Ionic Bonding Handouts

Name :_____

Date : _____

Table #1: Forming Ions

Name of neutral atom	Total # of electrons	metal / nonmetal	Symbol of the noble gas closest to the neutral atom	# of electrons lost or gained to be isoelectric with a noble gas	Symbol of the cation or anion	Name of the ion
Sodium (Na)	**11**	**m**	**Ne**	**lose 1**	**Na^{1+} cation**	**Sodium**
Calcium (Ca)	**20**	**m**	**Ar**	**lose 2**	**Ca^{2+} cation**	**Calcium**
Nitrogen (N)	**7**	**nm**	**Ne**	**gain 3**	**N^{3-} anion**	**Nitride**
Sulfur (S)	**16**	**nm**	**Ar**	**gain 2**	**S^{2-} anion**	**Sulfide**
Hydrogen (anion)	**1**	**nm**	**He**	**gain 1**	**H^{1-} anion**	**Hydride**
Carbon (anion)	**6**	**nm**	**Ne**	**gain 4**	**C^{4-} anion**	**Carbide**
Carbon (cation)	**6**	**nm**	**He**	**lose 4**	**C^{4+} cation**	**Carbon**

Table 2: Lewis Dot Diagrams

Neutral Atom	Group number	# of valence electrons	Lewis dot diagram
Oxygen	16 (VI)	6	
Aluminum	13 (III)	3	
Hydrogen	1 (I)	1	
Phosphorous	15 (V)	5	
Bromine	17 (VII)	7	

Table 3: Ionic Bonding and Lewis Dot Diagrams

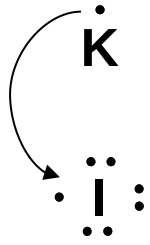
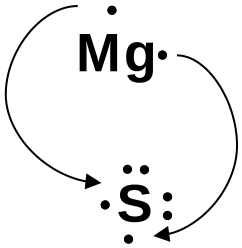
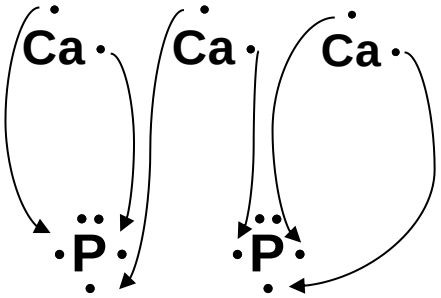
Ionic bond between K and I	Ionic bond between Mg and S	Ionic bond between Ca and P
K^{1+} and I^{1-} 	Mg^{2+} and S^{2-} 	3 Ca^{2+} and 2 P^{3-} 

Table 4: Writing formulas of binary ionic compounds:

The Cross Over Method

Steps	Example 1 Calcium fluoride	Example 2 Gallium arsenide	Example 3 Tungsten (IV) sulfide
1. Write the symbols of the elements in the order given in the name	Ca F	Ga As	W S
2. Write the charge above each element. If metal is multivalent, the roman numeral after the name indicates the charge of the metal	Ca^{2+} F^{1-}	Ga^{3+} As^{3-}	W^{4+} S^{2-}
3. Crossover the charges. Drop the signs and write them as subscripts	Ca_1 F_2	Ga_3 As_3	W_2 S_4
4. Reduce the subscripts to its lowest form	Ca_1 F_2	Ga_1 As_1	W_1 S_2
5. Drop any ones in the formula	Ca F_2	Ga As	W S_2
6. The formula	CaF_2	GaAs	WS_2

Table 5: Nomenclature of Binary Ionic Compounds: Fill in the table with appropriate metal ion, non-metal ion and the chemical formula of the compound.

	Name	Mono/ Multivalent metal	Metal ion (cation)	Non-metal ion (anion)	Chemical formula
1	Barium Fluoride	Monovalent	Ba^{2+}	F^{1-}	$Ba_1\ F_2 \rightarrow BaF_2$
2	Magnesium phosphide	Monovalent	Mg_{2+}	P_{3-}	Mg_3P_2
3	Calcium oxide	Monovalent	Ca^{2+}	O^{2-}	CaO
4	Gold (III) oxide	Multivalent	Au^{3+}	O^{2-}	Au_2O_3
5	Potassium bromide	Monovalent	K^{1+}	Br^{1-}	KBr
6	Beryllium sulfide	Monovalent	Be^{2+}	S^{2-}	BeS
7	Aluminum nitride	Monovalent	Al^{3+}	N^{3-}	AlN
8	Lead (IV) sulfide	Multivalent	Pb^{4+}	S^{2-}	PbS_2
9	Lithium nitride	Monovalent	Li^{1+}	N^{3-}	Li_3N
10	Sodium sulfide	Monovalent	Na^{1+}	S^{2}	Na_2S
11	Tungsten (VI) oxide	Multivalent	W^{6+}	O^{2-}	WO_3
12	Calcium fluoride	Monovalent	Ca^{2+}	F^{1-}	CaF_2

Table 6: Naming regular binary Ionic Compounds:

Fill in the table with appropriate metal ion, non-metal ion and the chemical name of the compound.

	Chemical formula	Metal ion (cation)	Non-metal ion (anion)	Name
1	$CaCl_2$	Ca^{2+}	Cl^{1-}	calcium chloride
2	AlI_3	Al^{3+}	I^{1-}	aluminum iodide
3	Ca_3P_2	Ca^{2+}	P^{3-}	calcium phosphide
4	MgO	Mg^{2+}	O^{2-}	magnesium oxide
5	KCl	K^{1+}	Cl^{1-}	potassium chloride
6	BeS	Be^{2+}	S^{2-}	beryllium sufide
7	Ba_3N_2	Ba^{2+}	N^{3-}	barium nitride
8	Ga_2S_3	Ga^{3+}	S^{2-}	gallium sufide
9	Li_3P	Li^{1+}	P^{3-}	lithium phosphide
10	Na_2S	Na^{1+}	S^{2-}	sodium sulfide
11	Ag_2O	Ag^{1+}	O^{2-}	silver oxide
12	CaF_2	Ca^{2+}	F^{1-}	calcium flouride

Table 7: Writing names of ionic compounds that contain a multivalent metal

Steps to follow when writing the chemical name for an ionic compound that contains a multivalent metal:(use paper copy to fill in)

Steps to follow	Example 1 Fe_3P_2	Example 2 V_2O_5	Example 3 PbS_2
1. Identify if the metal is multivalent. If Yes then proceed to the next step otherwise just name the compound	Yes	Yes	Yes
2. Place brackets above each element and place an equal sign between them	( ) = ( ) Fe P	( ) = ( ) V O	( ) = ( ) Pb S
3. Place the ratio of the ions in the chemical formula (the subscripts) outside the bracket	3( ) = 2( ) Fe P	2( ) = 5( ) V O	1( ) = 2( ) Pb S
4. ALWAYS place the negative charge (anion) first INSIDE the bracket. Calculate the total negative charge	3( ) = 2(3-)=-6 Fe P	2( ) = 5(2-)=-10 V O	1( ) = 2(2-)=-4 Pb S
5. Calculate the positive charge of the metal. So that the total + charge = total – charge	+6= 3(2+) = 2(3-)=-6 Fe P	+10= 2(5+) = 5(2-)=-10 V O	+4= 1(4+) = 2(3-)=-4 Pb S
6. The positive charge in the bracket is the charge of the metal ion. Write this charge as a Roman numeral after the name of the metal	iron (II) phosphide	vandium (V) oxide	lead (IV) sulfide

Table 8:Nomenclature of Multivalent Binary Ionic Compounds: Fill the table with appropriate metal ion, non-metal ion and the chemical formula of the compound.

	Chemical Formula	Metal	Non-metal	Calculations	Chemical Name
1	AuF	$Au^{1+, 3+}$	F^{1-}	total –'ve charge = -1,	Gold (I) Fluoride
2	NiTe	$Ni^{2+, 3+}$	Te^{2-}	total –'ve charge = -2,	Nickel(II) Telluride
3	HgI_2	$Hg^{1+, 2+}$	I^{1-}	total –'ve charge = -2,	Mecury (II) Iodide
4	FeF_2	$Fe^{2+, 3+}$	F^{1-}	total –'ve charge = -2,	Iron(II) Fluoride
5	V_2Se_5	$V^{5+, 4+}$	Se^{2-}	total –'ve charge = -10	Vandium (V) Selenide
6	Cu_3As	$Cu^{2+, 1+}$	As^{3-}	total –'ve charge = -3,	Copper (I) Arsenide
7	CoN	$Co^{2+, 3+}$	N^{3-}	total –'ve charge = -3,	Cobalt (III) Nitride
8	Ti_3P_4	$Ti^{3+, 4+}$	P^{3-}	total –'ve charge = -12,	Titanium (IV) Phosphide
9	Cr_2Se_3	$Cr^{2+, 3+}$	Se^{2-}	total –'ve charge = -6,	Chromium (III) Selenide
10	NiF_3	$Ni^{2+, 3+}$	F^{1-}	total –'ve charge = -3,	Nickel (III) Fluoride
11	UO_3	$U^{4+,5+,6+}$	O^{2-}	total –'ve charge = -6,	Uranium (VI) Oxide
12	SnS_2	$Sn^{2+, 4+}$	S^{2-}	total –'ve charge = -4,	Tin (IV) Sulfide

Table 9: Nomenclature of Binary Ionic Compounds

Name the following binary compounds. Not all of these binary compounds are multivalent.

	Chemical formula	Chemical name
1	$AlCl_3$	Aluminum Chloride
2	CuF	Copper (I) Fluoride
3	Zr_3N_4	Zirconium Nitride
4	$CaBr_2$	Calcium Bromide
5	MnS_2	Manganese (IV) Sulfide
6	NiP	Nickel (III) Phosphide

	Chemical formula	Chemical name
7	CdO	Cadmium Oxide
8	WP_2	Tungsten (VI) Phosphide
9	Zn_3N_2	Zinc Nitride
10	AgCl	Silver Chloride
11	Sn_3P_4	Tin (IV) Phosphide
12	$CuBr_2$	Copper (II) Bromide