# Accuracy, Precision, and Significant Figures

accuracy – a measure of the deviation of the measured value from the true or accepted value (% error, *etc*.)

precision – a measure of the agreement of experimental measurements with each other (range, standard deviation, *etc.*)

## Significant Figures

Digits expressing a measurement (or the results of a calculation involving such measurements) such that only the last digit is uncertain are called significant figures or significant digits.

Rules for counting the number of significant digits in a properly-reported measurement:

| | | |
|---|---|---|
| 1. Nonzero digits are always significant. | 1.245 m | 4 sig. fig. |
| 2. Leading zero's (zero's before any nonzero digit) are <u>not</u> significant. | 0.00421 g | 3 sig. fig. |
| 3. Embedded zero's are significant. | 205.01 g | 5 sig. fig. |
| 4. Trailing zero's <u>behind</u> the decimal point are significant | 2.500 m | 4 sig. fig. |
| Trailing zero's <u>in front of</u> the decimal point- can't tell | 1000 s | ? 1, 2, 3 or 4, can't tell |

For a number in scientific notation, the pre-exponential factor indicates the number of significant digits.
example: $2.50 \times 10^5$ g 3 sig. fig.

An exact number can be considered to have a infinite number of significant digits. Many integers are exact. Some other numbers are exact; for example, there are exactly 2.54 cm in one inch.

## Significant Figures and Mathematical Operations

addition and subtraction – retain as many digits to the right of the decimal as in the number with the fewest significant digits to the right of the decimal.
example: 215.47 g + 918.251 g - 0.000458 g = 1133.72 g

multiplication and division – retain as many significant digits as in the number with the fewest significant digits.
example: (214.21 g) x (11.2 cm) / (17.413 g) = 138 cm

## Rounding

If the first digit to be discarded is a 4 or less, the value of the last digit retained is <u>not</u> changed.
example: 1.8453 rounded to two digits is 1.8

If the first digit to be discarded is a 5 or above, the value of the last digit retained is increased by 1.
example: 1.8453 rounded to the second decimal place is 1.85