Chemistry Name: _____

Section _____ MATTER KEY Date: _____

Chapter 3: Matter – Properties and Changes Note Taking Guide

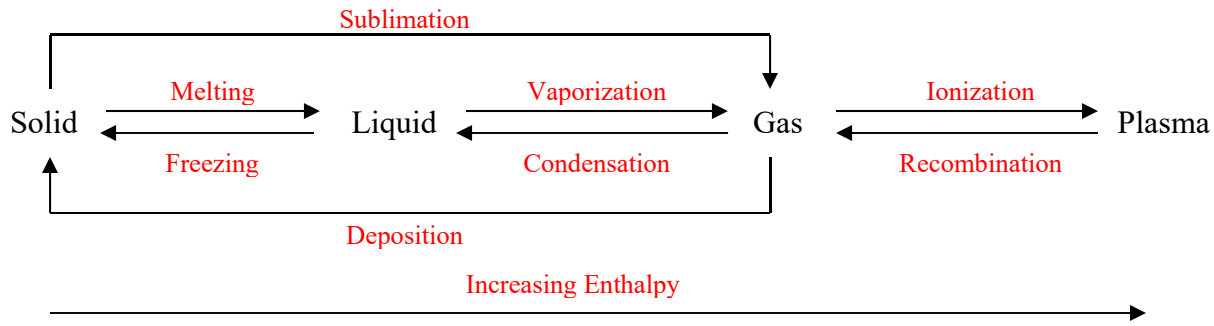
Old definitions of states of matter

Solid: has definite volume and definite shape

Liquid: : has definite volume but no definite shape

Gas: : has no definite volume and no definite shape

Phase Changes



In the solid to liquid transition, bonds are: weakened and energy must be added (endothermic process)

In the liquid to gas transition, bonds are: broken and energy must be added (endothermic)

In the gas to plasma transition, so much energy is added that: electrons are stripped from atoms forming positive ions

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Properties of Matter

Physical properties: can be observed or measured without changing the chemical identity (or composition) of the sample

Intensive properties: are independent of sample size

Examples: density, temperature, or color

Extensive properties: depend on sample size

Examples: mass, volume, or heat

Physical changes: alter the substance without changing its chemical identity

Examples: phase changes or dissolution

Chemical properties: ability of a substance to change the chemical identiy (or compostion) of the sample Examples: burning wood or rusting metal

Chemical changes always alter the chemical identity or composition of the substance

If a substance is ***not*** combustible, this is considered a chemical property

Indicators of a chemical reaction

1. Energy evolution (heat/light/temperature changes)
2. Evolution of a gas (bubbles form)
3. Formation of a precipitate (crystals form then settle out)
4. Color change
5. Change in odor

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Law of Conservation of Mass: (Antoine Lavoisier) matter is neither created nor destroyed in a chemical reaction – it is conserved

In equation form: $mass_{reactants} = mass_{products}$

Example: Use the data in the table to answer the questions

Aluminum and Liquid Bromine Reaction		
Substance	Before Reaction	After Reaction
Aluminum	10.3 g	0.0 g
Liquid Bromine	100.0 g	8.5 g
Compound	0.0 g	

How many grams of bromine reacted?

100 g – 8.5 g = 91.5 g

How many grams of compound were formed?

10.3 g + 91.5 g = 101.8 g

Mixtures

Homogeneous mixture: has a constant composition throughout, or has only a single phase

and is also called a solution

Heterogeneous mixture: the individual substances remain distinct, or has multiple phases with phase boundaries or interface layers

Separation of mixtures can be accomplished by physical means

1. Filtration: the removal of a solid from a liquid phase by passing through a medium which allows only the fluid to pass

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2. Distillation: vaporization of one component in a mixture of liquids followed by condensation of the most volatile phase separately

3. Crystallization: the slow precipitation of a substance from a solution

4. Sublimation: separation by causing one substance in a mixture to sublime and then redeposit in a different location

5. Chromatography: vaporization of one component in a mixture of liquids followed by condensation of the most volatile phase separately

Elements and Compounds: are the only possible pure substances

Element: a pure substance that cannot be separated into simpler substances by chemical or physical means

The smallest particle of an element is the atom

The periodic table lists 92 naturally occurring elements and more than 25 man-made elements occurring after uranium

Examples of element names and symbols sodium (Na), chlorine (Cl), carbon (C), and iron (Fe)

The first letter in a chemical symbol is always a capital block letter

The second letter in a chemical symbol is always a small case letter

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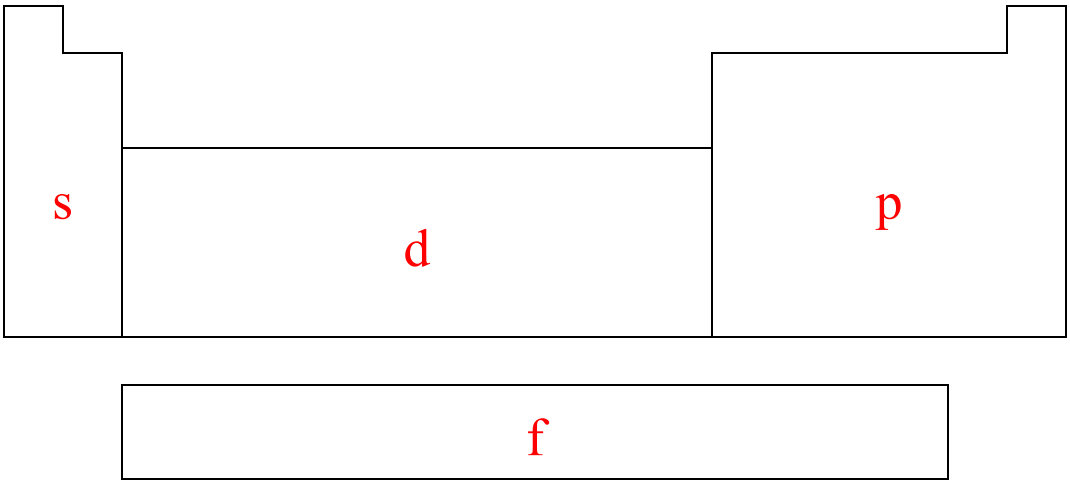
The Periodic Table



The rows are called periods or series

The columns are called groups or families

The **blocks** are labeled s, p, d, and f

Compound: a pure substance composed of two or more types of elements that can be decomposed by chemical means

The smallest particles of compounds are molecules or ions

Compounds are decomposed into elements by use of electrolysis

The Law of Definite Proportions: the elements which compose a compound always occur in the same proportions by mass

Percent Mass $= \frac{\text{mass of element}}{\text{mass of compound}} \times 100\%$ or $\frac{\text{mass of part}}{\text{mass of whole}} \times 100\%$

Example: Find the mass percent of sodium in sodium chloride ($CaCl_2$)

Ca = 40.08 g

Cl = 2 x 35.453 g

$CaCl_2$ = 110.99 g

% composition by mass $= \frac{\text{mass of part}}{\text{mass of whole}} \times 100\%$

$\%_{Na} = \frac{40.08\text{ g}}{110.99\text{ g}} \times 100\%$

$= \underline{36.11\%}$

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The Law of Multiple Proportions: when two elements combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element occur in a ratio of small, whole numbers

Example: Consider water (Compound I) and hydrogen peroxide (Compound II)

(I) H : O = 11.1 g : 88.9 g ÷ 11.1 g smallest whole number ratio = 1 : 8

(II) H : O = 5.9 g : 94.1 g ÷ 5.9 g smallest whole number ratio = 1 : 16

The ratio of mass of O in I : II = 8 : 16 smallest whole number ratio = 1 : 2

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