

Chapter 6 – Chemical Names and Formulas

Chapter 6: 1 – 9, 12, 14 – 24, 26 – 28, 31 – 36, 40, 42, 49, 52, 53, 56, 58, 62, 67 (37 total)

Practice Problems

1. Provide the name and symbol of the ion formed when

- a sulfur atom gains two electrons. S^{2-}
- an aluminum atom loses three electrons. Al^{3+}
- a calcium ion loses two electrons. Ca^{2+}

2. How many electrons are lost or gained in forming each ion?

- Ba^{2+} 2 e^- lost
- As^{3-} 3 e^- gained
- Cu^{2+} 2 e^- lost

Section Review 6.1

3. List three characteristics that distinguish ionic compounds from molecular compounds.

- ionic compounds are typically solids; molecular compounds can be solids, liquids or gases
- they have melting points that are typically higher than that of molecular compounds
- they are formed from a metal and a nonmetal; molecular compounds are formed from two or more non-metals.

4. What is a cation? What is an anion? Relate the two definitions to metals and nonmetals.

Metals tend to form positively-charge cations when they lose electrons; as an example, sodium (Na) readily loses one electron to form the sodium ion (Na^+).
Nonmetals tend to form negatively-charged anions when they gain electrons; oxygen typically gains two electrons to form the oxide ion (O^{2-}).

5. What does the presence of an *-ide* suffix on the name of an ion tell you about that ion?

An *-ide* suffix means the ion is an anion, such as chloride, nitride, fluoride.

6. What are the only elements that exist in nature as isolated atoms? What term is used to describe such elements?

He, Ar, and Ne are but a few of the noble gases, occupying Group 8A elements in the periodic table; since they exist as isolated atoms they are called monatomic.

7. What is a molecule? What is the difference between a diatomic molecule and a triatomic molecule? Provide an example of each.

A molecule is the smallest neutral particle of a substance that retains all the substance's properties; diatomic oxygen gas (O_2) has two atoms; triatomic oxygen (called ozone, O_3) has 3 atoms.

8. Write the symbol and name for the cation formed when

a. a potassium atom loses one electron. K^+

b. a zinc atom loses two electrons. Zn^{2+}

9. Write the symbol and name for the anion formed when

a. a fluorine atom gains one electron. F^-

b. a sulfur atom gains two electrons. S^{2-}

Section Review 6.2

12. Differentiate between a *chemical formula*, a *molecular formula*, and a *formula unit*.

A *chemical formula* shows the kinds and numbers of atoms in the smallest representative unit of a given substance. A *molecular formula* indicates the number of each kind of atom in a single molecule of the compound. The *formula unit* tells us the lowest whole number ratio of ions in a compound.

14. Which law is illustrated by this statement: “In every sample of carbon monoxide, the mass ratio of carbon to oxygen is 3:4”?

The law of definite proportions, states that a given chemical compound always contains its component elements in fixed ratio (by mass) that does not depend on its source and method of preparation.

15. Which law is illustrated in this statement: “When carbon and oxygen form the compounds carbon monoxide (CO) and carbon dioxide (CO₂), the different masses of carbon that combine with the same mass of oxygen are in the ratio of 2:1”?

The law of multiple proportions states that whenever two elements form more than one compound, the different masses of one element that combine with a fixed mass of the other element are in the ratio of whole, small numbers.

Practice Problems

16. What is the charge of the typical ion of each element?

a. selenium 2^- b. barium 2^+ c. cesium 1^+ d. phosphorus 3^-

17. How many electrons does the neutral atom gain or lose when each ion forms?

a. Fe^{3+} loses 3 b. O^{2-} gains 2 c. Cu^+ loses 1 d. Cd^{2+} loses 2

18. Name each ion in Practice Problem 16. Identify each as an anion or cation.

a. selenide ion - anion

b. barium ion - cation

c. cesium ion - cation

d. phosphide ion - anion

19. Name each ion in Practice Problem 17.

- a. Iron(III) ion b. oxide ion c. copper(I) ion d. cadmium(II) ion

Note there is no space between the element name, and the number for a, c, d.

Section Review 6.3

20. How can the periodic table be used to determine the charge of an ion? Use a specific example to explain.

In noting the group (or column) from which the ion is found, you can determine the charge of its ion. As an example, all Group 1A elements form 1^+ cations, such as Na^+

21. Explain what is meant by a *polyatomic ion*.

Polyatomic ions contain two or more tightly bound atoms that behave as an unbreakable, single unit. Examples of polyatomic ions are HO^- (hydroxide ion), NH_4^+ (hydronium ion).

22. Using only the periodic table, name and write the formula for the typical ion of each representative element.

- | | | | |
|--------------|------------------|------------|-----------------|
| a. potassium | K^+ | b. sulfur | S^{2-} |
| c. argon | no ion forms | d. bromine | Br^- |
| e. beryllium | Be^{2+} | f. sodium | Na^+ |

23. Write the formula (including charge) for each ion.

- | | | | |
|---------------------|---------------------|-----------------------|------------------|
| a. ammonium ion | NH_4^+ | b. tin (II) ion | Sn^{2+} |
| c. chromate | CrO_4^{2-} | d. nitrate ion | NO_3^- |
| e. cyanide ion | CN^- | f. iron (III) ion | Fe^{3+} |
| g. permanganate ion | MnO_4^- | h. manganese (II) ion | Mn^{2+} |

Practice Problems

24. Write formulas for compounds formed from these pairs of ions.

- | | | | |
|---------------------------------------|-------------------------|------------------------------------|-----------------------|
| a. Ba^{2+} , S^{2-} | BaS | b. Li^+ , O^{2-} | Li_2O |
| c. Ca^{2+} , N^{3-} | Ca_3N_2 | d. Cu^{2+} , I^- | CuI_2 |

Practice Problems

26. Write names for these binary ionic compounds.

- a. ZnS zinc sulfide
- b. KCl potassium chloride
- c. BaO barium oxide
- d. CuBr_2 copper(II) bromide

Although silver (Ag), cadmium (Cd) and Zinc (Zn) are transition metals, they do not need Roman numerals next to their names, because silver cations always have a 1+ charge, while zinc and cadmium always have a 2+ charge.

27. Write names for these binary ionic compounds.

- a. CaO calcium oxide
- b. Cu_2Se copper(I) selenide
- c. FeS iron(II) sulfide
- d. AlF_3 aluminum(III) fluoride

Practice Problems

28. Write formulas for compounds formed from these pairs of ions.

- a. NH_4^+ , SO_3^{2-} $(\text{NH}_4)_2\text{SO}_3$
- b. calcium ion, phosphate ion $\text{Ca}_3(\text{PO}_4)_2$
- c. Al^{3+} , NO_3^- $\text{Al}(\text{NO}_3)_3$
- d. potassium ion, chromate ion K_2CrO_4

Practice Problems

31. Write names for these compounds.

- a. $\text{Al}(\text{OH})_3$ aluminum hydroxide
- b. NaClO_3 sodium chlorate
- c. $\text{Sn}_3(\text{PO}_4)_2$ tin(III) phosphate
- d. Na_2CrO_4 sodium chromate

Section Review 6.4

32. How are formulas written for binary ionic compounds, given their names? How is the reverse done?

The formula must be written so the net ionic charge is zero. The cation is written first, and the anion, second; if writing the formula for calcium carbonate, you would write the cation (Ca^{2+}) first, and the anion (CO_3^{2-}) second, so it's CaCO_3 . To write the name from the formula, name the cation followed by the anion.

34. Write the name or formula, as appropriate.

a. chromium(III) nitrate $\text{Cr}(\text{NO}_2)_3$

b. $\text{Mg}_3(\text{PO}_4)_2$ magnesium phosphate

c. LiF lithium fluoride

d. sodium perchlorate NaClO_4

e. $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ lead acetate

f. magnesium hydrogen carbonate $\text{Mg}(\text{HCO}_3)_2$

35. When are parentheses used in writing chemical formulas?

When more than one polyatomic ion is needed to balance a formula (a. and f. above).

36. What conditions must be met in writing a balanced formula for an ionic compound?

The net ionic charge must be zero.

Section Review 6.5

40. Provide the formula or name for these compounds.

a. H_2SO_4 sulfuric acid

b. H_2CO_3 carbonic acid

c. nitric acid HNO_3

d. phosphoric acid H_3PO_4

42. What element typically appears in the formula of a common acid?

Hydrogen, "H"

Chapter 6 Review

49. Would you expect the following pairs of atoms to combine chemically to give an ionic or molecular compound? 6.2

a. Li and S ionic

b. O and S molecular

c. Al and O ionic

d. F and Cl molecular

e. I and K ionic

f. H and N molecular

52. The melting point of a compound is 1240 °C. Is this compound an ionic or a molecular compound? Explain.

The compound is ionic because it has a high melting point.

53. Write the symbol for each ion. Be sure to include the charge. 6.3

- a. oxide ion O^{2-} b. lead(II) ion Pb^{2+} c. lithium ion Li^+
 d. nitride ion N^{3-} e. cupric ion Cu^{2+} f. fluoride ion F^-

56. Without consulting Table 6.4, name the following ions. 6.3

- a. OH^- hydroxide b. Pb^{4+} lead(IV)
 c. SO_4^{2-} sulfate d. O^{2-} oxide
 e. HPO_4^{2-} hydrogen phosphate f. $Cr_2O_7^{2-}$ dichromate
 g. Al^{3+} aluminum h. ClO_2^- chlorite

62. Complete the table below by writing correct formulas for the compounds formed by combining positive and negative ions. Then name each compound. 6.4

	NO_3^-	CO_3^{2-}	CN^-	PO_4^{3-}
NH_4^+	NH_4NO_3	$(NH_4)_2CO_3$	NH_4CN	$(NH_4)_3PO_4$
Sn^{4+}	$Sn(NO_3)_4$	$Sn(CO_3)_2$	$Sn(CN)_4$	$Sn_3(PO_4)_4$
Fe^{3+}	$Fe(NO_3)_3$	$Fe_2(CO_3)_3$	$Fe(CN)_3$	$FePO_4$
Mg^{2+}	$Mg(NO_3)_2$	$MgCO_3$	$Mg(CN)_2$	$Mg_3(PO_4)_2$

67. Name these compounds.

- a. $NaClO_3$ sodium chlorate b. Hg_2Br_2 mercury(I) bromide
 c. K_2CrO_4 potassium chromate d. AlI_3 aluminum iodide
 e. SnO_2 tin(IV) oxide f. $Fe(C_2H_3O_2)_3$ iron(III) acetate
 g. $KHSO_4$ potassium hydrogen sulfate h. CaH_2 calcium hydride