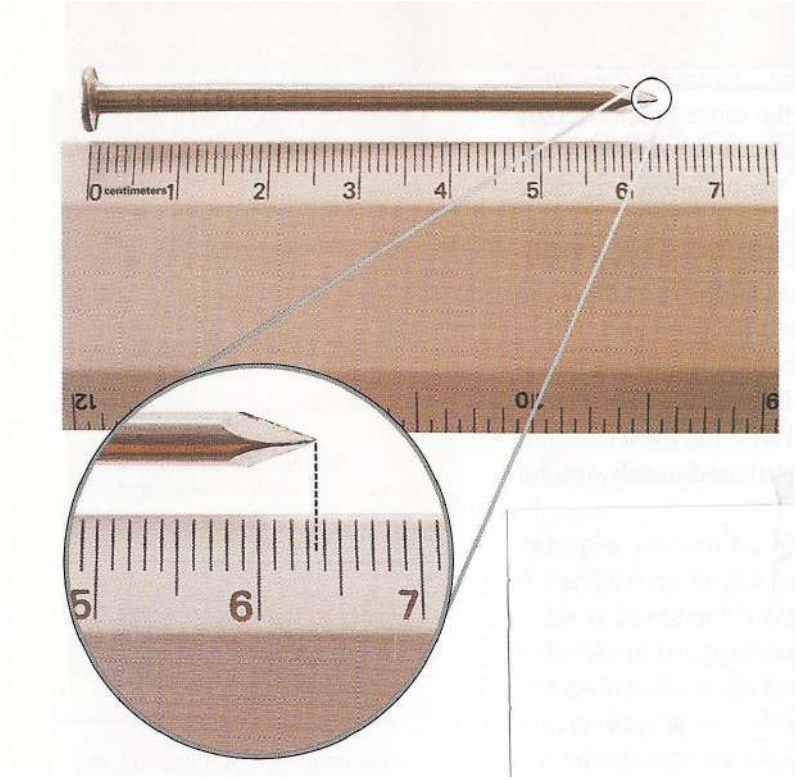
Significant Figures in measurement

- The valid digits in a measurement are called significant digits. Measurements are made with measuring tools that have a calibrated scale.
- The last digit given for any measurement is the uncertain or estimated digit. It is uncertain because it is estimated.

Measuring to a significant figure (precision)

- Contain all digits that are known precisely plus one last digit that is estimated

- How long is the nail?



Significant figures in a measurement

- Which digits in a measurement are significant?
- Every nonzero digit
- Certain zeros are significant
- See chart

TABLE 2-5 *Rules for Determining Significant Zeros*

Rule	Examples
1. Zeros appearing between nonzero digits are significant.	a. 40.7 L has three significant figures. b. 87 009 km has five significant figures.
2. Zeros appearing in front of all nonzero digits are not significant.	a. 0.095 897 m has five significant figures. b. 0.0009 kg has one significant figure.
3. Zeros at the end of a number and to the right of a decimal point are significant.	a. 85.00 g has four significant figures. b. 9.000 000 000 mm has 10 significant figures.
4. Zeros at the end of a number but to the left of a decimal point may or may not be significant. If a zero has not been measured or estimated but is just a placeholder, it is not significant. A decimal point placed after zeros indicates that they are significant.	a. 2000 m may contain from one to four significant figures, depending on how many zeros are placeholders. **For measurements given in this text, assume that 2000 m has one significant figure.** b. 2000. m contains four significant figures, indicated by the presence of the decimal point.

How many significant figures are in each or the following measurements?

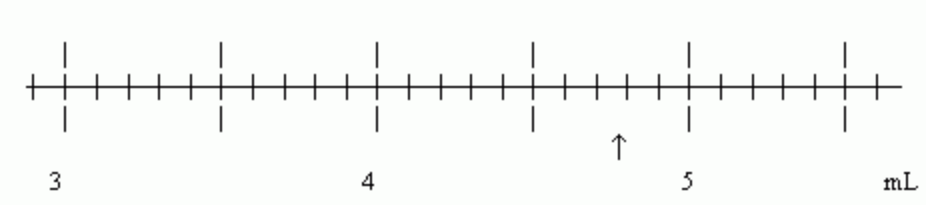
- 123 m
- 0.123 cm
- 9.80
- 22.80
- 0.07080 m

Practice

Each of five students used the same ruler to measure the length of the same pencil. These data resulted: 15.33 cm, 15.34 cm, 15.33 cm, 15.33 cm, 15.34 cm. The actual length of the pencil was 15.85 cm. Describe whether accuracy and precision are each good or poor for these measurements.

Measure the following to a significant figure

- Using the ruler below, record the position of the arrow to the nearest mL. Show the correct number of significant figures.



Measure each object to a correct significant figure with different rulers