Answers

Nomenclature
Naming Ionic Compounds
Worksheet #1

In forming ionic compounds with non-metals, the transition metals *often* exhibit more than one valence. For example, in the reaction between iron and chlorine, two products are possible because iron can form an Fe^{3+} ion and an Fe^{2+} ion. The products are $FeCl_3$ and $FeCl_2$.
Some periodic tables list the different possible charges for multi-valent transition metals with the most common charge listed first.

Example 1:
Copper is a multi-valent transition metal. Its possible charges are 2+ and 1+. The more common charge is 2+.
$CuCl_2$ is copper (II) chloride, and CuCl is copper (I) chloride.

Example 2:
Iron is a multi-valent metal. Its possible charges are 3+ and 2+. The more common charge is 3+.
Fe_2O_3 is iron (III) oxide, and FeO is iron (II) oxide.

Note that the sum of all charges in a compound must equal zero.

If a transition metal is not multi-valent, then there is no need for the Roman numeral in parenthesis. For example, AgCl is silver chloride, and $ZnCl_2$ is zinc chloride.

Practice exercise:
Supply the chemical formula for the following compounds.

1. manganese (IV) oxide MnO_2
2. copper (II) bromide $CuBr_2$
3. cobalt (II) chloride $CoCl_2$
4. silver nitrate $AgNO_3$
5. zinc sulfide ZnS
6. iron (III) chloride $FeCl_3$
7. nickel (II) oxide NiO
8. copper (II) sulfate $CuSO_4$
9. mercury (II) sulfide HgS
10. lead (IV) sulfide PbS_2

Nomenclature
Naming Binary Ionic Compounds

The name of a binary ionic compound is the name of the metal ion (the positively charged ion or cation) stated in full followed by the name of the non-metal ion (the negatively charged ion or anion) with the suffix *–ide*. For example,
$AlCl_3$ is aluminum chloride
CaO is calcium oxide
MgS is magnesium sulfide

Practice exercise:
If the IUPAC name is given, write the chemical formula. If the formula is supplied, write the IUPAC name.

1. calcium chloride $CaCl_2$
2. $MgBr_2$ Magnesium bromide
3. aluminum fluoride AlF_3
4. potassium iodide KI
5. $BeCl_2$ Beryllium chloride
6. sodium bromide NaBr
7. LiCl Lithium chloride
8. K_3N Potassium nitride
9. calcium sulfide CaS
10. MgO Magnesium oxide

Compounds with polyatomic ions

Predicting the formula of ionic compounds involving polyatomic ions is done in the same way as for binary ionic compounds.
For example, potassium nitrate is KNO_3 and calcium nitrate is $Ca(NO_3)_2$.

Sec 4 students should be familiar with the following polyatomic ions and charges.

Polyatomic ion	formula	charge
ammonium	NH_4^+	1+
hydroxide	OH^-	1-
nitrate	NO_3^-	1-
carbonate	CO_3^{2-}	2-
sulfate	SO_4^{2-}	2-
phosphate	PO_4^{3-}	3-

Practice exercise:
Supply chemical formulas for the following ionic compounds.
1. calcium carbonate $CaCO_3$
2. sodium hydroxide NaOH
3. ammonium chloride NH_4Cl
4. sodium phosphate Na_3PO_4

Nomenclature
Practice Exercise

Supply the chemical formula for the following ionic compounds.

1. nickel (II) oxide NiO
2. magnesium carbonate $MgCO_3$
3. zinc sulfide ZnS
4. aluminum oxide Al_2O_3
5. iron (III) chloride $FeCl_3$
6. silver nitrate $AgNO_3$
7. lithium chloride $LiCl$
8. ammonium hydroxide NH_4OH
9. copper (II) sulfate $CuSO_4$
10. potassium hydroxide KOH
11. calcium hydroxide $Ca(OH)_2$
12. sodium phosphate Na_3PO_4
13. cobalt (II) chloride $CoCl_2$
14. silver bromide $AgBr$
15. zinc carbonate $ZnCO_3$
16. lead (II) iodide PbI_2
17. copper (II) bromide $CuBr_2$
18. calcium fluoride CaF_2
19. iron (III) hydroxide $Fe(OH)_3$
20. magnesium sulfate $MgSO_4$
21. magnesium sulfide MgS
22. nickel (II) sulfide NiS
23. ammonium nitrate NH_4NO_3

Naming binary covalent compounds

According to IUPAC rules, the prefix system is used only for naming binary covalent compounds – molecular compounds composed of only two kinds of atoms.

Prefixes used in naming covalent compounds

mono	1
di	2
tri	3
tetra	4
penta	5
hexa	6
hepta	7

Exceptions to the above rule include the common molecular (covalent) compounds below:

water	H_2O
hydrogen peroxide	H_2O_2
ammonia	NH_3
propane	C_3H_8
octane	C_8H_{18}

Practice exercise:
Supply the formula for the following molecular compounds.

1) nitrogen dioxide NO_2
2) nitrogen monoxide NO
3) sulfur dioxide SO_2
4) sulfur trioxide SO_3
5) ammonia NH_3
6) propane C_3H_8
7) phosphorus trichloride PCl_3
8) phosphorus pentachloride PCl_5
9) hydrogen peroxide H_2O_2
10) carbon monoxide CO

Nomenclature
Practice exercise

If a formula is given, write the IUPAC name. If the name is supplied, write the chemical formula.

1. carbon dioxide CO_2
2. calcium fluoride CaF_2
3. K_2O Potassium oxide
4. $Ca(OH)_2$ Calcium hydroxide
5. K_3PO_4 Potassium Phosphate
6. ammonium chloride NH_4Cl
7. sulfur dioxide SO_2
8. PCl_3 Phosphorus trichloride
9. copper (II) nitrate $Cu(NO_3)_2$
10. iron (III) hydroxide $Fe(OH)_3$
11. N_2O_4 dinitrogen tetraoxide
12. NH_3 ammonia
13. $Zn(NO_3)_2$ zinc nitrate
14. sodium carbonate Na_2CO_3
15. PCl_5 Phosphorus pentachloride
16. sulfate ion SO_4^{-2}
17. potassium K
18. carbon monoxide CO
19. chloride ion Cl^{-1}
20. mercury Hg
21. zinc oxide ZnO
22. nitrate ion NO_3^{-1}