### Unit 5: Bonding and Inorganic Nomenclature

1. How did chemists solve the problem of assigning names to chemical compounds?

by using a set of systematic rules

2. Who developed the first systematic method for naming substances?

Antoine Lavoisier

#### 7.1

3. The official international system for naming chemical compounds originated in the year <u>1940</u> and are referred to as...

IUPAC nomenclature

4. What are the names and formulas of the three types of inorganic substances that contain carbon?

carbon dioxide (CO<sub>2</sub>), carbonates (CO<sub>3</sub><sup>2–</sup>), and hydrogen carbonates (HCO<sub>3</sub><sup>–</sup>)

- 5. A. A binary ionic compound contains, specifically... two elements, a metal and a nonmetal
  - B. A ternary ionic compounds contains, specifically... three elements, w/at least one M and one NM
  - C. A binary molecular compound contains, specifically... two nonmetal elements
- 6. An aqueous solution is produced when... a compound dissolves in water
- 7. A. Write the formulas of two binary acids.  $HCI and H_2S$ 
  - B. Write the formulas of two ternary acids. HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>
- 8. What is the difference between a cation and an anion?

a cation is a + ion; an anion is a - ion

9. What is the difference between a monatomic ion and a polyatomic ion?

a mono is a single atom bearing a charge, while a poly is a charged group of atoms

## 7.2

- 10. A. How do metal atoms become cations? *they lose valence electrons* 
  - B. How do nonmetal atoms become anions? *they gain valence electrons*
- 11. Based on the examples in the text, name the following main-group metal ions: K<sup>+</sup>, Ca<sup>2+</sup>, Ba<sup>2+</sup> *potassium ion, calcium ion, barium ion*
- 12. Based on the examples in the text, name the following transition metal ions: Co<sup>2+</sup>, Au<sup>+</sup>, Ni<sup>3+</sup> *cobalt(II) ion, gold(I) ion, nickel(III) ion*
- 13. Write the names and formulas of three transition metal ions that do NOT need Roman numerals in their names.

 $Ag^{+} = silver ion; Zn^{2+} = zinc ion; Cd^{2+} = cadmium ion$ 

14. The <u>Stock</u> system uses Roman numerals and the <u>Latin</u> system uses the suffixes -ic and -ous.

- 15. According to the Stock system, the Hg<sub>2</sub><sup>2+</sup> ion is called the <u>mercury(I)</u> ion. Similarly, the Hg<sup>2+</sup> ion has the name <u>mercury(II)</u> ion.
- 16. Nonmetal ions are named using what two things?

the nonmetal stem plus the suffix -ide

17. Write the formulas and names for the both ions of lead and tin.

 $Sn^{2+} = tin(II) ion; Sn^{4+} = tin(IV) ion; Pb^{2+} = lead(II) ion; Pb^{4+} = lead(IV) ion$ 

18. Given that selenium is in the same group as oxygen and sulfur, use Figure 7.3 to help you write the name and formula for the ion formed from a selenium atom.

selenide ion, Se<sup>2-</sup>

7.3

- 19. What is an oxyanion? a polyatomic ion containing oxygen
- 20. How do oxyanions that end in -ite differ from those that end in -ate?

the ones ending in -ite have one less oxygen than those ending in -ate

21. Write the formulas and names of the two important polyatomic ions that end in -ide.

 $CN^{-} = cyanide; OH^{-} = hydroxide$ 

22. With reference to Table 7.3, write the formula of each of the following polyatomic ions:

ammonium	$NH_4^+$	chromate	CrO4 <sup>2-</sup>	nitrate	$NO_3^-$
acetate	$C_2H_3O_2^-$	cyanide	CN	permanganate	MnO₄ <sup>−</sup>
carbonate	CO3 <sup>2-</sup>	dichromate	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	phosphate	PO4 <sup>3-</sup>
chlorate	C/O3 <sup>-</sup>	hydroxide	ОН	sulfate	SO4 <sup>2-</sup>

#### 7.4

- 23. An ionic compound is composed of what? positive and negative ions
- 24. What is a formula unit?

the simplest representative particle in an ionic compound

25. Why must the total positive charge equal the total negative charge in a formula unit?

because a formula unit is neutral

26. The text shows how one obtains the formula  $(NH_4)_2SO_4$  for ammonium sulfate. Using the same pattern, write the formula for ammonium phosphate.  $(NH_4)_3PO_4$ 

7.5

27. In naming binary compounds containing transition metal ions, what is the first thing we have to do?

determine the ionic charge of the metal cation

28. What is written first, in writing the formula of an ionic compound? What is written last?

the cation is written first, then the anion

- 29. Compounds containing a <u>metal</u> and two other <u>elements</u> are called ternary compounds.
  - 30. Why is the Roman numeral needed in the naming of copper(II) carbonate (CuCO<sub>3</sub>) but not in the naming of calcium carbonate (CaCO<sub>3</sub>)?

because copper has two possible ions, so we have to specify the charge on the copper

#### 7.7

- 31. A binary molecular compound is composed of... two nonmetal elements
- 32. For our purposes in this chapter: What is a molecule?

the simplest representative particle in a binary molecular compound

33. List the nonmetal elements in the order IUPAC prescribes for writing binary molecular compounds.

C, P, N, H, S, I, Br, Cl, O, F

34. In naming binary molecular compounds, what two things does IUPAC specify?

the first element in the compound be named first and the second element have the suffix -ide

35. How is the number of atoms to be indicated, in binary molecular compounds?

by Greek prefixes

36. What does the 1990 "Red Book" recommend about the prefix mono-?

it should be omitted unless it is necessary to avoid confusion

37. What are two common exceptions to the rule mentioned in Q36? Write their formulas and names.

CO (carbon monoxide) and NO (nitrogen monoxide)

38. Using Table 7.4 and the brief discussion at the top of page 182, how would P<sub>4</sub>O<sub>10</sub> be named? *tetraphosphorus decoxide* 

### 7.8

- 39. What three things are needed in the naming of binary acids? *the prefix hydro-, the nonmetal stem, and the suffix "–ic acid"*
- 40. Based on your answer to Q39, how would the acid with the formula HBr be named? *hydrobromic acid*

### 7.9

41. A ternary acid with the suffix -ic acid contains what?

an oxyanion with the suffix -ate

### 12.1

- 42. Where, specifically, are the valence electrons found?
- 43. Valence electrons are responsible for what? holding atoms together in chemical bonds

in the most distant s and p subshells

#### 7.6

44. What does the octet rule state?

that an atom tends to bond in such a way that it acquires eight e- in its outer shell

45. According to Lewis, two atoms may conform to the octet rule by doing one of what two things?

by the transfer of e- or the sharing of e- pairs

- 46. In an <u>ionic</u> bond, a cation is attracted to an anion; the ions are held together by <u>electrostatic</u> <u>attraction</u>. In a <u>covalent</u> bond, two nonmetal atoms <u>share</u> valence electrons.
- 47. In terms of bonding, what is the difference between a formula unit and a molecule?

f.u. = particles held by ionic bonds; m. = fundamental particle held together by covalent bonds

12.2

48. In an ionic bond, there is an \_electrostatic \_ attraction between ions, which is analogous to...

the attraction between magnets

- 49. In general, main-group metals (and, incidentally, nonmetals) usually achieve a <u>noble</u> <u>gas</u> electron configuration; that is, they become <u>isoelectronic</u> with a <u>noble</u> <u>gas</u>.
- 50. The radius of a cation is <u>smaller</u> than the radius of the corresponding atom; the radius of an anion is <u>larger</u> than the radius of the corresponding atom.

12.3

51. Once again, a covalent bond results from what?

the sharing of electrons by two nonmetal atoms

- 52. In a covalent bond, each atom uses the bonding electrons to complete an <u>octet</u>. In other words, each nonmetal atom uses shared electrons to complete its <u>valence</u> shell.
- 53. What is meant by the term "bond length"?

the distance between two nuclei

54. In terms of energy, what happens when an ionic bond is formed? When a covalent bond is formed?

energy is released

energy is released

55. What is meant by the term "bond energy"?

the amount of energy required to break a covalent bond between two atoms

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Name: \_\_\_\_\_ Text Questions from Corwin

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