AP Chemistry
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Chapter 1 Notes - Chemical Foundations

1.1 Chemistry: An Overview

A. Reaction of hydrogen and oxygen
   1. Two molecules of hydrogen react with one molecule of oxygen to form two molecules of water
      $$2H_2 + O_2 \rightarrow 2H_2O$$
   2. Decomposition of water
      $$2H_2O \rightarrow 2H_2 + O_2$$

B. Problem Solving in Chemistry (and life)
   1. Making observations
   2. Making a prediction
   3. Do experiments to test the prediction

1.2 The Scientific Method

A. General Framework
   1. Making observations
      a. Quantitative (measurement)
      b. Qualitative (color, phase, shape, etc)
   2. Making a prediction
   3. Do experiments to test the prediction

B. Vocabulary
   1. Observation
      a. Something that is witnessed and can be recorded
   2. Theory (Model)
      a. Tested hypotheses that explains WHY nature behaves in a certain way
      b. Theories change as more information becomes available
   3. Natural Law
      a. A summary of observed, measurable behavior

1.3 Units of Measurement

A. Measurements
   1. Number and Scale (units) are both essential
      "The number without the units is worthless!"

B. SI system

Important SI Units for Chemistry		
Mass	kilogram	kg
Length	meter	m
Time	second	s
Temperature	Kelvin	K
Amount of Substance	mole	mol
Volume	liter	L

C. SI Prefixes

mega	M	1,000,000	10^6
kilo	k	1,000	10^3
hecto	h	100	10^2
deka	da	10	10^1

nano	n	0.000000001	10^{-9}
micro	µ	0.000001	10^{-6}
milli	m	0.001	10^{-3}
centi	c	0.01	10^{-2}
deci	n	0.1	10^{-1}

1.4 Uncertainty in Measurement

A. Recording Measurements (Significant figures)
   1. Record all digits that are certain
   2. Record the first digit that is uncertain (all measurements have some degree of uncertainty)
   3. Uncertainty in the last number is $\pm$ 1, unless otherwise noted

B. Accuracy
   1. The agreement of a particular value with the accepted value

C. Precision
   1. The degree of agreement among several measurements made in the same way

      "You can be precise, but not accurate. If you are accurate, you are necessarily precise."

D. Errors
   1. Random Errors (indeterminate errors)
      a. Measurements may be high or low
      b. Causes:
         1) Interpretation of the uncertain digit
         2) Procedural ineptness
   2. Systematic Errors
      a. Always occur in the same direction
      b. Caused by poor measurement calibration
         1) gun sight set too high/low
         2) balance improperly zeroed
         3) thermometer improperly marked

1.5 Significant Figures and Calculations

A. Rules for Counting Significant Figures

Number	**Rule**	**Example**
Nonzero integers	Always significant	6.34 m (3 sig figs)
Leading zeroes	Never significant	0.00634 m (3 sig figs)
Captive zeroes	Always significant	6.0034 (5 sig figs)
Trailing zeroes	Significant if after a decimal	63400 (3 sig figs) 0.63400 (5 sig figs)
Exact numbers	Infinite significance	e.g. There is 1 star at the center of our solar system. There is no doubt about the number "1"
Scientific notation	All digits are significant	6.3400×10^6 (5 sig figs)

B. Multiplication and Division
   1. Keep as many sig figs in your answer as are in the piece of data with the least number of sig figs

      2.37 cm x 15.67 cm x 7.4 cm = 274.82046

      (keep two sig figs) = 2.7×10^2 cm^3

C. Addition and Subtraction
   1. Keep the same number of decimal places as the least precise measurement in your calculation

      34.039 m + 0.24 m + 1.332 m + 12.7 m = 48.311 m

      (keep one decimal place) = 48.3 m

D. Rules for Rounding
   1. Round at the end of a series of calculations, NOT after each step
   2. Use only the first number to the right of the last sig fig to decide whether or not to round
      a. Less than 5, the last significant digit is unchanged
      b. 5 or more, the last significant digit is increased by 1

Note from this section in your book: Detailed solutions and stepwise examples of problems in this text show correct sig figs at each step. Since you will most often do a sequence of calculations and then round to correct sig figs at the end, your answer will often be slightly different (usually only in the last place) than the answer given in the book.

1. Significant figures rules will be observed in all calculations throughout the year in this course. You need never ask, "Do we have to watch our sig figs?" The answer is always "Yes!"

1.6 Dimensional Analysis

A. Examine examples
    1. pages 18 - 21
B. Unit Conversions Questions
    1. What units am I given?
    2. What units must be in my answer?
    3. What is conversion factor?

Full credit can never be given for working a problem in which you do not do all of the following:

1. Observe significant figures rules
2. Label <u>all steps</u> of your work with the correct units
3. Correctly label and identify your answer
4. Solve the problem in a manner that can be understood by the reader.

1.7 Temperature

A. Celsius (°C) and Kelvin (K)
    1. Kelvin = Celsius + 273.15
    2. Celsius = Kelvin - 273.15
    3. Size of the temperature unit (degree) is the same
B. Fahrenheit
    1. $T_C = (T_F - 32°F)(5°C/9°F)$
    2. $T_F = T_C \times (9°F/5°C) + 32°F$

1.8 Density

A. Density = mass/volume

1.9 Classification of Matter

A. Matter
    1. Anything that occupies space and has mass
B. States of Matter
    1. Solids - rigid, fixed volume and shape
    2. Liquids - definite volume, no specific shape
    3. Gases - no fixed volume or shape, highly compressible
C. Mixtures - Matter of variable composition
    1. Heterogeneous mixtures
        a. Having visibly distinguishable parts
    2. Homogeneous mixtures (solutions)
        a. Having visibly indistinguishable parts
D. Components of Mixtures can be Separated by Physical Means
    1. Distillation
    2. Filtration
    3. Chromatography

E. Pure substances
   1. Elements
      a. Cannot be decomposed into simpler substances by physical or chemical means
   2. Compounds
      a. Constant composition
      b. Can be broken into simpler substances by chemical means, not by physical means

<u>The Organization of Matter</u>
(Slightly different than your book)