WELCOME TO GENERAL CHEMISTRY

General Chemistry is a two-semester presentation of the fundamental concepts of chemistry for the science and engineering major. Students are expected to have a good background in algebra and a fundamental knowledge of chemical terminology.

The prerequisites for this course are: One unit of high school chemistry. High school physics is recommended. A grade of "C" or better in College Algebra or accompanied by College Algebra or Calculus I .

So what is meant by a
"good background in algebra and
a fundamental knowledge of chemical terminology" ???

A good background in algebra:

- Solve an equation including linear equations, quadratic equations, and equations involving fractions.
- Use a calculator to square or cube a number, takes its root, reciprocal, change the number from a decimal to scientific notation and change a number in scientific notation to a decimal.
- Use a calculator to perform operations involving numbers in scientific notation

A fundamental knowledge of chemical terminology:

- Matter – States, Classes, Properties, Changes,
- Viscosity, Miscible, Diffusion, Precision, Accuracy
- Scientific Method
- Units, Metric System, Convert within the metric system and between the metric and English systems
- Significant Figures, Rules of Rounding
- Dimensional Analysis
- Nomenclature

A good review of these topics including problems and their solutions can be found in the General Chemistry textbook and the study guide that accompanies it:
Chemistry, the Central Science, 9th ed by Brown, LeMay, and Bursten;
Prentice Hall: New Jersey, 2003
Chapter One is the Introduction
Nomenclature is found at the end of Chapter Two.

What follows is a very basic introduction to the topics listed above:

STATES OF MATTER:

Solid – definite shape and volume, very little distance between molecules, not compressible, strong forces between molecules, molecules do not move much
Liquid – indefinite shape, definite volume, greater distance between molecules, somewhat compressible, weaker forces between molecules, molecules do move a little
Gases – indefinite shape, indefinite volume, great distance between molecules, very compressible, weak forces between molecules, molecules do move a great deal

CLASSES OF MATTER:

Substance -- Composition and properties are uniform throughout a sample AND from one sample to another.
COMPOUND -- Different elements combine with each other in fixed proportions.
ELEMENT -- Comprised of a single type of atom.
Mixture -- Combination of two or more substances in which each substance retains its own identity. Composition and properties can VARY from one sample to another. Mixtures can be separated into their components by PHYSICAL means.
HETEROGENEOUS MIXTURE --- Composition and properties vary throughout given sample.
HOMOGENEOUS MIXTURE --- Uniform composition and properties throughout a given sample.

PROPERTIES and CHANGES:

Physical Property -- can be measured without changing the identity or composition of the substance.
Chemical Property -- how a substance changes in composition when it interacts with other substances.
Physical Change -- physical property of substance may change, but the composition does not change.
Chemical Change -- a new substance is formed. The new substance has different chemical properties.

VISCOSITY, MISCIBLE, DIFFUSION, PERCISION, ACCURACY:

VISCOSITY – the resistance of a liquid to flow
MISCIBLE – liquids that mix in all proportions
DIFFUSION -- gases that mix in all proportions
PRECISION – degree of reproducibility of the measured quantity.
ACCURACY – how close the measured value is to the true or correct value.

SCIENTIFIC METHOD:

EXPERIMENT: Explore nature according to a planned strategy and make observations under controlled conditions.
LAW: States a measurable relationship. Summarizes pattern / trend. Does NOT attempt to explain the relationship / trend.
HYPOTHESIS: An initial, tentative proposal of a scientific principle. Further experiments are done for verification and support.
THEORY: A hypothesis that has been extensively tested, accepted by the scientific community, and used as a model to explain and predict behavior.

UNITS, METRIC SYSTEM:

1000 mg = 1 gram	1000 grams = 1 kg	$1 \times 10^6 \mu g = 1$ gram
100 cm = 1 meter	1000 mm = 1 meter	1000 meters = 1 km
1000 mL = 1 liter	1 mL = 1 cm^3	$1 \times 10^6 \mu L = 1$ liter

2.54 cm = 1 in
946 mL = 1 qt
454 g = 1 LB

°F = 1.8 °C + 32 K = °C + 273.15

SIGNIFICANT FIGURES:

THESE ARE SIGNIFICANT

1. All non-zero digits.
2. Zeros between non-zero digits.
3. Zeros at the end of a number which contains a decimal point.

THESE ARE NOT SIGNIFICANT

Zeros to the left of the first non-zero digit in a number.

THESE MAY OR MAY NOT BE SIGNIFICANT

Zeros at the end of a number which does not contain a decimal point. Use *Scientific Notation* to avoid confusion.

RULES OF ROUNDING:

Round only the FINAL answer.
If digit dropped is 0 - 4 round DOWN.
If digit dropped is 5 - 9 round UP.

SIGNIFICANT DIGITS AND CALCULATIONS:

MULTIPLICATION and DIVISION

The answer is limited by the value with the fewest number of significant figures.

ADDITION and SUBTRACTION

The answer is limited by the value with the most uncertainty ➔ the fewest number of decimal places.

Do not consider exact numbers when determining the number of significant digits in an answer.

DIMENSIONAL ANALYSIS:

1. Write down what you need to find.
2. Write down what you are given.
3. Apply a unit factor to convert the unit in the given value to the unit in the answer.

The KEY is to make sure your UNITS CANCEL!!!

DENSITY AND PERCENT PROBLEMS:

Density = Mass/Volume

$$Percent = \frac{\text{Quantity of Interest}}{\text{Total Sample}} \times 100$$

NOMENCLATURE:

TWO TYPES OF COMPOUNDS

IONIC COMPOUNDS --- those formed from a metal and a nonmetal.

MOLECULAR COMPOUNDS --- those formed from two nonmetals.

IONIC COMPOUNDS

- Formed when a METAL LOSES ELECTRONS and a NONMETAL GAINS ELECTRONS.
- The metal ion is called the CATION.
- The nonmetal ion is called the ANION.
- WRITE: CATION (1st) ANION (2nd)

TO NAME THE CATION: Learn the Cations

- Use the metal's name from the Periodic Table.
- If a metal can form more that one kind a cation, the charge is written in ROMAN NUMERALS and placed in ( ) after the ion's name.

TO NAME THE ANION: Learn the Anions

MONOATOMIC ANIONS:

- ROOT of nonmetal + IDE

POLYATOMIC OXYANIONS:

1 More Oxy = PER ___ ATE

Learn the ATE

1 Less Oxy = ITE

2 Less Oxy = HYPO ___ ITE

- The charge remains the same, just the number of oxygens change.

Perchlorate	ClO_4^{1-}
chlorate	ClO_3^{1-}
chlorite	ClO_2^{1-}
hypochlorite	ClO^{1-}

Prefix bi – means HYDROGEN

Prefix thio – means SULFUR has replaced oxy.

Words to Symbols:

- Write the symbol for the cation.
- Write the symbol for the anion.

Iron(III) Sulfate

Fe^{3+} SO_4^{2-}

- It will take TWO Fe^{3+} and THREE SO_4^{2-} to make a neutral compound.

.So the formula is: $Fe_2(SO_4)_3$

Words to Symbols:

- Write the symbol for the cation.
- Write the symbol for the anion

Iron(III) Sulfate

Fe^{3+} SO_4^{2-}

•Cross the charges --- the charge of the cation becomes the subscript of the anion, --- the charge of the anion becomes the subscript of the cation.

Fe^{3+} SO_4^{2-} $Fe_2(SO_4)_3$

Symbols to Words:

Fe_2O_3

- Write the name of the cation.
- Write the name of the anion.

Iron ( ) Oxide

- If the cation can have more than one charge, put in ( ).
- UNCross the subscripts to determine the charge of the ions.

Fe_2O_3 Fe^{3+} O^{2-} Iron (III) Oxide

NAMING ACIDS

The name of the ACID depends on its ANION.

Anion	Name	ACID	NAME
Cl^-	chloride	HCl	hydrochloric acid
ClO_4^-	perchlorate	$HClO_4$	perchloric acid
ClO_3^-	chlorate	$HClO_3$	chloric acid
ClO_2^-	chlorite	$HClO_2$	chlorous acid
ClO^-	hypochlorite	HClO	hypochlorous acid