

Name \_\_\_\_\_ Date \_\_\_\_\_  
 Class \_\_\_\_\_

# The Mole

## A. Molar Mass

The mass of a mole of a substance is equal to the total mass in grams, of the moles of atoms that make it up. This total mass, or mass of  $6.02 \times 10^{23}$  formula units of a substance, is called molar mass, and is usually expressed in grams.

- Complete each of the accompanying charts, filling in the items listed and determine the molar mass, in g, of each substance.

AMMONIA, NH <sub>3</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND

Molar mass = \_\_\_\_\_

GLUCOSE, C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND

Molar mass = \_\_\_\_\_

SULFURIC ACID, H <sub>2</sub> SO <sub>4</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND

Molar mass = \_\_\_\_\_

SODIUM BICARBONATE, NaHCO <sub>3</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND

Molar mass = \_\_\_\_\_

- Complete the chart below and answer the questions that follow it.

SUBSTANCE	FORMULA	MOLAR MASS
methane (marsh gas)	CH <sub>4</sub>	
hydrochloric acid	HCl	
benzene	C <sub>6</sub> H <sub>6</sub>	
oxygen gas	O <sub>2</sub>	
ozone	O <sub>3</sub>	
ethanol	C <sub>2</sub> H <sub>5</sub> OH	
sodium hydroxide	NaOH	
acetylene	C <sub>2</sub> H <sub>2</sub>	

- How many particles of methane are found in 16.0 grams of the gas?  
 In 32 grams of the gas? \_\_\_\_\_

- How many atoms of carbon are found in one mole of methane gas?  
 How many atoms of hydrogen are found in the same sample? \_\_\_\_\_

- How many atoms of oxygen are found in one mole of oxygen gas?  
 How many atoms of oxygen are found in one mole of ozone? \_\_\_\_\_

Name Key  
 Class \_\_\_\_\_ Date \_\_\_\_\_

# The Mole

## A. Molar Mass

The mass of a mole of a substance is equal to the total mass, in grams, of the moles of atoms that make it up. This total mass, or mass of  $6.02 \times 10^{23}$  formula units of a substance, is called molar mass, and is usually expressed in grams.

1. Complete each of the accompanying charts, filling in the items listed and determine the molar mass, in g, of each substance.

AMMONIA, NH <sub>3</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND
nitrogen	14.0 g	1	14.0 g
hydrogen	1.0 g	3	3.0 g

Molar mass = 17.0 g

GLUCOSE, C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND
carbon	12.0 g	6	72.0 g
hydrogen	1.0 g	12	12.0 g
oxygen	16.0 g	6	96.0 g

Molar mass = 180.0 g

SULFURIC ACID, H <sub>2</sub> SO <sub>4</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND
hydrogen	1.0 g	2	2.0 g
sulfur	32.1 g	1	32.1 g
oxygen	16.0 g	4	64.0 g

Molar mass = 98.1 g

SODIUM BICARBONATE, NaHCO <sub>3</sub>			
NAME OF COMPONENT ATOM	MASS OF 1 MOLE OF SINGLE COMPONENT ATOM	NUMBER OF THAT KIND OF ATOM IN MOLECULE	TOTAL MASS OF THE MOLES OF THAT KIND OF ATOM IN 1 MOLE OF THE COMPOUND
sodium	23.0 g	1	23.0 g
hydrogen	1.0 g	1	1.0 g
carbon	12.0 g	1	12.0 g
oxygen	16.0 g	3	48.0 g

Molar mass = 84.0 g

2. Complete the chart below and answer the questions that follow it.

SUBSTANCE	FORMULA	MOLAR MASS
methane (marsh gas)	CH <sub>4</sub>	16.0 g
hydrochloric acid	HCl	36.5 g
benzene	C <sub>6</sub> H <sub>6</sub>	78.0 g
oxygen gas	O <sub>2</sub>	32.0 g
ozone	O <sub>3</sub>	48.0 g
ethanol	C <sub>2</sub> H <sub>5</sub> OH	46.0 g
sodium hydroxide	NaOH	40.0 g
acetylene	C <sub>2</sub> H <sub>2</sub>	26.0 g

a. How many particles of methane are found in 16.0 grams of the gas?  $6.02 \times 10^{23}$

In 32 grams of the gas?  $2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$

b. How many atoms of carbon are found in one mole of methane?  $6.02 \times 10^{23}$

$$4 \times 6.02 \times 10^{23} = 2.408 \times 10^{24}$$

How many atoms of hydrogen are found in the same sample? \_\_\_\_\_

$$2 \times 6.02 \times 10^{23} = 1.204 \times 10^{24}$$

c. How many atoms of oxygen are found in one mole of oxygen gas? \_\_\_\_\_

$$3 \times 6.02 \times 10^{23} = 1.806 \times 10^{24}$$

How many atoms of oxygen are found in one mole of ozone? \_\_\_\_\_

## GRAM FORMULA MASS

Name \_\_\_\_\_

Determine the gram formula mass (the mass of one mole) of each compound below.

1.  $\text{KMnO}_4$  \_\_\_\_\_
2.  $\text{KCl}$  \_\_\_\_\_
3.  $\text{Na}_2\text{SO}_4$  \_\_\_\_\_
4.  $\text{Ca}(\text{NO}_3)_2$  \_\_\_\_\_
5.  $\text{Al}_2(\text{SO}_4)_3$  \_\_\_\_\_
6.  $(\text{NH}_4)_3\text{PO}_4$  \_\_\_\_\_
7.  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  \_\_\_\_\_
8.  $\text{Mg}_3(\text{PO}_4)_2$  \_\_\_\_\_
9.  $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$  \_\_\_\_\_
10.  $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$  \_\_\_\_\_
11.  $\text{H}_2\text{CO}_3$  \_\_\_\_\_
12.  $\text{Hg}_2\text{Cr}_2\text{O}_7$  \_\_\_\_\_
13.  $\text{Ba}(\text{ClO}_3)_2$  \_\_\_\_\_
14.  $\text{Fe}_2(\text{SO}_4)_3$  \_\_\_\_\_
15.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  \_\_\_\_\_

## MOLES AND MASS

Name \_\_\_\_\_

Determine the number of moles in each of the quantities below.

1. 25 g of  $\text{NaCl}$  \_\_\_\_\_
2. 125 g of  $\text{H}_2\text{SO}_4$  \_\_\_\_\_
3. 100. g of  $\text{KMnO}_4$  \_\_\_\_\_
4. 74 g of  $\text{KCl}$  \_\_\_\_\_
5. 35 g of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  \_\_\_\_\_

Determine the number of grams in each of the quantities below.

1. 2.5 moles of  $\text{NaCl}$  \_\_\_\_\_
2. 0.50 moles of  $\text{H}_2\text{SO}_4$  \_\_\_\_\_
3. 1.70 moles of  $\text{KMnO}_4$  \_\_\_\_\_
4. 0.25 moles of  $\text{KCl}$  \_\_\_\_\_
5. 3.2 moles of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  \_\_\_\_\_

## THE MOLE AND AVOGADRO'S NUMBER

Name \_\_\_\_\_

One mole of a substance contains Avogadro's Number ( $6.02 \times 10^{23}$ ) of molecules.

How many molecules are in the quantities below?

1. 2.0 moles

2. 1.5 moles

3. 0.75 mole

4. 15 moles

5. 0.35 mole

How many moles are in the number of molecules below?

1.  $6.02 \times 10^{23}$

2.  $1.204 \times 10^{24}$

3.  $1.5 \times 10^{20}$

4.  $3.4 \times 10^{26}$

5.  $7.5 \times 10^{19}$

## THE MOLE AND VOLUME

Name \_\_\_\_\_

For gases at STP (273 K and 1 atm pressure), one mole occupies a volume of 22.4 L. What volume will the following quantities of gases occupy at STP?

1. 1.00 mole of  $H_2$

2. 3.20 moles of  $O_2$

3. 0.750 mole of  $N_2$

4. 1.75 moles of  $CO_2$

5. 0.50 mole of  $NH_3$

6. 5.0 g of  $H_2$

7. 100. g of  $O_2$

8. 28.0 g of  $N_2$

9. 60. g of  $CO_2$

10. 10. g of  $NH_3$

## MIXED MOLE PROBLEMS

Name \_\_\_\_\_

Solve the following problems.

1. How many grams are there in  $1.5 \times 10^{25}$  molecules of  $\text{CO}_2$ ?

\_\_\_\_\_

2. What volume would the  $\text{CO}_2$  in Problem 1 occupy at STP?

\_\_\_\_\_

3. A sample of  $\text{NH}_3$  gas occupies 75.0 liters at STP. How many molecules is this?

\_\_\_\_\_

4. What is the mass of the sample of  $\text{NH}_3$  in Problem 3?

\_\_\_\_\_

5. How many atoms are there in  $1.3 \times 10^{22}$  molecules of  $\text{NO}_2$ ?

\_\_\_\_\_

6. A 5.0 g sample of  $\text{O}_2$  is in a container at STP. What volume is the container?

\_\_\_\_\_

7. How many molecules of  $\text{O}_2$  are in the container in Problem 6? How many atoms of oxygen?

\_\_\_\_\_

\_\_\_\_\_

# ANSWER KEY

Name \_\_\_\_\_

### GRAM FORMULA MASS

Determine the gram formula mass (the mass of one mole) of each of the following compounds below.

1. $KMnO_4$	158g
2. $KCl$	74.55g
3. $Na_2SO_4$	142g
4. $Ca(NO_3)_2$	164g
5. $Al_2(SO_4)_3$	342g
6. $(NH_4)_3PO_4$	149g
7. $CuSO_4 \cdot 5H_2O$	250g
8. $Mg_3(PO_4)_2$	262.86g
9. $Zn(C_2H_3O_2)_2 \cdot 2H_2O$	219g
10. $Sn_3(PO_4)_2 \cdot 4H_2O$	458g
11. $H_2CO_3$	62g
12. $Hg_2Cl_2$	617g
13. $Ba(ClO_3)_2$	304g
14. $Fe_2(SO_4)_3$	352g
15. $NH_4C_2H_3O_2$	77g

Page 49

Name \_\_\_\_\_

### MOLES AND MASS

Determine the number of moles in each of the quantities below.

1. 25 g of $NaCl$	0.43 mole
2. 125 g of $H_2SO_4$	1.28 moles
3. 100. g of $KMnO_4$	0.633 mole
4. 74 g of $KCl$	0.99 mole
5. 35 g of $CuSO_4 \cdot 5H_2O$	0.14 mole

Determine the number of grams in each of the quantities below.

1. 2.5 moles of $NaCl$	145 g
2. 0.50 moles of $H_2SO_4$	49g
3. 1.70 moles of $KMnO_4$	269g
4. 0.25 moles of $KCl$	19g
5. 3.2 moles of $CuSO_4 \cdot 5H_2O$	800g

Page 50

Name \_\_\_\_\_

### THE MOLE AND VOLUME

For gases at STP (273 K and 1 atm pressure), one mole occupies a volume of 22.4 L. What volume will the following quantities of gases occupy at STP?

1. 1.00 mole of $H_2$	22.4 L
2. 3.20 moles of $O_2$	71.7 L
3. 0.750 mole of $N_2$	16.8 L
4. 1.75 moles of $CO_2$	39.2 L
5. 0.50 mole of $NH_3$	11.2 L
6. 5.0 g of $H_2$	56 L
7. 100. g of $O_2$	70.0 L
8. 28.0 g of $N_2$	22.4 L
9. 60. g of $CO_2$	31 L
10. 10. g of $NH_3$	13 L

Page 51

Name \_\_\_\_\_

### THE MOLE AND AVOGADRO'S NUMBER

One mole of a substance contains Avogadro's Number ( $6.02 \times 10^{23}$ ) of molecules.

How many molecules are in the quantities below?

1. 2.0 moles	$1.2 \times 10^{24}$
2. 1.5 moles	$9.0 \times 10^{23}$
3. 0.75 mole	$4.5 \times 10^{23}$
4. 15 moles	$9.0 \times 10^{24}$
5. 0.35 mole	$2.1 \times 10^{23}$

How many moles are in the number of molecules below?

1. $6.02 \times 10^{23}$	1.00
2. $1.204 \times 10^{24}$	2.00
3. $1.5 \times 10^{24}$	0.00025
4. $3.4 \times 10^{24}$	560
5. $7.5 \times 10^{24}$	0.00012

Page 52

Name \_\_\_\_\_

### MIXED MOLE PROBLEMS

Solve the following problems.

1. How many grams are there in $1.5 \times 10^4$ molecules of $CO_2$ ?	$1.1 \times 10^3$ g
2. What volume would the $CO_2$ in Problem 1 occupy at STP?	$5.6 \times 10^2$ liters
3. A sample of $NH_3$ gas occupies 75.0 liters at STP. How many molecules is this?	$2.02 \times 10^{24}$ molecules
4. What is the mass of the sample of $NH_3$ in Problem 3?	56.9 g
5. How many atoms are there in $1.3 \times 10^{24}$ molecules of $NO_2$ ?	$3.9 \times 10^{22}$ atoms
6. A 5.0 g sample of $O_2$ is in a container at STP. What volume is the container?	3.5 liters
7. How many molecules of $O_2$ are in the container in Problem 6? How many atoms of oxygen?	$9.4 \times 10^{22}$ molecules $1.9 \times 10^{23}$ atoms

Page 53