

Chapter 1: Matter and Energy

August 24, 2022

Chemistry Department, Cypress College

Class Announcements

- chromebook checkout

Canvas

- when2meet office hours survey will be sent out after class
- Lecture slides will be posted after class
- 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)

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

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

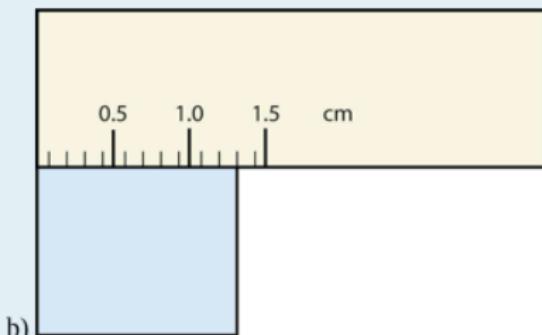
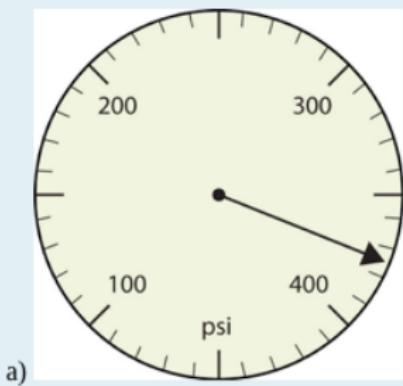
Basic Units deci (d) centi (c) milli (m) micro (μ) nano (n)

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

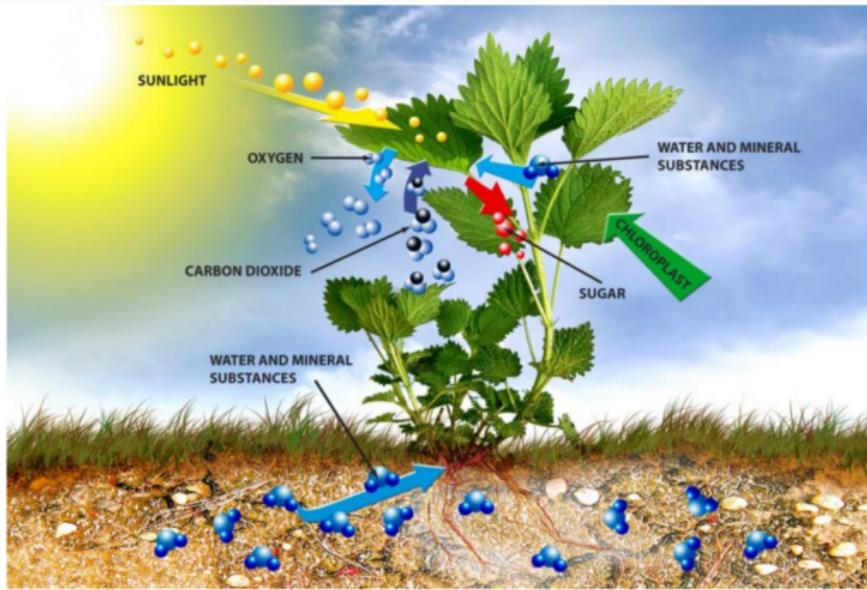
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Chemistry is Everywhere!



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)

Temperature																		0 °C	32 °F	273 K																																																																																																																																																																																																																																																																																																																																														
Periods: Chalcogens Halogens																		2 He	10 Ne	18 Ar																																																																																																																																																																																																																																																																																																																																														
32	2	8	18	4	1	H	Atomic Symbol	Solid	Metals	Nonmetals	Noble gases	5	B	Boron	10.81	6	C	Carbon	12.011	7	N	Nitrogen	14.007	8	O	Oxygen	15.999	9	F	Fluorine	18.998	10	Ne	Neon	20.180	11	Na	Sodium	22.990	12	Mg	Magnesium	24.305	13	Al	Aluminum	26.982	14	Si	Silicon	28.085	15	P	Phosphorus	32.06	16	S	Sulfur	32.06	17	Cl	Chlorine	35.45	18	Ar	Argon	39.948																																																																																																																																																																																																																																																																																															
Germanium	72.630	Series	Metalloids	1	Li	Lithium	6.94	2	Be	Beryllium	9.012	3	RF	Unknown	4	K	Potassium	39.098	5	Ti	Titanium	47.867	6	V	Vanadium	50.942	7	Cr	Chromium	51.996	8	Mn	Manganese	54.938	9	Fe	Iron	55.845	10	Ni	Nickel	58.933	11	Co	Cobalt	58.933	12	Rh	Ruthenium	101.09	13	Pd	Palladium	106.42	14	Ag	Silver	107.87	15	Zn	Zinc	65.38	16	Ga	Gallium	69.723	17	Ge	Germanium	72.630	18	Se	Arsenic	74.922	19	As	Selenium	75.971	20	Br	Bromine	79.964	21	Kr	Krypton	83.798	22	Rb	Rubidium	85.468	23	Y	Yttrium	91.234	24	Nb	Niobium	93.95	25	Tc	Technetium	98.91	26	Ru	Ruthenium	101.09	27	Os	Osmium	190.23	28	Pt	Platinum	195.08	29	Ir	Iridium	192.22	30	Hg	Mercury	200.59	31	Au	Gold	196.97	32	Tl	Thallium	204.18	33	Pb	Lead	207.2	34	Bi	Bismuth	208.98	35	Po	Po	208.98	36	At	Atatine	210	37	Fr	Rutherfordium	267	38	Db	Dubnium	268	39	Ta	Tantalum	180.95	40	W	Tungsten	183.84	41	Nb	Niobium	93.95	42	Ru	Ruthenium	101.09	43	Pd	Palladium	106.42	44	Rh	Ruthenium	101.09	45	Pt	Platinum	195.08	46	Ag	Silver	107.87	47	Cd	Cadmium	112.41	48	In	Indium	114.82	49	Zn	Zinc	65.38	50	Sn	Tin	118.71	51	Sb	Antimony	121.80	52	Te	Tellurium	131.76	53	Br	Bromine	79.964	54	Xe	Xenon	131.329	55	Cs	Cesium	132.91	56	La	Lanthanum	140.12	57	Ce	Cerium	140.91	58	Pr	Praseodymium	144.91	59	Nd	Nd	144.91	60	Pm	Promethium	145.91	61	Sm	Samarium	150.36	62	Eu	Europium	151.96	63	Tb	Terbium	157.29	64	Gd	Gadolinium	158.93	65	Dy	Dysprosium	162.50	66	Ho	Holmium	164.93	67	Er	Erbium	166.93	68	Tm	Thulium	169.93	69	Yb	Ytterbium	173.07	70	Lu	Lutetium	174.97	71	Fr	Fr	174.97	72	Ac	Actinium	227	73	Th	Thorium	231.04	74	Pa	Protactinium	231.04	75	U	Uranium	235.04	76	Np	Neptunium	237	77	Cm	Cerium	243	78	Mt	Mutherfordium	278	79	Rg	Rutherfordium	281	80	Ds	Darmstadtium	281	81	Cn	Copernicium	285	82	Hg	Hahnium	286	83	Fr	Flerovium	289	84	Mc	Moscovium	290	85	Lv	Livermorium	294	86	Ts	Ts	294	87	Og	Oganesson	294	88	Rn	Radon	222
Radius, calculated	125 pm	Hardness, Brinell	N/A MPa	Modulus, bulk	N/A GPa	Density, STP	5,323 kg/m³	Conductivity, thermal	50 W/mK																																																																																																																																																																																																																																																																																																																																																									

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

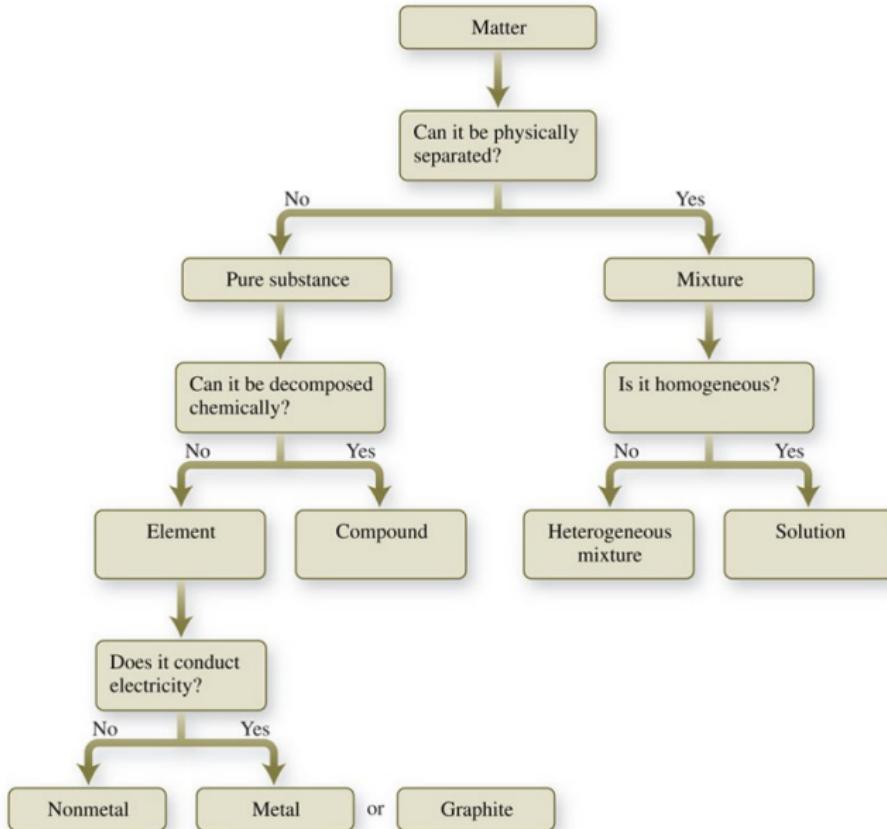


Rain

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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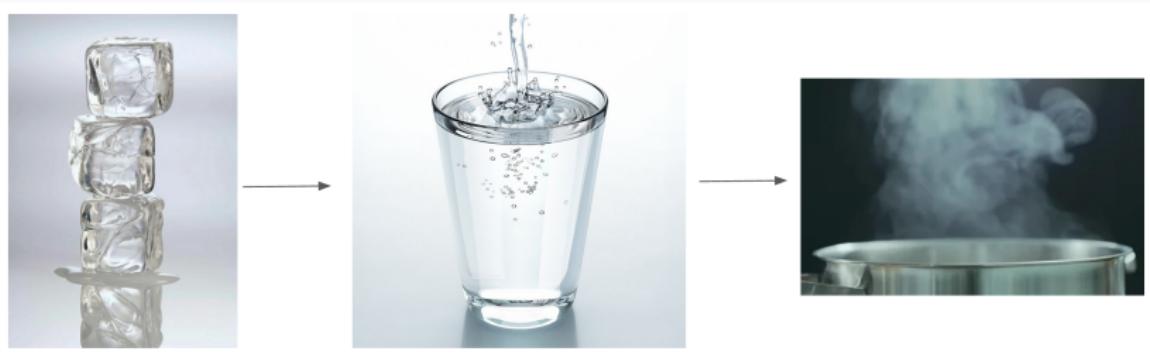
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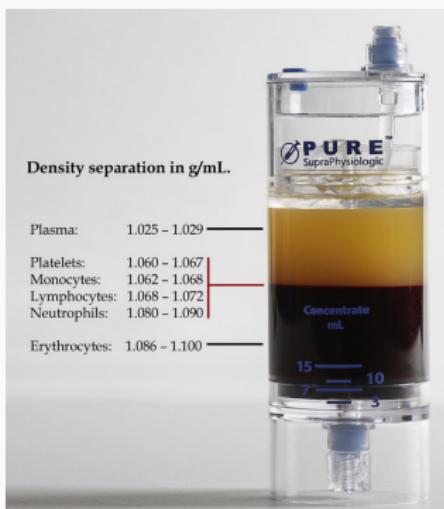
Physical Properties

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.