

## Chapter 1: Introduction: Matter and Measurement

### 1.1. The Study of Chemistry

#### 1.1.1. The Molecular Perspective of Chemistry

- **Matter** – physical material of the universe, has mass and takes up space
- **Atoms** – the building blocks of matter
- **Molecules** – groups of combined atoms

#### 1.1.2 Why Study Chemistry?

- important in understanding our world
- chemistry is the central science
- many various subjects have some kind of relation to chemistry

### 1.2 Classification of Matter

#### 1.2.1. States of Matter

- states of matter: liquid, solid, and gas

#### 1.2.2. Pure Substances and Mixtures

- **pure substance** – matter that has a fixed composition and distinct properties
- substances can be classified as **elements** or **compounds**
- **elements** – composed of only one atom
- **compounds** – two or more elements
- **mixtures** – combination of two or more substances
  - **heterogeneous** – mixtures that are not uniform throughout
  - **homogeneous** – mixtures that are uniform throughout; also called solutions

#### 1.2.3. Separation of Mixtures

- components in a mixture retain their own properties
- mixtures can be separated by using the different properties of each substance
- types of separation: filtration, distillation, chromatography

#### 1.2.4. Elements

- over 90% of earth's crust consists of oxygen, silicon, aluminum, iron, and calcium
- human body consists of 90% of oxygen, carbon, and hydrogen

#### 1.2.5 Compounds

- **law of constant composition (law of definite proportions)** – elemental composition of a pure compound is always the same

### 1.3 Properties of Matter

- **physical properties** – properties measured by not changing the identity and composition of the substance
- **chemical properties** – the way a substance may change or react to form other substances
- **intensive properties** – identify substances
- **extensive properties** – amount of substance

### 1.3.1 Physical and Chemical Changes

- physical change results in a change in appearance but not composition
- changes of state are physical changes
- chemical changes (chemical reactions) results in a chemically different substance

## 1.4 Units of Measurements

### 1.4.1 SI Units

- seven base units

Prefix	Abbreviation	Meaning
Mega-	M	$10^6$
Kilo-	K	$10^3$
Deci-	D	$10^{-1}$
Centi-	C	$10^{-2}$
Milli-	m	$10^{-3}$
Micro-	$\mu^a$	$10^{-6}$
Nano-	n	$10^{-9}$
Pico-	p	$10^{-12}$
Femto-	f	$10^{-15}$

### 1.4.2 Length and Mass

- SI base unit for length is the meter (m)
- Mass is a measure of the amount of material in an object

### 1.4.3 Temperature

- Celsius and Kelvin scales are used commonly in science
- Both have equal sized units
- $K = ^\circ C + 273.15$
- $^\circ C = (5/9)(^\circ F - 32)$
- $^\circ F = (9/5)(^\circ C) + 32$

### 1.4.4 Derived SI Units

#### 1.4.5 Volume

- SI unit is cubic meter
- Equipment to measure volume accurately : syringes, burets, and pipets

#### 1.4.6 Density

- density = mass/volume

## 1.5 Uncertainty in Measurement

### 1.5.1 Precision and Accuracy

- **precision** – the closeness of individual measurements to one another
- **accuracy** – the correctness of individual measurements

### **1.5.2 Significant Figures**

- Nonzero digits are always significant
- Zeros between nonzero digits are always significant
- Zeros at the beginning of a number are never significant
- Zeros that fall both at the end of a number and after the decimal point are always significant
- When a number ends in zeros but contains no decimal point, the zeros may or may not be significant
- Scientific notation can be used to get the correct significant numbers

### **1.5.3 Significant Figures in Calculations**

- the number of significant figures is determined by the number that has the fewest significant figures in the calculation

### **1.6 Dimensional Analysis**

- aid in problem solving
- conversion factor – fraction where the numerator and denominator are the same quantity
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