

# WRITING FORMULAE

## GENERAL RULES:

1. When *non-metals* bond to form a compound, *molecules* are formed. The atoms in the molecule *share* electrons when their orbitals with unpaired electrons overlap. These molecules are more stable than when the atoms are separate from each other. **COVALENT BONDING.**
2. When a *metal bonds with a non-metal*, electron(s) are *transferred* from the metal to the non-metal to form a positive ion (cation) and a negative ion (anion). These ions attract each other. **IONIC BONDING.**

Learn the formulas for the following molecules: (Add to the list as you come across more)

Sulphuric acid	H <sub>2</sub> SO <sub>4</sub>	Sulphur dioxide	SO <sub>2</sub>
Nitric acid	HNO <sub>3</sub>	Ammonia	NH <sub>3</sub> (Don't confuse with ammonium ion NH <sub>4</sub> <sup>+</sup> )
Hydrochloric acid	HCl	Carbon tetrachloride	CCl <sub>4</sub>
Carbonic acid	H <sub>2</sub> CO <sub>3</sub>	Carbon monoxide	CO
Sulphurous acid	H <sub>2</sub> SO <sub>3</sub>	Water	H <sub>2</sub> O
Phosphoric acid	H <sub>3</sub> PO <sub>4</sub>	_____	_____

**Diatomic Molecules:** There are 7 elements that are MOLECULES in their PURE/UNCOMBINED state:

Hydrogen (H<sub>2</sub>), Nitrogen (N<sub>2</sub>), Oxygen (O<sub>2</sub>), Fluorine(F<sub>2</sub>), Chlorine (Cl<sub>2</sub>), Bromine (Br<sub>2</sub>), Iodine (I<sub>2</sub>).

Draw the Aufbau diagram for each of these elements to see why they would be more stable when bonded as a molecule.

**NB: THEY ARE ONLY DIATOMIC WHEN THEY ARE PURE.**

## The following rules apply to IONIC BONDING:

- Group 1 elements become +1. E.g.  $\text{Na}^{+1}$ . We don't write the "1". ( $\text{Li}^+$ ,  $\text{K}^+$ ).
- Group 2 elements become +2. E.g.  $\text{Mg}^{+2}$ ,  $\text{Ca}^{+2}$  (Write +2 or 2+).
- Group 3 elements become +3. E.g.  $\text{Al}^{+3}$ .
- Group 4 elements: You will not have to give them charges.
- Group 5 elements become -3: E.g.  $\text{N}^{-3}$ .
- Group 6 elements become -2. E.g.  $\text{O}^{-2}$ ,  $\text{S}^{-2}$ .
- Group 7 elements become -1. E.g.  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ . (Don't write the "1").
- Group 8/0 elements do not bond. They are stable → Noble gases. (He, Ne, Ar).
- Transition elements (between groups 2 and 3) have a charge of +2, except silver ( $\text{Ag}^+$ ).  
 $\text{Cu}^{+2}$ ,  $\text{Pb}^{+2}$ ,  $\text{Sn}^{+2}$ ,  $\text{Zn}^{+2}$ .
- Stock notation: When charges are given as Roman numerals.  
E.g. Iron(II)chloride  $\text{Fe}^{+2}$  bonds to a chloride ion  $\text{Cl}^-$  \_\_\_\_\_(formula)  
Lead(IV)oxide  $\text{Pb}^{+4}$  bonds to an oxide ion  $\text{O}^{2-}$  \_\_\_\_\_(formula)

The Stock notation charges ARE ALWAYS POSITIVE and they can be given to metals and non-metals. You will only use this method with non-metals in grade 11.

## You have to know the formulae for the following polyatomic ions too:

Common Polyatomic Ions			
$\text{C}_2\text{H}_3\text{O}_2^-$	acetate	$\text{OH}^-$	hydroxide
$\text{NH}_4^+$	ammonium	$\text{ClO}^-$	hypochlorite
$\text{CO}_3^{2-}$	carbonate	$\text{NO}_3^-$	nitrate
$\text{ClO}_3^-$	chlorate	$\text{NO}_2^-$	nitrite
$\text{ClO}_2^-$	chlorite	$\text{C}_2\text{O}_4^{2-}$	oxalate
$\text{CrO}_4^{2-}$	chromate	$\text{ClO}_4^-$	perchlorate
$\text{CN}^-$	cyanide	$\text{MnO}_4^-$	permanganate
$\text{Cr}_2\text{O}_7^{2-}$	dichromate	$\text{PO}_4^{3-}$	phosphate
$\text{HCO}_3^-$	bicarbonate	$\text{SO}_4^{2-}$	sulfate
$\text{HSO}_4^-$	bisulfate	$\text{SO}_3^{2-}$	sulfite
$\text{HSO}_3^-$	bisulfite		

acetate  $\text{CH}_3\text{COO}^-$

When the name of a compound ends with “-ide”, e.g. sodium chloride, magnesium nitride, hydrogen sulphide, the “ide” part comes from the Periodic Table and is NOT a polyatomic ion.

- **The aim is to make the formula neutral.**
- **No + or – signs in the formula.**
- **Put polyatomic ions in brackets when more than one is needed.**
- **The positive ion is written first.**

**Examples:**

- 1) Calcium sulphate:  $\text{Ca}^{2+}$  and  $\text{SO}_4^{2-}$ . Need one of each ion to make it neutral.  
Formula:  $\text{CaSO}_4$ .
- 2) Aluminium hydroxide:  $\text{Al}^{+3}$  and  $\text{OH}^-$ . Need 3  $\text{OH}^-$  ions to cancel the +3 on the  $\text{Al}^{+3}$ .  
Formula:  $\text{Al}(\text{OH})_3$ .
- 3) Hydrogen sulphide:  $\text{H}^+$  and  $\text{S}^{-2}$ . Need 2  $\text{H}^+$  ions to cancel the -2 of  $\text{S}^{-2}$  ion.  
Formula:  $\text{H}_2\text{S}$ .
- 4) Ammonium carbonate:  $\text{NH}_4^+$  and  $\text{CO}_3^{2-}$ . Need 2  $\text{NH}_4^+$  ions to cancel the -2 in  $\text{CO}_3^{2-}$  ion.  
Formula:  $(\text{NH}_4)_2\text{CO}_3$ .

## Ionic Compound Formula Writing Worksheet

Write chemical formulas for the compounds in each box. Example: The first box is the intersection between the "zinc" cation and the "chloride" anion, so you should write "ZnCl<sub>2</sub>", as shown.

	<i>zinc</i>	<i>iron (II)</i>	<i>iron (III)</i>	<i>gallium</i>	<i>silver</i>	<i>lead (IV)</i>
<i>chloride</i>	ZnCl <sub>2</sub>					
<i>acetate</i>						
<i>nitrate</i>						
<i>oxide</i>						
<i>nitride</i>						
<i>sulfate</i>						

Write the formulas for the following compounds:

- 1) copper (II) chloride \_\_\_\_\_
- 2) lithium acetate \_\_\_\_\_
- 3) vanadium (III) oxide \_\_\_\_\_
- 4) manganese (IV) nitride \_\_\_\_\_
- 5) beryllium oxide \_\_\_\_\_
- 6) sodium sulfate \_\_\_\_\_
- 7) aluminum arsenide \_\_\_\_\_
- 8) potassium permanganate \_\_\_\_\_
- 9) chromium (VI) cyanide \_\_\_\_\_
- 10) tin (II) sulfite \_\_\_\_\_
- 11) vanadium (V) fluoride \_\_\_\_\_
- 12) ammonium nitrate \_\_\_\_\_

## Chemical Formula Writing Worksheet Solutions

Write chemical formulas for the compounds in each box.

	<i>zinc</i>	<i>iron (II)</i>	<i>iron (III)</i>	<i>gallium</i>	<i>silver</i>	<i>lead (IV)</i>
<i>chloride</i>	<b>ZnCl<sub>2</sub></b>	<b>FeCl<sub>2</sub></b>	<b>FeCl<sub>3</sub></b>	<b>GaCl<sub>3</sub></b>	<b>AgCl</b>	<b>PbCl<sub>4</sub></b>
<i>acetate</i>	<b>Zn(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub></b>	<b>Fe(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub></b>	<b>Fe(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>3</sub></b>	<b>Ga(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>3</sub></b>	<b>Ag C<sub>2</sub>H<sub>3</sub>O<sub>2</sub></b>	<b>Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>4</sub></b>
<i>nitrate</i>	<b>Zn(NO<sub>3</sub>)<sub>2</sub></b>	<b>Fe(NO<sub>3</sub>)<sub>2</sub></b>	<b>Fe(NO<sub>3</sub>)<sub>3</sub></b>	<b>Ga(NO<sub>3</sub>)<sub>3</sub></b>	<b>AgNO<sub>3</sub></b>	<b>Pb(NO<sub>3</sub>)<sub>4</sub></b>
<i>oxide</i>	<b>ZnO</b>	<b>FeO</b>	<b>Fe<sub>2</sub>O<sub>3</sub></b>	<b>Ga<sub>2</sub>O<sub>3</sub></b>	<b>Ag<sub>2</sub>O</b>	<b>PbO<sub>2</sub></b>
<i>nitride</i>	<b>Zn<sub>3</sub>N<sub>2</sub></b>	<b>Fe<sub>3</sub>N<sub>2</sub></b>	<b>FeN</b>	<b>GaN</b>	<b>Ag<sub>3</sub>N</b>	<b>Pb<sub>3</sub>N<sub>4</sub></b>
<i>sulfate</i>	<b>ZnSO<sub>4</sub></b>	<b>FeSO<sub>4</sub></b>	<b>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub></b>	<b>Ga<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub></b>	<b>Ag<sub>2</sub>SO<sub>4</sub></b>	<b>Pb(SO<sub>4</sub>)<sub>2</sub></b>

Write the formulas for the following compounds:

- 1) copper (II) chloride **CuCl<sub>2</sub>**
- 2) lithium acetate **LiC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>**
- 3) vanadium (III) oxide **V<sub>2</sub>O<sub>3</sub>**
- 4) manganese (IV) nitride **Mn<sub>3</sub>N<sub>4</sub>**
- 5) beryllium oxide **BeO**
- 6) sodium sulfate **Na<sub>2</sub>SO<sub>4</sub>**
- 7) aluminum arsenide **AlAs**
- 8) potassium permanganate **KMnO<sub>4</sub>**
- 9) chromium (VI) cyanide **Cr(CN)<sub>6</sub>**
- 10) tin (II) sulfite **SnSO<sub>3</sub>**
- 11) vanadium (V) fluoride **VF<sub>5</sub>**
- 12) ammonium nitrate **NH<sub>4</sub>NO<sub>3</sub>**

## Names & Formulas for Ionic Compounds

Give the name or formula of the following ionic compounds:

- |   |                                  |
|---|----------------------------------|
| 1) $\text{Na}_2\text{CO}_3$ _____       | 21) sodium phosphide _____       |
| 2) $\text{NaOH}$ _____                  | 22) magnesium nitrate _____      |
| 3) $\text{MgBr}_2$ _____                | 23) lead (II) sulfite _____      |
| 4) $\text{KCl}$ _____                   | 24) calcium phosphate _____      |
| 5) $\text{FeCl}_2$ _____                | 25) ammonium sulfate _____       |
| 6) $\text{FeCl}_3$ _____                | 26) silver cyanide _____         |
| 7) $\text{Zn(OH)}_2$ _____              | 27) aluminum sulfide _____       |
| 8) $\text{Be}_2\text{SO}_4$ _____       | 28) beryllium chloride _____     |
| 9) $\text{CrF}_2$ _____                 | 29) copper (I) arsenide _____    |
| 10) $\text{Al}_2\text{S}_3$ _____       | 30) iron (III) oxide _____       |
| 11) $\text{PbO}$ _____                  | 31) gallium nitride _____        |
| 12) $\text{Li}_3\text{PO}_4$ _____      | 32) iron (II) bromide _____      |
| 13) $\text{Cu}_2\text{CO}_3$ _____      | 33) vanadium (V) phosphate _____ |
| 14) $\text{Co}_3\text{N}_2$ _____       | 34) calcium oxide _____          |
| 15) $\text{Mg}_3\text{P}_2$ _____       | 35) magnesium acetate _____      |
| 16) $\text{Ga(NO}_2)_3$ _____           | 36) aluminum sulfate _____       |
| 17) $\text{Ag}_2\text{SO}_3$ _____      | 37) copper (I) carbonate _____   |
| 18) $\text{NH}_4\text{OH}$ _____        | 38) barium oxide _____           |
| 19) $\text{Al(CN)}_3$ _____             | 39) ammonium sulfite _____       |
| 20) $\text{Be(CH}_3\text{COO)}_2$ _____ | 40) silver bromide _____         |

## Naming Ionic Compounds – Answer Key

- 1)  $\text{Na}_2\text{CO}_3$  sodium carbonate
- 2)  $\text{NaOH}$  sodium hydroxide
- 3)  $\text{MgBr}_2$  magnesium bromide
- 4)  $\text{KCl}$  potassium chloride
- 5)  $\text{FeCl}_2$  iron (II) chloride
- 6)  $\text{FeCl}_3$  iron (III) chloride
- 7)  $\text{Zn(OH)}_2$  zinc hydroxide
- 8)  $\text{Be}_2\text{SO}_4$  beryllium sulfate
- 9)  $\text{CrF}_2$  chromium (II) fluoride
- 10)  $\text{Al}_2\text{S}_3$  aluminum sulfide
- 11)  $\text{PbO}$  lead (II) oxide
- 12)  $\text{Li}_3\text{PO}_4$  lithium phosphate
- 13)  $\text{Cu}_2\text{CO}_3$  copper(I) carbonate
- 14)  $\text{Co}_3\text{N}_2$  cobalt (II) nitride
- 15)  $\text{Mg}_3\text{P}_2$  magnesium phosphide
- 16)  $\text{Ga(NO}_2)_3$  gallium nitrite
- 17)  $\text{Ag}_2\text{SO}_3$  silver sulfite
- 18)  $\text{NH}_4\text{OH}$  ammonium hydroxide
- 19)  $\text{Al(CN)}_3$  aluminum cyanide
- 20)  $\text{Be(CH}_3\text{COO)}_2$  beryllium acetate

- 21) sodium phosphide  $\text{Na}_3\text{P}$
- 22) magnesium nitrate  $\text{Mg(NO}_3)_2$
- 23) lead (II) sulfite  $\text{PbSO}_3$
- 24) calcium phosphate  $\text{Ca}_3(\text{PO}_4)_3$
- 25) ammonium sulfate  $(\text{NH}_4)_2\text{SO}_4$
- 26) silver cyanide  $\text{AgCN}$
- 27) aluminum sulfide  $\text{Al}_2\text{S}_3$

28)	beryllium chloride	<b>BeCl<sub>2</sub></b>
29)	copper (I) arsenide	<b>Cu<sub>3</sub>As</b>
30)	iron (III) oxide	<b>Fe<sub>2</sub>O<sub>3</sub></b>
31)	gallium nitride	<b>GaN</b>
32)	iron (II) bromide	<b>FeBr<sub>2</sub></b>
33)	vanadium (V) phosphate	<b>V<sub>3</sub>(PO<sub>4</sub>)<sub>5</sub></b>
34)	calcium oxide	<b>CaO</b>
35)	magnesium acetate	<b>Mg(CH<sub>3</sub>COO)<sub>2</sub></b>
36)	aluminum sulfate	<b>Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub></b>
37)	copper (I) carbonate	<b>Cu<sub>2</sub>CO<sub>3</sub></b>
38)	barium oxide	<b>BaO</b>
39)	ammonium sulfite	<b>(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub></b>
40)	silver bromide	<b>AgBr</b>



# Polyatomic Ionic Formulas Worksheet

IONS	nitrate	sulfate	carbonate	phosphate	hydroxide	chromate
sodium	$\text{NaNO}_3$	$\text{Na}_2\text{SO}_4$				
silver						
ammonium						
mercury(I)						
zinc						
calcium						
magnesium						
copper(I)						
lead(II)						
aluminum						
manganese(III)						
cobalt(III)						
copper (II)						
iron (III)						
lead (IV)						
potassium						
barium						

# Polyatomic Ionic Formulas Worksheet

IONS	nitrate	sulfate	carbonate	phosphate	hydroxide	chromate
sodium	NaNO <sub>3</sub>	Na <sub>2</sub> SO <sub>4</sub>	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>3</sub> PO <sub>4</sub>	NaOH	Na <sub>2</sub> CrO <sub>4</sub>
silver	AgNO <sub>3</sub>	Ag <sub>2</sub> SO <sub>4</sub>	Ag <sub>2</sub> CO <sub>3</sub>	Ag <sub>3</sub> PO <sub>4</sub>	AgOH	Ag <sub>2</sub> CrO <sub>4</sub>
ammonium	NH <sub>4</sub> NO <sub>3</sub>	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>	(NH <sub>4</sub> ) <sub>3</sub> PO <sub>4</sub>	NH <sub>4</sub> OH	(NH <sub>4</sub> ) <sub>2</sub> CrO <sub>4</sub>
mercury(I)	HgNO <sub>3</sub>	Hg <sub>2</sub> SO <sub>4</sub>	Hg <sub>2</sub> CO <sub>3</sub>	Hg <sub>3</sub> PO <sub>4</sub>	HgOH	Hg <sub>2</sub> CrO <sub>4</sub>
zinc	Zn(NO <sub>3</sub> ) <sub>2</sub>					
calcium						
magnesium						
copper(I)						
lead(II)						
aluminum						
manganese(III)						
cobalt(III)						
copper (II)						
iron (III)						
lead (IV)						
potassium						
barium						