Activity 4 - Writing Formulas and Names Worksheet

Name Key

Section_____ Date_____

Exercise A. Electron Dot Structures

1. Using the example given, complete this table.

Element	Atomic Number	Electron arrangement of atom	Electron dot structure of atom	Loss/gain of electrons by atom	Electron arrangement of ion	Ionic charge	Symbol of ion	Name of ion
sodium	11	2-8-1	$Na\bullet$	lose 1 e^-	2-8	1+	Na^+	sodium ion
oxygen	8	2-6	$\cdot\ddot{O}\cdot$	gain $2e^-$	2-8	2-	O^{2-}	oxide
aluminum	13	2-8-3	$\cdot Al\cdot$	lose $3e^-$	2-8	3+	Al^{3+}	Aluminum ion
potassium	19	2-8-8-1	$K\cdot$	lose $1e^-$	2-8-8	1+	K^+	Potassium ion
chlorine	17	2-8-7	$:\ddot{C}l\cdot$	gain $1e^-$	2-8-8	1-	Cl^-	Chloride
calcium	20	2-8-8-2	$\cdot Ca\cdot$	lose $2e^-$	2-8-8	2+	Ca^{2+}	Calcium ion
nitrogen	7	2-5	$\cdot\ddot{N}\cdot$	gain $3e^-$	2-8	3-	N^{3-}	Nitride
sulfur	16	2-8-6	$\cdot\ddot{S}\cdot$	gain $2e^-$	2-8-8	2-	S^{2-}	Sulfide

2. Review the "Name of ion" column above. What distinguishes the naming of the metal cations from the naming of nonmetals anions?

The metal cations are named with the element name followed by ion. The nonmetal anions all end in -ide to designate they are anions.

Exercise B. Writing Ionic Formulas:

1. Use the periodic table to help complete the table below.

Name	Positive ion	Negative ion	Formula
sodium oxide	Na^+	O^{2-}	Na_2O
magnesium chloride	Mg^{2+}	Cl^-	$MgCl_2$
potassium chloride	K^+	Cl^-	KCl
calcium oxide	Ca^{2+}	O^{2-}	CaO
aluminum bromide	Al^{3+}	Br^-	$AlBr_3$
lithium phosphide	Li^+	P^{3-}	Li_3P
aluminum sulfide	Al^{3+}	S^{2-}	Al_2S_3
aluminum nitride	Al^{3+}	N^{3-}	AlN
calcium nitride	Ca^{2+}	N^{3-}	Ca_3N_2

2. Name the following ionic compounds:

Na_2S Sodium Sulfide

MgF_2 Magnesium fluoride

MgS Magnesium sulfide

K_3N potassium nitride

Ca_3P_2 Calcium phosphide

$AlCl_3$ aluminium chloride

3. Review the answers in problems 1 and 2 of exercise B above. What do the subscripts represent?

The subscripts designate the number of each ion in the compound.

Exercise C. Ionic Charges for Transition Metals

1. Complete the table below.

Name	Positive ion	Negative ion	Formula
iron (II) bromide	Fe^{2+}	Br^-	$FeBr_2$
iron (II) chloride	Fe^{2+}	Cl^-	$FeCl_2$
iron (III) sulfide	Fe^{3+}	S^{2-}	Fe_2S_3
copper (II) chloride	Cu^{2+}	Cl^-	$CuCl_2$
copper (II) sulfide	Cu^{2+}	S^{2-}	CuS
copper (II) nitride	Cu^{2+}	N^{3-}	Cu_3N_2
* zinc oxide	Zn^{2+}	O^{2-}	ZnO
* silver sulfide	Ag^+	S^{2-}	Ag_2S

* Both zinc and silver have only one charge state and do not require roman numerals.

2. Name the following ionic compounds:

Cu_3P Copper(I) phosphide or Cuprous phosphide

Fe_2O_3 Iron(III) Oxide or ferric Oxide

FeI_3 Iron(III) iodide or ferric iodide

$CuCl$ Copper(I) chloride or Cuprous Chloride

$ZnBr_2$ Zinc bromide — no roman numeral required

3. Consider your answers in problems 1 and 2 of exercise C above. What do the roman numerals in parentheses represent?

The roman numerals are the charge state on the cation.

Exercise D. Polyatomic Ions

1. Complete the table below.

Name	Positive ion	Negative ion	Formula
sodium nitrate	Na^+	NO_3^-	$NaNO_3$
lithium carbonate	Li^+	CO_3^{2-}	Li_2CO_3
potassium sulfate	K^+	SO_4^{2-}	K_2SO_4
calcium bicarbonate	Ca^{2+}	HCO_3^-	$Ca(HCO_3)_2$
aluminum hydroxide	Al^{3+}	OH^-	$Al(OH)_3$
lithium sulfite	Li^+	SO_3^{2-}	Li_2SO_3
sodium phosphate	Na^+	PO_4^{3-}	Na_3PO_4
iron (II) phosphate	Fe^{2+}	PO_4^{3-}	$Fe_3(PO_4)_2$

2. Name the following ionic compounds:

$CaSO_4$ Calcium Sulfate

Cu_3PO_4 Copper(I) phosphate or Cuprous phosphate

$Al(NO_3)_3$ Aluminium nitrate

Na_2CO_3 Sodium Carbonate

$MgSO_3$ Magnesium Sulfite

$Fe(HCO_3)_2$ Iron(II) bicarbonate or Iron(II) hydrogen carbonate or ferrous bicarbonate or ferrous hydrogen carbonate

3. Consider *all* of the nomenclature exercises in exercises B, C and D. What are the rules for the correct placement of parentheses in the naming and writing chemical formulas of ionic compounds?

Parentheses are used to inclose the roman numerals for the transition metal charge states and to inclose multiple groups of polyatomic anions.

Exercise E. Lewis Dot Structures of Atoms and Molecules

1. ***Electron dot formulas of elements:*** Atoms are represented by symbol with valence e⁻'s represented by dots. Complete the following table. Distribute dots on all four sides before pairing.

hydrogen	carbon	nitrogen	oxygen	sulfur	chlorine
H·	·C·	·N·	·O·	·S·	:Cl·

2. ***Electron dot formulas of covalent compounds:*** Lewis dot structures must have the correct number of valence electrons displayed in bonded or nonbonded pairs along with the octet rule being obeyed (duet rule for H). Complete the following table for the given binary covalent compounds.

Compound	Electron dot structure	Name
HCl	H:Cl:	hydrogen chloride H-Cl:
SBr_2	:Br:S:Br:	sulfur dibromide :Br-S-Br:
PCl_3	:Cl:P:Cl: :Cl:	Phosphorus trichloride :Cl-P-Cl: :Cl:
OF_2	:F:O:F:	Oxygen difluoride :F-O-F:
* This one is tough SO_3	:O: :O::S:O: or :O: :O:S:O:	Sulfur trioxide :O: :O-S-O: structure of SO_3 discussed in lecture

Questions and Problems

1. Write the correct formulas for the following ions:

sodium ion Na^+	oxide ion O^{2-}	calcium ion Ca^{2+}
chloride ion Cl^-	sulfate ion SO_4^{2-}	iron (II) ion Fe^{2+}

2. Write the correct name of the following compounds.

CuO	Copper(II) Oxide or Cupric oxide
N_2O_4	dinitrogen tetraoxide
$Al(NO_3)_3$	aluminum nitrate
PCl_3	phosphorus trichloride
$FeCO_3$	Iron(II) carbonate or ferrous carbonate
$Cu(OH)_2$	Copper(II) hydroxide or Cupric hydroxide
Ag_2O	Silver oxide

3. Identify the following compounds as ionic or covalent. (circle I or C) and write the corresponding molecular formula.

sodium oxide	[I] C	Na_2O
iron (III) bromide	[I] C	$FeBr_3$
sodium carbonate	[I] C	Na_2CO_3
aluminum sulfite	[I] C	$Al_2(SO_3)_3$
carbon tetrachloride	I [C]	CCl_4
nitrogen tribromide	I [C]	NBr_3

4. Your friend wants to know what the formula $FeSO_4$ on her vitamin bottle means and what the name of this ingredient is. Help her understand the meaning of the symbols and the correct name associated with this formula.

The name of the ionic compound is Iron(II) sulfate or ferrous sulfate. The compound is composed of a Fe^{2+} cation a single SO_4^{2-} anion which is a polyatomic anion containing one sulfur and four oxygens that together have a 2- charge.