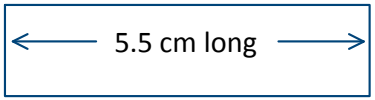
Exact numbers:

Measurements:

length:



Team A:	Team B:	Team C:
5.6 cm	5.68 cm	5.49 cm
5.5 cm	5.66 cm	5.51 cm
5.4 cm	5.67 cm	5.50 cm

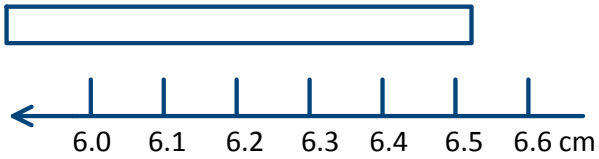
Averages:

Quality of measurements:

Accuracy: "correctness" - how close to "true" value

Precision: "repeatability" - how close a group of values are to each other

Precision is usually dependent on how many marks are on the measuring device.



Every metric measurement has exactly one

Significant figures: used to track uncertainty through calculations

10.0 cm / 3 =

Which digits in a measurement are significant?

1. All nonzero digits are significant
   a. 23.48 cm
   b. 1.22 cm
2. Leading zeroes (to left of nonzero digits) are never significant
   a. 0.00281 cm
   b. 0.000281 cm
3. Trapped zeroes (interior) are always significant
   a. 0.002081 cm
   b. 0.03002005 cm
4. Trailing zeroes (to right of nonzero digits) are significant **IF** there's a decimal point anywhere in the measurement
   a. 0.0050 cm
   b. 48000.0 cm
   c. 48000. cm
   d. 48000 cm

Rounding reduces the number of sig figs in a measurement.

421.38 cm → round to 4 s.f.

look at 1 digit to right of last sig fig:
0-4 round down
5-9 round up

922.248 cm → round to 4 s.f.

5497 cm → round to 2 s.f.

5497 cm → round to 3 s.f.

Scientific notation: • used to easily report very small or very large numbers

• always clearly shows any desired number of significant figures (never ambiguous)

x $10^{\square}$

10^0 =

10^1 =

10^2 =

10^3 =

2.00 x 10^2 =

2.000 x 10^2 =

5500 =

9.78 x 10^3 decimal →

1.34 x 10^{-2} decimal →

0.000 013 8 sci →

To use scientific notation on your calculator, you must use the [E] [EE] or [EXP] key.

To enter 1.38×10^5 :

To enter 2.551×10^{-3} :

text calculator:

numeric calculator:

1. Multiplying or dividing:
   a. find the value with the fewest sig figs
   b. round answer to that number of sig figs

You travel 20.0 miles in 3.0 hours. What is your average speed in miles per hour?

100.00 cm / 5 pieces =

4.873×10^2 cm x 9.2×10^{-4} cm =

2. Adding and subtracting:
   a. Find the value with the fewest number of decimal places (numbers to right of decimal point)
   b. Answer is rounded to that number of decimal places

142.1 cm + 2.108 cm + 28.32 cm =

Answer limited by

Multiplying or dividing

Adding or subtracting

Only round **once** at the end of a series of calculations!

Keep track of significance in intermediate calculations by underlining the last significant digit.

$$\frac{14.3\ \text{g} + 125\ \text{g}}{1.3\ \text{cm} \times 2.86\ \text{cm}} =$$

On your own...

(17.236 - 17.1) x (2.338 x 1.53) =

The **SI units** are a part of the metric system.

English system: feet, inches, pounds, etc.

Basic SI units:

length: meter (m)
mass: kilogram (kg)
temp: kelvin (K)

mass: measure of the amount of matter present
measured on a

weight: amount of gravitational force
measured on a

kg (SI unit):

g (gram):

SI prefixes change the size of a unit by a power of 10

prefix	abbrev.	power of 10 (definition)
kilo	k	$10^3 = 1000$
centi	c	$10^{-2} = 1/100 = 0.01$
milli	m	$10^{-3} = 1/1000 = 0.001$

1 kg = ____ g = ____ g

1 cm = ____ m = ____ m

1 m = ____ cm = ____ cm

1 mL = ____ L = ____ L

1 L = ____ mL = ____ mL

0.1234 m

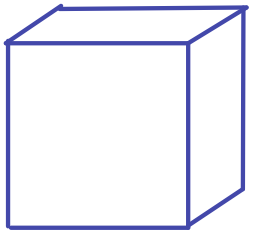
= _____ dm

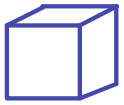
= _____ cm

= _____ mm

($d = 10^{-1}$)
$c = 10^{-2}$
$m = 10^{-3}$

Volume is the amount of space occupied





Dimensional analysis is a process of unit conversion that works by cancelling unwanted units.

Say you're throwing a party. You prepare for:

15 guests

3 drinks per guest

In dimensional analysis, we use:
- 1 single given value to start with
- conversion factors
  - 2 units "per"
  - equation (2.54 cm = 1 in)

Start with the single value…

…then mult. by conversion factor fraction so original unit cancels.

Dimensional analysis

43.2 m = ? cm

remember…
$k = 10^3$
$c = 10^{-2}$
$m = 10^{-3}$

217 in = ? km (start with a roadmap)
Give the answer with the correct number of sig figs and in scientific notation.

Density

Density is the amount of mass per unit volume

$$D = \frac{\text{mass}}{\text{volume}}$$

An object has a mass of14.3 g and a volume of 9.8 mL. What is its density?

Density is an **intensive property** (it does not depend on quantity.) So, it can be used to identify substances.

Substance	Density
gold	19.3 g/mL
mercury	13.6 g/mL
water	0.997 g/mL
air	0.00130 g/mL = 1.30 g/L

Density as a conversion factor

Density is **THE** conversion factor between mass and volume.

What volume Hg has a mass of 4.86 g?
The density of Hg is 13.6 g/mL.

If you have 9.48 L Hg, what is its mass in grams?

Conversion practice

An object has a mass of 12.1 kilograms and a density of 4.5 g/mL. What is the volume of this object in fluid ounces? (1 fl oz = 29.57 mL)