Chem 1014
In-Class Problem Set #10
InClass for the week of November 1, 1999
Fall 1999

Name_____
TA Name _____
Lab Section #_____

1. The elements in the periodic table can be classified into three groups based on their physical properties. The goal of this first exercise is to identify those elements belonging to each group.

   One group of elements is called the metals. The metallic elements are characterized by their solid phase (although there is one metal which is a liquid). They are shiny, malleable (can be easily hammered into a shape), ductile (can be easily drawn into a wire), have a high melting point (that is why they are solids!) and are able to conduct electricity.

   Another group of elements is called the nonmetals. The nonmetallic elements are characterized by their range of phases. Nonmetallic elements can be solid, liquid or gas phase. Nonmetallic elements do not conduct electricity very well (although one of the nonmetallic elements can). Nonmetallic elements are not shiny.

   The last group of elements are intermediate in their properties, some of their properties suggest metallic character, other properties suggest nonmetallic character. Needless to say these elements can not make up their minds! Interestingly enough the metalloids are found exactly between the metallic elements and the nonmetallic elements.

   Finally, if an element belongs to the metallic group it can not be in any of the other groups.

   Use the periodic table below and shade (use different shading) the elements that belong to each group.

Periodic Table of the Elements

	IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 H 1.008	IIA																2 He 4.00
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.30	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

2. When the elements in the periodic table form compounds chemists have tried to classify the compounds into two general groups, again based on their physical properties. The two groups of compounds are called ionic compounds and covalent compounds.

   Ionic compounds are characterized by the fact that they are always solids (there are some interesting exceptions to this rule that have recently been discovered) and have high melting points. They are called ionic compounds because they are composed of ions. Ions are charged atoms or molecules. Ions that have more electrons than they have protons are called anions, while ions with fewer electrons than they have protons are called cations. Cations and anions get together to form an ionic compound such that the total positive charge on the cation(s) equals the total negative charge on the anion(s). Chemists have discovered that ionic compounds almost always contain an element from a metallic group and at least one element from the nonmetallic group.

   Covalent compounds are characterized by the fact that they may be gases, liquids, or solids. So the melting point of covalent compounds is low. Covalent compounds are not composed of ions. When a covalent compound is formed the atoms are attracted together by the sharing of electrons (more about this later). Chemists have found that almost all covalent compounds contain only nonmetallic elements.

   Here is a list of formulas of some ionic and some covalent compounds. Based on the information above indicate whether the compound is ionic or covalent.

Compound	Ionic	Covalent
$NaCl$	**X**	
MgI_2	**X**	
P_4O_{10}		**X**
H_3PO_4		**X**
H_2O		**X**
$Ca(NO_3)_2$	**X**	
PF_5		**X**
Al_2O_3	**X**	
Na_3PO_4	**X**	
CCl_4		**X**
K_2CO_3	**X**	
C_7H_{14}		**X**
TiO_2	**X**	
$C_6H_{12}O_6$		**X**
$CuSO_4$	**X**	

3. Define the term *valence electron(s)*. How are the number of valence electrons determined?

Valence electrons are those electrons furthest from the nucleus in an atom or ion. We can determine the number of valence electrons by the Group number of the element.

4. Determine the number of valence electrons in each of the following atoms, or ions.

		# valence electrons
a)	Na	**1**
b)	Ca	**2**
c)	Si	**4**
d)	F	**7**
e)	Xe	**8**
f)	Zn	**2**
g)	Cs	**1**
h)	O	**6**
i)	Al	**3**
j)	V	**2 or 3**
k)	Br^-	**8**
l)	Mg^{2+}	**8**
m)	P^{3-}	**8**
n)	He	**2**
o)	H^+	**0**

5. Determine the formula of the ionic compounds given the following elements. Name each compound.

		Formula	Name
a)	lithium and bromine	**LiBr**	**lithium bromide**
b)	magnesium and iodine	**MgI_2**	**magnesium iodide**
c)	silver and chlorine	**AgCl**	**silver chloride**
d)	barium and oxygen	**BaO**	**barium oxide**
e)	zinc and nitrogen	**Zn_3N_2**	**zinc nitride**
f)	potassium and phosphorus	**K_3P**	**potassium phosphide**

6. Here is a list of polyatomic anions. Polyatomic anions are molecules with charge.

polyatomic anions	Name
NO_3^-	nitrate
SO_4^{2-}	sulfate
CO_3^{2-}	carbonate
HCO_3^-	bicarbonate
OH^-	hydroxide
CN^-	cyanide
PO_4^{3-}	phosphate
NO_2^-	nitrite

7. Determine the formula for the following metals and polyatomic anions. Name each of the compounds. Note: When there are more than one polyatomic anion in the formula of a particular compound we must use parentheses to specify the number of the polyatomic anions. For example, $Mg(OH)_2$ or $Al(NO_3)_3$.

		Formula	Name
a)	magnesium and carbonate	**$MgCO_3$**	**magnesium carbonate**
b)	sodium and hydroxide	**NaOH**	**sodium hydroxide**
c)	potassium and sulfate	**K_2SO_4**	**potassium sulfate**
d)	iron and phosphate	**$Fe_3(PO_4)_2$**	**iron(III) phosphate**
		$FePO_4$	**iron(II) phosphate**
e)	sodium and nitrite	**$NaNO_3$**	**sodium nitrite**
f)	potassium and cyanide	**KCN**	**potassium cyanide**

8. Try writing some formulas given the names.

	Formula
a) calcium oxide	**CaO**
b) sodium sulfide	**Na_2S**
c) magnesium nitrate	**$Mg(NO_3)_2$**
d) aluminum hydroxide	**$Al(OH)_3$**
e) potassium fluoride	**KF**