Basic Skills for Chemistry
CHEM-1020
Chapter 3 Lecture Notes
Kroschwitz, 3rd edition

Applying Measurements to Chemical Calculations

(Mathematics Review for Understanding Chemistry)

Fractions

What does a fraction mean?
Relationship to Decimal Fractions
Advantage of decimal fractions over ordinary fractions

Examples: 1/4, 1/3, 4/3, 7.21/7.21, etc.

How to multiply fractions
Symbolic Examples: a/b x c/d

How to *divide* fractions

Symbolic and *Calculator* Examples
Applicability to numbers and **units**

Unit Conversions

(aka Factor-Label Method or Dimensional Analysis)

To do any unit conversion, must first identify an *equality*

Metric equalities are implicit in the metric prefixes already discussed.

Examples of metric equalities:
1 m = 100 cm or 1 cm = 10^{-2} m
1 g = 10^{6} μg or 1 μg = 10^{-6} μg
1 L = 10^{3} mL or 1 mL = 10^{-3} L

Any equality can be expressed as two conversion factors whose value equals unity (no units).
(Multiplication by 1 changes nothing)

Single-Step conversions are too easy.
Go to multistep conversions.
Examples:
27.5 km → mm
4.00 ng → kg
0.750 μL → mL → cm^3
1.75 μm → cm
0.051 mi → mm
27.51 oz → kg

Density

Compare weight, mass and density
How is density used

Density is used to help identify metals and liquids, test urine, test battery acid, etc.

d = m/v

Units: SI units kg/m^3
Everyday solid and liquid lab units g/mL or g/cm^3
Gas units are g/L

Density is *intrinsic*
Density of aluminum for two different size pieces

Density depends slightly on temperature. Why?
Therefore must report temperature for any density value.

Density values can be found in the Handbook of Chemistry and Physics or in chemfinder.com or Wickipedia, etc.
Can use density values to differentiate Al from Mg or Ni from Pb.

Learn to rearrange to $\mathbf{m = d \cdot v}$ and $\mathbf{v = m/d}$

Calculate volume of 2.14 mg of Ti metal. d = 4.5 g/cm^3

Calculate mass in grams and kg of 52.40 L 0f CCl_4 whose density is 1.537 g/mL

Why is the density of water exactly 1.00 g/mL at 4 ºC?

Specific Gravity concept
Examples of specific gravity calculations at different water temperatures

Algebra

Main rule for working with any algebraic equation
Solve algebraic equations for any variable

$4a + x = 3y$

$PV = nRT$

$4x^2 = 2a$

$a/x = b + c$

$F - 32 = (9/5)C$

Per Cent

Meaning of "per cent" 100% = 1

% = part/whole x 100% or % = ratio x 100%

Examples showing unit cancellation and sig figs

Rearrange to solve for part or whole

Energy

"The ability to do work"

Types of energy examples

Energy *interconversion* examples

Units: Calorie, kilocalorie (metric system). joule and kJ (SI)

Chemistry applications include heating and cooling of matter and energy yields for reactions

Specific Heat

Definition of specific heat

Metric specific heat units are cal/(gram · ºC) or cal/(mol · ºC) ºC measures ΔT, not T

SI units are J/(gram · ºC) or J/(mol · ºC)

Water has the highest specific heat, defined to be 1.00O cal/(g · ºC)