Lab Activity #1 Math & the Calculator

Recap

Two types of numbers

- Measured has uncertainty in value
- Exact have no uncertainty
  - * Definitions
    Equalities 1 ft = 12 in
    1 m = 100 cm
  - * Counted values
    Whole number values that cannot be divided into fractions
- Uncertainty estimation in calculations
  System for estimating uncertainty in a calculation result is called Significant figures (Significant Digits)

Significant figures

- Simplified model for estimating uncertainty both in a measurement & a calculation.

- Tells how many of the digits in a measurement are important to the measurement or the calculation result. Tells where the uncertainty lies.

- It's all about the zero's

  Sometimes zeros are part of measurement & sometimes they are just placeholders for value.

1 Rule

Zeros that are placeholders for value are **not** Significant

(A value written in proper Scientific notation
- all digits are significant
- there are no placeholders in scientific notation)

Standard Rules

- All non-zero digits are Significant

1.732 m	4 sig figs
3.71 ft	3 sig figs
4,562 L	4 sig figs

- Any zero between non zero digits is significant (Captive zeros)

	Sig figs
1.02 mL	3
7003.1 gal	5
10.023 ft	5

- A zero to the left of non-zero is a placeholder & is not Significant.
  - leading zeros

			Sig figs
0.00321 s	=	3.21×10^{-3} s	3
0.064 mL	=	6.4×10^{-2} mL	2
0.00007 in	=	7×10^{-5} in	1
0.03026 J	=	3.026×10^{-2} J	4

- A zero to the right of the decimal & to the right of non-zeros is significant & part of the measurement

  - Trailing Zeros

	Significant figures	
7.600 m	4	7.600×10^{0}
100.0 km	4	1.000×10^{2}
30.6200 s	6	3.06200×10^{1}

what happens if zeros removed?

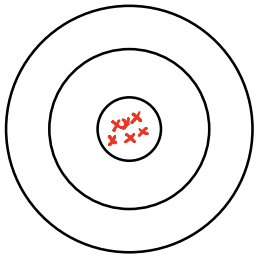
$7.600 \times 10^{0} \rightarrow 7.6 \times 10^{0}$

$1.000 \times 10 \rightarrow 1 \times 10^{2}$

$3.06200 \times 10^{0} \rightarrow 3.062 \times 10^{1}$

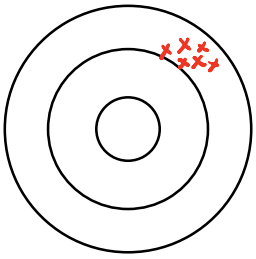
Because the value does not change by removing these zeros, they were only included because they were part of the measurment

Accuracy vs. Precision



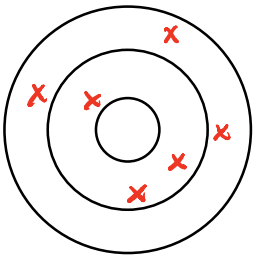
6 measurments all agree & on target

- Measurements agree with each other - Precise
- Measurements close to actual value - Accurate



6 measurments all agree but off

- Precise
- not accurate



6 measurments all off but average to correct value

- not precise
- but accurate

- Zeros to the left of the decimal & to the right of non-zero values.
  - These are placeholder zero's

			Sig Figs
13,000 ft	=	1.3×10^4 ft	2
2,160 m	=	2.16×10^3 m	3
760,000 km	=	7.6×10^5 km	2

13,000 → 13 (Significant to value) 13,000 vs 13 not the same value

1.6200 → 1.62 (Significant to the precision) 1.6200 vs 1.62

decimal form	Scientific not.	Sig figs
13,000	1.3×10^4	2
	1.30×10^4	3
	1.300×10^4	4
	1.3000×10^4	5

Textbook

13,000 place holders & 2 sig figs

13,000. 5 sig figs

↑ treat as non-zero

if you want 3 or 4 sig figs use sci not.

1.30×10^4 3 sf

1.300×10^4 4 sf

Examples	sci not	SF
0.00620	6.20×10^{-3}	3
10.02	1.002×10^{1}	4
3.6007	3.6007×10^{0}	5
1390	1.39×10^{3}	3
1620.0	1.6200×10^{3}	5
1200	1.2×10^{3}	2
1200.	1.200×10^{3}	4
1.6900×10^{3}		5

Leading placeholder ×

Trailing

Captive precision between nonzeros } Significant

placeholders

Placeholder ×

Rules for Sig figs in Mult & Div

Round the answer to the smallest # of sig figs

$$1.62\,m \times 3.2\,m = 5.184\,m^2$$

(3 sig figs) × (2 sig figs) → 2 sig figs

$$= \boxed{5.2\,m^2}$$

$$\frac{10.72\,m \times 15.6\,m}{3.1\,m} = 53.945806451\,6\,m$$

(4 sig figs) × (3 sig figs) / (2 sig figs) → 2 sig figs

$$= \boxed{54\,m}$$

Add & Subtraction Rule

	$0.1620\,m$	± 0.0001		4 sf
⇒	$10.62\,m$	± 0.01	least precise	4 sf
+	$3.102\,m$	± 0.001		4 sf
	13.8840			

$$\boxed{13.88\,m}$$ 4 SF

$$136.1\ m \times 5\ m = 680.5\ m^2$$

$$700\ m^2$$ 1 sf

$$7 \times 10^2\ m^2$$