EZPZ Unit 6 Review: Moles and Math

Part 1: Fill out the chart

Name	Ionic or Covalent?	Formula	Random question
tricarbon octahydride	covalent	C_3H_8	What's the molar mass of this compound? 44.09 g/mol
aluminum chloride	ionic	$AlCl_3$	What's the molar mass of this compound? 133.33 g/mol
potassium carbonate	ionic	K_2CO_3	How many moles of ions are in this compound? 3 mol ions
tin (IV) chlorate	ionic	$Sn(ClO_3)_4$	What is the % composition of tin? 26.23 % Sn
boron trifluoride	covalent	BF_3	What's the molar mass of this compound? 67.81 g/mol
calcium phosphate heptahydrate	ionic (hydrate)	$Ca_3(PO_4)_2 \cdot 7H_2O$	What is the % composition of water? 28.91 % H_2O

Part 2: Mole Math

1. How many formula units are in 0.429 mol of sodium bromide?
   2.58×10^{23} formula units NaBr
2. How many atoms of oxygen are in 78.21g of magnesium nitrite?
   1.619×10^{24} atoms O
3. How many ammonium ion $(NH_4)^{1+}$ are there in 396.24 g of ammonium sulfate?
   3.6103×10^{24} ions NH_4^+
4. What is the mass in grams of 3.17 moles of chlorine?
   225 g Cl_2
5. How many grams are in 3.94×10^{24} molecules of diphosphrous tetroxide?
   929 g P_2O_5
6. How many nitride ions are in aluminum nitride?
   1 N^{3-} ion
7. What is the number of moles in 4.17×10^{23} formulas units of copper (II) chlorite?
   0.693 mol $Cu(ClO_2)_2$
8. Calculate the number of carbon atoms in 25.0 grams of isopropyl alcohol (C_3H_8O).
   7.51×10^{23} atoms C
9. Which sample represents the greatest number of moles?
   a) 44.01 g CO_2 1 mol
   b) 1.0 moles C_3H_8 1 mol
   c) 6.022×10^{23} molecules C_4H_{10} 1 mol
   d) 18.02 g H_2O 1 mol
   e) All of the sample have the same number of moles.
10. Which of the following contains the largest number of molecules?
    a) 10.0 g CH_4
    b) 10.0 g C_2H_6
    c) 10.0 g SO_2
    d) 10.0 g Xe

Part 3: Empirical & Molecular

1. What is the empirical formula of C_8H_{16}?

$$\frac{C_8H_{16}}{8} = \boxed{CH_2}$$

2. What is the empirical formula of $N_3H_6C_3H_{12}$?

$$\frac{N_3H_6C_3H_{12}}{3} = \boxed{NH_2CH_4}$$

3. An unknown compound contains the following percents by mass: C: 60.86%, H: 5.83%, O: 23.16%, and N: 10.14%. Find the empirical formula.

$$\boxed{C_{14}H_{16}O_3N_2}$$

4. A compound containing nitrogen and oxygen is decomposed in the laboratory and produces 24.5 g nitrogen and 70.0 g oxygen. Calculate the empirical formula of the compound.

N: $24.5\text{ g N} \times \frac{1\text{ mol N}}{14.01\text{ g N}} = \frac{1.75\text{ mol N}}{1.75} = 1 \times 2 = 2$

O: $70.0\text{ g O} \times \frac{1\text{ mol O}}{16.00\text{ g O}} = \frac{4.38\text{ mol O}}{1.75} = 2.5 \times 2 = 5$

$$\boxed{N_2O_5}$$

5. Butanedione—a main component responsible for the smell and taste of butter and cheese—contains the elements carbon, hydrogen, and oxygen. The empirical formula of butanedione is C_2H_3O, and its molar mass is 86.09 g/mol. Find its molecular formula.

$2 \times 12.01 + 3 \times 1.008 + 16.00 = 43.044\text{ g/mol}$

$$\frac{86.09}{43.044} = 2 \times C_2H_3O = \boxed{C_4H_6O_2}$$

6. The empirical formula of a compound is CH_2O. Its molecular mass is 60 g/mol. What is its molecular formula?

$12.01 + 2 \times 1.008 + 16 = 30.026\text{ g/mol}$

$$\frac{60}{30.026} = 2 \times CH_2O = \boxed{C_2H_4O_2}$$

7. A compound with the percent composition shown next has a molar mass of 60.10 g/mol. Determine its molecular formula. C: 39.97%, H: 13.41%, N: 46.62% Assume 100. g

C: $39.97\text{ g C} \times \frac{1\text{ mol C}}{12.01\text{ g C}} = \frac{3.33\text{ mol C}}{3.33} = 1$

H: $13.41\text{ g H} \times \frac{1\text{ mol H}}{1.008\text{ g H}} = \frac{13.30\text{ mol H}}{3.33} = 4$

N: $46.62\text{ g N} \times \frac{1\text{ mol N}}{14.01\text{ g N}} = \frac{3.33\text{ mol N}}{3.33} = 1$

empirical → CH_4N

$12.01 + 4 \times 1.008 + 14.01 = 30.052$

$$\frac{60.10}{30.052} = 2 \times CH_4N$$

$$\boxed{C_2H_8N_2}$$

Part 1:

C_3H_8: $3\times12.01+8\times1.008 = \boxed{44.09\ g/mol}$

$AlCl_3$: $26.98+3\times35.45 = \boxed{133.33\ g/mol}$

K_2CO_3: $2\ K^+ + 1\ CO_3^{2-} = \boxed{3\ ions}$

$Sn(ClO_3)_4$: $\dfrac{118.71}{118.71+4\times35.45+12\times16}\times100 = \boxed{26.23\%\ Sn}$

BF_3: $10.81+3\times19.00 = \boxed{67.81\ g/mol}$

$Ca_3(PO_4)_2\cdot7H_2O$: $\dfrac{7(2\times1.008+16)}{3\times40.08+2\times30.97+8\times16.00+7(2\times1.008+16)}\times100$

$= \boxed{28.91\%\ H_2O}$

Part 2:

1. $0.429\ mol\ NaBr \times \dfrac{6.02\times10^{23}\ formula\ units\ NaBr}{1\ mol\ NaBr} = \boxed{2.58\times10^{23}\ formula\ units\ NaBr}$

2. $78.21\ g\ Mg(NO_2)_2 \times \dfrac{1\ mol\ Mg(NO_2)_2}{116.32\ g\ Mg(NO_2)_2} \times \dfrac{4\ mol\ O}{1\ mol\ Mg(NO_2)_2} \times \dfrac{6.02\times10^{23}\ atoms\ O}{1\ mol\ O}$

$= \boxed{1.619\times10^{24}\ atoms\ O}$

3. $396.24\ g\ (NH_4)_2SO_4 \times \dfrac{1\ mol\ (NH_4)_2SO_4}{132.144\ g\ (NH_4)_2SO_4} \times \dfrac{2\ mol\ NH_4^+}{1\ mol\ (NH_4)_2SO_4} \times \dfrac{6.02\times10^{23}\ ions\ NH_4^+}{1\ mol\ NH_4^+}$

$= \boxed{3.6103\times10^{24}\ ions\ NH_4^+}$

4. $3.17 \text{ mol } Cl_2 \times \frac{70.90 \text{ g } Cl_2}{1 \text{ mol } Cl_2} = \boxed{225 \text{ g } Cl_2}$

5. $3.94 \times 10^{24} \text{ molecules } P_2O_4 \times \frac{1 \text{ mol } P_2O_5}{6.02 \times 10^{23} \text{ molecules } P_2O_5} \times \frac{141.94 \text{ g } P_2O_5}{1 \text{ mol } P_2O_5}$

$= \boxed{929 \text{ g } P_2O_5}$

6. AlN - $\boxed{1 \ N^{3-} \text{ ion}}$

7. $4.17 \times 10^{23} \text{ formula units } Cu(ClO_2)_2 \times \frac{1 \text{ mol } Cu(ClO_2)_2}{6.02 \times 10^{23} \text{ formula units } Cu(ClO_2)_2}$

$= \boxed{0.693 \text{ mol } Cu(ClO_2)_2}$

8. $25.0 \text{ g } C_3H_8O \times \frac{1 \text{ mol } C_3H_8O}{60.094 \text{ g}} \times \frac{3 \text{ mol C}}{1 \text{ mol } C_3H_8O} \times \frac{6.02 \times 10^{23} \text{ atoms C}}{1 \text{ mol C}}$

$= \boxed{7.51 \times 10^{23} \text{ atoms C}}$

10. a) $10.0 \text{ g } CH_4 \times \frac{1 \text{ mol } CH_4}{16.042 \text{ g } CH_4} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } CH_4} = \boxed{3.75 \times 10^{23} \text{ molecules } CH_4}$

b) $10.0 \text{ g } C_2H_6 \times \frac{1 \text{ mol } C_2H_6}{30.068 \text{ g } C_2H_6} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } C_2H_6} = 2.00 \times 10^{23} \text{ molecules } C_2H_6$

c) $10.0 \text{ g } SO_2 \times \frac{1 \text{ mol } SO_2}{64.06 \text{ g } SO_2} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } SO_2} = 9.40 \times 10^{22} \text{ molecules } SO_2$

d) $10.0 \text{ g Xe} \times \frac{1 \text{ mol Xe}}{131.29 \text{ g Xe}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol Xe}} = 4.59 \times 10^{22} \text{ molecules Xe}$

Part 3:

Assume 100. g

3. C: $60.86\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} = \frac{5.07}{0.72} = 7.04 \times 2 = 14$

H: $5.83\ g\ H \times \frac{1\ mol\ H}{1.008\ g\ H} = \frac{5.78}{0.72} = 8.03 \times 2 = 16$

O: $23.16\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = \frac{1.45}{0.72} = 1.45 \times 2 = 3$

N: $10.14\ g\ N \times \frac{1\ mol\ N}{14.01\ g\ N} = \frac{0.72}{0.72} = 1 \times 2 = 2$

$C_{14}H_{16}O_3N_2$