Significant Digits

Significant digits indicate to people reading your results the amount of accuracy that you used in recording your data. In any recorded value, the last digit is an estimation, so while we will use it, we do not wish to compound the error when we use these values in our calculations.

Determining the number of significant digits:

- all non-zero digits are significant
  eg. 64 654 = five significant digits

- zeroes between non-zero digits are significant
  eg. 1001 = four significant digits

- zeroes before a decimal for numbers greater than one are significant
  eg. 98 000. = five significant digits

- zeroes trailing to the right of the decimal are significant
  eg. 98 000.00 = seven significant digits

- zeroes acting as place holders are **not** significant
  - zeroes in front of all non-zero digits are not significant
    eg. 0.0043 = two significant digits

  - numbers greater than one with zeroes but NO decimal place are not significant
    (since it is impossible to tell to which place the number was measured)
    eg 98 000 = two significant digits

Since zeroes can be confusing, it is often best to use scientific notation.
In scientific notation, all of the digits (not including the exponents) are significant.
eg. 3.750×10^{6} = four significant digits
eg. 6.00×10^{-4} = three significant digits

Significant Digit Rules for Manipulating Numbers

Addition and Subtraction

In an addition and subtraction equation, the final answer should be rounded to the LEAST ACCURATE decimal place. (Highlighted numbers are the values we "can't trust".)
eg. 30.00 - 9.245 = 20.755
= 20.76

eg. 65 321.1 + 2.64 + 8.006 54 + 984.654 = 66 316.40054
= 66 316.4

Multiplication, Division and Trig functions

In an addition and subtraction equation, the final answer should be rounded to the FEWEST significant digits in the question.

eg. 54.49 * 0.0064 = 0.348736
= 0.35
4 s.f. 2 s.f. 2 s.f.

eg. 654 987 / 321 = 2040.457944
6 s.f. 3 s.f. ??? s.f.
= 2040
= 2.04×10^3 3 s.f.

Notice that since 2040 is unclear to the number of significant digits involved, scientific notation is preferable and in some cases it may be required.

Notes:

1) Always carry at least one extra (non-significant) digit through your calculations in order to not introduce a rounding error. (If using a calculator, this is easily carried out by storing intermediate numbers in your calculators' memories.)

2) If multiple operations are involved, follow the standard order of operations, using the appropriate propagation rules for each step (remembering to carry at least one extra digit).

3) Carrying extra digits does not mean you write down your entire calculator screen - one is fine, three and more are irrelevant.

4) It is best to write down your final answer TWICE - once with the extra digit(s) and then the final rounded value.