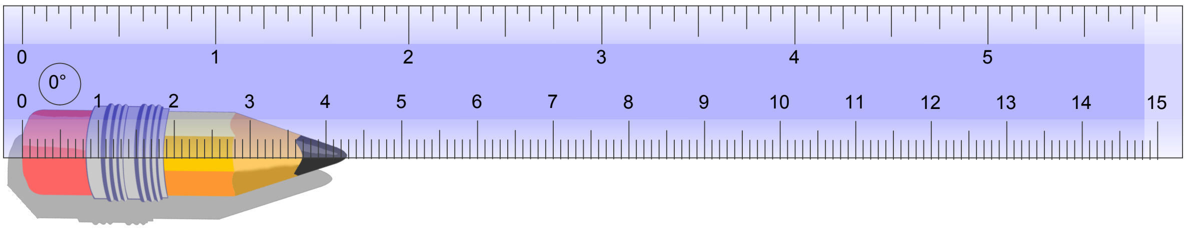
Tumble Buggy Speeds...

Dynamics Cart Speeds...

Working with Measurements in Science

→ in science our numbers cannot be exact

→ we never express measurements as exact values. (Measurements from last class.)



Errors in Measurements: This is what makes our measurements *not* exact.

(1) Parallax

→ an error caused by reading a scale from an incorrect position

→ ex, using a m-stick, measuring cup

→ reduce parallax by taking the measurement from directly in front of the scale

(2) Systematic Error

- causes the same amount of error each time you take a measurement
- ex. a needle on an ammeter that does not start at zero
- fix it by adding/subtracting the known error

(3) Random Error

- causes a different error each time you take a measurement
- ex. reaction time
- reduce it by repeating the measurement and use an average

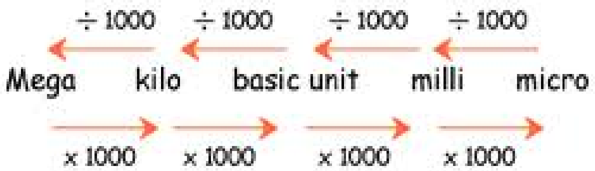
Metric Prefixes

- used to describe big or small units.

Base units:
metre (m)
gram (g)
second (s)

Table 3.2 Metric Prefixes

Prefix	Symbol	Multiple/Fraction
giga-	G	$1{,}000{,}000{,}000 = 1 \times 10^{9}$
mega-	M	$1{,}000{,}000 = 1 \times 10^{6}$
kilo-	k	$1{,}000 = 1 \times 10^{3}$
	Basic unit: meter, gram, liter, second	
deci-	d	$0.1 = 1 \times 10^{-1}$
centi-	c	$0.01 = 1 \times 10^{-2}$
milli-	m	$0.001 = 1 \times 10^{-3}$
micro-	µ*	$0.000\ 001 = 1 \times 10^{-6}$
nano-	n	$0.000\ 000\ 001 = 1 \times 10^{-9}$



http://physics.nist.gov/cuu/Units/index.html

Practice..

5m = cm

75mm = cm

974cm = m

467ml = l

46mg = g

8500mm = m

5467cm = m

2m = cm

87cm = mm

980mm = cm

56cm = mm

1m = mm

100km/h = m/s

100km/h = m/s

Scientific Notation

* we use it in science for very big or small numbers.

382 000 000 m

0.070 A

3.00×10^{8} m/s

9.11×10^{-31} kg

Significant Digits

When working with measured quantities in the sciences, particularly in Physics and Chemistry, is important to follow the conventions about how to round answers. In order to do this correctly, you have to know**how many digits in a number are significant**

Rules for Deciding How Many Digits in a Number are Significant:

All non-zero digits in a number are significant.

Zeros between other digits are significant.

Zeros at the end of adecimal value are significant.

Zeros at the beginning of a number are NOT significant.

All counted quantities are exact.

How many significant digits?

200g

0.20m

0.205 km

120.6 km/h

16 ducks

100 km/h

152 cm

45.2 cm/s

Multiplying and Dividing

RULE: When multiplying or dividing, your answer may only show as many significant digits as the measurement showing the least numbe of significant digits.

22.37 cm x 3.10 cm x 85.75 cm = 5946.50525 cm^3

Our answer can only show 3 significant digits because 3.10 has the least number of significant digits in the original problem (3).

5946.50525 shows 9 significant digits, we must round to show only 3 significant digits.

Our final answer becomes 5950 cm^3.

Adding and Subtracting

RULE: When adding or subtracting your answer can only show as many decimal places as the measurement having the fewest number of decimal places.

Example: When we add 3.76 g + 14.83 g + 2.1 g = 20.69 g

We look to the original problem to see the number of decimal places shown in each of the original measurements.

2.1 shows the least number of decimal places (1 decimal place).

We must round our answer, 20.69, to one decimal place. Our final answer is 20.7 g

Answer with the correct number of significant digits.

$(0.32)(14.50)(120) =$

$(24.1)/(0.005) =$

0.032m + 2.57m =

120.5km -75.25km =

Practice:

How many significant digits?

245 m

37.60 s

0.001205 g

Calculate and round to the right number of significant digits:

125.04 + 34.993 =

20.2 / 10.1 =