Unit 2: Matter and Energy Name: _____

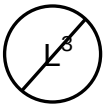
Matter ***Introductory Definitions***

matter: anything having mass and volume

mass:

weight:

volume:

units: L, dm^3, mL, cm^3 

state of matter:

composition:

copper: water:

properties:

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atom: a basic building block of matter

- ***Elements*** → contain only one type of atom

1. monatomic elements consist of unbonded, "like" atoms

e.g.,

2. polyatomic elements consist of several "like" atoms bonded together

diatomic elements:

others:

allotropes: different forms of the same element in the same state of matter

OXYGEN CARBON

molecule: a neutral group of bonded atoms

Description	Chemical Symbol	Model
1 oxygen atom		
1 oxygen molecule		
2 unbonded oxygen atoms		
1 phosphorus atom		
1 phosphorus molecule		
4 unbonded phosphorus atoms		

- ***Compounds***

…contain two or more different types of atoms

…have properties that are different from those of their constituent elements

Na (sodium):

Cl_2 (chlorine):

Atoms can only be altered by _____ means.

Molecules can be altered by _____ means.

e.g., Dehydration of sugar $C_{12}H_{22}O_{11}(s) \rightarrow 12\ C(s) + 11\ H_2O(g)$

Electrolysis of water $2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$

Compound Composition → All samples of a given compound have the same composition.

Phosgene gas ($COCl_2$) is 12.1% carbon, 16.2% oxygen, and 71.7% chlorine by mass. Find # of g of each element in 254 g of $COCl_2$.

A sample of butane (C_4H_{10}) contains 288 g carbon and 60 g hydrogen. Find…

A. …total mass of sample

B. …% of each element in butane

C. …how many g of C and H are in a 24.2 g sample

A 550 g sample of chromium (III) oxide (Cr_2O_3) has 376 g Cr. How many grams of Cr and O are in a 212 g sample of Cr_2O_3?

Classifying Matter

- ***(Pure) Substances***

ELEMENTS	COMPOUNDS
e.g.,	e.g.,

- ***Mixtures*** → two or more substances mixed together

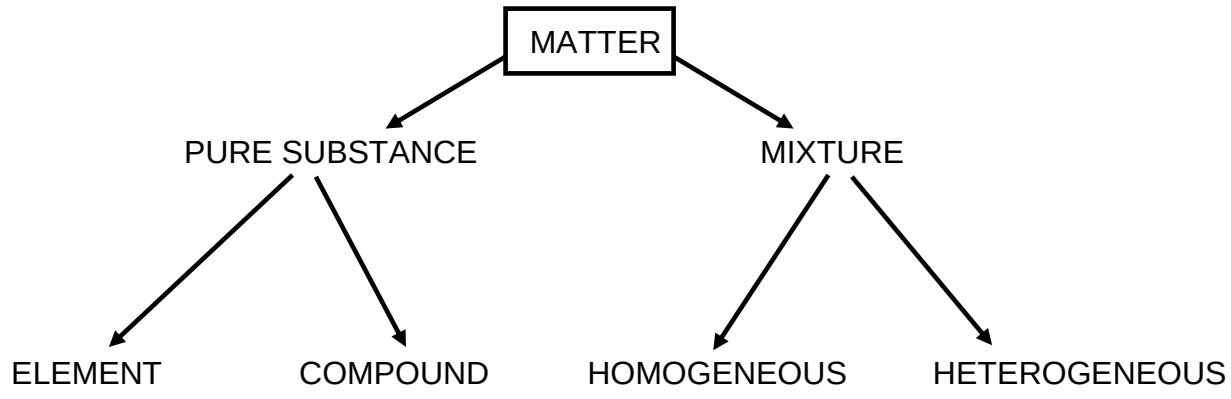
The substances are NOT chemically bonded, and they…

Two types of mixtures…

homogeneous: (or solution)	heterogeneous:
particles are microscopic; sample has same composition and properties throughout; evenly mixed	different composition and properties in the same sample; unevenly mixed
e.g.,	e.g.,
alloy: a homogeneous mixture of metals	suspension: settles over time
e.g.,	e.g.,

Contrast… 24K GOLD 14K GOLD

- ***Chart for Classifying Matter***



A sample of bronze contains 68 g copper and 7 g tin.

A. Find total mass of sample.

B. Find % Cu and % Sn.

C. How many grams of each element does a 346 g sample of bronze contain?

- ***Separating Mixtures***

  …involves physical means, or <u>physical changes</u>

1. <u>sorting</u>:

2. <u>filter</u>:

3. <u>magnet</u>:

4. <u>chromatography</u>:

5. <u>density</u>:

6. <u>distillation</u>:

Density → how tightly packed the particles are

Density =

Typical units: g/cm^3 for solids g/mL for fluids

To find volume, use… 1.

2.

** Density of water =

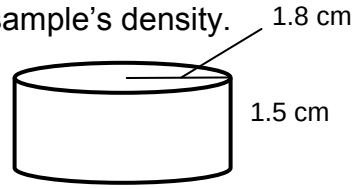
The density of a liquid or solid is nearly constant, no matter what the sample's mass.

- ***Density Calculations***

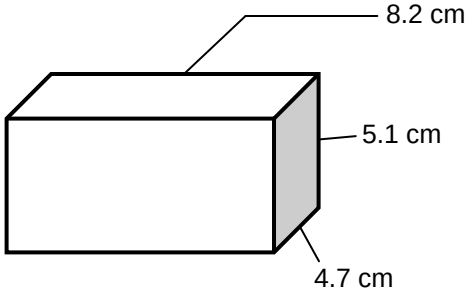
1. A sample of lead (Pb) has mass 22.7 g and volume 2.0 cm^3. Find sample's density.

2. Another sample of lead occupies 16.2 cm^3 of space. Find sample's mass.

3. A 119.5 g solid cylinder has radius 1.8 cm and height 1.5 cm. Find sample's density.



4. A 153 g rectangular solid has edge lengths 8.2 cm, 5.1 cm, and 4.7 cm. Will this object sink in water?



Properties of Matter

CHEMICAL properties tell how a substance reacts with other substances.

PHYSICAL properties can be observed without chemically changing the substance.

EXTENSIVE properties depend on the amount of substance present.

INTENSIVE properties do not depend on the amount of substance.

Examples: electrical conductivity……..…..

reactivity with water..…….

heat content (total energy)…….……

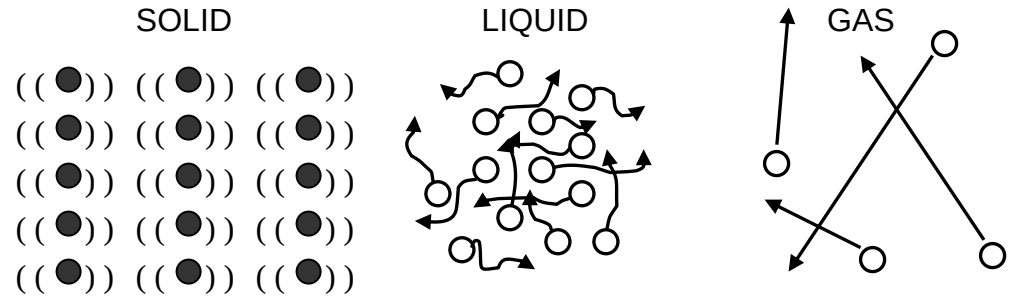
ductile: can be drawn (pulled) into wire……..

malleable: can be hammered into shape..…..

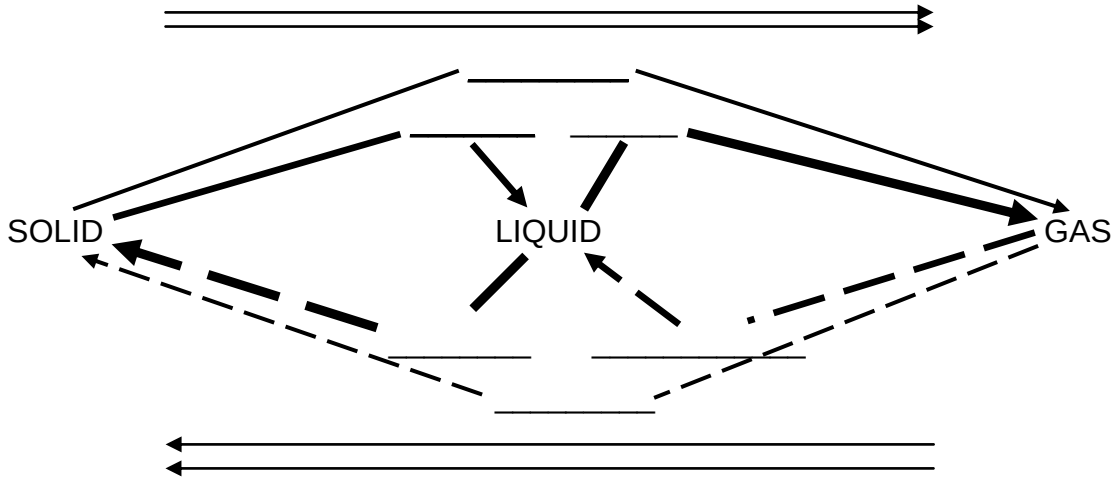
brittle…….……..…..…….

magnetism……

States of Matter



Changes in State



Energy → the ability to do work

potential energy:

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e.g.,

kinetic energy:

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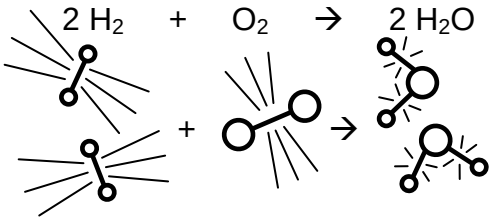
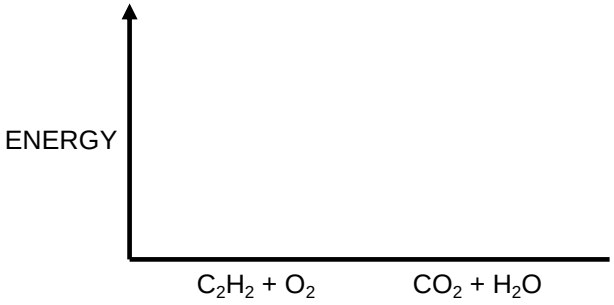
Law of Conservation of Energy:



For the combustion of acetylene…



- ***Energy Changes***

endothermic change: system absorbs heat

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exothermic change: system releases heat

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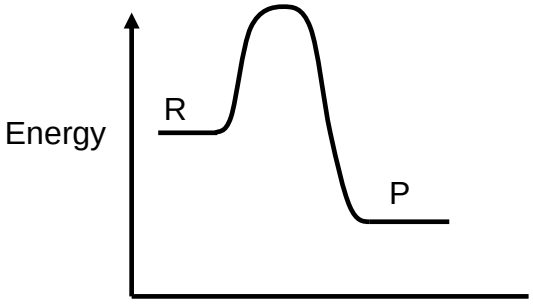
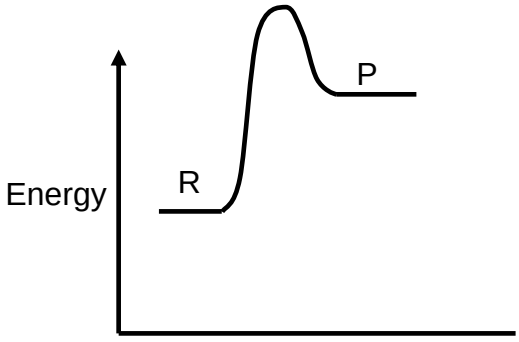
Choose "endo" or "exo."

- water boiling
- paper burning
- steam condensing
- CO_2 subliming
- water freezing
- ice melting





The Mole

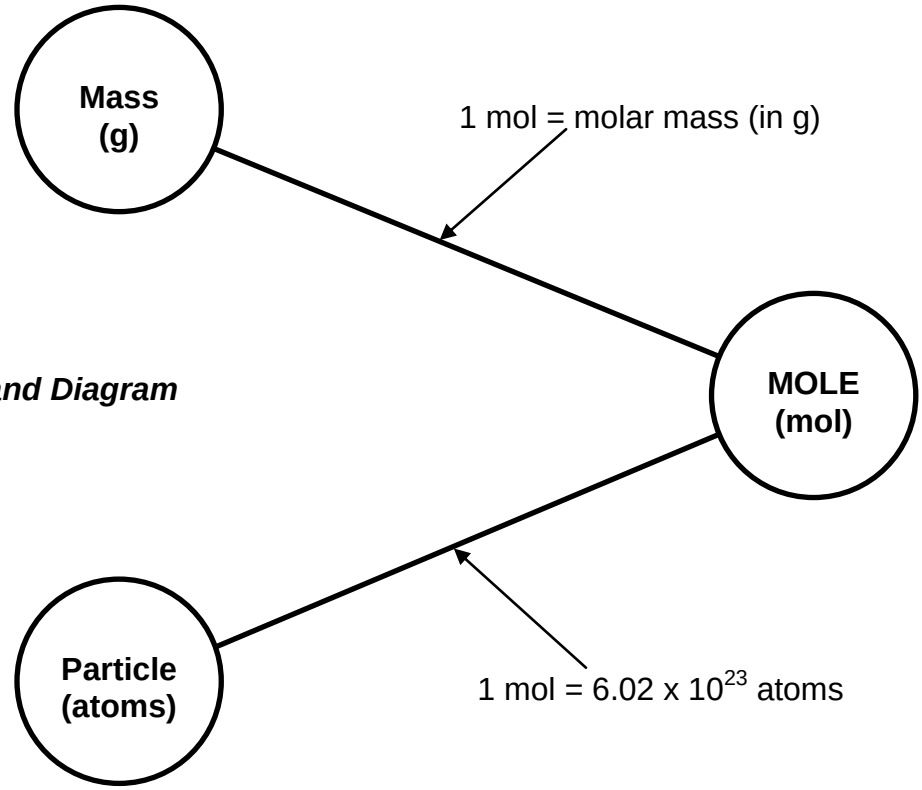
Atoms are so small, it is impossible to count them by the dozens, thousands, or even millions. To count atoms, we use the concept of the mole.

1 mole of atoms = 602,000,000,000,000,000,000,000 atoms

That is, 1 mole of atoms = _____ atoms

For any element on the Periodic Table, one mole of that element (i.e., 6.02×10^{23} atoms of that element) has a mass in grams equal to the decimal number on the Table for that element.

- ***Island Diagram***



- ***Island Diagram Problems***

1. How many moles is 3.79×10^{25} atoms of zinc?

2. How many atoms is 0.68 moles of zinc?

3. How many grams is 5.69 moles of uranium?

4. How many grams is 2.65×10^{23} atoms of neon?

5. How many atoms is 421 g of promethium?