

5.12: Exercises

5.2: Chemical Formulas

1. Classify each of the following as an atomic element, a molecular element, an ionic compound, or a molecular compound. State how many atoms are in each formula unit or molecule.
 - a. Fe
 - b. PCl_3
 - c. P_4
 - d. CaBr_2

Answer

- a. atomic element
- b. molecular compound, 4 atoms
- c. molecular element, 4 atoms
- d. ionic compound, 3 atoms

2. Classify each of the following as an atomic element, a molecular element, an ionic compound, or a molecular compound. State how many atoms are in each formula unit or molecule.
 - a. I_2
 - b. $\text{Fe}(\text{NO}_3)_2$
 - c. H_2O
 - d. Al

Answer

- a. molecular element, 2 atoms
- b. ionic compound, 9 atoms
- c. molecular compound, 3 atoms
- d. atomic element

3. What is the difference between CO and Co?

Answer

CO is a molecular compound containing carbon and oxygen. Co is the atomic element cobalt.

4. What is the difference between H_2O and H_2O_2 (hydrogen peroxide)?

Answer

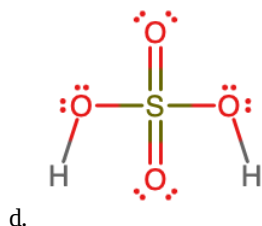
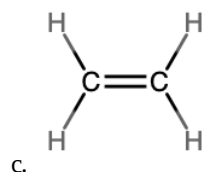
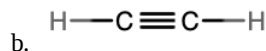
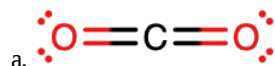
H_2O has two hydrogen atoms and one oxygen atom. H_2O_2 has two hydrogen atoms and two oxygen atoms.

5. Explain why the formula for an atom of the element oxygen and the formula for a molecule of oxygen differ.

Answer

The symbol for the element oxygen, O, represents both the element and one atom of oxygen. A molecule of oxygen, O_2 , contains two oxygen atoms; the subscript 2 in the formula must be used to distinguish the diatomic molecule from two single oxygen atoms.

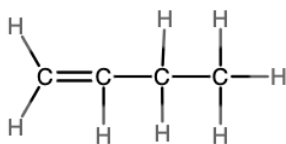
6. Write the molecular and empirical formulas of the following compounds:



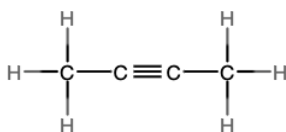
Answer

- a. molecular = CO_2 , empirical = CO_2
- b. molecular = C_2H_2 , empirical = CH
- c. molecular = C_2H_4 , empirical = CH_2
- d. molecular = H_2SO_4 , empirical = H_2SO_4

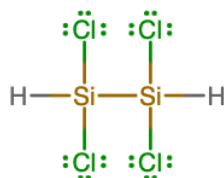
7. Write the molecular and empirical formulas of the following compounds:



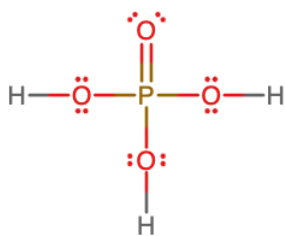
a.



b.



c.



d.

Answer

- a. molecular = C_4H_8 ; empirical = CH_2
- b. molecular = C_4H_6 ; empirical = C_2H_3
- c. molecular = $Si_2H_2Cl_4$; empirical = $SiHCl_2$
- d. molecular = H_3PO_4 ; empirical = H_3PO_4

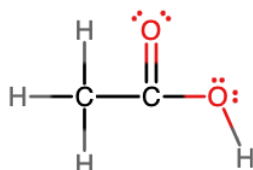
8. Determine the empirical formulas for the following compounds:

- a. caffeine, $C_8H_{10}N_4O_2$
- b. sucrose, $C_{12}H_{22}O_{11}$
- c. hydrogen peroxide, H_2O_2
- d. glucose, $C_6H_{12}O_6$
- e. ascorbic acid (vitamin C), $C_6H_8O_6$

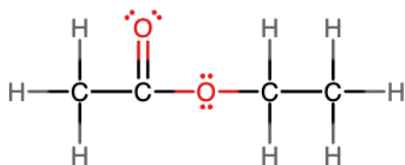
Answer

- a. $C_4H_5N_2O$
- b. $C_{12}H_{22}O_{11}$
- c. HO
- d. CH_2O
- e. $C_3H_4O_3$

9. Write the empirical formulas for the following compounds:



a.



b.

Answer

- a. CH_2O
- b. C_2H_4O

10. Determine the empirical formulas for the following compounds:

- a. acetic acid, $C_2H_4O_2$
- b. citric acid, $C_6H_8O_7$

- c. hydrazine, N_2H_4
- d. nicotine, $\text{C}_{10}\text{H}_{14}\text{N}_2$
- e. butane, C_4H_{10}

Answer

- a. CH_2O
- b. $\text{C}_6\text{H}_8\text{O}_7$
- c. NH_2
- d. $\text{C}_5\text{H}_7\text{N}$
- e. C_2H_5

5.3: A Closer Look at Elements and Compounds

11. From their positions on the periodic table, will Cu and I form a molecular compound or an ionic compound?

Answer

ionic compound

12. From their positions on the periodic table, will N and S form a molecular compound or an ionic compound?

Answer

molecular compound

13. Using the periodic table, predict whether the following chlorides are ionic or covalent: KCl , NCl_3 , ICl , MgCl_2 , PCl_5 , and CCl_4 .

Answer

ionic = KCl , MgCl_2 ; covalent = NCl_3 , ICl , PCl_5 , CCl_4

14. Using the periodic table, predict whether the following chlorides are ionic or covalent: SiCl_4 , PCl_3 , CaCl_2 , CsCl , CuCl_2 , and CrCl_3 .

Answer

ionic = CaCl_2 , CsCl , CuCl_2 , CrCl_3 ; covalent = SiCl_4 , PCl_3

5.4: Chemical Nomenclature and the Classification of Compounds

15. Classify each of the following compounds as binary ionic, ionic containing polyatomic ions, binary molecular, binary acid, or oxyacid.

- a. NF_3
- b. HI
- c. $(\text{NH}_4)_2\text{CO}_3$
- d. $\text{Sr}_3(\text{PO}_4)_2$
- e. BaO
- f. H_2SO_4

Answer

- a. binary molecular
- b. binary acid

- c. ionic containing polyatomic ions
- d. ionic containing polyatomic ions
- e. binary ionic
- f. oxyacid

16. Classify each of the following compounds as binary ionic, ionic containing polyatomic ions, binary molecular, binary acid, or oxyacid.
- a. HClO_3
 - b. $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$
 - c. H_2S
 - d. Ag_2S
 - e. N_2Cl_4
 - f. CoBr_2

Answer

- a. oxyacid
- b. ionic containing polyatomic ions
- c. binary acid
- d. binary ionic
- e. binary molecular
- f. binary ionic

5.5: Binary Ionic Compounds

17. Give the formula and name for each ionic compound formed between the two listed ions.
- a. Mg^{2+} and Cl^-
 - b. Na^+ and O^{2-}
 - c. Cd^{2+} and O^{2-}

Answer

- a. MgCl_2 , magnesium chloride
- b. Na_2O , sodium oxide
- c. CdO , cadmium oxide

18. Give the formula and name for each ionic compound formed between the two listed ions.
- a. K^+ and S^{2-}
 - b. Ag^+ and Br^-
 - c. Sr^{2+} and N^{3-}

Answer

- a. K_2S , potassium sulfide
- b. AgBr , silver bromide
- c. Sr_3N_2 , strontium nitride

19. Give the formula and name for each ionic compound formed between the two listed ions.
- a. Zn^{2+} and F^-
 - b. Ca^{2+} and O^{2-}
 - c. Li^+ and P^{3-}

Answer

- a. ZnF_2 , zinc fluoride
- b. CaO , calcium oxide
- c. Li_3P , lithium phosphide

20. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Na^+ and N^{3-}
- b. Sr^{2+} and I^-
- c. Al^{3+} and S^{2-}

Answer

- a. Na_3N , sodium nitride
- b. SrI_2 , strontium iodide
- c. Al_2S_3 , aluminum sulfide

5.6: Ions With Variable Charges

21. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Ni^{2+} and Cl^-
- b. Fe^{2+} and O^{2-}
- c. Fe^{3+} and O^{2-}

Answer

- a. NiCl_2 , nickel(II) chloride
- b. FeO , iron(II) oxide
- c. Fe_2O_3 , iron(III) oxide

22. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Cu^+ and S^{2-}
- b. Pt^{2+} and Br^-
- c. Cr^{2+} and N^{3-}

Answer

- a. Cu_2S , copper(I) sulfide
- b. PtBr_2 , platinum(II) bromide
- c. Cr_3N_2 , chromium(II) nitride

23. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Cu^{2+} and F^-
- b. U^{6+} and O^{2-}
- c. Au^+ and P^{3-}

Answer

- a. CuF_2 , copper(II) fluoride
- b. UO_3 , uranium(VI) oxide
- c. Au_3P , gold(I) phosphide

24. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Sn^{2+} and N^{3-}
- b. Co^{2+} and I^{-}
- c. Au^{3+} and S^{2-}

Answer

- a. Sn_3N_2 , tin(II) nitride
- b. CoI_2 , cobalt(II) iodide
- c. Au_2S_3 , gold(III) sulfide

25. Name each of the following compounds:

- a. Cr_2O_3
- b. FeCl_2
- c. CrO_3
- d. TiCl_4
- e. CoO
- f. SnS_2

Answer

- a. chromium(III) oxide
- b. iron(II) chloride
- c. chromium(VI) oxide
- d. titanium(IV) chloride
- e. cobalt(II) oxide
- f. tin(IV) sulfide

26. Name each of the following compounds:

- a. NiBr_2
- b. WO_3
- c. CoS
- d. V_2O_5
- e. MnO_2
- f. Fe_2O_3

Answer

- a. nickel(II) bromide
- b. tungsten(VI) oxide
- c. cobalt(II) sulfide
- d. vanadium(V) oxide
- e. manganese(IV) oxide
- f. iron(III) oxide

5.7: Ionic Compounds Containing Polyatomic Ions

27. Give the formula and name for each ionic compound formed between the two listed ions.

- a. K^{+} and SO_4^{2-}
- b. NH_4^{+} and S^{2-}
- c. NH_4^{+} and PO_4^{3-}

Answer

- a. K_2SO_4 , potassium sulfate
- b. $(\text{NH}_4)_2\text{S}$, ammonium sulfide
- c. $(\text{NH}_4)_3\text{PO}_4$, ammonium phosphate

28. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Ca^{2+} and NO_3^-
- b. Ca^{2+} and NO_2^-
- c. W^{3+} and $\text{C}_2\text{H}_3\text{O}_2^-$

Answer

- a. $\text{Ca}(\text{NO}_3)_2$, calcium nitrate
- b. $\text{Ca}(\text{NO}_2)_2$, calcium nitrite
- c. $\text{W}(\text{C}_2\text{H}_3\text{O}_2)_3$, tungsten(III) acetate

29. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Pb^{4+} and SO_4^{2-}
- b. Na^+ and NO_3^-
- c. Li^+ and CO_3^{2-}

Answer

- a. $\text{Pb}(\text{SO}_4)_2$, lead(IV) sulfate
- b. NaNO_3 , sodium nitrate
- c. Li_2CO_3 , lithium carbonate

30. Give the formula and name for each ionic compound formed between the two listed ions.

- a. NH_4^+ and N^{3-}
- b. Mg^{2+} and CN^-
- c. Al^{3+} and OH^-

Answer

- a. $(\text{NH}_4)_3\text{N}$, ammonium nitride
- b. $\text{Mg}(\text{CN})_2$, magnesium cyanide
- c. $\text{Al}(\text{OH})_3$, aluminum hydroxide

31. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Ag^+ and SO_3^{2-}
- b. Na^+ and HCO_3^-
- c. Fe^{3+} and ClO_3^-

Answer

- a. Ag_2SO_3 , silver sulfite
- b. NaHCO_3 , sodium bicarbonate or sodium hydrogen carbonate
- c. $\text{Fe}(\text{ClO}_3)_3$, iron(III) chlorate

32. Give the formula and name for each ionic compound formed between the two listed ions.

- a. Sn^{2+} and $\text{C}_2\text{H}_3\text{O}_2^-$

- b. Au^{3+} and SO_3^{2-}
- c. Sr^{2+} and NO_2^-

Answer

- a. $\text{Sn}(\text{C}_2\text{H}_3\text{O}_2)_2$, tin(II) acetate
- b. $\text{Au}_2(\text{SO}_3)_3$, gold(III) sulfite
- c. $\text{Sr}(\text{NO}_2)_2$, strontium nitrite

33. The uranyl cation has the formula UO_2^{2+} . Propose formulas and names for the ionic compounds between the uranyl cation and F^- , SO_4^{2-} , and PO_4^{3-} .

Answer

UO_2F_2 , uranyl fluoride; UO_2SO_4 , uranyl sulfate; $(\text{UO}_2)_3(\text{PO}_4)_2$, uranyl phosphate

34. The permanganate anion has the formula MnO_4^- . Propose formulas and names for the ionic compounds between the permanganate ion and K^+ , Ca^{2+} , and Fe^{3+} .

Answer

KMnO_4 , potassium permanganate; $\text{Ca}(\text{MnO}_4)_2$, calcium permanganate; $\text{Fe}(\text{MnO}_4)_3$, iron(III) permanganate

35. For each of the following pairs of ions, write the formula of the compound they will form:

- a. Ca^{2+} , S^{2-}
- b. NH_4^+ , SO_4^{2-}
- c. Al^{3+} , Br^-
- d. Na^+ , SO_4^{2-}
- e. Mg^{2+} , PO_4^{3-}

Answer

- a. CaS
- b. $(\text{NH}_4)_2\text{SO}_4$
- c. AlBr_3
- d. Na_2SO_4
- e. $\text{Mg}_3(\text{PO}_4)_2$

36. For each of the following pairs of ions, write the formula of the compound they will form:

- a. K^+ , O^{2-}
- b. NH_4^+ , PO_4^{3-}
- c. Al^{3+} , O^{2-}
- d. Li^+ , CO_3^{2-}
- e. Ba^{2+} , PO_4^{3-}

Answer

- a. K_2O
- b. $(\text{NH}_4)_3\text{PO}_4$
- c. Al_2O_3
- d. Li_2CO_3
- e. $\text{Ba}_3(\text{PO}_4)_2$

37. Write the formulas for each of the following compounds:

- a. potassium phosphate
- b. copper(II) sulfate
- c. calcium chloride
- d. titanium(IV) oxide
- e. ammonium nitrate

Answer

- a. K_3PO_4
- b. CuSO_4
- c. CaCl_2
- d. TiO_2
- e. NH_4NO_3

38. Name each of the following compounds:

- a. $\text{Ca}(\text{ClO}_3)_2$
- b. FeSO_4
- c. CaCO_3
- d. AgNO_2
- e. $\text{Ni}(\text{CN})_3$

Answer

- a. calcium chlorate
- b. iron(II) sulfate
- c. calcium carbonate
- d. silver nitrite
- e. nickel(III) cyanide

5.8: Binary Molecular Compounds

39. What is the stem of fluorine used in molecule names? CF_4 is one example.

Answer

fluor–

40. What is the stem of bromine used in molecule names? SiBr_4 is an example.

Answer

brom–

41. Give the proper name for each molecule.

- a. PF_3
- b. SCl_2
- c. N_2O_3

Answer

- a. phosphorus trifluoride

- b. sulfur dichloride
- c. dinitrogen trioxide

42. Give the proper name for each molecule.

- a. NO
- b. CS₂
- c. As₂O₃

Answer

- a. nitrogen monoxide
- b. carbon disulfide
- c. diarsenic trioxide

43. Give the proper name for each molecule.

- a. XeF₂
- b. O₂F₂
- c. SF₆

Answer

- a. xenon difluoride
- b. dioxygen difluoride
- c. sulfur hexafluoride

44. Give the proper name for each molecule.

- a. P₄O₁₀
- b. B₂O₃
- c. P₂S₃

Answer

- a. tetraphosphorus decoxide
- b. diboron trioxide
- c. diphosphorus trisulfide

45. Give the proper name for each molecule.

- a. N₂O
- b. N₂O₄
- c. N₂O₅

Answer

- a. dinitrogen monoxide
- b. dinitrogen tetroxide
- c. dinitrogen pentoxide

46. Give the proper name for each molecule.

- a. SO₂
- b. Cl₂O

c. XeF_6

Answer

- a. sulfur dioxide
- b. dichlorine monoxide
- c. xenon hexafluoride

47. Give the proper formula for each name.

- a. dinitrogen pentoxide
- b. tetraboron tricarbide
- c. phosphorus pentachloride

Answer

- a. N_2O_5
- b. B_4C_3
- c. PCl_5

48. Give the proper formula for each name.

- a. nitrogen triiodide
- b. diarsenic trisulfide
- c. iodine trichloride

Answer

- a. NI_3
- b. As_2S_3
- c. ICl_3

49. Give the proper formula for each name.

- a. dioxygen difluoride
- b. dinitrogen trisulfide
- c. xenon tetrafluoride

Answer

- a. O_2F_2
- b. N_2S_3
- c. XeF_4

50. Give the proper formula for each name.

- a. chlorine dioxide
- b. sulfur dibromide
- c. dinitrogen trioxide

Answer

- a. ClO_2
- b. SBr_2
- c. N_2O_3

51. Give the proper formula for each name.

- a. iodine trifluoride
- b. xenon trioxide
- c. disulfur decafluoride

Answer

- a. IF_3
- b. XeO_3
- c. S_2F_{10}

52. Give the proper formula for each name.

- a. silicon dioxide
- b. carbon disulfide
- c. disulfur dibromide

Answer

- a. SiO_2
- b. CS_2
- c. S_2Br_2

5.9: Acids

53. Give the formula for each acid.

- a. chloric acid
- b. hydroiodic acid

Answer

- a. HClO_3
- b. HI

54. Give the formula for each acid.

- a. hydrosulfuric acid
- b. phosphorous acid

Answer

- a. H_2S
- b. H_3PO_3

55. Name each acid.

- a. $\text{HF}(\text{aq})$
- b. $\text{HNO}_3(\text{aq})$
- c. $\text{HC}_2\text{H}_3\text{O}_2(\text{aq})$

Answer

- a. hydrofluoric acid
- b. nitric acid
- c. acetic acid

56. Name each acid.

- a. $\text{H}_2\text{SO}_4(\text{aq})$
- b. $\text{H}_3\text{PO}_4(\text{aq})$
- c. $\text{HCl}(\text{aq})$

Answer

- a. sulfuric acid
- b. phosphoric acid
- c. hydrochloric acid

5.10: Nomenclature Summary

57. Name the following compounds:

- a. HClO_2
- b. CuO
- c. K_2SO_4
- d. BrCl_3
- e. HBr
- f. AlF_3

Answer

- a. chlorous acid
- b. copper(II) oxide
- c. potassium sulfate
- d. bromine trichloride
- e. hydrobromic acid
- f. aluminum fluoride

58. Name the following compounds:

- a. NaF
- b. $(\text{NH}_4)_2\text{O}$
- c. MnCl_3
- d. H_2S
- e. P_4O_6
- f. HNO_3

Answer

- a. sodium fluoride
- b. ammonium oxide
- c. manganese(III) chloride
- d. hydrosulfuric acid
- e. tetraphosphorus hexoxide
- f. nitric acid

59. Write the formulas of the following compounds:

- a. strontium bromide
- b. acetic acid
- c. lead(II) oxide
- d. gold(III) hydroxide

- e. hydrofluoric acid
- f. diphosphorus pentasulfide
- g. aluminum sulfite
- h. krypton tetrafluoride

Answer

- a. SrBr_2
- b. $\text{HC}_2\text{H}_3\text{O}_2$
- c. PbO
- d. $\text{Au}(\text{OH})_3$
- e. HF
- f. P_2S_5
- g. $\text{Al}_2(\text{SO}_3)_3$
- h. KrF_4

60. Write the formulas of the following compounds:

- a. lithium carbonate
- b. silver sulfide
- c. molybdenum(III) nitride
- d. diboron hexahydride
- e. sulfuric acid
- f. trisulfur heptachloride
- g. manganese(IV) chlorate
- h. hydrobromic acid

Answer

- a. Li_2CO_3
- b. Ag_2S
- c. MoN
- d. B_2H_6
- e. H_2SO_4
- f. S_3Cl_7
- g. $\text{Mn}(\text{ClO}_3)_4$
- h. HBr

61. Write the formulas of the following compounds:

- a. chlorine dioxide
- b. carbonic acid
- c. potassium phosphide
- d. nickel(III) nitrite
- e. aluminum chlorite
- f. carbon disulfide

Answer

- a. ClO_2
- b. H_2CO_3
- c. K_3P
- d. $\text{Ni}(\text{NO}_2)_3$
- e. $\text{Al}(\text{ClO}_2)_3$
- f. CS_2

62. Write the formulas of the following compounds:

- a. barium chloride
- b. xenon dioxide
- c. iron(III) nitrate
- d. acetic acid
- e. dinitrogen trioxide
- f. tin(IV) chloride

Answer

- a. BaCl_2
- b. XeO_2
- c. $\text{Fe}(\text{NO}_3)_3$
- d. $\text{HC}_2\text{H}_3\text{O}_2$
- e. N_2O_3
- f. SnCl_4

This page was adapted from "Beginning Chemistry (Ball)" by LibreTexts and "Chemistry (OpenStax)" by LibreTexts and is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by Vicki MacMurdo (Anoka-Ramsey Community College) and Lance S. Lund (Anoka-Ramsey Community College).

This page titled 5.12: Exercises is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by Anonymous.