## Unit 1 – Properties and Classification of Matter and Energy

Chemistry I

## Part I. Elements to Learn NOW!

The Internet has many Periodic Tables that provide information about elements' properties and names. Find the origin of the names of the following elements. This website provides an interactive Periodic Table that will help you with this assignment. http://www.webelements.com/

	Name	Symbol	Name comes from
1	Hydrogen		
2	Lithium		
3	Sodium		
4	Potassium		
5	Rubidium		
6	Cesium		
7	Francium		
8	<b>Beryll</b> ium		
9	Magnesium		
10	Calcium		
11	Strontium		
12	Barium		
13	Radium		
14	Boron		
15	Aluminum		
16	Gallium		
17	Carbon		
18	Silicon		
19	Germanium		
20	Tin		

21	Lead	
22	Nitrogen	
23	Phosphor <b>us</b>	
24	Arsenic	
25	Antimony	

26	Bismuth	
27	Oxygen	
28	Sulfur	
29	Selenium	
30	Fluorine	
31	<b>Chl</b> orine	
32	Bromine	
33	lodine	
34	Astatine	
35	Helium	
36	Neon	
37	Argon	
38	Krypton	
39	Xenon	
40	Radon	
41	Nickel	
42	Titanium	
43	Chromium	
44	Gold	
45	Iron	
46	Cobalt	
47	Copper	

48	Zinc	
49	Cadmium	
50	Platinum	
51	Silver	
52	Mercury	

## Practice!

Group the Elements to Learn into 4 groups, according to how the symbol relates to the element name. One example of each type is shown.

C – Carbon Ca – Calcium Cl – Chlorine Pb – lead	First letter of name	First 2 letters of name	First letter + predominant letter	Latin or other
	C. Carban	Co. Coloium		language name
		Ca – Calcium	Ci – Chiorine	PD – lead

# Part II. Classification of Matter

### Pure Substances

- 1. A given compound always contains the same relative masses of its constituent elements. How is this idea related to the relative numbers of each kind of atom present?
- 2. Write the formula for each of the following compounds, listing the elements in the order given:
  - a. a molecule containing one phosphorus atom and three chlorine atoms
  - b. a molecule containing two boron atoms and six hydrogen atoms
  - c. a compound containing one calcium atom for every two chlorine atoms
  - d. a molecule containing one carbon atom and four bromine atoms

3. Compare Atom, Element, Molecule, Compound.	Check each box that applies.
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	a. N <sub>2</sub>	b. O <sub>2</sub>	c. H <sub>2</sub> O	d. P <sub>4</sub>	e. CO <sub>2</sub>	f. Cu	g. NH₃ (ammonia)
1. atom							
2. element							
3. molecule							
4. compound							

### **Mixtures**

4. Classify the following materials as to whether it is a pure substance or a mixture. If it is a pure substance, write E (Element) or C (Compound). If it is a mixture, write H (Heterogeneous) or S (Solution, which is the same as a homogeneous mixture) in the Mixture column.

Type of Matter	Pure Substance E or C	Mixture H or S
5. soil		
6. water		
7. oxygen gas		
8. sugar water		
9. carbon dioxide		
10.air		
11.iron		
12. milk		

13. brass

14. Gatorade

### 15. Rubbing alcohol

5. Give three examples of heterogeneous mixtures and three examples of solutions that you might use in everyday life.

6. Describe how the process of distillation could be used to separate a solution into its component substances. Give an example.

7. Describe how the process of filtration could be used to separate a mixture into its components. Give an example.

8. In a common laboratory experiment in general chemistry, students are asked to determine the relative amounts of benzoic acid and powdered charcoal in a solid mixture. Benzoic acid is relatively soluble in hot water, but charcoal is not. Devise a method for separating the two components of this mixture.

### Part III. Changes in Properties

(For Exercises 9 and 10) Solutions of the substance potassium dichromate are bright orange in color. If a potassium dichromate solution is added to an acidic solution of iron(II) sulfate, the orange color of the potassium dichromate disappears, and the mixture takes on a bright green color as chromium(III) ion forms.

- 9. From the information above, indicate one physical property of potassium dichromate in solution.
- 10. From the information above, indicate one chemical property of potassium dichromate in solution.
- 11. What is meant by electrolysis? Are the changes produced by electrolysis chemical or physical in nature? Give an example to show your reasoning.

- 12. Classify the following changes as chemical (C) or physical (P) changes/properties.
- a. A pellet of sodium is sliced in two.
- b. Salt dissolves in water.
- c. Mothballs gradually vaporize in a closet.
- d. An antacid tablet fizzes and releases carbon dioxide gas when it comes into contact with hydrochloric acid in the stomach.
- e. A flashlight battery corrodes and leaks on storage.
- f. Whole milk curdles if you add vinegar to it.
- g. A piece of rubber stretches when you pull it.
- h. Rubbing alcohol evaporates quickly from the skin.
- i. Acetone is used to dissolve and remove nail polish.
- j. The tires on your car seem to be getting flat in the cold weather.
- k. Dry ice sublimes when left out at room temperature.
- 1. Are all physical changes accompanied by chemical changes?

#### m. Are all chemical changes accompanied by physical changes?

#### 13. Vocabulary Review

Complete the following s	entences. Each word can be	used once, more than once	or not at all.
chemical	solute	electrolysis	solution
energy	filtration	liquid	elements
matter	physical means	solid	homogeneous
phase	distillation		heterogenous
evaporation	gas	solvent	
physical	plasma	compounds	

- a. Mixtures are separated by \_\_\_\_\_.
- b. Separating a solid/liquid suspension such as sand from water can be done by \_\_\_\_\_\_.
- c. The separation technique that takes advantage of differences in boiling points is called \_\_\_\_\_\_.
- d. The best way to decompose water into oxygen and hydrogen is by \_\_\_\_\_\_.
- e. \_\_\_\_\_\_ is anything that has mass and volume.
- f. \_\_\_\_\_ changes alter the identity of a substance whereas \_\_\_\_\_\_ changes \_\_\_\_\_ changes

and are the two

g. The two states of matter that occupy a definite volume are \_\_\_\_\_ and

other states of matter.

h. The dissolved material in a solution is the \_\_\_\_\_.

- i. \_\_\_\_\_\_ are substances, such as pure salt or pure sugar, that always have elements chemically combined in the same proportion.
- j. A(n) \_\_\_\_\_\_ is homogeneous matter composed of more than one material.
- k. Substances composed of only one kind of atom are called \_\_\_\_\_\_.
- 1. \_\_\_\_\_ materials are those consisting of only one phase.

### Part IV. Energy! The Nature of Energy

14. Explain the difference between kinetic and potential energy.

#### **Temperature and Heat**

15. Explain the differences among heat, temperature and thermal energy.

- 16. Provide a molecular-level explanation of why the temperatures of a cold soft drink and hot coffee in the same room will eventually be the same.
- 17. In which case is more heat involved: mixing 100.0-g samples of 90°C water and 80°C water or mixing 100.0-g samples of 60°C water and 10 °C water? Assume no heat is lost to the environment.

18. If 100.0 g of water at 90°C is added to 50.0 g of water at 10 °C, estimate the final temperature of the water. Explain your reasoning.

#### **Exothermic and Endothermic Processes**

- 19. Are the following processes exothermic or endothermic? Explain.
  - a. When solid KBr is dissolved in water, the solution gets colder.
  - b. Natural gas (CH<sub>4</sub>) is burned in a furnace.

- c. When concentrated sulfuric acid is added to water, the solution gets very hot.
- d. Water is boiled in a tea kettle.

### Part V. Challenge Problem

<u>Crossword Puzzle:</u> In the 2x2 box shown here, each answer must be correct four ways: horizontally, vertically, diagonally, and by itself. Instead of words, use symbols of elements. When the puzzle is complete, the four spaces will contain the overlapping symbols of 10 elements. There is only one correct solution. (Puzzle appeared in Chemical& Engineering News, p.86, December 14, 1987 and in Chem Matters, October 1988.)

1	2
3	4

### Horizontal

- 1-2: Two-letter symbol for a metal used in ancient times
- 3-4: Two-letter symbol for a metal that burns in air and is found in Group 5A (Group 15)

### Vertical

- 1-3: Two-letter symbol for a metalloid
- 2-4: Two-letter symbol for a metal used in U.S. coins

### Single squares: All one-letter symbols

1: A colorful nonmetal	Diagonal
2: Colorless, gaseous nonmetal	1-4: Two-letter symbol for an element used
3: An element that makes fireworks green	in electronics
4: An element that has medicinal uses	2-3: Two-letter symbol for a metal used
	with Zr to make wires for superconducting
	magnet