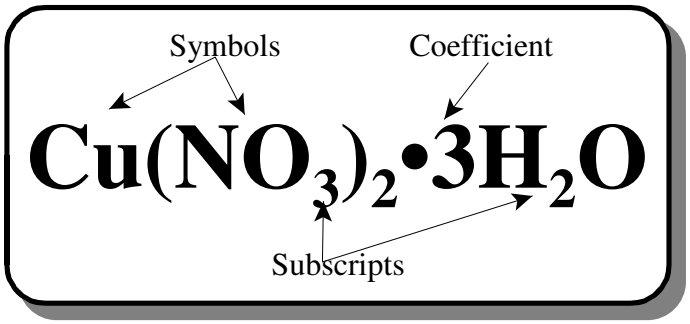
Test Review № 5

Polar Molecules. Electronegativity differences between 0.4 and 1.7 are found in molecules with polar bonds. These molecules can be polar depending on their shapes. Molecules with polar bonds distributed symmetrically are nonpolar. Asymmetrical molecules with polar bonds are polar. Water is polar. An imaginary line can be drawn through a water molecule separating the positive pole from the negative pole. This is because the charges are distributed asymmetrically. Carbon dioxide is nonpolar because the electronegative oxygens are distributed symmetrically around the carbon. (O=C=O)

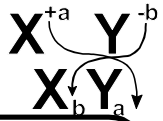
Chemical Formulas. A chemical formula consists of chemical symbols, subscripts, and, in some cases, a coefficient. The chemical symbols show which elements are present in the compound. Subscripts are small numbers written to the lower right of the symbol to which they refer.



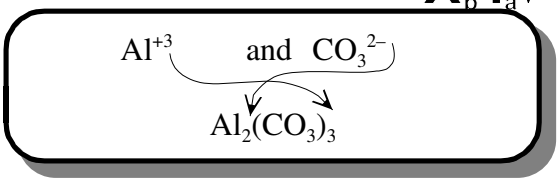
Example (Atoms in a Formula)

$5(NH_4)_3PO_4$ . . . . . N = 15, H = 60, P = 5, O = 20, *TOTAL* = 100

Formula Writing. The quickest way to determine the formula of a compound of two elements or polyatomic ions is to use the Cross-Over Rule. Look up the oxidation state of each element or ion and reduce to lowest terms. Then cross over the oxidation states in lowest terms without the sign to find the subscripts as shown in the diagram to the right and the example below.



Finding the Charge on Polyvalent Metals. Many transition metals have more than one oxidation state. They are called polyvalent. The fact that a metal is polyvalent becomes important when the compound is named. In order to properly name a compound, it is necessary to first check the *Periodic Table* to see if the metal is polyvalent. If it is, you need to figure out the oxidation state of the metal by checking to see which one will make the sum of the oxidation states in the compound add up to zero. The process is shown in the box to the left. The process is only applied for metals that have more than one oxidation state.



Finding the Charge on the Cation

Prepare a table as shown to the right.

Step 1: List the subscripts for the cations and the anions.

Step 2: Look up the oxidation state of the anion on the *Periodic Table*.

Step 3: Multiply the oxidation state of the anion by the its subscript to get the total charge.

Step 4: Determine the total charge of the cations by calculating the number which, when added to the total charge of the anions, gives the compound a total charge of zero.

Step 5: Divide the total charge of the cations by the subscript of the cation to get the oxidation state.

$Fe_2(S_2O_3)_3$

ion	Fe	S_2O_3	
subscript	2	3	
oxidation state	+3	−2	*TOTAL*
total	+6	−6	= 0

STEP 1 STEP 2 STEP 3 STEP 4 STEP 5

The Stock System . The stock system is a set of rules for naming compounds of metals and non metals. The metal always comes first in the name and the formula. Monatomic metal ions, those consisting of only one type of atom, come in two varieties – univalent and polyvalent. For univalent metal ions, those having only one oxidation state, the name of the ion is exactly the same as that of the element that formed it. For polyvalent metal ions, those having multiple oxidation states, a roman numeral indicates the oxidation state. Polyatomic metal ions, those consisting of more than one type of element such as NH_4^+, ammonium, are found on *Table E*.

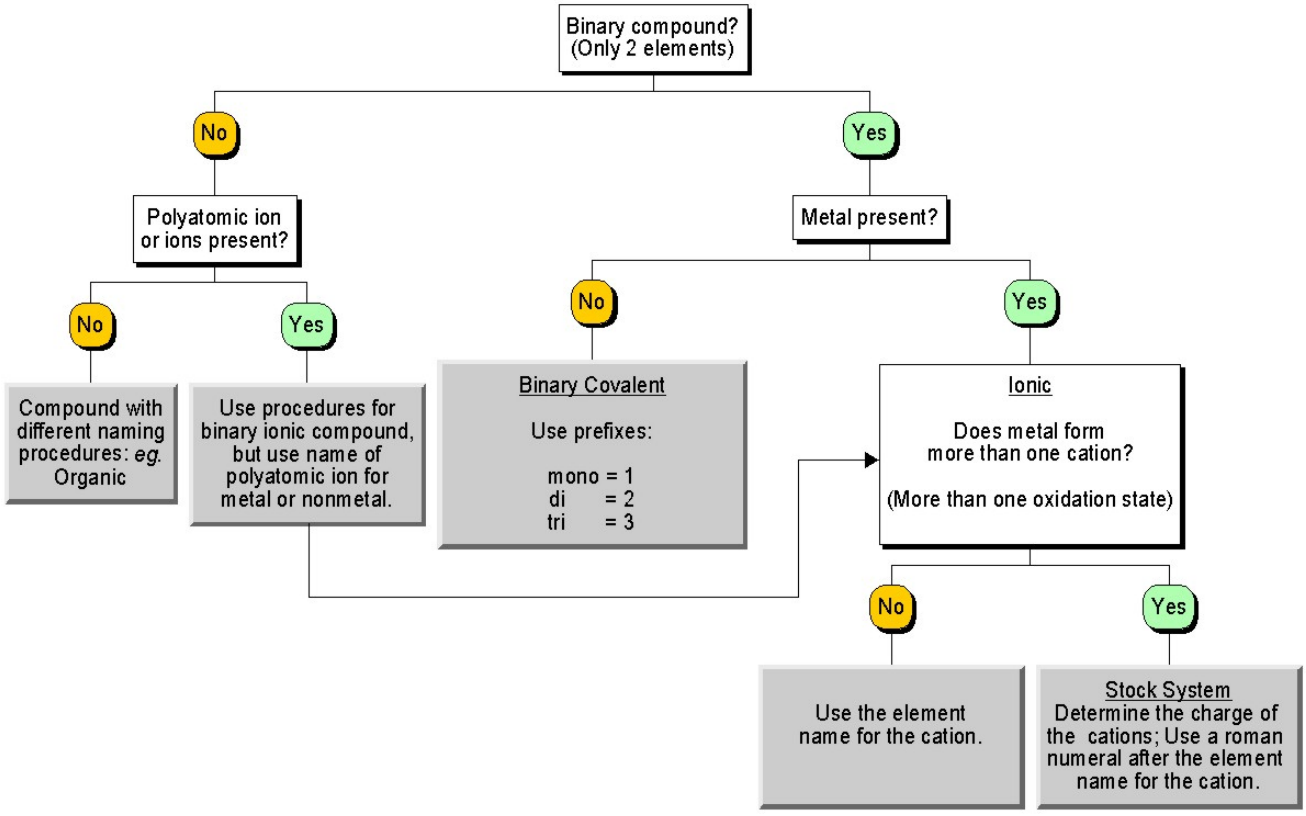
The nonmetal always comes last in the name and in the formula. For monatomic nonmetal ions, delete the last part of the elements name and add "IDE". Polyatomic nonmetal ions, such as SO_4^{-2} (sulfate) or OH^- (hydroxide) are found on *Table E*.

To write the name from the formula, it is necessary to first check the *Periodic Table* to see if the metal is polyvalent. If it is, you need to figure out the oxidation state of the metal by checking to see which one will make the sum of the oxidation states in the compound add up to zero. To write the formulas from the name, you need to look up the oxidation states of the ions, and apply the crossover rule

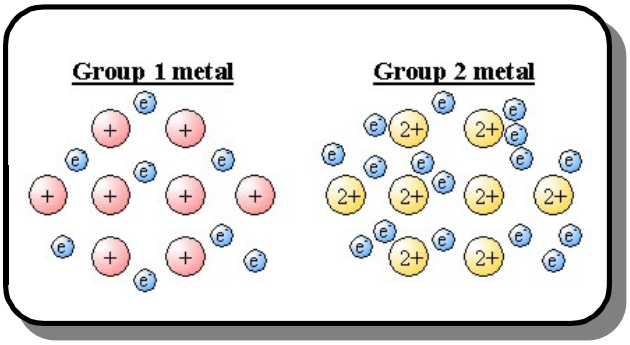
Binary Covalent Compounds. Two nonmetals can combine to form compounds. When two nonmetals combine, they form covalent bonds. The nonmetal with the lower electronegativity behaves like a metal and has a positive oxidation state. In carbon dioxide (CO_2), the carbon behave like a metal while the oxygen behaves like a nonmetal. The metal is written first in the name and the formula. The name of the metal is the same as the name of the element. If there is more than one atom of the metal, the number of atoms is indicated with a prefix. (See the list of prefixes to the right.) The nonmetal is written last in the name and formula..The name of the nonmetal is the same as the name of the element minus the final syllable or two, plus IDE.The number of nonmetal atoms is indicated with a prefix (even when there is only one). Writing formulas for these compounds is easy, because the prefix tells the subscript.

Number of Atoms	Prefix	Number of Atoms	Prefix
1	mono	6	hexa
2	di	7	hepta
3	tri	8	octa
4	tetra	9	nona
5	penta	10	deca

Selecting a Naming System. See below.



Metallic Bonding. Metals have low ionization energies. This means they hold onto electrons loosely. As a result, in a metal crystal, the valence electrons move easily and do not belong to any single atom. Since the atoms in the crystal do not hold on to their own valence electrons, they become like cations in a sea of mobile electrons. The attraction between the cations and the electrons holds the metal crystal together. Because of this, metals are lustrous, flexible, good conductors of heat and electricity, and are solids at room temperature except for mercury.



Answer the questions below by circling the number of the correct response

1. Which molecule is nonpolar and has a symmetrical shape? (1) HCl (2) CH_4 (3) H_2O (4) NH_3

2. Which formula represents a polar molecule? (1) CH_4 (2) Cl_2 (3) NH_3 (4) N_2

3. In which compound does the bond between the atoms have the least ionic character? (1) HF (2) HCl (3) HBr (4) HI

4. Which substance contains a polar covalent bond? (1) Na_2O (2) Mg_3N_2 (3) CO_2 (4) N_2

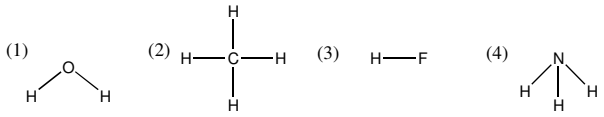
5. In which pair do the members have identical electron configurations? (1) S^{2-} and Cl^- (2) S^0 and Ar^0 (3) K^0 and Na^+ (4) Cl^- and K^0

6. When a chlorine atom reacts with a sodium atom to form an ion, the chlorine atom will (1) lose one electron, (2) gain one electron, (3) lose two electrons, (4) gain two electrons.

7. When a calcium atom loses its valence electrons, the ion formed has an electron configuration that is the same as the configuration of an atom of (1) Cl (2) Ar (3) K (4) Sc

8. Which molecule is nonpolar and contains a nonpolar covalent bond? (1) CCl_4 (2) F_2 (3) HF (4) HCl

9. Which structural formula represents a nonpolar symmetrical molecule?



10. Why is NH_3 classified as a polar molecule? (1) It is a gas at STP. (2) H—H bonds are nonpolar. (3) Nitrogen and hydrogen are both nonmetals. (4) NH_3 molecules have asymmetrical charge distributions.

11. Which statement best explains why carbon tetrachloride (CCl_4) is nonpolar? (1) Each carbon-chloride bond is polar. (2) Carbon and chlorine are both nonmetals. (3) Carbon tetrachloride is an organic compound. (4) The carbon tetrachloride molecule is symmetrical.

12. What is the total number of oxygen atoms in the formula $MgSO_4 \cdot 7H_2O$? [The • represents seven units of H_2O attached to one unit of $MgSO_4$.] (1) 11 (2) 5 (3) 7 (4) 4

13. In the formula for water, H_2O, the number 2 refers to the number of (1) hydrogens and oxygens, (2) waters, (3) hydrogens only, (4) oxygens only.

14. The number of atoms in $Cu_3(PO_4)_2$ is (1) 13, (2) 9, (3) 10, (4) 24.

15. Which of the following has the most oxygen? (1) $4Fe_2O_3$ (2) $3Ba_3(PO_4)_2$ (3) $2(NH_4)_2CO_3$ (4) $3Al(CO_3)_3$

16. In which compound is the oxidation state of iron +3? (1) $FeCl_2$ (2) FeO (3) $FePO_4$ (4) FeS_2O_3

17. What is the formula for a compound of NH_4 and CO_3? (1) NH_4CO_3 (2) $(NH_4)_2CO_3$ (3) $NH_4(CO_3)_2$ (4) NH_3CO_4

18. What is the correct formula for copper II nitrate? (1) $Cu(NO_3)_2$ (2) Cu_3N_2 (3) Cu_2NO_3 (4) Cu_2N_3

19. What is the correct name for BaO? (1) barium oxide (2) barium oxygen (3) barium II oxide (4) barium oxalate

20. The formula for zinc hydroxide is (1) $Zn(OH)_2$, (2) $ZnOH_2$, (3) ZnH_2, (4) Zn_2H.

21. The formula for ammonium carbonate is (1) $(NH_3)_2(CO_4)_3$, (2) $NH_2(CO_3)_4$, (3) $(NH_4)_3CO$, (4) $(NH_4)_2CO_3$.

22. The formula for iron II sulfide is (1) $Fe_2(SO_4)_3$, (2) FeS, (3) Fe_2S_3 (4) $FeSO_4$.

23. The name of the compound $CuCO_3$ is (1) copper II carbonate, (2) copper I carbonate, (3) copper III carbonate, (4) copper oxide.

24. The formula for barium nitrate is (1) Ba_3NO_2, (2) Ba_3N_2, (3) $Ba(NO_3)_2$, (4) BaN.

25. The name of the compound H_2S is (1) hydrogen II sulfate, (2) hydrogen sulfate, (3) helium I sulfide, (4) hydrogen sulfide.

26. Which is the compound whose formula is P_2O_5? (1) potassium dioxide (2) dipotassium pentoxide (3) phosphorus dioxide (4) diphosphorus pentoxide

27. The formula for sulfur hexafluoride is (1) SHF, (2) SF, (3) SF_6, (4) S_6F.

28. The IUPAC name for N_2O_3 is (1) dinitrogen trioxide, (2) nitrogen oxide, (3) nitrogen trioxide, (4) dinitrogen oxide.

29. The prefix used to show there are four atoms of an element in a binary covalent compound is (1) quadra, (2) recta, (3) hepta, (4) tetra.

30. Which of the following is a binary covalent compound? (1) Na_2O (2) P_2S_5 (3) Hg_2Cl_2 (4) KI

31. What is the name of $FeCO_3$? (1) iron monocarbon trioxide (2) iron carbonate III (3) iron I carbonate (4) iron II carbonate

32. Which substance will conduct electricity in both the solid phase and the liquid phase? (1) AgCl (2) H_2 (3) Ag (4)HCl

33. What type of bonds are present in a strip of magnesium ribbon? (1) covalent (2) metallic (3) ionic (40 van der Waals

34. Which substance, in the solid state, is the best conductor of electricity? (1) Ag (2) NaCl (3) I_2 (4) CO_2

35. Which substance exists as a metallic crystals? (1) Ar (2) SiO_2 (3) Au (4) CO_2

36. Mobile electrons are a distinguishing characteristic of (1) an ionic bond (2) a metallic bond (3) an electrovalent bond (4) a covalent bond

37. Which element consists of positive ions immersed in a "sea" of mobile electrons.? (1) sulfur (2) calcium (3) nitrogen (4) chlorine

Answers

1. 2	10. 4	19. 1	28. 1
2. 3	11. 4	20. 1	29. 4
3. 4	12. 1	21. 4	30. 2
4. 3	13. 3	22. 2	31. 4
5. 1	14. 1	23. 1	32. 3
6. 2	15. 4	24. 3	33. 2
7. 2	16. 3	25. 4	34. 1
8. 2	17. 2	26. 2	35. 3
9. 2	18. 1	27. 3	36. 2
			37. 2