

**Chapter 2 Worksheet:  
Atoms, Molecules, and Ions**

1. Briefly define the following:
  - a. Law of Conservation of Mass  
Matter is neither created nor destroyed in a chemical reaction – molecules change to create new substances.
  - b. Law of Definite Proportions  
All samples of a given substance will have the same ratio of atoms by mass (e.g., carbon dioxide is always CO<sub>2</sub>).
  - c. Dalton's Atomic Theory  
4 postulates: all matter is made of atoms (once thought to be indivisible); all atoms of a given elements are identical (atoms of different elements are different); atoms are not created or destroyed in a reaction; atoms combine in small, whole-number ratios to form compounds.
  - d. Law of Multiple Proportions  
Two different compounds made up of the same elements will have mass ratios that are small whole-number ratios of each other. For example, ratio of oxygen in CO to oxygen in CO<sub>2</sub> is 1:2.
2. Describe the contribution made by the following scientists:
  - a. Priestley  
Isolated oxygen by heating HgO in a closed container to observe conservation of mass.
  - b. Lavoisier  
Discovered Law of Definite Proportions.
  - c. Thomson  
Worked with cathode ray tubes to discover the presence of electrons in the atom.
  - d. Millikan  
Used the oil drop experiment to calculate the charge (in Coulombs) of an electron.
  - e. Rutherford  
Used the gold foil experiment to determine the structure of an atom (relative positions of protons and electrons).
  - f. Chadwick  
Worked w/ alpha particles and beryllium to discover the presence of neutrons

3. Fill in the table below:

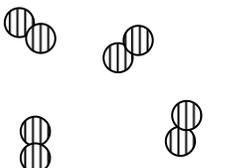
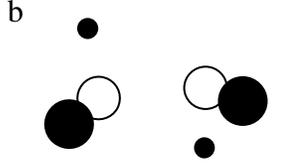
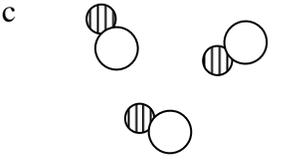
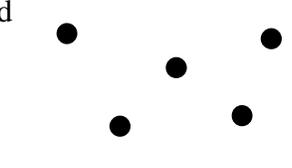
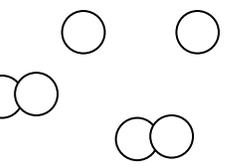
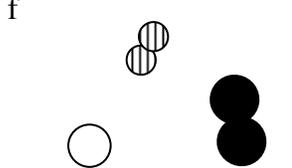
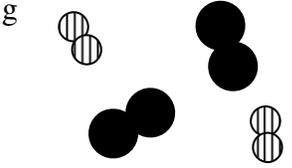
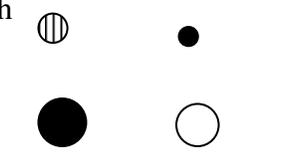
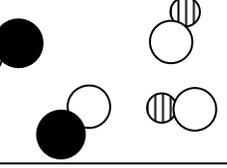
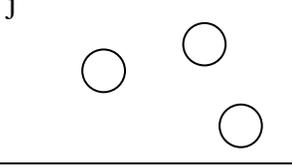
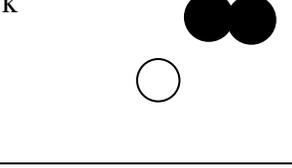
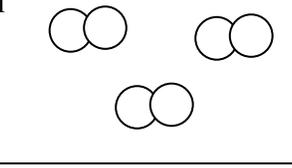
Symbol	Atomic Number	Mass Number	Number of Neutrons
<sup>1</sup> <sub>1</sub> H	1	1	0
<sup>17</sup> O	8	17	9
<sup>199</sup> Hg	80	199	119
<sup>63</sup> Cu	29	63	34

$^{71}\text{Br}$	35	71	36
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4. How many gold-197 atoms are in a 0.156 gram sample? (Watch sig figs in your answer!)

$4.77 \times 10^{20}$  atoms

5. Classify the following as a mixture or pure substance, and atom, molecule, or compound.

a 	b 	c 	d 
Pure substance; Molecules	Mixture of atoms and compounds	Pure substance; compound	Pure substance; Atoms
e 	f 	g 	h 
Mixture of atoms and molecules	Mixture of atoms and molecules	Mixture of molecules	Mixture of atoms
i 	j 	k 	l 
Mixture of compounds	Pure substance; Atoms	Mixture of atoms and molecules	Pure substance; Molecules

6. Describe the difference between ionic and covalent compounds.

Ionic bonds form when electrons transfer from one atom to another (between metals and nonmetals). Covalent bonds form when electrons are shared between atoms (between two or more nonmetals).

7. Circle the substances that are ionic in the list below:

$\text{CH}_4$

$\text{LiCl}$

$\text{C}_2\text{H}_4$

$\text{NaNO}_3$

$\text{CoCl}_2$

$\text{CO}_2$

$\text{KBr}$

Name: KEY

Section: \_\_\_\_\_

8) Fill in the table below:

Symbol	Atomic #	Mass #	# of p <sup>+</sup>	# of n <sup>o</sup>	# of e <sup>-</sup>	Ion?	Isotope?
<sup>31</sup> <sub>15</sub> P <sup>3-</sup>	15	31	15	16	18	Y	N
<sup>19</sup> <sub>9</sub> F	9	19	9	10	9	N	N
<sup>64</sup> <sub>29</sub> Cu <sup>2+</sup>	29	64	29	35	27	Y	N
<sup>27</sup> <sub>13</sub> Al <sup>3+</sup>	13	27	13	14	10	Y	N
<sup>80</sup> <sub>35</sub> Br <sup>-</sup>	35	80	35	45	36	Y	N
<sup>57</sup> <sub>25</sub> Mn	25	57	25	32	25	N	Y
<sup>23</sup> <sub>11</sub> Na	11	23	11	12	11	N	N

9) Rubidium has two common isotopes, <sup>85</sup>Rb and <sup>87</sup>Rb. If the abundance of <sup>85</sup>Rb is 72.2% and the abundance of <sup>87</sup>Rb is 27.8%, what is the average atomic mass of rubidium?

85.6 amu

10) Copper used in electric wires comes in two flavors (isotopes): <sup>63</sup>Cu and <sup>65</sup>Cu. <sup>63</sup>Cu has an atomic mass of 62.9298 amu and an abundance of 69.09%. The other isotope, <sup>65</sup>Cu, has an abundance of 30.91%. The average atomic mass between these two isotopes is 63.546 amu. Calculate the actual atomic mass of <sup>65</sup>Cu.

64.91 amu

11) Perform the following conversions:

- How many grams of water are in 3.983 moles of water? 71.77 g
- How many molecules of carbon dioxide are in 1.98 g of carbon dioxide?  $2.71 \times 10^{22}$  molec.
- How many atoms of iron are in a 38.0285 g sample of iron?  $4.10002 \times 10^{23}$  atoms
- If you have 5.2943 g of aluminum chloride (AlCl<sub>3</sub>), how many molecules of aluminum chloride are there? How many atoms of aluminum? How many atoms of chlorine?  
 $2.3912 \times 10^{22}$  molecules of AlCl<sub>3</sub>,  $2.3912 \times 10^{22}$  atoms of Al,  $7.1737 \times 10^{22}$  atoms of Cl

12) Name the following groups in the periodic table:

- Group 1 Alkali Metals
- Group 2 Alkaline Earth Metals
- Groups 3-12 Transition Metals
- Group 17 Halogens
- Group 18 Noble Gases

13) What state of matter are most metals in at room temperature?

Solid

Name: KEY

Section: \_\_\_\_\_

14) What state of matter are most nonmetals in at room temperature?

Gas

15) What two (2) elements on the periodic table are liquid at room temperature?

Bromine (Br) and Mercury (Hg)

16) List the 8 metalloids on the periodic table. Where are they located?

B, Si, Ge, As, Sb, Te, Po, At (Note that different sources will report different elements as metalloids). Metalloids are located on the stair step of the periodic table.