Chemistry, The Central Science, 10th edition
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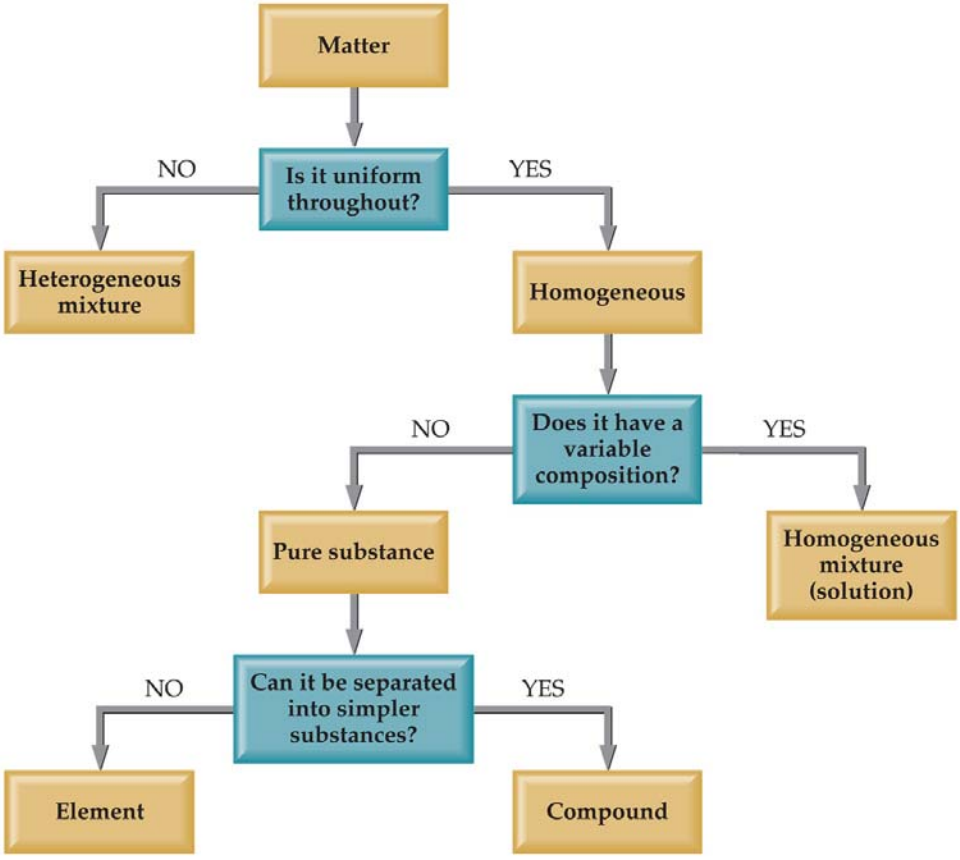
Chapter 1
Introduction:
Matter and Measurement

Matter:
Anything that has mass and takes up space
Atoms are the building blocks of matter.
Each element is made of the same kind of atom.
A compound is made of two or more different kinds of elements.

Classification of Matter



Mixtures and Compounds

Properties of Matter

- Physical Properties:
  - Can be observed without changing a substance into another substance.
    - Boiling point, density, mass, volume, etc.
- Chemical Properties:
  - Can *only* be observed when a substance is changed into another substance.
    - Flammability, corrosiveness, reactivity with acid, etc.

Properties of Matter

- Intensive Properties:
  - Independent of the amount of the substance that is present.
    - Density, boiling point, color, etc.
- Extensive Properties:
  - Dependent upon the amount of the substance present.
    - Mass, volume, energy, etc.

Changes of Matter

- Physical Changes:
  - Changes in matter that do not change the composition of a substance.
    - Changes of state, temperature, volume, etc.
- Chemical Changes:
  - Changes that result in new substances.
    - Combustion, oxidation, decomposition, etc.

In the course of a chemical reaction, the reacting substances are converted to new substances.

Compounds
Compounds can be broken down into more elemental particles

Separation of Mixtures

Distillation:
Separates homogeneous mixture on the basis of differences in boiling point.
Filtration:
Separates solid substances from liquids and solutions

Chromatography:
Separates substances on the basis of differences in solubility in a solvent.

Units of Measurement
SI Units

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Meter	m
Time	Second	s[a]
Temperature	Kelvin	K
Amount of substance	Mole	mol
Electric current	Ampere	A
Luminous intensity	Candela	cd

[a]The abbreviation sec is frequently used.

- *Système International d'Unités*
- Uses a different base unit for each quantity

Prefixes convert the base units into units that are appropriate for the item being measured.

Prefix	Abbreviation	Meaning	Example
Giga	G	10^9	1 gigameter (Gm) = 1×10^9 m
Mega	M	10^6	1 megameter (Mm) = 1×10^6 m
Kilo	k	10^3	1 kilometer (km) = 1×10^3 m
Deci	d	10^{-1}	1 decimeter (dm) = 0.1 m
Centi	c	10^{-2}	1 centimeter (cm) = 0.01 m
Milli	m	10^{-3}	1 millimeter (mm) = 0.001 m
Micro	μ[a]	10^{-6}	1 micrometer (μm) = 1×10^{-6} m
Nano	n	10^{-9}	1 nanometer (nm) = 1×10^{-9} m
Pico	p	10^{-12}	1 picometer (pm) = 1×10^{-12} m
Femto	f	10^{-15}	1 femtometer (fm) = 1×10^{-15} m

[a]This is the Greek letter mu (pronounced "mew").

- The most commonly used metric units for volume are the liter (L) and the milliliter (mL).
  - A liter is a cube 1 dm long on each side.
  - A milliliter is a cube 1 cm long on each side.

Different measuring devices have different uses and different degrees of accuracy.

Temperature:
A measure of the average kinetic energy of the particles in a sample

- In scientific measurements, the Celsius and Kelvin scales are most often used.

- The Celsius scale is based on the properties of water.
  - 0°C is the freezing point of water.
  - 100°C is the boiling point of water.

- The Kelvin is the SI unit of temperature.
- It is based on the properties of gases.
- There are no negative Kelvin temperatures.
- K = °C + 273.15

- The Fahrenheit scale is not used in scientific measurements.
- °F = 9/5(°C) + 32
- °C = 5/9(°F − 32)

- Physical property of a substance
-
- Density = mass/ volume

Uncertainty in Measurement

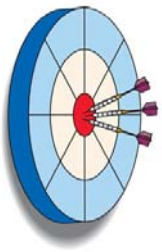
- The term significant figures refers to digits that were measured.
- When rounding calculated numbers, we pay attention to significant figures so we do not overstate the accuracy of our answers.

- All nonzero digits are significant.
- Zeroes between two significant figures are themselves significant.
- Zeroes at the beginning of a number are never significant.
- Zeroes at the end of a number are significant if a decimal point is written in the number.

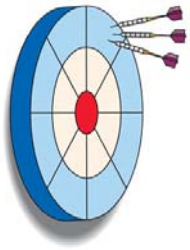
- When addition or subtraction is performed, answers are rounded to the least significant decimal place.

- When multiplication or division is performed, answers are rounded to the number of digits that corresponds to the *least* number of significant figures in any of the numbers used in the calculation.

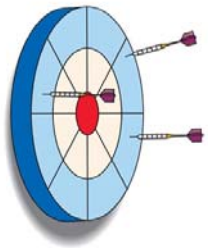
- Accuracy refers to the proximity of a measurement to the true value of a quantity.
- Precision refers to the proximity of several measurements to each other.



Good accuracy
Good precision



Poor accuracy
Good precision



Poor accuracy
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