CHAPTER 1: Introduction to Chemistry

1.1 The Nature of Chemistry

1.2 Matter

Matter - has mass, occupies space
Mass: measure of the quantity of matter

Extensive property - depends on quantity, i.e., mass, volume
Intensive property - depends on identity of substance, i.e., density, color
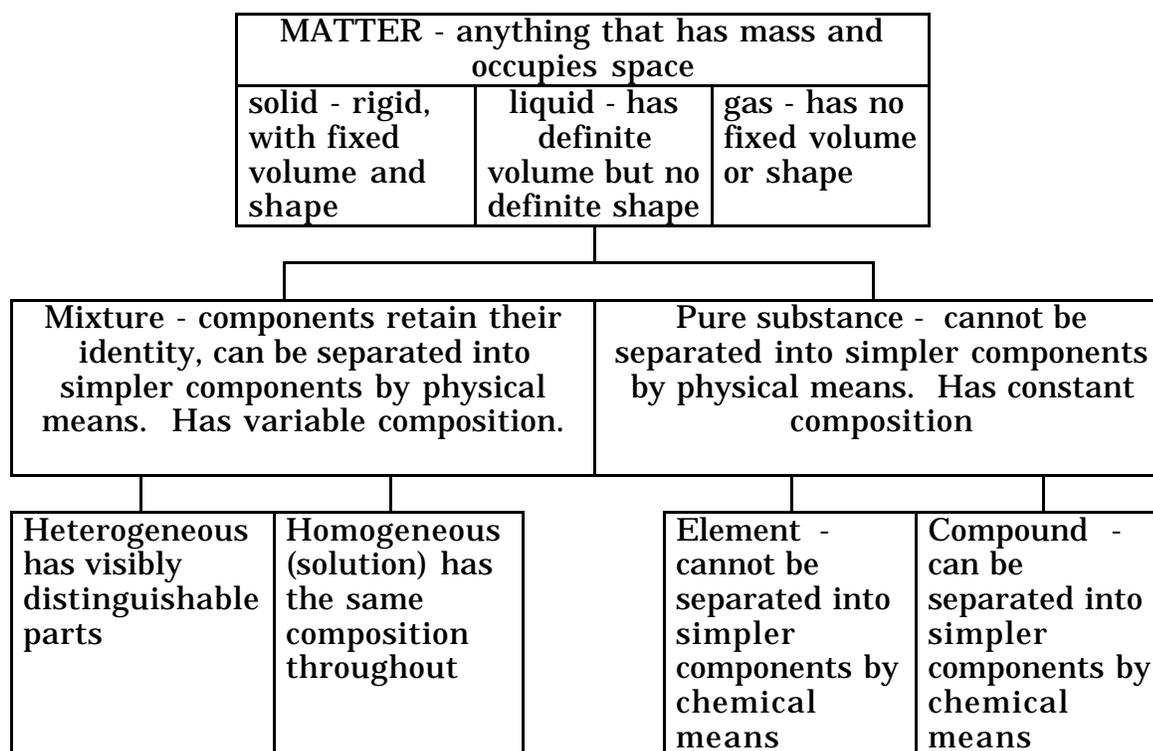
Physical property - can be measured without changing the composition of the substance
Physical change - change in the form of the substance, but not its chemical composition. (distillation, chromatography, filtration)
Extensive vs. intensive property (mass vs. density)

Chemical property - describes tendancy of material to react; must carry out a reaction to observe
Chemical Change - substance is changed into new substance(s) with different properties and composition.

MATTER - anything that has mass and occupies space		
solid - rigid, with fixed volume and shape	liquid - has definite volume but no definite shape	gas - has no fixed volume or shape

Mixture - components retain their identity, can be separated into simpler components by physical means. Has variable composition.	Pure substance - cannot be separated into simpler components by physical means. Has constant composition

Heterogeneous has visibly distinguishable parts	Homogeneous (solution) has the same composition throughout	Element - cannot be separated into simpler components by chemical means	Compound - can be separated into simpler components by chemical means

Elements with symbols based on original names (see table 2.2, pg 58 ... add gold to list)

antimony (stibium)	Sb	lead (plumbum)	Pb	sodium (natrium)	Na
copper (cuprum)	Cu	mercury (hydrargyrum)	Hg	tin (stannum)	Sn
gold (aurum)	Au	potassium (kallium)	K	tungsten (wolfram)	W
iron (ferrum)	Fe	silver (argentum)	Ag		

1.3 The Periodic Table

Dimitri Mendeleev, Lothar Meyer

Groups (columns) run 1 - 18 or 1 - 8 and 1 - 8
Periods (rows) run 1 - 7

Main Group, transition metals, lanthanides, actinides, inner transition metals

coinage metals

metals tend to lose electrons to form cations
nonmetals tend to gain electrons to form anions, and react with each other to form covalent compounds

1.4 Separation of Mixtures

filtration, distillation, chromatography

1.5 Measurement and Units

International System Base Units: m, kg, s, K, mol, A, cd (table 1.5, pg. 26)

conversion factors

$100 \text{ cm} = 1 \text{ m}$ $(100 \text{ cm})^3 = 1 \text{ m}^3$ $1,000,000 \text{ cm}^3 = 1 \text{ m}^3$

$1 \text{ L} = 1 \text{ dm}^3 = (10 \text{ cm})^3 = 1000 \text{ cm}^3$ $1 \text{ mL} = 10^{-3} \text{ L} = 10^{-3} \text{ x } (1,000 \text{ cm}^3) = 1 \text{ cm}^3$

density $d = m/v$

temperature $F° = 9/5 \text{ C}° + 32°$ $K = C + 273.15$

Equivalencies and conversion factors: The density of Ti is 4.50 g/cm^3 or $4.50 \text{ g} = 1 \text{ cm}^3$
What is the volume of 7.20 g Ti?

$$7.20 \text{ g Ti x } \frac{1 \text{ cm}^3}{4.50 \text{ g}} = 1.60 \text{ g Ti}$$

1.6 Uncertainty in Measurement

Accuracy: agreement with true value
Precision: agreement among repeated results

Absolute uncertainty: expressed in same units as the measurement $40.05 \text{ g} \pm 0.01 \text{ g}$

% relative uncertainty $= \left(\dfrac{\text{absolute uncertainty}}{\text{measured value}}\right)$ x 100% $= \dfrac{0.01 \text{ g}}{40.05 \text{ g}}$ x 100% = 0.02 %

Significant digits (significant figures) A number is expressed in a number of digits such that the uncertainty is ± 1 unit in the last reported digit

40.05 g means 40.05g ± 0.01 g

The number of significant digits is important when doing calculations with measured quantities. It is the number of digits from the first nonzero digit to the last digit.

1205   0.0301   5000 5.0×10^3

Addition and subtraction: the absolute uncertainty can be no smaller than the least accurate number.

$\qquad$ 12.02 - 10.4 = 12.05 ± 0.01 - 10.4 ± 0.1 = 1.62 ±0.11 = 1.6

The answer should have as many decimal places as the least accurate (absolute) number.

Multiplication and division: the answer should have no more significant figures than the least accurate (relative) number

$\qquad$ 3121 x 12 = 37452 = 3.7×10^4

Mixing operations: determine accuracy in the same heirarchy as the operations

$\qquad$ d = m/v = $\dfrac{2.79 \text{ g}}{8.34 \text{ mL - 7.58 mL}}$ = 3.67 g/mL = 3.7 mL

1. How many significant figures?

0.0012	106	2006	437,000	125,904,000	3050	900.0
1.0012	0.001060	100	1.0×10^2	1.00×10^3	100.	0.0048
4.80×10^{-3}	4.800×10^{-3}					

2. Perform the operations to the correct # of significant figures:

4.184 x 100.620 x (25.27 - 24.16) = $\qquad$ (9.04 - 8.23 + 21.954 + 81.0) ÷ 3.1416

$\dfrac{8.925 - 8.904}{8.925}$ x 100 = $\qquad$ $\dfrac{9.2 \times 100.65}{8.321 + 4.026}$ =

0.1654 + 2.07 - 2.114 = $\qquad$ 8.27 (4.987 - 4.962) =

$\dfrac{9.5 + 4.1 + 2.8 + 3.175}{4}$ = (4 is exact) $\qquad$ $\dfrac{9.025 - 9.024}{9.025}$ x 100 =