1. Carry out the following operations. (7 pt.)

a. \[ 2.345 + 13.21 + 0.0286 = 15.58 \]

b. \[ 89.3 \div 34.56783 = 2.58 \]

c. \[ \frac{3.41 - 0.23}{5.233} \times 0.205 \Rightarrow \frac{3.18}{5.233} \times 0.205 \Rightarrow 0.008 \times 0.205 \Rightarrow 0.125 \]

2. Indicate the number of significant figures. (3 pt.)

a. \[ 0.00000000203 \text{ g} \quad 3 \]

b. \[ 2.0000 \text{ cm} \quad 5 \]

c. \[ 8.00060 \text{ mL} \quad 6 \]

3. For the following isotope, \[ ^{207}_{82}X \], indicate the following: (9 pt.)

a. the identity of the element: \( \text{Pb, lead} \)

b. the number of protons: \( 82 \)

c. the number of neutrons: \( 127 \)

d. the number of electrons: \( 82 \)
4. A certain element is 51.84% of an isotope of mass 106.9051 amu and 48.16% of an isotope of mass 108.9048 amu. What is the atomic mass of the element? (8 pt.)

\[
(0.5184 \times 106.9051) + (0.4816 \times 108.9048) = 55.42 + 52.45 = 107.87 \text{ amu}
\]

5. Name the following compounds. (3 pt. each)
   a. Fe(NO₃)₃  iron (III) nitrate
   b. Sn₃(PO₄)₂  tin (IV) phosphate

6. Give the formulas of the following compounds. (3 pt. each)
   a. Calcium chloride  CaCl₂
   b. Chromium (III) carbonate  Cr₂(CO₃)₃

7. How many grams of O are there in 15.0 g of C₆H₁₂O₆? (8 pt.)

\[
15.0 \text{ g C}_6\text{H}_{12}\text{O}_6 \times \frac{1 \text{ mol C}_6\text{H}_{12}\text{O}_6}{120.09 \text{ g C}_6\text{H}_{12}\text{O}_6} \times 6 \text{ mol O} \times \frac{16.00 \text{ g O}}{1 \text{ mol O}} = 8.00 \text{ g O}
\]
8. Balance the following equation (8 pt.)

$$2C_4H_{10} + 13O_2 \to 8CO_2 + 10H_2O$$

9. a. How many grams of the dry-cleaning solvent ethylene chloride, $C_2H_4Cl_2$, can be prepared by the reaction of 15.4 g of ethylene, $C_2H_4$, with 3.74 g of $Cl_2$? (9 pt.)

$$C_2H_4 + Cl_2 \to C_2H_4Cl_2$$

b. Which is the limiting reagent? (3 pt.)

c. How much of the other reagent will remain? (4 pt.)

$$15.4 \, g \, C_2H_4 \times \frac{1 \, mol \, C_2H_4}{28.0 \, g \, C_2H_4} \times \frac{1 \, mol \, C_2H_4Cl_2}{1 \, mol \, C_2H_4} \times \frac{98.9 \, g \, C_2H_4Cl_2}{1 \, mol \, C_2H_4Cl_2} = 54.395 \, g \, C_2H_4Cl_2$$

$$3.74 \, g \, Cl_2 \times \frac{1 \, mol \, Cl_2}{70.9 \, g \, Cl_2} \times \frac{1 \, mol \, C_2H_4Cl_2}{1 \, mol \, Cl_2} \times \frac{98.9 \, g \, C_2H_4Cl_2}{1 \, mol \, C_2H_4Cl_2} = 5.22 \, g \, C_2H_4Cl_2$$

b. $Cl_2$ is limiting reagent.

C. How much $C_2H_4$ left over?

$$5.22 \, g \, C_2H_4 \times \frac{1 \, mol \, C_2H_4}{98.9 \, g \, C_2H_4Cl_2} \times \frac{1 \, mol \, C_2H_4}{1 \, mol \, C_2H_4} \times \frac{28.0 \, g \, C_2H_4}{1 \, mol \, C_2H_4} = 10.48 \, g \, C_2H_4$$

Start with $15.4 \, g \, C_2H_4$ - 1.48 $C_2H_4$ remaining

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10. A bottle of 12.0 M hydrochloric acid has only 37.5 mL left in it. What will the HCl concentration be if the solution is diluted to 250.0 mL? (5 pt.)

\[ V_i \times M_i = V_f \times M_f \]

\[ M_f = \frac{M_i \times V_i}{V_f} = \frac{(12.0 \text{ M})(37.5 \text{ mL})}{250.0 \text{ mL}} = 1.80 \text{ M HCl} \]

11. Determine the oxidation number of the indicated element in the following compounds or ions. (9 pt.)

a. Cl in ClO₃⁻
   \[ \text{Cl} + 3(-2) = 1 \]
   \[ \text{Cl} = +5 \]

b. C in CH₄
   \[ \text{C} + 4(+1) = 0 \]
   \[ \text{C} = -4 \]

c. S in SF₆
   \[ \text{S} + 6(-1) = 0 \]
   \[ \text{S} = +6 \]

12. List the six strong acids. (6 pt.)

   a. HCl, hydrochloric acid
   b. HBr, hydrobromic acid
   c. HI, hydroiodic acid
   d. HNO₃, nitric acid
   e. H₂SO₄, sulfuric acid
   f. HClO₄, perchloric acid

13. What is the empirical formula of zircon if the mass percent composition is 15.32% Si, 34.91% O, and 49.76% Zr? (9 pt.)

Assume 100g

\[ 15.32 \text{g Si} \times \frac{1 \text{ mol Si}}{28.085 \text{ g Si}} = 0.55 \text{ mol Si} \]

\[ 34.91 \text{g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 2.18 \text{ mol O} \]

\[ 49.76 \text{g Zr} \times \frac{1 \text{ mol Zr}}{91.224 \text{ g Zr}} = 0.55 \text{ mol Zr} \]

\[ \text{Empirical formula: Zr}_5\text{Si}_4\text{O}_7 \]