Take-Home Quiz
Topic 08: Solutions and Empirical Formula

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: 1.2, 11.2, 11.3, 6.3, 6.4, 6.2

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.

1.2 Phases and Classification of Matter

1) (From Chapter 1.2 #10) How does a heterogeneous mixture differ from a homogeneous mixture? How are they similar?

2) (From Chapter 1.2 #11) How does a homogeneous mixture differ from a pure substance? How are they similar?

11.1 The Dissolution Process

3) (From Chapter 11.1 #1) How do solutions differ from other mixtures?

(From Chapter 11.1 #6) Predict whether each of the following substances would be more soluble in water (polar solvent) or in a hydrocarbon such as heptane (C_7H_{16}, nonpolar solvent):

4) vegetable oil (nonpolar) 5) isopropyl alcohol (polar) 6) potassium bromide (ionic)

11.2 Electrolytes

(From Chapter 11.2 #15) Indicate the most important type of intermolecular attraction responsible for miscibility in each of the following solutions:

7) the solutions in Figure 11.7 (below)

8) methanol, CH_3OH, dissolved in ethanol, C_2H_5OH

9) methane, CH_4, dissolved in benzene, C_6H_6

10) the polar halocarbon CF_2Cl_2 dissolved in the polar halocarbon $CF_2ClCFCl_2$

11) $O_2(l)$ in $N_2(l)$

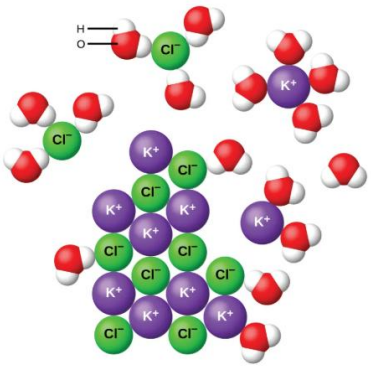

Figure 11.7 As potassium chloride (KCl) dissolves in water, the ions are hydrated. The polar water molecules are attracted by the charges on the K^+ and Cl^- ions. Water molecules in front of and behind the ions are not shown.

6.3 Molarity

12) (From Chapter 6.3 #19) Explain what changes and what stays the same when 1.00 L of a solution of NaCl is diluted to 1.80 L.

13) (From Chapter 6.3 #21) A 200-mL sample and a 400-mL sample of a solution of salt have the same molarity. In what ways are the two samples identical? In what ways are these two samples different?

(From Chapter 6.3 #23) Determine the molarity of each of the following solutions:

14) 1.457 mol KCl in 1.500 L of solution

15) 0.515 g of H_2SO_4 in 1.00 L of solution

16) 20.54 g of $Al(NO_3)_3$ in 1575 mL of solution

17) 2.76 kg of $CuSO_4 \cdot 5H_2O$ in 1.45 L of solution

18) 0.005653 mol of Br_2 in 10.00 mL of solution

19) 0.000889 g of glycine, $C_2H_5NO_2$, in 1.05 mL of solution

20) (From Chapter 6.3 #25) Consider this question: What is the mass of solute in 200.0 L of a 1.556-*M* solution of KBr? Also, outline the steps necessary to answer the question.

(From Chapter 6.3 #27) Calculate the number of moles and the mass of the solute in each of the following solutions: (remember to covert to L)

21) 325 mL of 8.23×10^{-5} *M* KI, a source of iodine in the diet

22) 75.0 mL of 2.2×10^{-5} *M* H_2SO_4, a sample of acid rain

23) 0.2500 L of 0.1135 *M* K_2CrO_4, an analytical reagent used in iron assays

24) 10.5 L of 3.716 *M* $(NH_4)_2SO_4$, a liquid fertilizer

25) (From Chapter 6.3 #29) Consider this question: What is the molarity of HCl if 35.23 mL of a solution of HCl contain 0.3366 g of HCl? Also, outline the steps necessary to answer the question.

(From Chapter 6.3 #31) Calculate the molarity of each of the following solutions:

26) 293 g HCl in 666 mL of solution, a concentrated HCl solution

27) 2.026 g $FeCl_3$ in 0.1250 L of a solution used as an unknown in general chemistry laboratories

28) 0.001 mg Cd^{2+} in 0.100 L, the maximum permissible concentration of cadmium in drinking water

29) 0.0079 g $C_7H_5SNO_3$ in one ounce (29.6 mL), the concentration of saccharin in a diet soft drink.

30) (From Chapter 6.3 #33) What volume of a 1.00-*M* $Fe(NO_3)_3$ solution can be diluted to prepare 1.00 L of a solution with a concentration of 0.250 *M*?

31) (From Chapter 6.3 #35) If 4.12 L of a 0.850 *M*-H_3PO_4 solution is be diluted to a volume of 10.00 L, what is the concentration of the resulting solution?

32) (From Chapter 6.3 #37) What is the concentration of the NaCl solution that results when 0.150 L of a 0.556-*M* solution is allowed to evaporate until the volume is reduced to 0.105 L?

33) (From Chapter 6.3 #39) What is the final concentration of the solution produced when 225.5 mL of a 0.09988-*M* solution of Na_2CO_3 is allowed to evaporate until the solution volume is reduced to 45.00 mL?

34) (From Chapter 6.3 #41) An experiment in a general chemistry laboratory calls for a 2.00-*M* solution of HCl. How many mL of 11.9 *M* HCl would be required to make 250 mL of 2.00 *M* HCl?

6.4 Other Units for Solution Concentrations

35) (Adapted From Chapter 6.4 #44) Consider this question: What mass of a concentrated solution of nitric acid (100% HNO_3 by mass) is needed to prepare 400.0 g of a 10.0% solution of HNO_3 by mass? Also, outline the steps necessary to answer the question.

36) (From Chapter 6.4 #45) What mass of a 4.00% NaOH solution by mass contains 15.0 g of NaOH?

37) (From Chapter 6.4 #47) What mass of HCl is contained in 45.0 mL of an aqueous HCl solution that has a density of 1.19 g/mL and contains 37.21% HCl by mass? (get mass of HCl using the density)

6.2 Determining Empirical and Molecular Formulas

(From Chapter 6.2 #9) Determine the following to four significant figures:

38) the percent composition of hydrazoic acid, HN_3

39) the percent composition of TNT, $C_6H_2(CH_3)(NO_2)_3$

40) the percent of SO_4^{2-} in $Al_2(SO_4)_3$

41) (From Chapter 6.2 #11) Determine the percent water in $CuSO_4 \cdot 5H_2O$ to three significant figures.

(From Chapter 6.2 #12) Determine the empirical formulas for compounds with the following percent compositions:

42) 15.8% carbon and 84.2% sulfur

43) 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen

(From Chapter 6.2 #13) Determine the empirical formulas for compounds with the following percent compositions:

44) 43.6% phosphorus and 56.4% oxygen

45) 28.7% K, 1.5% H, 22.8% P, and 47.0% O