Name _____ Class_____Date_____

Skills Worksheet

Math Skills

Writing Ionic Formulas

After you study each sample problem and solution, work out the practice problems on a separate sheet of paper. Write your answers in the space provided.

The following table lists most of the ionic formulas you will need for the Practice section. The charge on other positive ions will be indicated by a Roman numeral.

TABLE OF SOME COMMON IONS

Name	Formula	Name	Formula	Name	Formula
Aluminum ion	Al^{3+}	Bromide ion	Br^-	Carbonate ion	CO_3^{2-}
Ammonium ion	NH_4^+	Chloride ion	Cl^-	Cyanide ion	CN^-
Calcium ion	Ca^{2+}	Fluoride ion	F^-	Hydrogen carbonate ion	HCO_3^-
Lithium ion	Li^+	Iodide ion	I^-	Hydroxide ion	OH^-
Potassium ion	K^+	Nitride ion	N^{3-}	Nitrate ion	NO_3^-
Sodium ion	Na^+	Oxide ion	O^{2-}	Phosphate ion	PO_4^{3-}
Strontium ion	Sr^{2+}	Sulfide ion	S^{2-}	Sulfate ion	SO_4^{2-}

PROBLEM

Tungsten has the highest melting point of any element. It appears in nature in the mineral, *wolframite*, as the compound tungsten(VI) oxide. Write the ionic formula for this compound.

SOLUTION

Step 1: List the symbols for each ion.

Symbol for tungsten(VI) ion: W^{6+} (*VI* indicates a charge of 6+)
Symbol for oxide ion: O^{2-}

Step 2: Write the symbols for the ions with the cation first.

$W^{6+}O^{2-}$

Step 3: Find the least common multiple of the ions' charges.

The least common multiple of 6 and 2 is 6. To make a neutral compound, you need a total of six positive charges and six negative charges.
To get six positive charges, you need only one W^{6+} ion, because $1 \times 6+ = 6+$.
To get six negative charges, you need three O^{2-} ions, because $3 \times 2- = 6-$.

Step 4: Write the chemical formula, indicating with subscripts how many of each ion are needed to make a neutral compound.

WO_3

PRACTICE

1. Write the formulas for the following ionic compounds:
   a. potassium chloride _____
   b. tin(II) bromide _____
   c. calcium nitride _____
   d. sodium fluoride _____
2. Write the ionic formula for the compound lithium chloride.

   _____
3. Copper is found in a number of different ores, among them *cuprite* (copper(I) oxide), *nantokite* (copper(I) chloride), and *chalcocite* (copper(I) sulfide). Write the formulas for these three compounds.

   _____
4. Titanium is a metal commonly used in building airplanes and rockets, because it is light and is stronger than either steel or aluminum. Titanium is most commonly found in the form of the mineral rutile as titanium(IV) oxide. Write the ionic formula for this compound.

   _____
5. Mercury is obtained by heating the ore *cinnabar*, or mercury(II) sulfide. Write the ionic formula for mercury(II) sulfide.

   _____
6. Iridium is named after the Latin word for *rainbow* because the ionic salts it forms are of many different colors. An example of this is the two kinds of iodine compounds formed with iridium: one, iridium(III) iodide, is a green crystalline compound, while the other, iridium(IV) iodide, consists of black crystals. Write the ionic formula for each of these iridium compounds.

   _____
7. The mineral *molybdenite* is the main source of the element molybdenum, which is added to steel and other alloys to strengthen them. Molybdenite consists of the compound molybdenum(IV) sulfide. Write the ionic formula for this compound.

   _____
8. The human body needs small quantities of iodine in order for the thyroid gland to function normally. Potassium iodide is used in table salt as a dietary source of iodine. Write the ionic formula for potassium iodide.

   _____

9. Iron(III) bromide and iron(II) bromide, also known as ferric bromide and ferrous bromide, respectively, are both used in organic chemistry as catalysts. Write the ionic formula for each of these compounds.

_____

10. Calcium chloride is commonly used as a drying agent. Write the ionic formula for this compound.

_____

11. Tin(II) fluoride, also known as stannous fluoride, has been used in toothpaste to help prevent tooth decay. The presence of fluoride ions helps tooth enamel to resist attack by acids. Write the ionic formula for tin(II) fluoride.

_____

12. Write the ionic formula for the compound strontium bromide.

_____

PROBLEM

Write the ionic formula for the compound lithium phosphate.

SOLUTION

Step 1: List the symbols for each ion.

Symbol for lithium ion: Li^+ Symbol for phosphate ion: $(PO_4)^{3-}$

Step 2: Write the symbols for the ions side by side, with the cation first.

$Li^+(PO_4)^{3-}$

Step 3: Find the least common multiple of the ions' charges.

The least common multiple of 1 and 3 is 3. To make a neutral compound, you need a total of three positive charges and one negative charge.

To get three positive charges, you need three Li^+ ions, because $3 \times 1+ = 3+$.

To get three negative charges, you need one $(PO_4)^{-3}$ ion, because $1 \times 3- = 3-$

Step 4: Write the chemical formula, using subscripts to indicate how many of each ion are needed to make a neutral compound.

$Li_3(PO_4)$

PRACTICE

13. Many ionic compounds that contain calcium have been in use for so long that they are often identified by their mineral or common names, which were given to them before their chemical composition was determined. Write the ionic formulas for the following calcium compounds, whose common or mineral names are in parentheses:

    a. calcium oxide (quicklime) _____

    b. calcium fluoride (fluorite or fluorspar) _____

    c. calcium carbonate (calcite) _____

14. One of the features that has made gold attractive for centuries is that it does not lose its luster. This is because gold, unlike many metals, does not react with air or water. In fact, gold is not highly reactive at all. Nevertheless, there are a few gold compounds. Among the more common of these are gold(III) chloride and gold(I) cyanide. Write the ionic formulas for these two compounds.

    _____

15. The element manganese is used in the production of types of steel, serves as a catalyst, and is the primary source of color in amethyst. The two forms of ore from which manganese is extracted are *pyrolusite,* or manganese(IV) oxide, and *rhodochrosite,* or manganese(II) carbonate. Determine the ionic formulas for these two compounds.

    _____

16. Certain compounds change colors when water is incorporated into their crystal structure. One example of these compounds is cobalt(II) chloride, which is naturally lavender in color and turns a pinkish red when water is added. Another example is copper(II) sulfate, which turns from white to deep blue when water is added. Write the ionic formulas for these two compounds.

    _____

17. The word *chromium* is derived from the Greek word for color, and the element chromium is so named because of the bright colors that many of its compounds have. Listed below are several chromium compounds and, in parentheses, their colors. Write the ionic formulas for these compounds.

    a. chromium(VI) oxide (red) _____

    b. chromium(II) hydroxide (yellow-brown) _____

    c. chromium(III) oxide (green) _____

    d. chromium(III) chloride (violet) _____