Your Guide for Success—Chemistry Unit

Name: __________________________
Chemistry Outline

I. Atoms
   A. Structure of an Atom
      1. Subatomic Particles
      2. Different Form
         b. Isotope

II. Periodic Table
    1. Arranging
       a. Mendeleev
       b. Mosely
    2. Grouping the Elements

III. Chemical Bonding
    A. Ionic Bonding
       1. Forming Ionic Bonds
       2. Forming Positive Ions
       3. Forming Negative Ions
       4. Properties
    B. Covalent and Metallic Bonds
       1. Molecules
       2. Movement of Electrons in Metallic Bonds
       3. Properties of Metallic Bonds

IV. Chemical Reactions
    A. Forming New Substances
    B. Chemical Formulas and Equations
       1. Chemical Formulas
       2. Writing Formulas for Covalent and Ionic Compounds
       3. Chemical Equations
       4. Law of Conservation of Mass
       5. Balancing Equations
The Periodic Table of Elements

<table>
<thead>
<tr>
<th>Atomic Number</th>
<th>Number of Protons</th>
<th>Number of Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Weight</td>
<td>Number of Protons</td>
<td>+ Number of Neutrons</td>
</tr>
</tbody>
</table>

**METALS**

**NON-METALS**

KEY

- Solid at room temperature
- Liquid at room temperature
- Gas at room temperature
- Radioactive
- Artificially Made

*The atomic weights listed on this Table of Elements have been rounded to the nearest whole number. As a result, this chart actually displays the mass number of a specific isotope for each element. An element's complete, unrounded atomic weight can be found on the It's Elemental web site: http://education.jlab.org/itselemental/index.html*
The Atom vs. The Isotope
Chapter 4 Section 2 Pages 88-94

Nucleus:
- Tiny, _______ core of an atom
- Contains ____________ and neutrons
- Most of an atom’s __________
- Very small and ____________.

Protons:
- __________ charged
- 1 ________ = 1 amu
- Atomic # = the num-
- ber of __________
- Symbol: + or ____

Neutrons
- 1 ________ = 1 amu
- Symbol: 0 or ____

Together:
- Protons + _____________ = atomic mass

Electron Cloud:
- _______ the nucleus
- Most of an atom’s ______
- Contains _______ charged
- MUCH ______
- VERY ______
- # of Electrons = # of ________
- Symbol: - or _______
- ________

Isotope:
- An ________ that has the same number of ____________ (atomic num-
- ber) but a ________ number
- of ____________, there-
- fore it has a different

Smallest unit of an __________ that maintains the properties of that element.
- Contains subatomic particles: Protons, ____________, and Electrons

Protons: Neutrons: Electrons: Mass number =

This isotope is a hydrogen atom that has one proton in its nucleus.

This isotope is a hydrogen atom that has one proton one neutron in its nucleus.

Protons: Neutrons: Electrons: Mass number =

Protons: Neutrons: Electrons: Mass number =
IDENTIFY AND COMPLETE EACH ATOM. MAKE SURE YOU PUT THE CORRECT NUMBER OF ELECTRONS IN EACH ORBITAL. USE YOUR PERIODIC TABLE!

REFERENCE BOX

# Neutrons = Atomic Mass - Atomic Number
# Protons = Atomic Number
# Electrons = # Protons (for neutral atoms)

The inner orbital holds a maximum of two electrons and gets filled first.

The second orbital holds a maximum of eight electrons and gets filled after inner orbital.

1. Atomic Number: 3
   Atomic Mass: 7
   Name:

2. Atomic Number: 4
   Atomic Mass: 9
   Name:

3. Atomic Number: 5
   Atomic Mass: 11
   Name:

4. Atomic Number: 6
   Atomic Mass: 12
   Name:

5. Atomic Number: 7
   Atomic Mass: 14
   Name:

6. Atomic Number: 8
   Atomic Mass: 16
   Name:

7. Atomic Number: 9
   Atomic Mass: 19
   Name:

8. Atomic Number: 10
   Atomic Mass: 20
   Name:

Which two atoms could GAIN 1-2 electrons in order to complete their outer shell?

Which two atoms could LOSE 1-2 electrons in order to have a complete outer shell?

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Arranging the Elements  
Chapter 5  Section 1  Pages 106-112

History 101-The Periodic Table

- Dmitri Mendeleev—______________ Chemist—__________
- Discovered a _______________ in the elements properties.
- His final arrangement—increasing atomic ____________.
- He left gaps in the his table—for yet _______________ elements.
- He could _________________ the properties of the undiscovered elements.

Our Current Periodic Table

- Henry Mosely—___________________ Scientist—____________
- Rearranged original table—Our current periodic table is by atomic ________________.
- This allowed all elements to fit the __________________________.

Classification of Elements on the Periodic Table

<table>
<thead>
<tr>
<th>Metals</th>
<th>Metalloids</th>
<th>Nonmetals</th>
</tr>
</thead>
<tbody>
<tr>
<td>______ of zig-zag line</td>
<td>____________ zig-zag line</td>
<td>____________ of zig-zag line</td>
</tr>
<tr>
<td>______ valence electrons</td>
<td>About ______ a complete set of valence electrons</td>
<td>______ or almost complete set of valence electrons</td>
</tr>
</tbody>
</table>

An element’s classification is determined by its number of ____________ electrons. The ____________ line helps you recognize where to locate each classification on the Periodic Table.

Decoding The Elements of the Periodic Table

| 8 | Atomic Number |
| 0 | Symbol        |
| O | Name          |
| 15.999 | Atomic Mass |

<table>
<thead>
<tr>
<th>Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction =</td>
</tr>
<tr>
<td>Period # = ________</td>
</tr>
<tr>
<td>There are ______ periods.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groups/Families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction = ______________</td>
</tr>
<tr>
<td>Each group has ____________ properties.</td>
</tr>
<tr>
<td>If you know the group number you can determine the number of ____________ electrons.</td>
</tr>
<tr>
<td>There are ______ groups.</td>
</tr>
</tbody>
</table>
These are two ________es from the __________ _________e. They show that from ______t to ______t, the n________ of v________ _________s for each element ________es. The number of valence electrons determines the ______’s ________g ability and ________y. Each vertical pair has the ________e number of valence electrons. In the periodic table, each pair is part of a larger ________p with similar chemical properties.
Grouping the Elements
Chapter 5 Section 2 Pages 114-120

<table>
<thead>
<tr>
<th>Group 1 (G1)—Alkali Metals:</th>
<th>Group 2 (G2)—Alkaline-Earth Metals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ___________ reactive metals</td>
<td>• ___________ reactive than G1</td>
</tr>
<tr>
<td>• 1 ___________ electron</td>
<td>• 2 ___________ electrons</td>
</tr>
<tr>
<td>• Often store in ____________</td>
<td>• Physical Properties—Silver,</td>
</tr>
<tr>
<td>• Found in nature in __________</td>
<td>density than G1</td>
</tr>
<tr>
<td>• Physical Properties — Soft,</td>
<td></td>
</tr>
<tr>
<td>___________, shiny, and low</td>
<td></td>
</tr>
</tbody>
</table>

![Group 1 (G1)—Alkali Metals Table]

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>Be</td>
<td>Mg</td>
<td>Ca</td>
<td>Sr</td>
<td>Ba</td>
<td>Ra</td>
<td></td>
</tr>
<tr>
<td>3 Li</td>
<td>4 Be</td>
<td>12 Mg</td>
<td>20 Ca</td>
<td>38 Sr</td>
<td>56 Ba</td>
<td>88 Ra</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 3-12 (G3-12)—Transition Metals:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 or 2 ___________ electrons (Do not let them go as easily as G1 or G2)</td>
<td></td>
</tr>
<tr>
<td>• Less ___________ than G1 and G2</td>
<td></td>
</tr>
<tr>
<td>• Good ___________ density, ___________ melting point than G1 and G2</td>
<td></td>
</tr>
</tbody>
</table>

**Lanthanide Series:**

**Actinide Series:**

• ___________/Unstable
• After element number ___________ made in laboratories.

<table>
<thead>
<tr>
<th>Group 13 (G13)—Boron Group:</th>
<th>Group 14 (G14)—Carbon Group:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• _____ metalloid and _____ metals</td>
<td>• _____ nonmetal, _____ metalloids, and _____ metals</td>
</tr>
<tr>
<td>• 3 ___________ electrons</td>
<td>• 4 ___________ electrons</td>
</tr>
<tr>
<td>• _________ at RT</td>
<td>• Varying ___________</td>
</tr>
<tr>
<td>• Most common = ___________</td>
<td>• ___________ at RT</td>
</tr>
</tbody>
</table>

![Group 13 (G13)—Boron Group Table]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>5 B</td>
<td>6 C</td>
<td></td>
</tr>
</tbody>
</table>

![Group 14 (G14)—Carbon Group Table]

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Si</td>
<td>Ge</td>
<td>Sn</td>
<td>P</td>
<td>Pb</td>
<td>U</td>
</tr>
<tr>
<td>6 C</td>
<td>14 Si</td>
<td>32 Ge</td>
<td>50 Sn</td>
<td>52 P</td>
<td>82 Pb</td>
<td>114 U</td>
</tr>
</tbody>
</table>

Appears at the bottom of the table to keep it from being too wide.
### Grouping the Elements.....continued

**Chapter 5 Section 2 Pages 114-120**

#### Group 15 (G15)—Nitrogen Group:
- _____ nonmetals, _____ metalloids, and _____ metals
- 5 ___________ electrons

#### Group 16 (G16)—Oxygen Group:
- _____ nonmetals, _____ metalloids, and _____ metals
- 6 ___________ electrons

#### Groups 17 G(17)—Halogens:
- All _______________________
- 7 ___________ electrons
- Very _______________________
- Need to gain only _________ valence electron
- Forms compounds with __________ very easily.
- Chemical properties _______________________
- Physical properties ____________ different

#### Group 18 (G18)—Noble Gases:
- All _______________________
- 8 ___________ electrons—Exception is He—__________ valence electrons.
- __________
- __________!

#### Hydrogen:
- 1 ___________ electron
- Set a part because the ___________ do not ___________ any other group.
- Is placed above ___________ because the ___________ of valence electrons is the same.
- Most ___________ element
### Ionic Bonding

**Chapter 1 Section 2 Pages 8-11**

#### Ionic Compounds
- Forms when ___________ electrons are transferred (gained or lost) from one atom to another to ___________ each others outer energy level.
- Forms between ___________ (+ ions) and nonmetals ( ____ ions)
- When formed, the # of ___________ lost equals the # of electrons ___________.
- Therefore, ionic compounds are ___________.
- The charges ___________ each other out.
- Properties include; ___________ bond, ___________ melting and boiling points.

#### Writing Ionic Formulas
- Always write the ____ ion or ________ first.
- Write the ____ ion or the _________ second.
- Polyatomic ion—an ion that is made up of more than one atom (2 capital letters—Ex (NH₄)⁺
1. When written name remains the same.
2. Use parentheses
- ________ numerals show ___________ number.
- An oxidation number is the number of ___________ electrons an atom gains or loses to become ___________.
- Make sure compounds are ___________.

#### Forming + Ions - Cation
- Occurs when an atom ___________ valence electrons.
- An atom now has ___________ protons than negative electrons. (Unbalanced + and -)
- ___________ form + ions because they have _______ valance electrons (1, 2, or 3)
- Only takes a small amount of ___________ to lose their few ___________ electrons.
- _____ and _____ are examples of atoms that form + ions.

#### Forming - Ions—Anion
- Occurs when an atom ___________ valence electrons.
- An atom now has move ___________ electrons than positive protons. (Unbalanced + and -)
- ___________ form - ions because they have an almost full outer level.
- Ending of the elements name changes to _________ (Ex. Fluorine —> Fluoride)
- _____ and _____ are examples that form - ions.
Section A: Complete the chart using a periodic table to help you.

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Symbol</th>
<th>Total # of Electrons</th>
<th># of Valence Electrons</th>
<th># of Electrons Gained or Lost</th>
<th>Oxidation Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Cl</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>K</td>
<td>19</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>Mg</td>
<td>12</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorine</td>
<td>F</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>Al</td>
<td>13</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>Na</td>
<td>11</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>O</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodine</td>
<td>I</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section B: Answer these questions:
1. An atom that gains one or more electrons will have a ________________ charge.
2. An atom that loses one or more electrons will have a ________________ charge.
3. An atom that gains or loses one or more electrons is called an ________________.
4. A positive ion is called a ________________ and a negative ion is called a ________________.
5. Atoms will transfer one or more ________________ to another to form the bond.
6. Each atom is left with at ________________ outer shell.
7. An ionic bond forms between a ________________ ion with a positive charge and a ________________ ion with a negative charge.

Section C: Draw the ionic compounds below. Show the transfer, give the name of the compound and give the formula.

Example #1: Sodium + Chlorine
Example #2: Magnesium + Iodine

Example #3: Sodium + Oxygen
Example #4: Aluminum + Chlorine
**Covalent Molecules**
- Forms when atoms ___________ valence electrons to complete an atom’s outermost energy level.
- Forms between 2 or more ___________.
- May have ___________ bonds between the atoms.
- Consist of individual particles called ___________.
- Simplest type = ___________.

Example—Hydrogen H₂ and Oxygen O₂
- Properties: ___________ bond, ___________ melting and boiling points.

**Metallic Compounds**
- This type of bond is formed by the ___________ between positively charged metal ions and the ___________ in the metal.
- The metals outermost energy levels ___________.
- This overlapping allows the ___________ electrons to move throughout the metal.
- The ___________ ___ cancel the ___________ charge of the ions.

**Writing Covalent Formulas**
- Usually the name tells you the ___________.
- However, many molecules have ___________ names

Example—dihydrogen monoxide = water
- Pay attention to ___________ used.

<table>
<thead>
<tr>
<th>Mono—</th>
<th>Hexa—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Di—</td>
<td>Hepta-</td>
</tr>
<tr>
<td>Tri—</td>
<td>Octa-</td>
</tr>
<tr>
<td>Tetra—</td>
<td>Nona-</td>
</tr>
<tr>
<td>Penta—</td>
<td>Deca—</td>
</tr>
</tbody>
</table>

**Properties of Metals**
- Metallic bonding is what gives ___________ their particular properties.
- When metals are ___________ electric current, the ___________ electrons are moving through the metal.
- Because of the “___________” electrons, metals may be ___________. Malleability and ___________ describe how a metal may be reshaped.
Section A: Answer these questions:
1. Atoms __________________ one or more electrons with each other to form the bond.
2. Each atom is left with a __________________ outer shell.
3. A covalent bond form between two ________________________________.

Section B: Draw the molecular compounds below. Show how they share, give the name of the molecule and give the formula.

Example #1: Hydrogen + Hydrogen
Example #2: Hydrogen + Oxygen
Example #3: Chlorine + Chlorine
Example #4: Oxygen + Oxygen
Example #5: Carbon + 2 Oxygen
Example #6: Carbon + 4 Hydrogen

Write the formulas for the following covalent compounds:

1) antimony tribromide ____________________
2) hexaboron silicide ____________________
3) chlorine dioxide ____________________
4) hydrogen iodide ____________________
5) iodine pentafluoride ____________________
6) dinitrogen trioxide ____________________
7) ammonia ____________________
8) phosphorus triiodide ____________________
9) P₃S₅- ____________________
10) O₂ ____________________
11) SeF₆ ____________________
12) Si₂Br₆- ____________________
13) SCl₄ ____________________
14) CH₄ ____________________
15) B₂Si ____________________
16) NF₃ ____________________
Chemical Reactions

- A process in which one or more substances __________ to make one or more __________ substances.
- The ___________ and physical properties __________ from the original substances.

Some Signs of Chemical Reactions

Reactions often have more than one of these signs. And the more of these signs you see, the more likely that a chemical reaction is taking place. However there is NO guarantee. The MOST important sign is ________________ of a _________ substance!

How do new substances form in a chemical reaction?

- Chemical bonds in the original substances must ________________.
- The ___________ rearrange.
- New ____________ form to make ____________ substances.
On your desk place the “Physical Change” card to your left and the “Chemical Change” card to your right.
Using what you know about physical and chemical changes, place each card into the correct category.
Record your data in the chart below.

<table>
<thead>
<tr>
<th>Physical Change</th>
<th>Chemical Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Were there any cards you had trouble classifying?
Give an example of a physical change that was not listed above.
Give an example of a chemical change that was not listed above.
Use symbols and ______________ to describe a chemical reaction.
Starting materials = _____________________________
Ending materials = _____________________________

Accuracy is key when writing chemical equations!

Equations MUST BE Balanced!
- Atoms are never ____________ or gained in a chemical reaction—just ________________.
- The ______________ of reactants must equal the number of ______________.
- Based on the work of Antoine Lavoisier—Law of __________________________ of ____________________________.

Steps to balance a chemical equation.
1. Write symbols and ________________ correctly.
2. Make 2 lists of ______________ - write it the ______________ on both sides of the arrow.
3. Count
4. Use ________________ to balance
5. Recount/ ________________ if necessary.

Never Ever Balance by Changing a Subscript!
Balancing Equations Practice

Part A: Identify the following parts of each chemical formula by circling the subscripts and drawing a square around the coefficients.

\[
\begin{align*}
&H_2 & 2HCl & 4O_2 & CH_4 & 3CO_3 & 2NaOH \\
\end{align*}
\]

Part B: List the symbols for the atoms in each formula and give the number of each.

\[
\begin{align*}
&C_2H_6 & 2MgO & 4P_4O_{10} \\
&NH_3 & 3Al(OH)_3 & 2H2O \\
\end{align*}
\]

Part C: Balance each of the following equations following the procedure described in class. Be sure to show your work.

\[
\begin{align*}
P + O_2 & \rightarrow P_4O_{10} & Mg + O_2 & \rightarrow MgO \\
P = & P = & Mg = & Mg = \\
O = & O = & O = & O = \\
HgO & \rightarrow Hg + O_2 & Al_2O_3 & \rightarrow Al + O_2 \\
Hg = & Hg = & Al = & Al = \\
O = & O = & O = & O = \\
BaCl_2 + H_2SO_4 & \rightarrow BaSO_4 + HCl \\
Ba = & Ba = \\
Cl = & Cl = \\
H = & H = \\
S = & S = \\
O = & O = \\
\end{align*}
\]