Unit 3 Problem Set

Learning Objectives in this Assignment:

- *Perform calculations using Avogadro's number and use the concept of the mole to convert between atomic/molecular and macroscopic quantities*
- *Determine the empirical and molecular formulas of compounds from elemental analysis data*
- *Calculate molarity for solutions and molarity of diluted solutions.*

Read more about these topics: Section 3.1, Section 3.2, and Section 3.3.

1. What is the total mass (amu) of carbon in $C_9H_{10}O_8$?

2. What is the total mass (amu) of carbon in $CH_3(CH_2)_{11}CH_3$?

3. Compare 1 mole of H_2, 1 mole of O_2, and 1 mole of F_2. Which has the largest number of molecules?

4. Compare 1 mole of H_2, 1 mole of O_2, and 1 mole of F_2. Which has the greatest mass?

5. Which contains the greatest number of oxygen atoms: 1 mol of ethanol (C_2H_5OH), 1 mol of formic acid (HCO_2H), or 1 mol of water (H_2O)?

6. Which contains the greatest number of carbon atoms: 1 mol of ethanol (C_2H_5OH), 1 mol of formic acid (HCO_2H), or 1 mol of water (H_2O)?

7. Which contains the greatest mass of oxygen: 1 mol of ethanol (C_2H_5OH), 1 mol of formic acid (HCO_2H), or 1 mol of water (H_2O)?

8. Calculate the molar mass of $C_{10}H_{11}N_4O_6$

9. How many moles of the herbicide Treflan ($C_{13}H_{16}N_2O_4F$) are in 30.3 lb? (1 lb = 454 g)
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10. What is the mass (in kg) of 617.9 moles of glucose ($C_6H_{12}O_6$)?
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11. Determine the mass (in g) of 0.766 moles of O_3.
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12. How many hydrogen atoms are in the empirical formula of a compound with the following composition: 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen?
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13. Several chemicals used in dry-cleaning consist of carbon, hydrogen, and chlorine. One of these compounds has a molar mass of 198 g/mol. Analysis of a sample shows that it contains 24.3% carbon and 4.1% hydrogen. How many chlorine atoms are there in a molecule of this compound based on its molecular formula?
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14. A major textile dye manufacturer developed a new yellow dye. The dye has a percent composition of 75.95% C, 17.72% N, and 6.33% H by mass with a molar mass of about 240 g/mol. How many nitrogen atoms are there in a molecule of this compound based on its molecular formula?
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15. Determine the molarity of 0.586 mol of in 555.0 mL of solution

16. Determine the molarity of 2.61 kg of $CuSO_4 \cdot 5H_2O$ in 1.412 L of solution
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17. What is the mass (in g) of the glucose ($C_6H_{12}O_6$) delivered by intravenous injection if a 0.561 L bag of 0.313 *M* glucose is used?

18. What volume (in mL) of a 1.05 *M* $Fe(NO_3)_3$ solution can be diluted to prepare 100 mL of a solution with a concentration of 0.324 *M*?

19. A 2.31 L bottle of a solution of concentrated HCl was purchased for the general chemistry laboratory. The solution contained 801.7 g of HCl. What is the molarity of the solution?

20. The US Environmental Protection Agency (EPA) places limits on the quantities of toxic substances that may be discharged into the sewer system. Limits have been established for a variety of substances, including hexavalent chromium, which is limited to 0.523 mg/L. If an industry is discharging hexavalent chromium as potassium dichromate ($K_2Cr_2O_7$), what is the maximum permissible molarity (in µM) of that substance?