Scientific Notation

A shorthand method of displaying very large (distance to the sun) or very small numbers (lengths of atoms).

Consists of a coefficient, a base 10, and an exponent

e.g. 3.95×10^3

The coefficient must be between 1 and 10 or it is not in scientific notation.

If the exponent is positive (such as above), the number will be large (greater than 1).

If the exponent is negative, the number will be small (less than 1).

Express in Scientific Notation

3756 = 3.756×10^3

0.000493 = 4.93×10^{-4}

Express in Standard Notation

5.21×10^4 = 52100

.0000 2.694×10^{-5} = 0.00002694

Put in scienfic notaon

1. 8720000 = 8.72×10^6
2. 0.0000513 = 5.13×10^{-5}
3. 5302 = 5.302×10^3
4. 0.00117 = 1.17×10^{-3}

Put in standard notaon

1. 7.03×10^{-2} = 0.0703
2. 1.38×10^{4} = 13800
3. 3.99×10^{-5} = 0.0000399
4. 2.781×10^{7} = 27810000

Write in Scientific Notation - Answers

1. $34.79 \times 10^{3} = 3.479 \times 10^{4}$
2. $0.497 \times 10^{6} = 4.97 \times 10^{5}$
3. $19.5 \times 10^{-2} = 1.95 \times 10^{-1}$
4. $0.837 \times 10^{-4} = 8.37 \times 10^{-5}$

Accuracy
&
Precision

Accuracy

Depicts how close a measured value is to the actual value

EX. If you weigh 150 lbs. But the scale reads 130 lbs., the scale is not accurate.

Precision of a single measurement

A term used to depict how many decimal places (place values) you can acquire from a measuring device

If scale 1 reads 142.6 lbs and scale 2 reads 143 lbs, then scale 1 is more precise – it has smaller measuring increments (tenths compared to ones)

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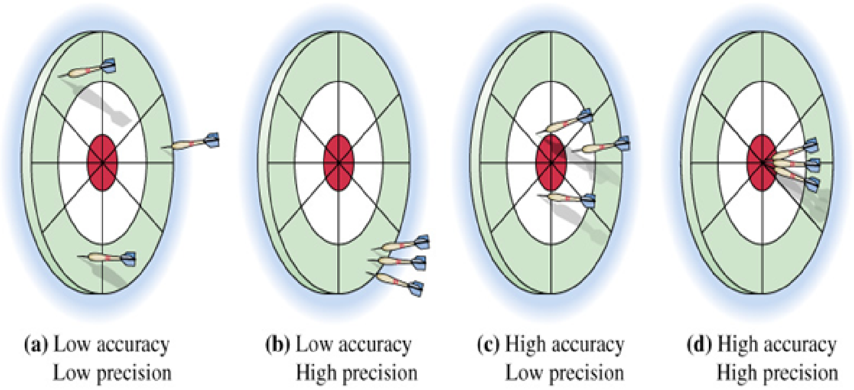
Precision of multiple measurements

Precision can be used to describe reproducible measurements as well

Ex. You weigh the same piece of zinc on a scale 3 times, and you get 7.60, 7.61, and 7.59 grams. the scale is precise (it gives reproducible results).

Suppose you are shooting for the bullseye!



RESULTS NOT ACCURATE OR REPRODUCIBLE

RESULTS INACCURATE BUT REPRODUCIBLE

RESULTS ACCURATE BUT NOT REPRODUCIBLE

ACCURATE AND REPRODUCIBLE

Significant Figures

When counting objects we can find an exact number that's indisputable (100% accurate)

eg numbers of students in class

number of books on a shelf

Significant Figures

When measuring quantities you are always limited by the precision of the measuring device (what place value it can measure to).

The precision can always be better (to infinity), thus you can never get a completely accurate, indisputable measurement

eg length of classroom, mass of person

For example, measure the length of the arrow using the ruler:

You couldn't say the measurement was 28.7492743. There's a limit to the amount of digits in your measurement that are meaningful.

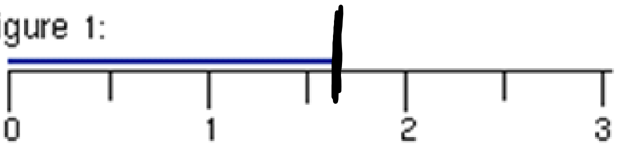
Significant Figures

A significant figure (or significant digit) is a measured or meaningful digit.

Significant figures (or “Sig figs”) are the digits known to be exact **plus one more that may have some uncertainty but is an educated guess**

How long is each line?

Figure 1:



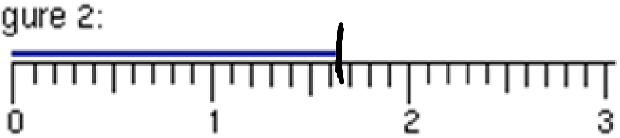
1.6

2 sig Figs

How long is each line?

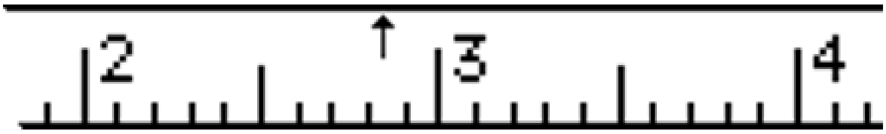
1.62

Figure 2:



3 sig figs

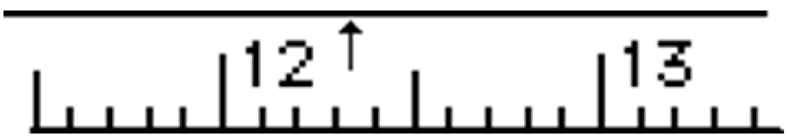
What is the length on this ruler?



2.85

3 sf

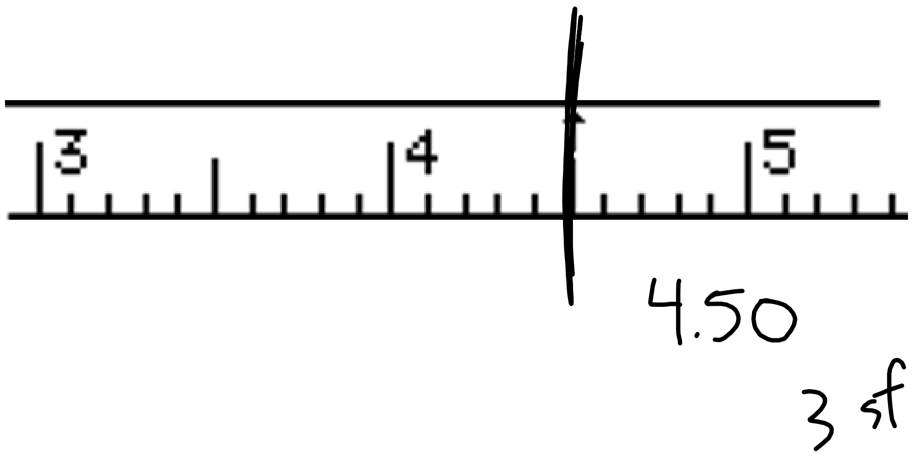
What is the length on this ruler?



12.33

4 sigfigs

What is the length on this ruler?



What if the measurement has been made by someone else, and then you are to work with it.

How do you count the number of sig figs in the measurement?

Rules for Counting Significant Figures

A) all <u>non-zero</u> digits are significant

B) zeros are significant if:

- They are at at the end of a number to the right of the decimal point. ex. 2.50 (3 sig figs as the 0 counts)
- They are sandwiched by non-zero numbers.

ex. 2002 (4 sig figs) or 10.003 (5 sf)

C) zeros that help define the number are not significant (zeros at the end of a number to the le of the decimal).

100 has only 1 sig fig but 100.0 has 4 sig figs

OR zeros leading off a number

0.00034 has 2 sig figs

Examples

1. 34.500 5 significant figures
2. 0.0087 2 significant figures
3. 350.007 6 significant figures
4. 1500 2 significant figures
5. 120.0 4 significant figures

Scientific Notation & Sig Figs

What if you measure 100 to three sig figs?
How would you show this?

Use scienfic notaon…

1.00×10^2 is 100 expressed with three sig figs

The number of digits in the coefficient IS the number of sig figs!

Same number with different amounts of Sig. Figs.

1200

1200.0

1.2×10^3

1.20×10^3

1.200×10^3

REMEMBER:

Counting numbers or defined values are considered to be exact or perfect numbers and are exempt from rules of sig. figs.

7 cheers for chemistry (counting #)

100 cm = 1 m (conversions: defined value)