DENSITY

(*Chemistry* 6th ed. pages 25–26 / 7th ed. pages 24–25)

Density is the mass of substance per unit volume of substance. Density = mass/volume.

The density of an object can be determined through the *water displacement method*. The object is massed and then submerged in a measured amount of water in a graduated cylinder. The final volume in the graduated cylinder is read. The volume of water displaced by the object is the volume of the object.

EXAMPLE: A sample containing 33.42 g of metal pellets is poured into a graduated cylinder containing 12.7 mL of water, causing the water level in the cylinder to rise to 21.6 mL. Calculate the density of the metal.

SOLUTION:

Volume of metal = (Volume H_2O metal) – Volume H_2O

= 21.6 mL – 12.7 mL = 8.9 mL

Density of metal = 33.42 g / 8.9 mL = 3.8 g/mL

Note: The answer has 2 significant figures.

TEMPERATURE

(*Chemistry* 6th ed. pages 22–24 / 7th ed. pages 19–22)

You should be able to interconvert among Fahrenheit, Celsius and Kelvin. You should also know the freezing and boiling points of water on each scale.

$$°C \times (9/5) + 32 = °F$$

$$T_K = T_C + 273.15$$

EXAMPLE: The boiling point of water on top of Long's Peak in Colorado (14,255 feet above sea level) is about 86.0°C. What is the boiling point in Kelvins and degrees Fahrenheit?

SOLUTION:

$T_K = T_C + 273.15 = 86.0°C + 273.15 = 359.2$ K

$T_F = T_C \times (9/5) + 32.0°F = 86.0 \times (9/5) + 32 = 187°F$

CLASSIFICATION OF MATTER

(*Chemistry* 6th ed. pages 26–31 / 7th ed. pages 25–28)

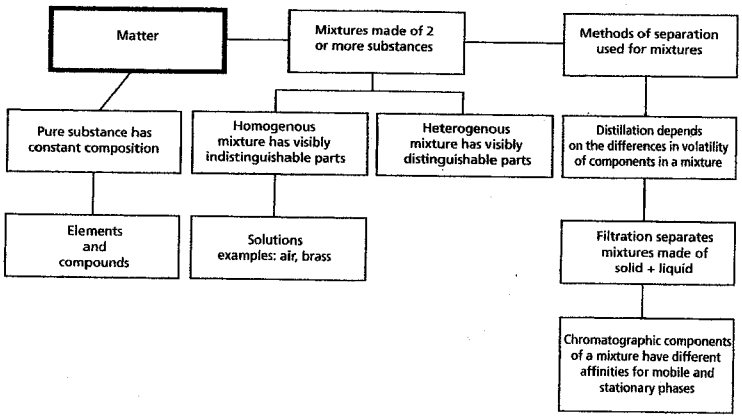
Matter exists in three states: solid, liquid, and gas. Properties of these three states of matter are listed below.

State of Matter	Shape	Volume
Solid	Fixed	Fixed
Liquid	Not definite	Fixed
Gas	Not fixed; shape of container	Not fixed; volume of container

MIXTURES AND PURE SUBSTANCES

(*Chemistry* 6th ed. page 30 / 7th ed. page 28)

Pure substances, such as elements or compounds, make up mixtures. The following chart summarizes mixtures and the methods for separating them.



CHANGES IN MATTER

Matter can undergo physical or chemical changes.

Physical changes in matter do not change the original composition of the substance. Changes in state such as boiling or melting are physical changes. Changes involving an alteration in the form of the substance such as grinding or tearing are physical. Physical properties are properties of a substance that can be observed without changing the composition of the substance. During a physical change, bonds are not broken and no reaction between atoms occurs. For example, density, color, and boiling point are physical properties.

Chemical changes in matter change the composition of the original substance by breaking and making bonds between atoms. A new substance is produced when a chemical change occurs. Evidence that a chemical change has occurred includes change in color or odor or the production of a gas or a solid (precipitate). Some examples of chemical properties include flammability and reactivity to air.

ATOMIC THEORY AND ATOMIC STRUCTURE

Ch. 2

This chapter will help you to understand the nature of atoms and how they combine. You will also review the rules for naming compounds.

You should be able to

- Discuss the development of the atom from its earliest model to the modern day atom.
- Identify the correct number of subatomic particles for atoms, ions, and isotopes.
- Calculate the average atomic mass of an atom from isotopic data.
- Name compounds and write chemical formulas for binary compounds, ternary compounds (those with polyatomic ions), and acids.
  - Memorize the chemical formulas and charges of the polyatomic ions and the most common transition metal ions.

AP Tips

Mastery of chemical nomenclature is essential in writing net-ionic equations in the free response section on the AP test. Students must have memorized the formulas and charges of monoatomic ions, including the transition metals, and also polyatomic ions.

FUNDAMENTAL CHEMICAL LAWS

(*Chemistry* 6th ed. pages 43–46

THE LAW OF DEFINITE PROPORTION

The law of definite proportion states that a given compound always contains exactly the same proportions of elements by mass.

EXAMPLE: A sample of H_2SO_4 contains 2.02 g hydrogen, 32.07 g sulfur, and 64.00 g oxygen. How many grams of sulfur and grams of oxygen are present in a second sample of H_2SO_4 containing 7.27 g of hydrogen?

SOLUTION: Hydrogen is increased by a factor of 3.60 (7.27/2.02). Therefore

g sulfur = 32.07 × 3.60 = 115.45 g sulfur = 115 g sulfur

g oxygen = 64.00 g × 3.60 = 230.4 g oxygen = 230 g oxygen

THE LAW OF MULTIPLE PROPORTIONS

The law of multiple proportions states that when two elements form a series of compounds, the ratio of masses of the second element that combine with 1 g of the first element can always be reduced to the smallest whole numbers.

EXAMPLE: Sulfur and oxygen can react to form both sulfur dioxide and sulfur trioxide. In sulfur dioxide there are 32.06 g sulfur and 32.00 g oxygen. In sulfur trioxide there are 32.06 g sulfur combined with 48.00 g oxygen. What is the ratio of the weights of oxygen that combine with 32.06 g sulfur?

SOLUTION: 48.00/32.00 = 1.5 or 3:2, demonstrating the law of multiple proportions.

HISTORY OF THE ATOM

(*Chemistry* 6th ed. pages 46–53

You should know the historical developments leading to the modern day atom, including the works of Dalton, Avogadro, Thomson, and Rutherford.

MODERN VIEW OF ATOMIC STRUCTURE

(*Chemistry* 6th ed. pages 53-54, 56 /

ASSIGNMENT OF SUBATOMIC PARTICLES TO ATOMS

The atomic number equals the number of protons in a neutral atom. In an atom, the number of protons equals the number of electrons.