You have mastered this topic when you can:

1) define or describe **BINARY COMPOUNDS**, **BINARY IONIC COMPOUNDS**, and **TERTIARY IONIC COMPOUNDS**.
2) define or describe **VALENCE**, **UNIVALENT METAL**, and **MULTIVALENT METAL**.
3) describe the difference between **MONATOMIC** and **POLYATOMIC IONS**.
4) identify the **VALENCE** of an ion from the formula of an ionic compound.
5) name and write chemical formulae for ionic compounds.

## BINARY IONIC COMPOUNDS

I) ***A BINARY COMPOUND is a compound composed atoms of two different kinds of elements.***

**e.g.** $NaCl_{(s)}$, $MgO_{(s)}$, $Sc_2S_{3(s)}$, $CO_2$, $N_2O_4$, $H_2O$, etc.

A) ***A BINARY IONIC COMPOUNDS is a compound composed of atoms of a metal element bonded to atoms of a non-metal element.***

**e.g.** $NaCl_{(s)}$, $MgO_{(s)}$, $CuO_{(s)}$, $Sc_2S_{3(s)}$, $Ni_2O_{3(s)}$, $Li_3N_{(s)}$, etc.

II) **WRITING FORMULAE FOR *BINARY IONIC COMPOUNDS***

A) When writing the formula of an ionic compound, we must use the ***valence*** of each element in the compound. **REMEMBER** that the ***valence*** for metals gives the charge of metal ions. Study your Periodic Table while reading the following.

1) The metals found in groups 1, 2 and 3 have only one ***valence***. This means that they form one kind of ion. Metals that only form one kind of ion having a single charge are called **UNIVALENT METALS**.
   a) **e.g.** Lithium atoms form only one kind of ion, a $Li^+$ ion; magnesium atoms form only one kind of ion, a $Mg^{2+}$ ion; while scandium atoms form only one kind of ion, a $Sc^{3+}$ ion.
   b) **On your periodic table, every element that has a single valence is *univalent*.**
2) The metals found in groups 4 through 12 of the transition metals have more than 1 ***valence***. This means that they form more than one kind of ion. Metals that form more than one kind of ion, each having a different charge are called **MULTIVALENT METALS**. **e.g.** copper atoms form two kinds of ions: $Cu^{2+}$ and $Cu^{1+}$ ions; nickel atoms form two kinds of ions: $Ni^{2+}$ and $Ni^{3+}$ ions.
   a) **On your periodic table, every *metal element* that has more than one *valence* listed is *multivalent*.** The ***multivalent*** metals have the most common ***valence*** is listed first.

B) **WRITING FORMULAE FOR *BINARY IONIC COMPOUNDS* CONTAINING *UNIVALENT METALS***

1) **USE THESE STEPS TO WRITE FORMULAE FOR BINARY IONIC COMPOUNDS CONTAINING UNIVALENT METALS**
   ***(1) Write the symbol and the valence for the metal followed by the non-metal.***
   ***(2) Crisscross the numbers only making them subscripts. Crisscrossing cancels each charge.***
   ***(3) Simplify the subscript ratio if possible and omit any 1's to complete the formula.***

2) **SAMPLE PROBLEMS 1:** Write the formula for these ionic compounds: potassium oxide, beryllium iodide, scandium sulphide and barium oxide.

***(1) Write the symbol and the valence for the metal followed by the non-metal.***

| potassium oxide | beryllium iodide | scandium sulphide | barium oxide |
|---|---|---|---|
| $K^{+1}$ $O^{-2}$ | $Be^{+2}$ $I^{-1}$ | $Sc^{+3}$ $S^{-2}$ | $Ba^{+2}$ $O^{-2}$ |

***(2) Crisscross the numbers only making them subscripts. Crisscrossing cancels each charge.***


***(3) Simplify the subscript ratio if possible and omit any 1's to complete the formula.***

$K_2O_{(s)}$ $BeI_{2(s)}$ $Sc_2S_{3(s)}$ $Ba_{\frac{2}{2}}O_{\frac{2}{2}} = Ba_1O_1$

$BaO_{(s)}$

C) **Required Practice 1:** Write the formula of each of these ionic compounds. **{Answers are on page 7 of these notes.}**

1. Potassium chloride _____
2. Magnesium chloride _____
3. Aluminum bromide _____
4. Zinc bromide _____
5. Aluminum oxide _____
6. Sodium phosphide _____
7. Barium nitride _____
8. Calcium sulphide _____
9. Scandium nitride _____
10. Strontium selenide _____
11. Beryllium phosphide _____
12. Yttrium carbide _____

III) **NOMENCLATURE**

A) Due to the infinite variety of compounds possible, chemists quickly realized that a system of naming compounds that the entire world used was necessary to ensure a chemical formula had the same name in all parts of the world. In 1787, Guyton de Morveau, devised a system of naming compounds that was based on the Latin name of the elements. de Morveau's system proved too complex so the **I**nternational **U**nion of **P**ure and **A**pplied **C**hemistry (IUPAC) developed a new system called **CHEMICAL NOMENCLATURE**. This system is based on the names of elements found on the periodic table rather than the Latin or common names of previous systems. Although the name of a compound as determined by ***chemical nomenclature*** is preferred over common names, due to their popularity, some common names continue to be used today thus you must memorize them.

B) NAMING ***BINARY IONIC COMPOUNDS*** CONTAINING ***UNIVALENT METALS***

1) In the formula of ***binary ionic compounds***, the ***metal cation always*** appears first followed by the non-metal anion (positive before negative). ***Chemical nomenclature***, naming compounds, also follows this pattern: the ***binary ionic compound's*** name begins with the full name of the metal followed by the name of the non-metal ending with the suffix "***ide***".

2) **SAMPLE PROBLEMS 2:** Names of four ***binary ionic compounds***.

| Elements in compound | | IUPAC Name |
|---|---|---|
| sodium and oxygen | $Na_2O_{(s)}$ | sodium oxide |
| magnesium and nitrogen | $Mg_3N_{2(s)}$ | magnesium nitride |
| aluminum and sulphur | $Al_2S_{3(s)}$ | aluminum sulphide |
| scandium and bromine | $ScBr_{3(s)}$ | scandium bromide |
| potassium and phosphorous | $K_3P_{(s)}$ | potassium phosphide |

C) **Required Practice 2:** Write the name of each of these ionic compounds. **{Answers are on page 7 of these notes.}**

1. $KF_{(s)}$ _____
2. $RbBr_{(s)}$ _____
3. $NaI_{(s)}$ _____
4. $CaCl_{2(s)}$ _____
5. $Li_2S_{(s)}$ _____
6. $Na_3P_{(s)}$ _____
7. $Sc_2O_{3(s)}$ _____
8. $YN_{(s)}$ _____
9. $ScN_{(s)}$ _____
10. $SrO_{(s)}$ _____
11. $BeI_{2(s)}$ _____
12. $Ca_3N_{2(s)}$ _____

IV) **IONIC COMPOUNDS WITH *MULTIVALENT METALS***

A) **REMEMBER** that ***multivalent metals*** are metals that are able to form more than one kind of ion, each with its own distinct ***valence* = *ion charge***. Elements in groups 4 through 12, known as the *transition metals*, tend to be ***multivalent*** as indicated by their having ***multiple valences***: **e.g.** Iron can form two kinds of ions: $Fe^{3+}$ and $Fe^{2+}$ ions; cobalt can form two kinds of ions: $Co^{2+}$ and $Co^{3+}$ ions. **NOTE: *Your periodic table is designed to show which of the transition metals are univalent and which are multivalent.***

1) ***The metal is univalent if only one valence is shown.***
2) ***The metal is multivalent if two valences are shown. The valence for the two most common ions is shown.*** *It is possible for multivalent metals to form three or more different kinds of ions each with an individual valence.*

B) When making a compound between a ***multivalent metal*** and a non-metal, we must indicate which ***valence*** (***ion charge***) is used by the metal. Chemists indicate the metal's ***valence*** (***ion charge***) by including Roman numerals in the compounds name. The Roman numeral states the ***valence*** to be used as indicated in this table.

| ***Roman numeral*** | ***Valence* (*ion charge*)** |
|---|---|
| I | 1 |
| II | 2 |
| III | 3 |
| IV | 4 |
| V | 5 |
| VI | 6 |
| VII | 7 |

1) **e.g.** Copper(I) = $Cu^{+1}$, Copper(II) = $Cu^{+2}$; Nickel(II) = $Ni^{+2}$, Nickel(III) = $Ni^{+3}$.

2) ***<u>This system of naming multivalent metals is called the Stock System</u>***.

C) ***USE THESE STEPS TO WRITE FORMULAE FOR BINARY IONIC COMPOUNDS CONTAINING MULTIVALENT METALS***

***(1) Write the symbol and the valence for the metal followed by the non-metal.***
***(2) Crisscross the numbers only making them subscripts. Crisscrossing cancels each charge.***
***(3) Simplify the subscript ratio if possible and omit any 1's to complete the formula.***

D) **SAMPLE PROBLEMS 3:** Write the formula for these ionic compounds: nickel(III) oxide, copper(I) iodide, manganese(IV) nitride and lead(II) sulphide.

***(1) Write the symbol and the valence for the metal followed by the non-metal.***

| nickel(III) oxide | copper(I) iodide | manganese(IV) nitride | lead(II) sulphide |
|---|---|---|---|
| $Ni^{+3}$ $O^{-2}$ | $Cu^{+1}$ $I^{-1}$ | $Mn^{+4}$ $N^{-3}$ | $Pb^{+2}$ $S^{-2}$ |

***(2) Crisscross the numbers only making them subscripts. Crisscrossing cancels each charge.***

| | | | |
|---|---|---|---|
| $Ni^{+3}$ $O^{-2}$ → $Ni_2$ $O_3$ | $Cu^{+1}$ $I^{-1}$ → $Cu_1$ $I_1$ | $Mn^{+4}$ $N^{-3}$ → $Mn_3$ $N_4$ | $Pb^{+2}$ $S^{-2}$ → $Pb_2$ $S_2$ |

***(3) Simplify the subscript ratio if possible and omit any 1's to complete the formula.***

| | | | |
|---|---|---|---|
| $Ni_2O_{3(s)}$ | $CuI_{(s)}$ | $Mn_3N_{4(s)}$ | $Pb_{\frac{2}{2}}S_{\frac{2}{2}} = Pb_1S_1$ |
| | | | $PbS_{(s)}$ |

E) **Required Practice 3:** Write the formula of each of these ionic compounds. **{Answers are on page 7 of these notes.}**

1. Iron(III) chloride _____
2. Iron(III) oxide _____
3. Lead(II) sulphide _____
4. Tin(IV) fluoride _____
5. Nickel(II) bromide _____
6. Copper(I) oxide _____
7. Copper(II) oxide _____
8. Manganese(II) phosphide _____
9. Cobalt(III) nitride _____
10. Nickel(III) chloride _____
11. Lead(II) oxide _____
12. Lead(IV) oxide _____

V) **WRITING NAMES FOR *BINARY IONIC COMPOUNDS* CONTAINING *MULTIVALENT* METALS**

A) The name of a ***binary ionic compound*** begins with the full name of the metal cation followed by the name of the non-metal anion ending in "***ide***". If the metal is ***multivalent***, the name must include a Roman numeral in brackets indicating which ***valence*** was used.

1) **Sample Problems:** CuF: the valence on Cu is **+1**, so its name is copper**(I)** fluoride.
$CuF_2$: the valence on Cu is **+2**, so its name is copper**(II)** fluoride.

B) Determining the charge on a ***multivalent metal***. **REMEMBER** that ionic compounds are neutral which means that the total negative charge supplied by the non-metal anions is equal to the total positive charge supplied by the metal cations. Chemists use this information to calculate the ***valence*** (***ion charge***) of ***multivalent metals*** within compounds.

C) **Required Practice 4:** Write the name of each of these ionic compounds. **{Answers are on page 7 of these notes.}**

1. $FeCl_{2(s)}$ _____
2. $SnBr_{2(s)}$ _____
3. $Mn_3P_{2(s)}$ _____
4. $CuCl_{2(s)}$ _____
5. $Cu_2S_{(s)}$ _____
6. $Fe_2S_{3(s)}$ _____
7. $PbBr_{2(s)}$ _____
8. $Pb_3N_{4(s)}$ _____
9. $NiO_{(s)}$ _____
10. $Ni_2O_{3(s)}$ _____
11. $PbS_{2(s)}$ _____
12. $PbS_{(s)}$ _____

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## TERTIARY IONIC COMPOUNDS

I) **A *TERTIARY COMPOUND* IS A COMPOUND COMPOSED OF THREE DIFFERENT KINDS OF ELEMENTS**

**e.g.** $Na_2CO_{3(s)}$, $MgMnO_{4(s)}$, $BaSO_{4(s)}$, $C_6H_{12}O_6$, $C_2H_5OH$, etc.

A) ***A TERTIARY IONIC COMPOUND* is an ionic compound composed of three different kinds of element, one of which is a metal.**

**e.g.** $K_2S_2O_{3(s)}$, $Mg(OH)_{2(s)}$, $AgNO_{3(s)}$, $Al(BrO_3)_{3(s)}$, etc.

II) As with all ionic compounds, ***TERTIARY IONIC COMPOUNDS*** **ARE COMPOSED OF 1 KIND OF CATION AND 1 KIND OF ANION.**

A) The cation is a metal ion and the anion is a **POLYATOMIC ION**. ***A POLYATOMIC ION is an ion composed of 2 or more different non-metal atoms bonded together***.

1) Each ***polyatomic ion*** has its own unique formula and behaves as a single particle whose formula does not change when it forms a bond within a compound: **e.g.** nitrate has the formula $NO_3^-$, and it reacts with $Mn^{4+}$ to form $Mn(NO_3)_4$ : **NOTICE** that its formula ($NO_3^-$) remains the same.

2) ***An OXYANION is any polyatomic anion whose formula ends with oxygen*** [Figure 1, pg. 94].

**e.g.** $C_2H_3O_2^-$, $BrO_3^-$, $CO_3^{2-}$, etc.

a) **NOTICE** that most ***polyatomic ions*** are ***oxyanions***. **Your polyatomic ion chart is found the end of this package of notes.**

3) Naming ***polyatomic ions***: When looking at the name of a compound, it can be difficult to know whether the anion in a compound is a ***monatomic*** non-metal ion or a ***polyatomic ion***. To simplify the identification of anions, chemists decided to end the name of ***polyatomic ions*** with "***-te***" while the names of ***monatomic*** anions ($F^-$, $O^{2-}$, etc.) end with "***-de***".

a) **SAMPLE PROBLEM:** Sodium chlorate: the name ends in ***te*** thus it contains the ***polyatomic ion*** $ClO_3^{-1}$ and its formula is $NaClO_3$. Sodium chloride; the name ends in ***de*** thus it contains the ***monatomic ion*** $Cl^{-1}$ and its formula is$NaCl$.

B) ***USE THESE STEPS TO WRITE FORMULAE FOR TERTIARY IONIC COMPOUNDS***

***(1) Write the symbol and the valence for the metal followed by the polyatomic ion. Place brackets around the formula of the polyatomic ion with the charge outside them.***

***(2) Crisscross the charge numbers only making them subscripts. The charge number goes outside the brackets on the polyatomic ion. Crisscrossing cancels each charge.***

***(3) Simplify the crisscrossed subscript numbers if possible and omit the 1's to complete the formula.***
**REMEMBER:** ***NEVER CHANGE THE FORMULA OF THE POLYATOMIC ION, ONLY NUMBERS OUTSIDE THE BRACKETS CAN BE SIMPLIFIED!!!***

C) **SAMPLE PROBLEMS 5:** Write the formula for these ionic compounds: silver chromate, aluminum carbonate, lead(IV) sulphate and nickel(II) sulphite.

***(1) Write the symbol and the valence for the metal followed by the polyatomic ion. Place brackets around the formula of the polyatomic ion with the charge outside the brackets.***

| silver chromate | aluminum carbonate | lead(IV) sulphate | nickel(II) sulphite |
|---|---|---|---|
| $Ag^{+1}\ (CrO_4)^{-2}$ | $Al^{+3}\ (CO_3)^{-2}$ | $Pb^{+4}\ (SO_4)^{-2}$ | $Ni^{+2}\ (SO_3)^{-2}$ |

***(2) Crisscross the charge numbers only making them subscripts. The charge number goes outside the brackets on the polyatomic ion. Crisscrossing cancels each charge.***

| | | | |
|---|---|---|---|
| $Ag^{+1}\ (CrO_4)^{-2}$ | $Al^{+3}\ (CO_3)^{-2}$ | $Pb^{+4}\ (SO_4)^{-2}$ | $Ni^{+2}\ (SO_3)^{-2}$ |
| $Ag_2\ (CrO_4)_1$ | $Al_2\ (CO_3)_3$ | $Pb_2\ (SO_4)_4$ | $Ni_2\ (SO_3)_2$ |

***(3) Simplify the crisscrossed subscript numbers if possible and omit the 1's to complete the formula.***
**REMEMBER:** ***NEVER change the formula of the polyatomic ion, only numbers outside the brackets can be simplified!!***

| | | | |
|---|---|---|---|
| $Ag_2CrO_{4(s)}$ | $Al_2(CO_3)_{3(s)}$ | $Pb\,\frac{2}{2}\,(SO_4)\,\frac{4}{2} = Pb_1(SO_4)_{2(s)}$ | $Ni\,\frac{2}{2}\,(SO_3)\,\frac{2}{2} = Ni_1(SO_3)_1$ |
| | | $Pb(SO_4)_{2(s)}$ | $NiSO_{3(s)}$ |

D) **Required Practice 5:** Write the formula of each of these ionic compounds. **{Answers are on page 7.}**

1. Sodium nitrate _____
2. Calcium carbonate _____
3. Potassium sulphate _____
4. sodium thiosulphate _____
5. zinc hydroxide _____
6. barium cyanide _____
7. Copper(II) nitrite _____
8. Manganese(IV) nitrate _____
9. Cobalt(III) bromate _____
10. Nickel(III) hydroxide _____
11. Lead(IV) dichromate _____
12. ammonium chromate _____

E) Writing names for ***tertiary ionic compounds***. ***Tertiary ionic compounds*** are named using the same rules as previously discussed. **REMEMBER** *to include a Roman numeral for all multivalent metals*:

**e.g.** $Sr_2(S_2O_3)_3$ = strontium thiosulphate; $CoPO_3$ = cobalt(III) phosphite.

F) **Required Practice 6:** Write the name of each of these ionic compounds. **{Answers are on page 7.}**

1. $Na_2SO_{4(s)}$ _____
2. $ZnSO_{3(s)}$ _____
3. $KClO_{4(s)}$ _____
4. $Ca(HCO_3)_{2(s)}$ _____
5. $Mn(HPO_4)_{2(s)}$ _____
6. $NH_4Br_{(s)}$ _____
7. $NH_4NO_{2(s)}$ _____
8. $Be(ClO_2)_{2(s)}$ _____
9. $CuCN_{(s)}$ _____
10. $Au_2(Cr_2O_7)_{3(s)}$ _____
11. $Ni_2(S_2O_3)_{3(s)}$ _____
12. $(NH_4)_3PO_{4(s)}$ _____

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## BASES & SALTS ← MEMORIZE THIS INFORMATION!!

I) ***BASES*** **ARE IONIC COMPOUNDS THAT CONTAIN THE POLYATOMIC ION HYDROXIDE = $(OH)^{-1}$**

**e.g.** $NaOH_{(aq)}$, $KOH_{(aq)}$, $NH_4OH_{(aq)}$, $Ba(OH)_{2(aq)}$, $Al(OH)_{3(aq)}$, etc.

A) All ***bases*** share these properties: ***bases*** are electrolytes (they conduct electricity when dissolved in water), ***bases*** neutralize acids, and ***bases*** cause the compound litmus to change its colour from red to blue.

II) **A *SALT* IS ANY IONIC COMPOUND THAT DOES NOT CONTAIN THE POLYATOMIC ION HYDROXIDE = $OH^{-1}$, NOR DO THEY BEGIN WITH HYDROGEN = H**

**e.g.** $NaHCO_{3(s)}$, $NaClO_{(s)}$, $KCl_{(s)}$, $Ba_3N_{2(s)}$, $(NH_4)_2CO_{3(s)}$, $Ni_2(S_2O_3)_{3(s)}$, $Ca(HCO_3)_{2(s)}$, etc.

A) All ***salts*** share these properties: ***salts*** are electrolytes (they conduct electricity when dissolved in water), ***salts*** are hard brittle solid crystals or powders as SATP.

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## COMMON NAMES OF SOME IONIC COMPOUNDS

I) Some ionic compounds have been known to chemists for so long that their common name is still used. These names are useful to know, however make sure you are able to name ionic compounds according to the stock or UIPAC rules when requested to do so. The formula, common name and uses of several ionic compounds are listed at the top of the next page in the table on page 632 of your text.

| FORMULA | COMMON NAME | USES |
|---|---|---|
| $NaHCO_{3(s)}$ | baking soda | cooking |
| $NaClO_{(s)}$ | bleach | cleaning |
| $NaCl_{(s)}$ | table salt | seasoning food |
| $NaOH_{(s)}$ | lye (caustic soda) | oven/drain cleaner |

## ANSWERS TO THE REQUIRED PRACTICE

**Required Practice 1 from page 2**

**1.** $KCl_{(s)}$ **2.** $MgCl_{2(s)}$ **3.** $AlBr_{3(s)}$ **4.** $ZnBr_{2(s)}$ **5.** $Al_2O_{3(s)}$ **6.** $Na_3P_{(s)}$ **7.** $Ba_3N_{2(s)}$ **8).** $CaS_{(s)}$ **9.** $ScN_{(s)}$
**10.** $SrSe_{(s)}$ **11.** $Be_3P_{2(s)}$ **12.** $Y_4C_{3(s)}$

**Required Practice 2 from page 2**

**1.** potassium fluoride **2.** rubidium bromide **3.** sodium iodide **4.** calcium chloride **5.** lithium sulphide
**6.** sodium phosphide **7.** scandium oxide **8.** yttrium nitride **9.** scandium nitride **10.** strontium oxide
**11.** beryllium iodide **12.** calcium nitride

**Required Practice 3 from page 4**

**1.** $FeCl_{3(s)}$ **2.** $Fe_2O_{3(s)}$ **3.** $PbS_{(s)}$ **4.** $SnF_{4(s)}$ **5.** $NiBr_{2(s)}$ **6.** $Cu_2O_{(s)}$ **7.** $CuO_{(s)}$ **8.** $Mn_3P_{2(s)}$ **9.** $CoN_{(s)}$
**10.** $NiCl_{3(s)}$ **11.** $PbO_{(s)}$ **12.** $PbO_{2(s)}$

**Required Practice 4 from page 4**

**1.** iron(II) chloride **2.** tin(II) bromide **3.** manganese(II) phosphide **4.** copper(II) chloride
**5.** copper(I) sulphide **6.** iron(III) sulphide **7.** lead(II) bromide **8.** lead(IV) nitride **9.** nickel(II) oxide
**10.** nickel(III) oxide **11.** lead(IV) sulphide **12.** lead(II) sulphide

**Required Practice 5 from page 6**

**1.** $NaNO_{3(s)}$ **2.** $CaCO_{3(s)}$ **3.** $K_2SO_{4(s)}$ **4.** $Na_2S_2O_{3(s)}$ **5.** $Zn(OH)_{2(s)}$ **6.** $Ba(CN)_{2(s)}$; **7.** $Cu(NO_2)_{2(s)}$
**8.** $Mn(NO_3)_{4(s)}$ **9.** $Co(BrO_3)_{3(s)}$ **10.** $Ni(OH)_{3(s)}$ **11.** $Pb(Cr_2O_7)_{2(s)}$ **12.** $(NH_4)_2CrO_{4(s)}$

**Required Practice 6 from page 6**

**1.** sodium sulphate **2.** zinc sulphite **3.** potassium perchlorate **4.** calcium bicarbonate
**5.** manganese(IV) hydrogen phosphate **6.** ammonium bromide **7.** ammonium nitrite **8.** beryllium chlorite
**9.** copper(I) cyanide **10.** gold(III) dichromate **11.** nickel(III) thiosulphate **12.** ammonium phosphate

| # | CATION NAME | CATION FORMULA |
|---|---|---|
| 1 | Ammonium | $(NH_4)^{1+}$ |

| # | ANION NAME | ANION FORMULA |
|---|---|---|
| 1 | Acetate | $(C_2H_3O_2)^{1-}$ or $(CH_3COO)^{1-}$ |
| 2 | Borate | $(BO_3)^{3-}$ |
| 3 | Bromate | $(BrO_3)^{1-}$ |
| 4 | Carbonate | $(CO_3)^{2-}$ |
| 5 | Hydrogen carbonate (bicarbonate) | $(HCO_3)^{1-}$ |
| 6 | Hypochlorite | $(ClO)^{1-}$ or $(OCl)^{1-}$ |
| 7 | Chlorite | $(ClO_2)^{1-}$ |
| 8 | Chlorate | $(ClO_3)^{1-}$ |
| 9 | Perchlorate | $(ClO_4)^{1-}$ |
| 10 | Chromate | $(CrO_4)^{2-}$ |
| 11 | Dichromate | $(Cr_2O_7)^{2-}$ |
| 12 | Iodate | $(IO_3)^{1-}$ |
| 13 | Nitrate | $(NO_3)^{-}$ |
| 14 | Nitrite | $(NO_2)^{1-}$ |
| 15 | Oxalate | $(C_2O_4)^{2-}$ |
| 16 | Permanganate | $(MnO_4)^{1-}$ |
| 17 | Phosphate | $(PO_4)^{3-}$ |
| 18 | Hydrogen phosphate | $(HPO_4)^{2-}$ |
| 19 | Dihydrogen phosphate | $(H_2PO_4)^{1-}$ |
| 20 | Phosphite | $(PO_3)^{3-}$ |
| 21 | Hydrogen phosphite | $(HPO_3)^{2-}$ |
| 22 | Dihydrogen phosphite | $(H_2PO_3)^{1-}$ |
| 23 | Silicate | $(SiO_3)^{2-}$ |
| 24 | Sulphate | $(SO_4)^{2-}$ |
| 25 | Hydrogen sulphate (Bisulphate) | $(HSO_4)^{1-}$ |
| 26 | Sulphite | $(SO_3)^{2-}$ |
| 27 | Hydrogen sulphite (Bisulphite) | $(HSO_3)^{1-}$ |
| 28 | Thiosulphate | $(S_2O_3)^{2-}$ |
| 29 | Thiocyanate | $(SCN)^{1-}$ |
| 30 | Cyanide | $(CN)^{1-}$ |
| 31 | Hydrogen sulphide (Bisulphide) | $(HS)^{1-}$ |
| 32 | Hydroxide | $(OH)^{1-}$ |

## ASSIGNMENT

At the top of your assignment, please print **"T19 – Naming & Writing Formulae for Ionic Compounds", your LAST then First name, block and date** assignment. Complete these questions in the order given here. *[Marks indicated in italicized brackets.]*

# COPY THE QUESTION THEN ANSWER IT. INCLUDE THE STATE FOR FORMULAE. *[4]*

1. What characteristic do multivalent metals share? *[1]*

2. Write the formula for these compounds. *[6]*
   a. calcium fluoride
   b. sodium sulphide
   c. aluminum nitride
   d. aluminum chloride
   e. copper(II) oxide
   f. copper(I) sulphide
   g. lead(II) bromide
   h. barium nitride
   i. iron(II) fluoride
   j. nickel(II) bromide
   k. cobalt(III) chloride
   l. gold(I) chloride

3. Name these formulae. *[6]*
   a. $NaCl_{(s)}$
   b. $CaO_{(s)}$
   c. $CaCl_{2(s)}$
   d. $MgO_{(s)}$
   e. $Al_2O_{3(s)}$
   f. $ZnS_{(s)}$
   g. $Cu_2S_{(s)}$
   h. $PbS_{2(s)}$
   i. $Fe_2O_{3(s)}$
   j. $MoO_{3(s)}$
   k. $Ag_2S_{(s)}$
   l. $ZnO_{(s)}$

4. Write the formula for these compounds. *[4]*
   a. calcium carbonate
   b. sodium bicarbonate
   c. calcium sulphate
   d. ammonium nitrate
   e. copper(II) sulphate
   f. copper(I) phosphate
   g. lead(II) nitrate
   h. sodium hydroxide

5. Name these formulae. *[4]*
   a. $NaNO_{3(s)}$
   b. $NaNO_{2(s)}$
   c. $Cu(NO_3)_{2(s)}$
   d. $CuNO_{3(s)}$
   e. $Al_2(SO_3)_{3(s)}$
   f. $Ca(OH)_{2(s)}$
   g. $PbCO_{3(s)}$
   h. $Sn_3(PO_4)_{2(s)}$

***[25 marks in total]***