Molar Quantities **Worksheet 1**

* For each of the following compounds or molecules, find and label the gram atomic mass (GAM), gram molecular mass (GMM) OR gram formula mass (GFM). SHOW WORK.
* Give the oxidation numbers for EACH element of every formula
* On the line for each formula, name that compound or molecule

1. KBr

2. MgCl2

3. KClO3

4. N2

5. NH3

6. (NH4)3(PO4)

7. O2

8. Zn(C2H3O2)2

GFM 🡪 ionic compound GMM 🡪 covalent moleculeMolar Quantities **Worksheet 2**

* Solve each problem, SHOWING all UNITS and WORK.

1. How many **moles** are in 45 g of water?
2. How many **moles** are in the following?
3. 92 g Na b. 350 g CaCO3

c. 348 g NaCl d. 50. g (NH4)2(SO4)

1. How many **grams** are there in the following?

a. 5.0 moles PbO2  b. 4.0 moles O2

c. 0.60 moles Pb(NO3)2 d. 10. moles HCl

Molar Quantities **Worksheet 3**

* Solve each problem, SHOWING all UNITS and WORK.

1. How many **particles** are there in the following?

a. 3.4 moles HCl b. 0.80 moles Na2S

2. How many **atoms** are there in the following?

a. 2.5 moles HNO3 b. 0.50 moles Al2(SO4)3

3. How many **molecules (particles)** are there in the following?

a. 88 g CO2 GMM = 44 g/mole b. 50. g CaCO3 GFM = 100 g/mole

4. How many **moles** are there in the following?

a. 3.01 x 1023 molecules CO2  b. 24.08 x 1023 particles PbBr2

5. How many **grams** are there in the following?

a. 4.00 x 1023 particles AlCl3  b. 12.04 x 1023 molecules C6H12O6

6. How many **molecules (formula units)** and **atoms** are there in the following?

a. 26.8 moles CCl4 b. 0.25 moles BaS

Review Equation **Worksheet 4**

1. If one fills a balloon with 80.0 liters of helium @ STP, how many moles of helium did he use?

2. Calculate the liters of oxygen gas @ STP found in 5.00 moles?

3. How many grams of Hydrogen gas are in 44.8 liters @ STP?

4. Determine the number of atoms in 84 grams of hydrogen peroxide.

5. Find the number of liters in a reaction using 170. grams of ammonia gas @ STP.

6. What is the molecular mass of a gas whose density is 1.64 grams per liter @ STP? Use the reference table and determine the gas.

7. Determine the density of sulfur dioxide gas at STP?

8. What is the molecular mass of methane gas at STP using the density on reference table C.

9. The relative abundance of Carbon’s two isotopes, C-12 and C-14, are 99.45% and 0.55%. What is carbon’s average weight?

Molar Quantities **Worksheet 5**

1. Calculate the percent composition of the underlined element(s). Show all work.

a. CaSO4 b. NaNO3

2. What is the percentage composition of each element present in C3H5(OH)3?

3. Find the percentage of water by weight in the following hydrates:

a. FeSO4∙7 H2O b. Na2CO3∙10 H2O

4. Using the information provided, determine the empirical formula of each compound:

a. 1.24 % H, 98.76 % Br b. 44.9 % K, 18.4 % S, 36.7 % O

c. 27.73 % Mg, 23.58 % P, 48.69 % O d. 0.463 g Tl, 0.0544 g C, 0.00685 g H, 0.0725 g O

# Molar Quantities Worksheet 6

1. Find the molecular formula of a carbon chloro-nitride molecule whose empirical formula is CClN (GMM = 184.5 g).

2. A certain hydrocarbon was found to be 80.0 % Carbon and 20.0 % Hydrogen. The molecular weight was determined to be 30.0 grams. What is the molecular formula?

3. What is the molecular mass of a gas if 500. ml of that gas weighs 10.0 grams?

4. What is the density of propane gas @ STP (molecular formula = C3H8)

5. A sample of gas occupies 0.250 L @ STP. Its mass is 0.625 grams.

a. What is the molecular mass of the gas?

b. What is the number of molecules in this sample?

Molar Quantities **Worksheet 1 ANSWERS**

* For each of the following compounds or molecules, find and label the gram atomic mass (GAM), gram molecular mass (GMM) OR gram formula mass (GFM). SHOW WORK.
* Give the oxidation numbers for EACH element of every formula
* On the line for each formula, name that compound or molecule

1. K+Br - 1 x 39.1 g/mole = 39.1 g/mol Potassium Bromide

1 x 79.9 g/mole = 79.9 g/mol GFM = 119 g/mol

2. Mg+2Cl2-1 x 24.3 = 24.3 g/mol Magnesium Chloride

2 x 35.5 = 71.0 g/mol GFM = 95.3 g/mol

3. K+Cl+5O3-21 x 39.5 = 39.1 g/mol Potassium Chlorate

1 x 35.5 = 35.5 g/mol GFM = 123 g/mol

3 x 16.0 = 48.0 g/mol

4. N202 x 14.0 = 28.0 g/mol Nitrogen gas

GAM = 28.0 g/mol

5. N+3H3-11 x 14.0 = 14.0 g/mol Ammonia – nitrogen trihydride

3 x 1.00 = 3.00 g/mol GMM = 17.0 g/mol

6. (N-3H4+)3+(P+5O4-2)-3 3 x 14.0 = 42.0 g/mol Ammonium Phosphate

1 x 12.0 = 12.0 g/mol GFM = 149 g/mol

1 x 31.0 = 31.0 g/mol

4 x 16.0 = 64.0 g/mol

7. O202 x 16.0 = 32.0 g/mol Oxygen gas

GMM = 32.0 g/mol

8. Zn+2(C2H3+O2-2)2-1 x 65.4 = 65.4 g/mol Zinc Acetate

4 x 12.0 = 48 g/mol GFM = 183 g/mol

6 x 1.00 = 6.00 g/mol

4 x 16.0 = 64.0 g/mol

GFM 🡪 ionic compound GMM 🡪 covalent moleculeMolar Quantities **Worksheet 2 ANSWERS**

* Solve each problem, SHOWING all UNITS and WORK.

1. How many **moles** are in 45 g of water?

H 2 x 1.0 g/mol = 2.0 g/mol 45 g x 1 mol / 18.0 g = **2.5 moles**

O 1 x 16.0 g/mol = 16.0 g/mol

2. How many **moles** are in the following?

a. 92 g Na b. 350 g CaCO3

Na 🡪 23.0 g/mol Ca 1 x 40.1 g/mol = 40.1 g/mol

C 1 x 12.0 g/mol = 12.0 g/mol

92 g x 1 mol / 23.0 g = **4.0 moles** O 3 x 16.0 g/mol = 48.0 g/mol

350 g x 1 mol / 100.1 g = **3.5 moles**

c. 348 g NaCl d. 50. g (NH4)2(SO4)

Na 1 x 23.0 g/mol = 23.0 g/mol N 2 x 14.0 g/mol = 28.0 g/mol

Cl 1 x 35.5 g/mol = 35.5 g/mol H 8 x 1.00 g/mol = 8.00 g/mol

S 1 x 32.1 g/mol = 32.1 g/mol

348 g x 1 mol / 58.5 g = **5.95 moles** O 4 x 16.0 g/mol = 64.0 g/mol

50. g x 1 mol/ 132.1 g = **0.38 moles**

3. How many **grams** are there in the following?

a. 5.0 moles PbO2  b. 4.0 moles O2

Pb 1 x 207 g/mol = 207 g/mol O 2 x 16.0 g/mol = 32.0 g/mol

O 2 x 16 g/mol = 32 g/mol 4 mol x 32.0 g / mol = 128 g

5.0 mol x 239 g / mol = 1195 g **= 130 g**

= **1200 g**

c. 0.60 moles Pb(NO3) 2 d. 10.0 moles HCl

Pb 1 x 207.2 g/mol = 207.2 g/mol H 1 x 1.00 g/mol = 1.00 g/mol

N 2 x 14.0 g/mol = 28.0 g/mol Cl 1 x 35.5 g/mol = 35.5 g/mol

O 6 x 16.0 g/mol = 96.0 g/mol

10.0 moles x 36.5 g / mol = **365 g**

0.60 moles x 331.2 g / mol = 198.6 g

**= 2.0 x 102 g**

Molar Quantities **Worksheet 3 ANSWERS**

* Solve each problem, SHOWING all UNITS and WORK.

1. How many **particles** are there in the following?

a. 3.4 moles HCl b. 0.80 moles Na2S

3.4 mol x 6.02 x 1023 particles/mol 0.80 mol x 6.02 x 1023 particles/mol

**2.0 x 1024 particles 4.8 x 1023 particles**

2. How many **atoms** are there in the following?

a. 2.5 moles HNO3 b. 0.50 moles Al2(SO4)3

2.5 mol x 6.02 x 1023 particles/mol 0.50 mol x 6.02 x 1023 particles/mol

1.5 x 1024 particles x 5 atoms/particle3.01 x 1023 particles x 17 atoms/particle

**7.5 x 1024 atoms 5.1 x 1024 atoms**

3. How many **molecules (particles)** are there in the following?

a. 88 g CO2 GMM = 44 g/mole b. 50. g CaCO3 GFM = 100 g/mole

88 g x 1 mol / 44 g = 2.0 moles 50. g x 1 mol / 100 g = 0.50 moles

2.0 mol x 6.02 x 1023 particles/mol0.50 mol x 6.02 x 1023 particles/mol

**1.2 x 1024 molecules 3.0 x 1023 formula units**

4. How many **moles** are there in the following?

a. 3.01 x 1023 molecules CO2  b. 24.08 x 1023 particles PbBr2

3.01 x 1023 particles x 1 mol/6.02 x 1023 particles 24.08 x 1023 particles x 1 mol/6.022 x 1023 particles **0.500 moles 4.000 moles**

5. How many **grams** are there in the following?

a. 4.00 x 1023 particles AlCl3  b. 12.04 x 1023 molecules C6H12O6

4.00 x 1023 particles x 1 mol/6.02 x 1023 particles 12.04 x 1023 particles x 1 mol/6.022 x 1023 particles0.660 mol x 132 g/mol 2.000 mol x 180.0 g/mol

**87.7 g 360.0 g**

6. How many **molecules (formula units)** and **atoms** are there in the following?

a. 26.8 moles CCl4 b. 0.25 moles BaS

26.8 mol x 6.02 x 1023 molecules/mol 0.25 mol x 6.022 x 1023 formula units/mol

**1.61 x 1025 molecules** **1.5 x 1023 formula units**

1.61 x 1025 molecules x 5 atoms/molecule 1.5 x 1023 formula units x 2 atoms/formula units

**8.05 x 1025 atoms** **3.0 x 1023 atoms**

Molar Quantities **Worksheet 4 ANSWERS**

1. If one fills a balloon with 80.0 liters of helium @ STP, how many moles of helium did he use?

80.0 L x 1 mol / 22.4 L = **3.57 moles**

2. Calculate the liters of oxygen gas @ STP found in 5.00 moles?

O2 (g) 5.00 mol x 22.4 L / mol = **112 L**

3. How many grams of Hydrogen gas are in 44.8 liters @ STP?

H2 (g) 44.8 L x 1 mol / 22.4 L = 2.00 mol x 2 g / mol = **4.00 g**

4. Determine the number of atoms in 84 grams of hydrogen peroxide.

H2O2  H = 2 x 1 g/mol = 2 g/mol

O = 2 x 16 g/mol = 32 g/mol 34 g/mol

84 g x 1 mol / 34 g = 2.47 mol x 6.02 x 1023 molecules/mol x 4 atoms/molecule =

**5.9 x 1024 atoms**

5. Find the number of liters in a reaction using 170. grams of ammonia gas @ STP.

NH3 (g) N = 1 x 14 g/mol = 14 g/mol

H = 3 x 1 g/mol = 3 g/mol 17 g/mol

170. g x 1 mol / 17 g =10.0 mol x 22.4 L / mol = **224 L**

6. What is the molecular mass **(g/mol)** of a gas whose density is 1.64 **grams per liter** @ STP? Use the reference table and determine the gas.

GMM 1.64 g/L x 22.4 L / mol = **36.7 g/mol HCl (g)**

7. Determine the density of sulfur dioxide gas at STP?

SO2 (g) S = 1 x 32 g/mol = 32.0 g/mol

O = 2 x 16 g/mol = 32.0 g/mol 64.0 g/mol

64.0 g / mol x 1 mol / 22.4 L = **2.86 g/L** [*check reference table*]

8. What is the molecular mass of methane gas at STP using the density on reference table C.

density of methane = 0.71 g/L 0.71 g/L x 22.4 L / mol = **16 g/mole**

CH4 (g) C = 1 x 12 g/mol = 12 g/mol

H = 4 x 1 g/mol = 4 g/mol 16 g/mol

9. The relative abundance of Carbon’s two isotopes, C-12 and C-14, are 99.45% and 0.55%. What is carbon’s average weight?

(0.9945)(12) + (0.0055)(14) = 11.934 + 0.077 = **12.011 amu**Molar Quantities **Worksheet 5 ANSWERS**

1. Calculate the percent composition of the underlined element(s). Show all work.

a. CaSO4 b. NaNO3

Ca 1 x 40.0 g/mol = 40.0 g/mol Na 1 x 23.0 g/mol = 23.0 g/mol

**S 1 x 32.1 g/mol = 32.1 g/mol** N 1 x 4.0 g/mol = 14.0 g/mol

O 4 x 16.0 g/mol = 64.0 g/mol **O 3 x 16.0 g/mol = 48.0 g/mol**

136 g/mol 85.0 g/mol

32 g/mol / 136 g/mol = **23.5 %** 48.0 g/mol / 85.0 g/mol = **56.0%**

2. What is the percentage composition of each element present in C3H5(OH)3?

C 3 x 12.0 g/mol = 36.0 g/mol 36.0 g/mole / 92.0 g/mol = **39 %**

H 8 x 1.00 g/mol = 8.00 g/mol 8.00 g/mole / 92.0 g/mol = **8.7 %**

O 3 x 16.0 g/mol = 48.0 g/mol 48.0 g/mole / 92.0 g/mol = **52 %**

92.0 g/mol

3. Find the percentage of water by weight in the following hydrates:

a. FeSO4∙7 H2O b. Na2CO3∙10 H2O

Fe 1 x 55.8 g/mol = 55.8 g/mol Na 2 x 23.0 g/mol = 46.0 g/mol

S 1 x 32.1 g/mol = 32.1 g/mol C 1 x 12.0 g/mol = 12.0 g/mol

O 4 x 16.0 g/mol = 64.0 g/molO 3 x 16.0 g/mol = 48.0 g/mol

152 g/mol 106 g/mol

**H2O 7 x 18.0 g/mol = 126 g/mole H2O 10 x 18.0 g/mol = 180. g/mol**

126 g/mol / 278 g/mol = **45.3 %** 180. g/mol / 286 g/mol = **62.9%**

4. Using the information provided, determine the empirical formula of each compound:

a. 1.24 % H, 98.76 % Br b. 44.9 % K, 18.4 % S, 36.7 % O

* *Let percentage be grams out of 100 g Use the GAM of each element*

1.24 g x 1 mol / 1 g = 1.24 moles 44.9 g x 1 mol / 39 g = 1.15 moles

98.76 g x 1 mol / 79.9 g = 1.24 moles 18.4 g x 1 mol / 32 g = 0.575 moles

36.7 g x 1 mol / 16 g = 2.29 moles

* *Divide by the smallest moles*

1 : 1 🡪 **HBr** 2 : 1 : 4 🡪 **K2SO4**

c. 27.73 % Mg, 23.58 % P, 48.69 % O d. 0.463 g Tl, 0.0544 g C, 0.00685 g H, 0.0725 g O

27.73 g x 1 mol / 24.3 g = 1.14 moles 0.463 g x 1 mol / 204 g = 0.0023 moles

23.58 g x 1 mol / 31 g = 0.76moles 0.0544 g x 1 mol / 12 g = 0.045 moles

48.69 g x 1 mol / 16 g = 3 moles 0.00685 g x 1 mol / 1 g = 0.00685 moles

0.0725 g x 1 mol / 16 g = 0.045 moles

1.5 : 1 : 4 … *make whole numbers* 1 : 2 : 3 : 2

Mg3P2O8 🡪 **Mg3(PO3)2** magnesium phosphite**TlC2H3O2**🡪 telurium acetate

# Molar Quantities Worksheet 6 ANSWERS

1. Find the molecular formula of a carbon chloro-nitride molecule whose empirical formula is CClN (GMM = 184.5 g).

C 1 x 12.0 g/mol = 12.0 g/mole 184.5 g / 61.5 g/mol = 3 moles

Cl 1 x 35.5 g/mol = 35.5 g/mole

N 1 x 14.0 g/mol = 14.0 g/mole (CClN)3 🡪 **C3Cl3N3**

61.5 g/mole

2. A certain hydrocarbon was found to be 80.0 % Carbon and 20.0 % Hydrogen. The molecular weight was determined to be 30.0 grams. What is the molecular formula?

C 80.0 g / 12.0 g/mol = 6.67 moles 1 x 12.0 g/mol = 12.0 g/mol

H 20.0 g / 1.00 g/mol = 20.0 moles 3 x 1.00 g/mol = 3.00 g/mol

6.67 moles / 20.0 moles = 1 : 3 🡪 CH3 15.0 g/mol

30.0 g / 15.0 g/mol = 2 units (CH3)2 🡪 **C2H6**

3. What is the molecular mass of a gas if 500. ml of that gas weighs 10.0 grams?

Since there is a mass and a volume, consider density

d = m / V g/L Molecular mass is g/mol

10.0 g / 500. ml = 10.0 g / 0.500 L x 22.4 L/mol = **448 g/mole**

4. What is the density of propane gas @ STP (molecular formula = C3H8)

Density = mass / volume 🡪 grams / liters

C 3 x 12.0 g/mol = 36 g/mole GFM = 44.0 g/mole

H 8 x 1.00 g/mol = 8 g/mole

44.0 g/mol x 1 mole / 22.4 L = **1.96 g/L** [check reference table C]

5. A sample of gas occupies 0.250 L @ STP. Its mass is 0.625 grams.

a. What is the molecular mass of the gas?

0.625 g / 0.250 L x 22.4 L / mol = **56.0 g/mole**

b. What is the number of molecules in this sample?

0.250 L x 1 mole / 22.4 L = 0.0112 moles

0.0112 moles x 6.022 x 1023 molecules/mol = **6.72 x 1021 molecules**