

CH 221 Practice Problem Set #3

This is a **practice problem set** and not the actual graded problem set that you will turn in for credit.
Answers to each problem can be found at the end of this assignment.

Covering: **Chapter Two, Chapter 3.1-3.2 and Chapter Guide Three**

Important Tables and/or Constants: 1 mol = 6.022×10^{23} , "Have No Fear Of Ice Clear Brew" (7 Diatomics)

- Give the symbol, including the correct charge, for each of the following ions:
a. barium ion b. titanium(IV) ion c. phosphate ion d. hydrogen carbonate ion
e. sulfide ion f. perchlorate ion g. cobalt(II) ion h. sulfate ion
- When a potassium atom becomes a monatomic ion, how many electrons does it lose or gain? What noble gas atom is *isoelectronic* (i.e. has the same number of electrons) as a potassium ion?
- For each of the following compounds, give the formula, charge, and the number of each ion that makes up the compound:
a. K_2S b. $CoSO_4$ c. $KMnO_4$ d. $(NH_4)_3PO_4$ e. $Ca(ClO)_2$
- Cobalt forms Co^{2+} and Co^{3+} ions. Write the formulas for the two cobalt oxides formed by these transition metal ions.
- Which of the following are correct formulas for ionic compounds? For those that are not, give the correct formula.
a. $AlCl_2$ b. KF_2 c. Ga_2O_3 d. MgS
- Name each of the following ionic compounds:
a. K_2S b. $CoSO_4$ c. $(NH_4)_3PO_4$ d. $Ca(ClO)_2$
- Give the formula for each of the following ionic compounds:
a. ammonium carbonate
b. calcium iodide
c. copper(II) bromide
d. aluminum phosphate
e. silver(I) acetate
- Sodium ion, Na^+ , forms ionic compounds with fluoride, F^- , and iodide, I^- . The radii of these ions are as follows: $Na^+ = 116$ pm; $F^- = 119$ pm; and $I^- = 206$ pm. In which ionic compound, NaF or NaI , are the forces of attraction between cation and anion stronger? Explain your answer.
- Name each of the following binary, nonionic compounds:
a. NF_3 b. HI c. BI_3 d. PF_5
- Give the formula for each of the following compounds:
a. sulfur dichloride
b. dinitrogen pentoxide
c. silicon tetrachloride
d. diboron trioxide
- Calculate the molar mass of each of the following compounds:
a. Fe_2O_3 , iron(III) oxide
b. BCl_3 , boron trichloride
c. $C_6H_8O_6$, ascorbic acid (vitamin C)

12. What mass is represented by 0.0255 mol of each of the following compounds?
 - a. C_3H_7OH , propanol, rubbing alcohol
 - b. $C_{11}H_{16}O_2$, an antioxidant in foods, also known as BHA (butylated hydroxyanisole)
 - c. $C_9H_8O_4$, aspirin
13. Calculate the weight percent of lead in PbS , lead(II) sulfide. What mass of lead (in grams) is present in 10.0 g of PbS ?
14. Succinic acid occurs in fungi and lichens. Its empirical formula is $C_2H_3O_2$ and its molar mass is 118.1 g/mol. What is its molecular formula?
15. A large family of boron-hydrogen compounds has the general formula B_xH_y . One member of this family contains 88.5% B; the remainder is hydrogen. Which of the following is its empirical formula: BH_2 , BH_3 , B_2H_5 , B_5H_7 , or B_5H_{11} ?
16. A new compound containing xenon and fluorine was isolated by shining sunlight on a mixture of Xe (0.526 g) and F_2 gas. If you isolate 0.678 g of the new compound, what is its empirical formula?
17. The "alum" used in cooking is potassium aluminum sulfate hydrate, $KAl(SO_4)_2 \cdot x H_2O$. To find the value of x , you can heat a sample of the compound to drive off all of the water and leave only $KAl(SO_4)_2$. Assume you heat 4.74 g of the hydrated compound and that the sample loses 2.16 g of water. What is the value of x ?
18. Direct reaction of iodine (I_2) and chlorine (Cl_2) produces an iodine chloride, I_xCl_y , a bright yellow solid. If you completely used up 0.678 g of iodine and produced 1.246 g of I_xCl_y , what is the empirical formula of the compound? A later experiment showed that the molar mass of I_xCl_y was 467 g/mol. What is the molecular formula of the compound?

Answers to the Practice Problem Set:

- a. Ba^{2+} b. Ti^{4+} c. PO_4^{3-} d. HCO_3^{-1} e. S^{2-} f. ClO_4^{-1} g. Co^{2+} h. SO_4^{2-}
- One electron; argon.
- Answers:*
 - 2 K^+ ions, 1 S^{2-} ion d. 3 NH_4^+ ions, 1 PO_4^{3-} ion
 - 1 Co^{2+} ion, 1 SO_4^{2-} ion e. 1 Ca^{2+} ion, 2 ClO^- ions
 - 1 K^+ ion, 1 MnO_4^- ion
- CoO , Co_2O_3
- a. incorrect, AlCl_3 b. incorrect, KF c. correct d. correct
- a. potassium sulfide b. cobalt(II) sulfate c. ammonium phosphate d. calcium hypochlorite
- Answers:*
 - $(\text{NH}_4)_2\text{CO}_3$ d. AlPO_4
 - CaI_2 e. AgCH_3CO_2
 - CuBr_2
- NaF stronger, shorter cation-anion distance
- Answers:*
 - nitrogen trifluoride c. boron triiodide
 - hydrogen monoiodide d. phosphorus pentafluoride
- a. SCl_2 b. N_2O_5 c. SiCl_4 d. B_2O_3
- a. Fe_2O_3 159.69 g/mol b. BCl_3 117.17 g/mol c. $\text{C}_6\text{H}_8\text{O}_6$ 176.13 g/mol
- a. 1.53 g b. 4.60 g c. 4.60 g
- 86.59%, 8.66 g
- $\text{C}_4\text{H}_6\text{O}_4$
- B_5H_7
- XeF_2
- $x = 12$
- I_2Cl_6