Take-Home Quiz
Topic 10: Stoichiometry

Objective:

This is to assess your comprehension of the material we have covered so far and to help prepare you for the exam.

Instructions and Notes:

- Most of the quiz problems are from or adapted from "Exercises" at the end of the chapters in the Chemistry: Atoms First 2e Online Textbook (OpenStax)
- You must *CLEARLY LABEL* all problems and *SHOW ALL WORK* neatly and legibly to receive credit. If the problems do not require calculations/work then you must explain how you got the answer. (can be a few words up to a few sentences or even a few arrows)
- If the problem requires calculations, the answers should be highlighted or boxed.
- Book sections covered: 7.3, 7.4, 7.5

Submission:

The quiz is usually due ~1 week after we start this section (see our due date schedule). Summer session is due sooner. This should be scanned as a single PDF and submitted online through Canvas. The file cannot be larger than 20 Mb (20,000 kB).

Helpful Tips:

- Start as soon as we're done with the lecture.
- Refer to the lecture and/or videos (if available).
- Use the corresponding chapter in the book to help you through difficult problems/concepts.
- There are answers and solutions available to the odd numbered problems (book number not quiz number) on the OpenStax website under "Student Resources". It is not advised to rely on the solutions because you will not have access to the solutions during the exam. Only use the solutions as a last resort. Struggling is good and that is when you are learning the most!
- Work together with your classmates.
- Go to tutoring in the ASTC or MESA, ask your classmates in our Discord room, watch YouTube Videos, come to office hours, etc.
- To ensure your mastery of the material, do the quiz multiple times.

7.3 Reaction Stoichiometry

1) (From Chapter 7.3 #43) $2Na + Cl_2 \rightarrow 2NaCl$; using this equation, calculate the number of moles and the mass of chlorine, Cl_2, required to react with 10.0 g of sodium metal, Na, to produce sodium chloride, NaCl.

2) (From Chapter 7.3 #43) $2HgO \rightarrow 2Hg + O_2$; using this equation, calculate the number of moles and the mass of oxygen formed by the decomposition of 1.252 g of mercury(II) oxide.

3) (From Chapter 7.3 #43) $2NaNO_3 \rightarrow 2NaNO_2 + O_2$; using this equation, calculate the number of moles and the mass of sodium nitrate, $NaNO_3$, required to produce 128 g of O_2.

4) (From Chapter 7.3 #43) $C + O_2 \rightarrow CO_2$; using this equation, calculate the number of moles and the mass of CO_2 formed by the combustion of 20.0 kg of C in an excess of O_2.

5) (From Chapter 7.3 #43) $CuCO_3 \rightarrow CuO + CO_2$; using this equation, calculate the number of moles and the mass of copper(II) carbonate needed to produce 1.500 kg of CuO.

6) (From Chapter 7.3 #43) $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$; using this equation, calculate the number of moles and the mass of $C_2H_4Br_2$ formed by the reaction of C_2H_4 with an excess of Br.

7) (From Chapter 7.3 #47) $2\text{Ga} + 6\text{HCl} \rightarrow 2\text{GaCl}_3 + 3\text{H}_2$; using this equation; gallium chloride is formed by the reaction of 2.6 L of a 1.44 M solution of HCl. Calculate the number of moles and mass of gallium chloride.

8) (From Chapter 7.3 #49) $2\text{K}[\text{Ag}(\text{CN})_2](aq) + \text{Zn}(s) \rightarrow 2\text{Ag}(s) + \text{Zn}(\text{CN})_2(aq) + 2\text{KCN}(aq)$; using this equation, silver is often extracted from ores such as $K[Ag(CN)_2]$. What is the mass and how many molecules of $Zn(CN)_2$ are produced by the reaction of 35.27 g of $K[Ag(CN)_2]$?

9) (From Chapter 7.3 #51) Carborundum is silicon carbide, SiC, a very hard material used as an abrasive on sandpaper and in other applications. It is prepared by the reaction of

pure sand, SiO_2, with carbon at high temperature. Carbon monoxide, CO, is the other product of this reaction. Write the balanced equation for the reaction, and calculate how much SiO_2 is required to produce 3.00 kg of SiC.

10) (From Chapter 7.3 #53) $CO_2(g) + 2NH_3(g) \rightarrow CO\,(NH_2)_2(s) + H_2O(l)$; using this equation, urea, $CO(NH_2)_2$, is manufactured on a large scale for use in producing urea-formaldehyde plastics and as a fertilizer. What is the maximum mass of urea that can be manufactured from the CO_2 produced by combustion of 1.00×10^3 kg of carbon followed by the reaction?

11) (From Chapter 7.3 #57) $2Cu(NO_3)_2 + 4KI \rightarrow 2CuI + I_2 + 4KNO_3$; using this equation, what volume of a 0.2089 *M* KI solution contains enough KI to react exactly with the $Cu(NO_3)_2$ in 43.88 mL of a 0.3842 *M* solution of $Cu(NO_3)_2$?

7.4 Reaction Yields

12) (From Chapter 7.4 #61) $2Na + Cl_2 \rightarrow 2NaCl$; using this equation, what is the limiting reactant in a reaction that produces sodium chloride from 8 g of sodium and 8 g of diatomic chlorine?

13) (From Chapter 7.4 #70) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$; using this equation, determine the limiting reactant when 30.0 g of propane, C_3H_8, is burned with 75.0 g of oxygen.

14) (From Chapter 7.4 #71) $2Cr + 2H_3PO_4 \rightarrow 2CrPO_4 + 3H_2$; using this equation, determine the limiting reactant when 0.50 mol of Cr and 0.75 mol of H_3PO_4 react.

15) (From Chapter 7.4 #72) $6Li + N_2 \rightarrow 2Li_3N$; using this equation, what is the limiting reactant when 1.50 g of lithium and 1.50 g of nitrogen combine to form lithium nitride, a component of advanced batteries.

16) (From Chapter 7.4 #73) $Na_2C_2O_4 + UO_2(NO_3)_2 + 3H_2O \longrightarrow UO_2(C_2O_4)\cdot 3H_2O + 2NaNO_3$; using this equation, uranium can be isolated from its ores by dissolving it as $UO_2(NO_3)_2$, then separating it as solid $UO_2(C_2O_4)\cdot 3H_2O$. Addition of 0.4031 g of sodium oxalate, $Na_2C_2O_4$, to a solution containing 1.481 g of uranyl nitrate, $UO_2(NO_3)_2$, yields solid $UO_2(C_2O_4)\cdot 3H_2O$. Determine the limiting reactant.

7.5 Quantitative Chemical Analysis

17) (From Chapter 7.5 #79) $H_2SO_4 + 2NaOH \rightarrow 2H_2O + Na_2SO_4$; using this equation, titration of a 20.0-mL sample of acid rain required 1.7 mL of 0.0811 *M* NaOH to reach the end point. If we assume that the acidity of the rain is due to the presence of sulfuric acid, what was the concentration of sulfuric acid in this sample of rain?

18) (From Chapter 7.5 #81) $2Cl^-(aq) + Hg(NO_3)_2(aq) \rightarrow 2NO_3^-(aq) + HgCl_2(s)$; using this equation, in a common medical laboratory determination of the concentration of free chloride ion in blood serum, a serum sample is titrated with a $Hg(NO_3)_2$ solution. What is the Cl^- concentration in a 0.25-mL sample of normal serum that requires 1.46 mL of 8.25×10^{-4} *M* $Hg(NO_3)_2(aq)$ to reach the end point?

19) (From Chapter 7.5 #87) $NaHCO_3(aq) + HCl(aq) \rightarrow NaCl(aq) + CO_2(g) + H_2O(l)$; using this equation, what volume of 0.600 *M* HCl is required to react completely with 2.50 g of sodium hydrogen carbonate?

20) (From Chapter 7.5 #89) $C_2O_4H_2(aq) + 2NaOH(aq) \rightarrow Na_2C_2O_4(aq) + 2H_2O(l)$; using this equation, what volume of a 0.3300-*M* solution of sodium hydroxide would be required to titrate 15.00 mL of 0.1500 *M* oxalic acid?

21) (From Chapter 7.5 #91) $Ca(OH)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$; using this equation, a sample of solid calcium hydroxide, $Ca(OH)_2$, is allowed to stand in water until a saturated solution is formed. A titration of 75.00 mL of this solution with 5.00×10^{-2} *M* HCl requires 36.6 mL of the acid to reach the end point. What is the molarity?

22) (From Chapter 7.5 #93) $H_3PO_4(aq) + 2KOH(aq) \rightarrow K_2HPO_4(aq) + 2H_2O(l)$; using this equation, how many milliliters of a 0.1500-*M* solution of KOH will be required to titrate 40.00 mL of a 0.0656-*M* solution of H_3PO_4?