

## CH 151 Problem Set #5

Complete problem set on separate pieces of paper showing all work, circling final answers, etc.

Covering: Chapter Three and Chapter Six

Important Tables and/or Constants: none

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- For the chemical reaction:  $4 \text{FeS}_2(\text{s}) + 11 \text{O}_2(\text{g}) \rightarrow 2 \text{Fe}_2\text{O}_3(\text{s}) + 8 \text{SO}_2(\text{g})$ 
  - How many moles of  $\text{O}_2$  are needed to produce 3.50 moles of  $\text{SO}_2$ ?
  - How many moles of  $\text{Fe}_2\text{O}_3$  will be produced from 1.02 mole of  $\text{FeS}_2$ ?
  - How many moles of  $\text{FeS}_2$  are needed to react with 5.40 moles of  $\text{O}_2$ ?
  - How many moles of  $\text{Fe}_2\text{O}_3$  are produced at the same time that 0.908 moles of  $\text{SO}_2$  are produced?
- In the atmosphere, the air pollutant nitrogen dioxide ( $\text{NO}_2$ ) reacts with water to produce nitric acid ( $\text{HNO}_3$ ). The reaction for the formation of nitric acid is:  
 $3 \text{NO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2 \text{HNO}_3(\text{aq}) + \text{NO}(\text{g})$ 
  - How many grams of  $\text{NO}_2$  are needed to react with 2.30 moles of  $\text{H}_2\text{O}$ ?
  - How many grams of  $\text{NO}$  are produced when 2.04 moles of  $\text{H}_2\text{O}$  react?
  - How many grams of  $\text{HNO}_3$  are produced at the same time that 0.500 mole of  $\text{NO}$  are produced?
  - How many grams of  $\text{NO}_2$  must react in order to produce 1.23 moles of  $\text{HNO}_3$ ?
- Potassium thiosulfate,  $\text{K}_2\text{S}_2\text{O}_3$ , is used to remove any excess chlorine from fibers and fabrics that have been bleached with that gas. The reaction:  
 $\text{K}_2\text{S}_2\text{O}_3 + 4 \text{Cl}_2 + 5 \text{H}_2\text{O} \rightarrow 2 \text{KHSO}_4 + 8 \text{HCl}$ 
  - How many moles of  $\text{K}_2\text{S}_2\text{O}_3$  must react to produce 2.500 g of  $\text{HCl}$ ?
  - How many grams of  $\text{Cl}_2$  must react to produce 20.00 g of  $\text{KHSO}_4$ ?
  - How many molecules of  $\text{HCl}$  are produced at the same time that 2.000 g of  $\text{KHSO}_4$  is produced?
  - How many milliliters of  $\text{H}_2\text{O}$  are consumed as 12.50 g of  $\text{Cl}_2$  reacts?  $d(\text{H}_2\text{O}) = 0.9978 \text{ g/mL}$
- If 70.0 g of  $\text{TiCl}_4$  and 16.0 g of  $\text{Ti}$  are present in a reaction mixture, determine how many grams of each reactant will be left unreacted upon completion of the following reaction:  
 $3 \text{TiCl}_4 + \text{Ti} \rightarrow 4 \text{TiCl}_3$
- Aluminum and oxygen react to form aluminum oxide. In a certain experiment, 125 g of  $\text{Al}_2\text{O}_3$  are produced from 75.0 g of  $\text{Al}$  and 200.0 g of  $\text{O}_2$ . What is the theoretical yield and percent yield of  $\text{Al}_2\text{O}_3$ ? The equation:  $4 \text{Al} + 3 \text{O}_2 \rightarrow 2 \text{Al}_2\text{O}_3$
- For each of the following sets of elements, choose the two that would be expected to have similar chemical properties.
  - $_{11}\text{Na}$ ,  $_{14}\text{Si}$ ,  $_{23}\text{V}$ ,  $_{55}\text{Cs}$
  - $_{13}\text{Al}$ ,  $_{19}\text{K}$ ,  $_{32}\text{Ge}$ ,  $_{50}\text{Sn}$
  - $_{37}\text{Rb}$ ,  $_{38}\text{Sr}$ ,  $_{54}\text{Xe}$ ,  $_{56}\text{Ba}$
  - $_{2}\text{He}$ ,  $_{6}\text{C}$ ,  $_{8}\text{O}$ ,  $_{10}\text{Ne}$

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7. Give the maximum number of electrons that can occupy each of the following electron **subshells**.
  - a.  $6p$
  - b.  $1s$
  - c.  $5f$
  - d.  $4d$
8. Give the maximum number of electrons that can occupy each of the following electron **orbitals**.
  - a.  $1s$
  - b.  $3d$
  - c.  $5p$
  - d.  $4d$
9. Which of the following electron subshell and electron orbital designations is not allowed?
  - a.  $2d$  subshell
  - b.  $4s$  orbital
  - c.  $3p$  subshell
  - d.  $2f$  orbital
10. With the help of an Aufbau diagram, write the complete electron configuration for each of the following atoms.
  - a.  ${}^6\text{C}$
  - b.  ${}^{10}\text{Ne}$
  - c.  ${}^{15}\text{P}$
  - d.  ${}^{36}\text{Kr}$
11. With the help of an Aufbau diagram, write the complete electron configuration for each of the following atoms.
  - a.  ${}^{31}\text{Ga}$
  - b.  ${}^{38}\text{Sr}$
  - c.  ${}^{48}\text{Cd}$
  - d.  ${}^{88}\text{Ra}$
12. Based on total number of electrons present, identify the element represented by each of the following electron configurations.
  - a.  $1s^2 2s^2 2p^2$
  - b.  $1s^2 2s^2 2p^6 3s^2 3p^3$
  - c.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
  - d.  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
13. Determine how many unpaired electrons there are in an atom of the following elements. Indicate whether the elements are **paramagnetic** or **diamagnetic**.
  - a. lithium
  - b. aluminum
  - c. calcium
  - d. bromine
14. Using the periodic table as a guide, indicate the number of:
  - a.  $3s$  electrons and valence electrons in a  ${}_{12}\text{Mg}$  atom
  - b.  $4p$  electrons and valence electrons in a  ${}_{32}\text{Ge}$  atom
  - c.  $3d$  electrons in a  ${}_{47}\text{Ag}$  atom
  - d.  $4p$  electrons and valence electrons in a  ${}_{15}\text{P}$  atom
15. How many elements are there that have the following generalized condensed electron configurations?
  - a.  $[\text{noble gas}]ns^1$
  - b.  $[\text{noble gas}]ns^2 np^2$
16. Write the electron configuration for each of the following ions.
  - a.  $\text{S}^{2-}$
  - b.  $\text{P}^{3-}$
  - c.  $\text{Be}^{2+}$
  - d.  $\text{Na}^{+1}$