Chemistry: ***Properties of Matter***

Name: _____ Hr: ___

Composition and Properties of Matter

In this unit, we will cover the composition and properties of matter.

composition =

properties =

Matter: The Substance of the Known Universe

matter =

mass =

In chemistry, we measure mass with an instrument called a _____.

Mass is related to weight, but it is NOT the same thing.

What does an object's **weight** depend on?

An object's mass does NOT change, no matter where it is.

Compare the definitions for matter and mass. What is wrong with these definitions?

volume =

Is air matter?

Examples of matter:

NOT examples of matter:

The most basic unit of matter is the **atom**. There are _____ different varieties of atom.

Often, atoms combine together to form a **molecule =**

Examples: carbon dioxide molecule water molecule

hydrogen molecule oxygen molecule

At the smallest level, all matter is **composed** of atoms.

How Do We Classify Matter?

All matter can be classified as either a pure substance or a mixture. For example:

pure gold	vs.	gold alloy
pure substance		mixture

pure substance (sometimes, just "substance")

There are 2 types of pure substances, elements and compounds.

elements =

An element CAN'T be broken down into simpler substances by chemical means.

From the Periodic Table of the Elements, there are _____ different elements.

Usually, we associate: "atoms" → "element"

Examples of elements:

Elements consist of: a) single atoms, or…

b) groups of atoms of the same type (molecules).

Example: diatomic gases

atomic oxygen	molecular oxygen
atomic hydrogen	molecular hydrogen
atomic nitrogen	molecular nitrogen

Even though they differ slightly, we still say that the above examples are elements because they contain…

Some elements have allotropic forms.

allotropes =

oxygen atom	oxygen gas	ozone
carbon atom	graphite	buckyball

compound =

How many different types of compounds do you think there are?

Why?

A compound CAN be broken down into simpler substances by chemical means.

Usually, we associate: "molecules" → "compound"

Properties of Compounds - every sample of a particular compound has the same properties as every other sample

Sample Problem: In every 100 g sample of pure water, there are 11.2 g of hydrogen and 88.8 g of oxygen. How many grams of hydrogen are in a 120 g sample of pure water?

mixture =

In a mixture, there are no _____ between the different substances.

There are 2 types of mixtures: homogeneous mixtures and heterogeneous mixtures.

homogeneous mixture =

Homogeneous mixtures are evenly-mixed, or uniformly distributed, at the _____ level, and are also referred to as **solutions**.

Examples:

Solids can also form solutions. .

alloy =

Examples: bronze = brass =

heterogeneous mixture =

In heterogeneous mixtures, although the particles may appear to be evenly mixed at the macroscopic level, they are NOT uniformly-distributed at the microscopic (particle) level.

Examples:

One special type of heterogeneous mixture is a …

suspension =

Examples:

Why do many liquid medications say to “Shake Well Before Using”?

Another special type of heterogeneous mixture is a…

colloid =

Examples:

Characteristics that Distinguish Pure Substances from Mixtures

1. A pure substance has only one set of properties, but a mixture retains the properties of each of its constituents.
2. The composition of a pure substance is fixed, but the composition of a mixture can vary widely.

Chart for Classifying Matter

Matter

Pure Substances | **Mixtures**

Elements | **Compounds** | **Homogeneous** | **Heterogeneous**

same atoms | **different atoms** | **solutions** | **colloids** | **suspensions**

How Can We Separate Mixtures?

There are many ways to separate mixtures. We can separate mixtures because the various constituents of the mixture have different properties. Since chemical reactions are NOT needed to separate mixtures, we say that we separate them physically (_____ _____), as opposed to separating them chemically (_____ _____.) What kinds of materials must we separate chemically?

Methods of Separating Mixtures

Method	***Property Involved***	***Applications***
Magnet		
Filter		
Decant		
Evaporation		
Distillation		
Chromatography		
Centrifuge		

Distillation Apparatus

Once again, **none** of the methods for separating mixtures involve _____.

Density: An Important Property of Matter

The **density** of a sample of matter is

Formula for density:

Mass

Using algebra, write out the 2 variations of this formula…

Volume

The **units for density** are always _____ units. We will most often use the units:

→ for fluids (liquids and gases)

→ for solids

Example 1: A piece of lead (Pb) has a mass of 22.7 g and occupies a volume of 2.00 cm^3. What is the density of Pb?

Example 2: A piece of lead (Pb) takes up 16.20 cm^3 of space. Use your answer from Example 1 to find the mass of the Pb piece.

Example 3: A piece of lead (Pb) has a mass of 1544 g. Use your answer from Example 1 to find the volume of the piece of Pb.

Density Can Be Used To Identify Substances

Archimedes and the crown of King Hiero of Syracuse

Properties of Matter

The **properties** of matter:

Some properties are given below.

Property	***Description***	***Example***
electrical conductivity	conducts electrical energy	
heat conductivity	conducts heat energy	
density	mass per unit volume	
melting point	the temp. at which a substance melts / freezes	
boiling point	the temp. at which a substance boils / condenses	
malleability	able to be hammered or stamped into shape	
ductility	able to be pulled into wire	

How would you tell the following about a substance? color, taste, odor, state of matter, flammability, density, temperature, whether it reacts with acids

We will group "properties" four different ways: extensive properties, intensive properties, physical properties, and chemical properties.

extensive properties depend on the size of the sample

Examples:

intensive properties DO NOT depend on the size of the sample

Examples:

physical properties are observed wo/changing the chem. composition of the matter

Examples:

And for metals:

chemical properties = these describe how the substance reacts (or fails to react) with other substances to produce new substances

Examples:

Keep in mind that these categories are NOT mutually exclusive. A single property can be classified in several ways. How would you classify these properties?

VOLUME	E	I	P	C	FLAMMABILITY	E	I P C
LUSTER	E	I	P	C	COLOR	E	I P C
ELECTRICAL CONDUCTIVITY	E	I	P	C	DENSITY	E	I P C

Changes in Matter

All around us, matter is constantly changing. In chemistry, we will classify changes as being either physical changes or chemical changes.

physical change = occurs when a physical property of a substance changes without any change in the substances chemical properties or composition

Physical changes DO NOT affect chemical composition.

Examples:

chemical change = any change that results in the production of one or more substances that differ in chemical properties and composition from the original substances

Chemical changes only occur when _____ take place.

Examples:

Is a change in the **state of matter** a physical or a chemical change?

Energy added…

solid (s) **liquid (l)** **gas (g)**

Energy removed…

Energy content:

Changes in Energy

All physical and chemical changes are accompanied by changes in energy.

Do you think that a physical or a chemical change would involve the greater energy change?

energy =

In chemistry, we will discuss 2 basic types of energy.

potential energy =

Examples:

kinetic energy =

Examples:

Some changes release heat into the environment; others absorb heat.

exothermic change =

the products have _____ energy than the reactants

Examples:

endothermic change =

the products have _____ energy than the reactants

Examples:

Identify each of the following as an “exothermic” or “endothermic” change.

melting of ice condensing steam into liquid water

burning paper combining hydrogen and oxygen to produce water

Chemical reactions, as a rule, need a slight “push” to get started.

activation energy =

Graphically, the activation energy can be shown as follows:

The Law of Conservation of Energy

In our introductory unit, we mentioned the Law of Conservation of Mass, which is quite similar to another fundamental idea in chemistry: the Law of Conservation of Energy.

law of conservation of energy =

Energy is _____ from one form to another, but it cannot be _____ or _____.

How is energy from coal eventually able to power an electric fan in your home?

Is there any energy that is lost in these transformations?

Changes in energy will be an important topic of study, especially in our units on chemical bonding and heat energy.

Conversion Factors

Many of the problems we will solve will require the use of conversion factors.

Example: Change (i.e., convert) 1.4 feet to inches

conversion factor =

consists of a numerator and a denominator

What is the numerical value of any conversion factor?

Why is this important?

The set-up for conversion problems is very important because it will help you understand what you are doing. Your teacher will show you the proper method of setting up your solution to the problem. You must use this method, even if it seems strange at first. Much of what we will later learn depends upon you understanding how to correctly use conversion factors.

Example 1: Find the number of m in 2.35 km.

Example 2: Find the number of km in 756 m.

Example 3: How many g is 8503 mg?

Example 4: How many mm is 0.331 km?

Sometimes we will need to use more than 1 conversion factor. We can use as many as we want. Why?

Chemical Quantities: The Mole

The most important "new" quantity we will use in chemistry is the mole, which is abbreviated "mol".

1 mole of atoms =

1 mole of molecules =

Avogadro's number =

Atoms and molecules are so small that it is impossible to efficiently count them one at a time, or even by the thousands or millions. We use the concept of the mole to more easily measure numbers of atoms and molecules.

How large a number is 6.022×10^{23}?

Do all atoms (gold atoms, uranium atoms, hydrogen atoms, etc.) have the exact same mass?

The mole concept is closely related to the Periodic Table. The Table has been set up so that…

When doing "mole problems," we will use the standard set-up, just as we did with conversion factors.

Number of mol and Substance	***Mass of Substance***	***Number of Atoms of Substance***
1 mol of iron (Fe)		
2 mol of aluminum (Al)		
1.45 mol of neon (Ne)		
0.58 mol of calcium (Ca)		

Once you take the time to understand it, the **mole concept** is a very useful idea, and NOT an overly-difficult one. We will see it repeatedly in future units of this course.

Student Signature _____ **Date** _____

Teacher Sign-off _____ **Points** _____