Name Key

Class _____ Date _____

The Mole

Solve each of the following problems. Show your work in the space provided, and write your final answer on the blank line.

Part A

1. If the mass of a stone is 2.603 kg, and that of a pencil is 5.15 g, calculate the mass of the stone relative to that of the pencil.

$\frac{2603\text{ g}}{5.15\text{ g}} = 505$

505

2. If the mass of a lithium atom is 6.94 amu, and that of a uranium atom is 238.1 amu, calculate the mass of the lithium atom relative to that of the uranium atom.

$\frac{6.94\text{ u}}{238.1\text{ u}} = 0.0291$

2.91×10^{-2}

Part B

3. Calculate the number of fluorine atoms in 4.25 moles of fluorine gas.

$4.25\text{ mol} \times \frac{6.02 \times 10^{23}\text{ molec.}}{1\text{ mol}} \times \frac{2\text{ atoms}}{1\text{ molec.}}$

5.12×10^{24} atoms

4. a. Calculate the number of moles of methane, CH_4, in 8.71×10^{22} molecules of methane.

$8.71 \times 10^{22}\text{ molec.} \times \frac{1\text{ mol}}{6.02 \times 10^{23}\text{ molec.}}$

$= 0.145$ mol

b. Calculate the number of atoms of hydrogen present in this same sample of methane.

$8.71 \times 10^{22}\text{ molec} \times \frac{4\text{ atoms}}{1\text{ molec.}} = 3.48 \times 10^{23}$ atoms

8. A 7.00-g sample of a molecular compound whose molar mass is 32.0 g/mol is analyzed, and is found to yield 6.13 of nitrogen and 0.87 of hydrogen. Determine the empirical and molecular formulas of the compound.

$6.13\text{ g N} \times \frac{1\text{ mol}}{14.0\text{ g}} = 0.438\text{ mol}$

$0.87\text{ g H} \times \frac{1\text{ mol}}{1.0\text{ g}} = 0.87\text{ mol}$

$N:H = 1:2$

empirical formula: NH_2

$N = \frac{32.0\text{ g/mol}}{16.0\text{ g/mol}} = 2$

molecular formula: N_2H_4

9. 18.48 g of carbon and 58.52 g of fluorine are obtained from the analysis of a molecular compound whose molar mass is 150.0 g/mol.

a. Determine the empirical and molecular formulas of the compound.

$18.48\text{ g} \times \frac{1\text{ mol}}{12.0\text{ g}} = 1.54\text{ mol}$

$58.52\text{ g} \times \frac{1\text{ mol}}{19.0\text{ g}} = 3.08\text{ mol}$

CF_2

empirical formula: CF_2

$N = \frac{150.0\text{ g/mol}}{50\text{ g/mol}} = 3$

molecular formula: C_3F_6

b. Calculate the percent composition of carbon and of fluorine in the compound.

$\%\text{ C} = \frac{36.0}{150.0} \times 100 = 24.0\%$

$\%\text{ F} = \frac{114.0}{150.0} \times 100 = 76.0\%$

c. Calculate the number of moles of hydrogen atoms present in the sample.

$0.145\,mol \times \frac{4\,mol\,H}{1\,mol\,CH_4}$ 0.580 mol

Part C

5. How many moles are present in 288.9 g of sodium carbonate, Na_2CO_3?

$288.9\,g \times \frac{1\,mol}{106.0\,g} = 2.725\,mol$

6. What mass of $Fe(NO_3)_2$ is present in 0.0157 mole of this substance?

$0.0157\,mol \times \frac{179.8\,g}{1\,mol}$ 2.82 g

Part D

7. Sulfur combines chemically with oxygen to produce an oxide of sulfur. Determine the empirical formula of this compound, given that 22.7 g of the sulfur produces 45.3 g of the sulfur oxide.

$45.3g - 22.7g = 22.6g\ O$

$22.6g \times \frac{1mol}{16.0g} = 1.41\,mol$] 2

$22.7g \times \frac{1mol}{32.1g} = 0.71\,mol$] 1

SO_2

Part E — Not on test

10. What is the molarity of a solution made by adding to 295.6 g of potassium sulfide, K_2S, sufficient water to make 10.00 L of solution?

$295.6g \times \frac{1mol}{110.3g} \times \frac{1}{10.00L} = 0.2680\,M$

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11. How many grams of magnesium chloride, $MgCl_2$, are contained in 755 mL of a 0.64*M* solution?

$\frac{0.64\,mol}{L} \times 0.755L \times \frac{95.3g}{1mol}$

46.9

12. 75.7 g of lithium chloride, LiCl, is diluted with sufficient water to make a 0.885*M* solution. Calculate the volume of this solution.

$75.7g \times \frac{1mol}{42.4g} \times \frac{1L}{0.885mol}$

2.02 L