

## 1.6 Dimensional Analysis

- **Dimensional analysis** is a method of calculation utilizing a knowledge of units.
- Given units can be multiplied and divided to give the desired units.
- Conversion factors are used to manipulate units.
  - desired unit = given unit x (conversion factor)
- The **conversion factors** are simple ratios.
  - conversion factor = (desired unit) / (given unit)
    - These are fractions whose numerator and denominator are the same quantity expressed in different units.
    - Multiplication by a conversion factor is equivalent to multiplying by a factor of one.

### Using Two or More Conversion Factors

- We often need to use more than one conversion factor in order to complete a problem.
- When identical units are found in the numerator and denominator of a conversion, they will cancel. The final answer **MUST** have the correct units.
- For example:
  - Suppose that we want to convert length in meters to length in inches. We could do this conversion with the following conversion factors:
    - 1 meter = 100 centimeters and 1 inch = 2.54 centimeters
  - The calculation would involve both conversion factors; the units of the final answer will be inches:
    - (# meters) (100 centimeters / 1 meter) (1 inch / 2.54 centimeters) = # inches

### Conversions Involving Volume

- We will often encounter conversions from one measure to a different measure.
- For example:
  - Suppose that we wish to know the mass in grams of 2.00 cubic inches of gold given that the density of the gold is 19.3 g/cm<sup>3</sup>.
  - We could do this conversion with the following conversion factors:
    - 2.54 cm = 1 inch and 1 cm<sup>3</sup> = 19.3 g gold
  - The calculation would involve both of these factors:
    - (2.00 in.<sup>3</sup>) (2.54 cm / in.)<sup>3</sup> (19.3 g gold / 1 cm<sup>3</sup>) = 633 g gold
  - Note that the calculation will **NOT** be correct unless the centimeter to inch conversion factor is cubed!! Both the units **AND** the number must be cubed.

### Summary of Dimensional Analysis

- In dimensional analysis always ask three questions:
  1. What data are we given?
  2. What quantity do we need?
  3. What conversion factors are available to take us from what we are given to what we need?