

Chapter 1: Matter and Energy

August 24, 2022

Chemistry Department, Cypress College

Class Announcements

- chromebook checkout
- Extended due date for the prerequisite scan - provide ID card, transcript for algebra class, and the blue worksheet (give 1 EC)

Canvas

- when2meet office hours survey will be sent out after class
- Lecture slides will be posted after class
- First quiz will be posted Thurs at 11am and you have until Mon, Aug 29th at 11:59pm
- First homework assignment posted Fri, Aug 26th at 3pm

Outline

Review: Scientific Notation and Unit Conversion

Matter and Its Classification

Chemical and Physical Changes

Potential and Kinetic Energy

Scientific Method

Recap: Building the Mathematical Toolbox

- Scientific notation simplifies large numbers to a manageable one
- Significant figures imply accuracy
 - Leading, sandwiched, and trailing zeroes
 - Addition and subtraction round to the fewest digits after the decimal
 - Multiplication and division round to the least significant digit
- Unit conversion - *familiarize* the metric system e.g. Gm, Mm, km, m, dm, cm, ...

Prefixes of Metric System

Giga (G) Mega (M) kilo (k) hecto (h) deca (da)

$$\left(\frac{1 \text{ Gm}}{1 \times 10^9 \text{ m}} \right) \quad \left(\frac{1 \text{ Mm}}{1 \times 10^6 \text{ m}} \right) \quad \left(\frac{1 \text{ km}}{1000 \text{ m}} \right) \quad \left(\frac{1 \text{ hm}}{100 \text{ m}} \right) \quad \left(\frac{1 \text{ dam}}{10 \text{ m}} \right)$$

$$\left(\frac{1 \times 10^9 \text{ m}}{1 \text{ Gm}} \right) \quad \left(\frac{1 \times 10^6 \text{ m}}{1 \text{ Mm}} \right) \quad \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \quad \left(\frac{100 \text{ m}}{1 \text{ hm}} \right) \quad \left(\frac{10 \text{ m}}{1 \text{ dam}} \right)$$

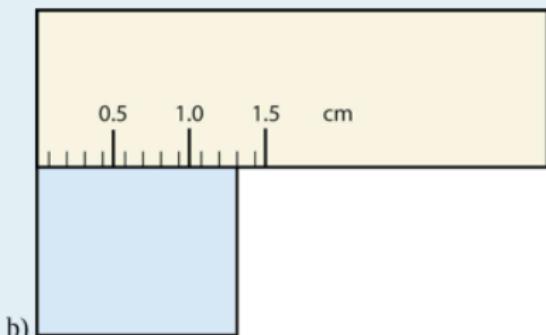
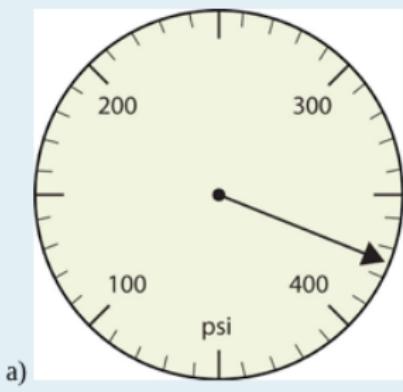
Basic Units deci (d) centi (c) milli (m) micro (μ) nano (n)

meter (m)
gram (g)
Liter (L)
second (s)
mole (mol)
calorie (cal)
Joule (J)

$$\left(\frac{10 \text{ dm}}{1 \text{ m}} \right) \quad \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) \quad \left(\frac{1000 \text{ mm}}{1 \text{ m}} \right) \quad \left(\frac{1 \times 10^6 \text{ } \mu\text{m}}{1 \text{ m}} \right) \quad \left(\frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right)$$

$$\left(\frac{1 \text{ m}}{10 \text{ dm}} \right) \quad \left(\frac{1 \text{ m}}{100 \text{ cm}} \right) \quad \left(\frac{1 \text{ m}}{1000 \text{ mm}} \right) \quad \left(\frac{1 \text{ m}}{1 \times 10^6 \text{ } \mu\text{m}} \right) \quad \left(\frac{1 \text{ m}}{1 \times 10^9 \text{ nm}} \right)$$

Quick Practice: Significant Figures



Strategy for Dimensional Analysis

1. Identify the information given and the information needed to answer.
2. Find the relationship(s) between the known information and unknown answer, and plan a series of steps, including conversion factors, for getting from one to the other.
3. Solve the problem by canceling units.
4. Check the answer to make sure it makes sense, both in magnitude and units.

Whiteboard: Sig Figs and Dimensional Analysis

Outline

Review: Scientific Notation and Unit Conversion

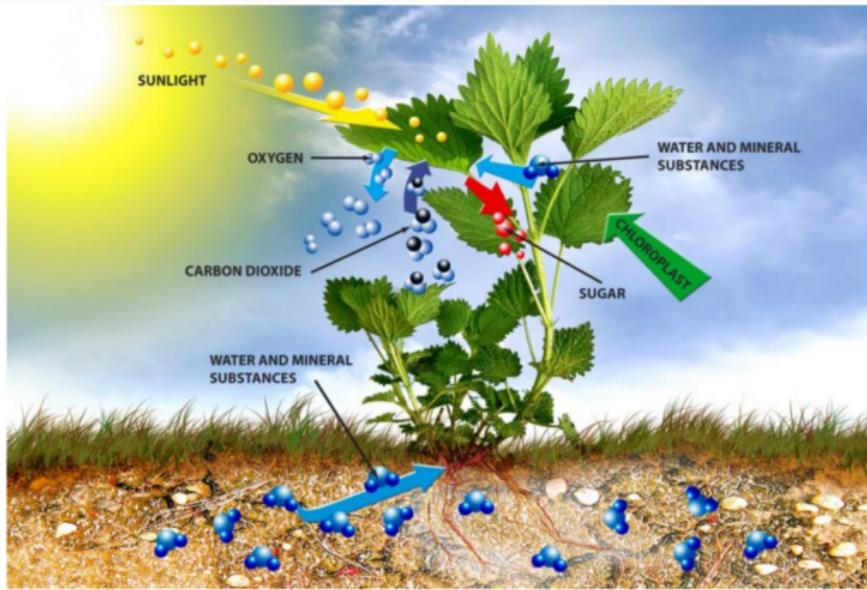
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Chemistry is Everywhere!



Conservation of Mass

Any system closed to all transfers of matter and energy, the mass of the system must remain constant over time

Classification: Composition of Matter

Pure substance - cannot be separated into components

Mixture - consists at least 2 pure substances mixed together

Classification: Composition of Matter

Pure substance - cannot be separated into components

Checkout the preiodic table (ptable)

The table displays the following information for each element:

- Element Data:** Atomic Number, Symbol, Name, Weight, and Element Number.
- Physical State:** Solid, Liquid, or Gas.
- Electron Configuration:** Shown as a sequence of numbers (e.g., 1s2, 2s2, 2p6).
- Periodic Properties:** Ionization energy, Electron affinity, and Ionization energy.
- Radius:** Calculated radius in pm.
- Hardness:** Brinell hardness in N/mm².
- Modulus:** Bulk modulus in GPa.
- Density:** STP density in kg/m³.
- Conductivity:** Electrical conductivity in S/cm.

The table is organized into groups and periods, with a color-coded legend for element types:

- Metals:** Blue background.
- Nonmetals:** Orange background.
- Noble gases:** Green background.
- Actinoids:** A purple shaded area below the lanthanides.
- Post-transition metals:** A light blue shaded area between the transition metals and the noble gases.

Examples of Pure Substances



Is water a pure substance?



Types of Mixtures

Heterogeneous Mixture



particles distributed non-uniformly



Cereal in milk



Ice in soda



Soil



Blood

VS

Homogeneous Mixture



particles distributed uniformly



Vodka



Steel



Air

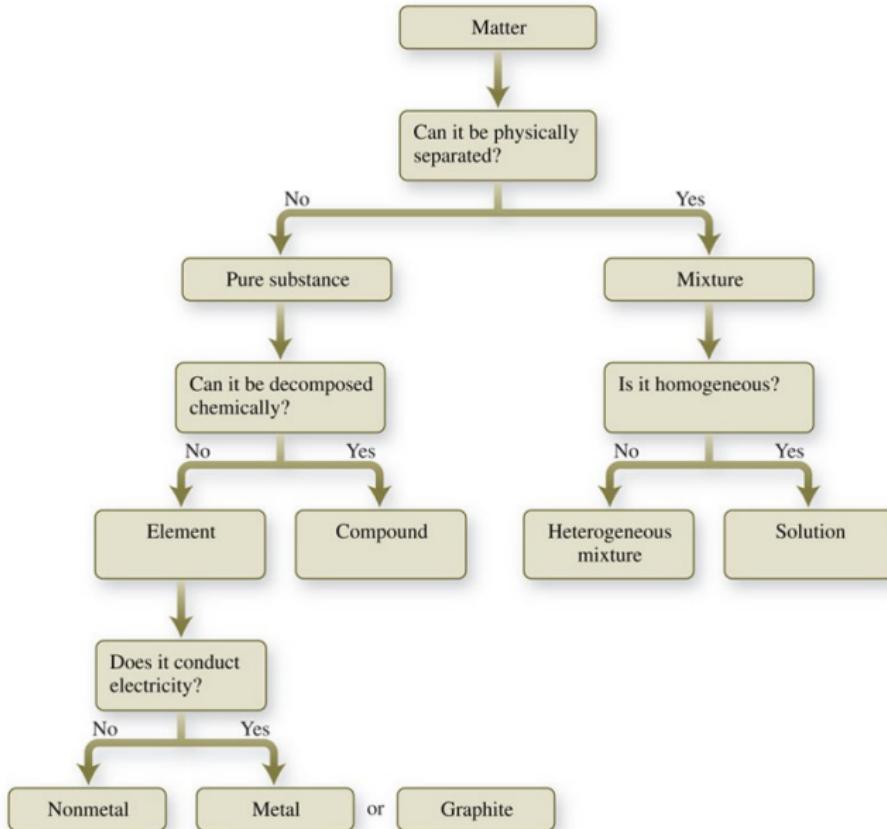


Rain

ThoughtCo.

Mixture Flowchart

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States of Matter: Water



- Solid has the smallest volume whereas gas occupies the largest space
- Water molecules have the most energy in which state?
- Notation for states - $\text{H}_2\text{O}(s)$, $\text{H}_2\text{O}(l)$, $\text{H}_2\text{O}(g)$
- **Aqueous state** - substance dissolved in water e.g. NaCl(aq)

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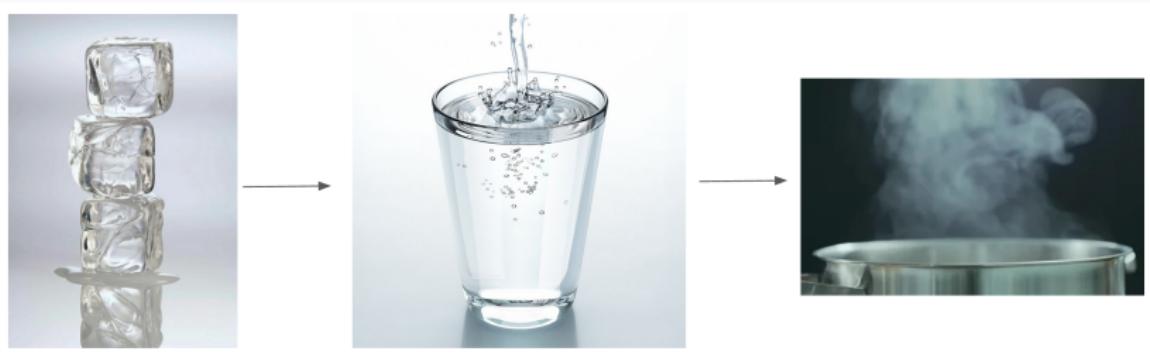
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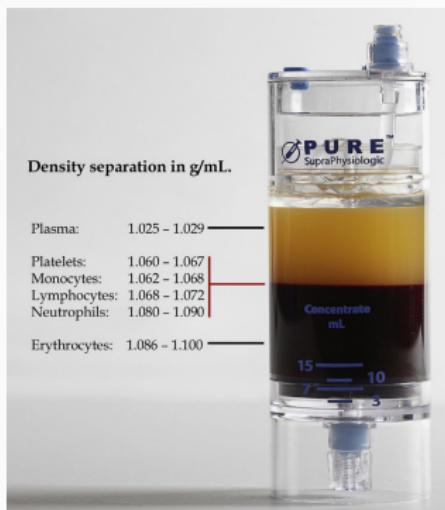
Physical Properties

A characteristic that can be observed or measured without changing the composition of a substance



Quantifying Physical Properties

- Mass - quantifies matter; measuring in grams
- Volume - amount of space occupied; measuring in L
- Density - ratio of mass and volume



- Temperature - quantifies the intensity of heat in a substance or object

Chemical Properties

A characteristic of a particular substance that can be observed in a chemical reaction e.g. combustion



Practice: Classify the following as chemical or physical changes

1. Melting solid gold into liquid gold
2. Combining copper and tin to form bronze (an alloy)
3. Electrolysis of water (H_2O) into hydrogen (H_2) gas and oxygen (O_2) gas
4. Filtering algae from water

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Whiteboard: Potential and Kinetic Energy

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Research Uses Scientific Method

1. Gather observations
2. Ask a question. Propose a hypothesis which is a supposed explanation of a given phenomenon
3. Design and perform your experiment
4. If results support the hypothesis, then propose a theory, which explains the observation. If not, then revise the hypothesis.