FPST 2343
INDUSTRIAL HYGIENE

VIDEO LECTURE
WEEK 1 LAB 1A
REVIEW OF
SIGNIFICANT FIGURES

Learning Objectives

- Understand the application of SifFigs in measurements
- Recall the rules of significant figures in computed values

Significant Figures

Significant figures are digits that are statistically significant.

There are two kinds of values in Science:

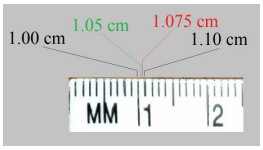
1. Measured Values
2. Computed Values

Measured Values

The last significant digit in a measured value will be the first estimated position.

For example:

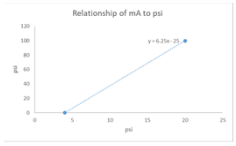
A metric ruler is calibrated with numbered calibrations equal to 1 cm. In addition, there will be ten unnumbered calibration marks between each numbered position. Reporting between these marks is an estimate



Measured Values

	Low	High	Range
mA	4	20	16
psi	0	100	100

Bits	Binary Value	Precision (mA)
8	256	0.0625
16	65536	0.000244141



8-bit Signifcance at 0.1 psi		
mA	psi	psi
4.0000	0.000000	0.0
4.0625	0.390625	0.4
4.1250	0.781250	0.8
4.1875	1.171875	1.2
4.2500	1.562500	1.6
4.3125	1.953125	2.0
20	100.000000	100.0

16-bit Significance at 0.001 psi		
mA	psi	psi
4.0000	0.0000000000000	0.000
4.0002	0.00152587890625	0.002
4.0005	0.0030517578125 0	0.003
4.0007	0.00457763671875	0.005
4.0010	0.00610351562500	0.006
4.0012	0.00762939453125	0.008
20	100.000000000000	100.000

Computed Values

The other type of value is a computed value.

THE PROPER NUMBER OF SIGNIFICANT FIGURES THAT A COMPUTED VALUE SHOULD HAVE IS DECIDED BY A SET OF CONVENTIONAL RULES.

Rules for Significant Figures in Computed Values

All non-zero digits are considered significant. For example, 91 has two significant figures (9 and 1), while 123.45 has five significant figures (1, 2, 3, 4 and 5).

Zeros appearing anywhere between two non-zero digits are significant. Example: 101.1203 has seven significant figures: 1, 0, 1, 1, 2, 0 and 3.

Leading zeros are not significant. For example, 0.00052 has two significant figures: 5 and 2.

Trailing zeros in a number containing a decimal point are significant. For example, 12.2300 has six significant figures: 1, 2, 2, 3, 0 and 0. The number 0.000122300 still has only six significant figures (the zeros before the 1 are not significant). In addition, 120.00 has five significant figures since it has three trailing zeros.

Rules for Significant Figures in Computed Values

The significance of trailing zeros in a number not containing a decimal point can be ambiguous. For example, it may not always be clear if a number like 1300 is precise to the nearest unit (and just happens coincidentally to be an exact multiple of a hundred) or if it is only shown to the nearest hundred due to rounding or uncertainty. Various conventions exist to address this issue:

A bar may be placed over the last significant figure; any trailing zeros following this are insignificant. For example, if 1300 has three significant figures (and hence indicates that the number is precise to the nearest ten) the last significant figure of a number may be underlined; for example, "13$\underline{0}$0" has three significant figures.

A decimal point may be placed after the number; for example "100." indicates specifically that three significant figures are meant.

How many significant digits does the following number have?

3.010×10^{57}

Multiplication and Division

THE PRODUCT OR QUOTIENT WILL BE REPORTED AS HAVING AS MANY SIGNIFICANT DIGITS AS THE NUMBER INVOLVED IN THE OPERATION WITH THE LEAST NUMBER OF SIGNIFICANT DIGITS.

$0.000170 \times 100.40 = 0.017068 \rightarrow 0.0171$

$(20.04)\ (16.0)\ (4.0 \times 10^2) = 128{,}256 \rightarrow 130{,}000$

Example

120.00420

The digits 1, 2, 4, and 2 are all considered significant (Rule 1).

All zeros are considered significant since they have non-zero digits somewhere to their left (Rule 2).

So there are a total of eight significant digits.

Conversions and Constants

In the combination of a number and a unit of measurement, the ambiguity can be avoided by choosing a suitable unit prefix. For example, the number of significant figures in a mass specified as 1300 g is ambiguous, while in a mass of 13 hg or 1.3 kg it is not.

Conversions and Constants

Exact conversion factors are not considered when determining significant figures.

For example, if we have 1.1 km and covert to meters by multiplying by 1,000 m/km (1,100 m) we retain the 2 SigFigs from the measured value (not 1,000 m).

Essentially, conversion factors that are definitive have infinite SigFigs.

Conversions and Constants

Conversion factors that are not definitive, or fundamental constants require the same, or greater, number of SigFigs as the measured values to retaining the same level of significance.

Example, how far does light travel in one year if the speed of light is 186,000 miles/second?

186,000 mi/sec x 60 sec/min x 60 min/hr x 24 hr/day x 365 day/yr = 5.87E12 miles

Conversions and Constants

What if we use the more accurate speed of light at 186,282 miles/sec.

Example, how far does light travel in one year if the speed of light is 186,282 miles/second?

186,282 mi/sec x 60 sec/min x 60 min/hr x 24 hr/day x 365.25 day/yr = 5.8697E12 miles

Rounding

Round to the number of significant digits

Look one place to the right of the last significant digit

Round the following number to 3 sig figs

89.445

Rounding

Round to the number of significant digits

Look one place to the right of the last significant digit

Round the following number to 3 sig figs

89.445

Rounding

Round to the number of significant digits

Look one place to the right of the last significant digit

Round the following number to 3 sig figs

89.445 → 89.4

Digits of Precision

When using Excel or a calculator with memory function, retain all digits of precision throughout the mathematical operations, then round to the correct number of significant digits at the end.

When performing hand calculations, keep n+2 digits of precision where n = the number of significant figures.

Example in Excel

Have a great day!