SI Units, Accuracy and Precision

SI (Systeme International) Base units

- Length = m (meters)
- Mass = kg (any version of a gram is ok)
- Time = s (seconds)
- Electric current = A (amperes)
- Temperature = K (Kelvin)
- Amount of a substance = mole (mol)
- And just for fun –
  Luminous intensity = candela (cd)

SI Units Continued

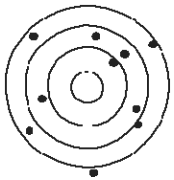
SI Prefixes

- Tera (T) = trillion (10^{12})
- Giga (G) = billion (10^{9})
- Mega (M) = million (10^{6})
- Kilo (k) = thousand (10^{3})
- Hecto (h) = hundred (10^{2})
- Deca (da) = ten (10^{1})
- -------BASE UNIT----------
- Deci (d) = tenth (10^{-1})
- Centi (c) = hundreth (10^{-2})
- Milli (m) = thousandth (10^{-3})
- Micro (μ) = millionth (10^{-6})
- Nano (n) = billionth (10^{-9})
- Pico (p) = trillionth (10^{-12})

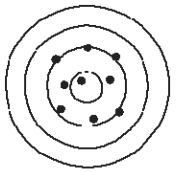
Accuracy and Precision

- Which is better – to be accurate or precise? (ponder for a moment)

Accuracy and Precision

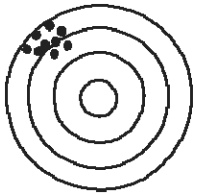


Low Accuracy,
Low Precision

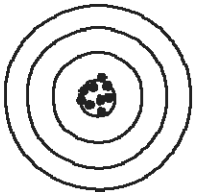


High Accuracy,
Low Precision

Accuracy and Precision



Low Accuracy,
High Precision



High Accuracy,
High Precision

Accuracy and Precision

- Precision is the reproducibility of the measurements. Precise measurements all end up very close in value.
- Accuracy is the closeness of a measurement to the true value.
- Which is better? To be accurate or precise?

Sig Digs!!! How many?

1. All non-zero numbers are always significant.

Example: 345 has 3 significant digits

2. Captive zeros (zeros between non-zero numbers) are always significant.

Example: 2.004 has 4 significant digits

3. Trailing zeros (zeros to the right of a non-zero number) are significant only when the number contains a decimal point.

Example: 300.0 has 4 significant digits, but 300 has only 1 significant digit

4. Leading zeros (zeros to the left of the first non-zero number) are not significant.

   Example: 0.00429 has 3 significant digits

5. Exact numbers are considered to have unlimited significant digits. Numbers such as those determined by counting, or from definitions are considered exact.

   Examples: 3 pennies – the 3 has unlimited significant digits
   1 foot = 12 inches – the 1 and 12 have unlimited significant digits, based on the definition of a foot

Calculating with Sig Digs

Multiplication and Division: Your answer can only have as many significant digits as the factor with the *least* number of significant digits.

Example: 29.1 cm x 1.04 cm x 22 cm = 665.808 cm^3 (on calculator), but must be rounded to 2 significant digits which equals 670 cm^3.

Addition and Subtraction: Your answer must be rounded to the decimal place of the number that had the *least* number of decimal places.

Example: 145.92 g + 22.0 g + 57.712 g = 225.632 g (on calculator), but must be rounded to the tenths place because 22.0 is only to the tenths place. Thus, the answer is changed to 225.6 g.

Remember – multiplication and division go by total number of digits; addition and subtraction go by least decimal place.