

# Chapter 1

## Matter and Measurement

Chemistry:

The study of matter and the changes it undergoes.

Scientific Method:

A systematic approach to solving problems.

Matter:

Anything that has mass and takes up space.

Matter

- 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.

States of Matter

Classification of Matter

Mixtures and Compounds

Properties and Changes of Matter

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.

Chemical Reactions

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.

Electrolysis of Water

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

- Système International d'Unités*

- Uses a different base unit for each quantity

## Metric System

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

### Volume

- 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.

## Uncertainty in Measurements

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.

### Temperature

- 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.

- $K = ^\circ C + 273.15$

- The Fahrenheit scale is not used in scientific measurements.

- $^{\circ}F = 9/5(^{\circ}C) + 32$

- $^{\circ}C = 5/9(^{\circ}F - 32)$

### Density:

Physical property of a substance

## Uncertainty in Measurement

## Significant Figures

- The term significant figures refer 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.

## Significant Digit Calculations

### Accuracy versus Precision

- 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.