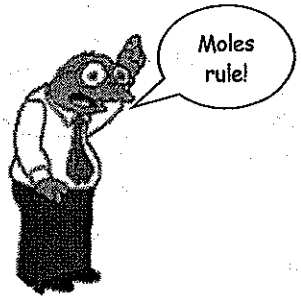
Molar Mass Lab

Name: KEY Date: _____



Around the room you will find several stations with different items at them. Follow the directions for each station in order to gain practice in molar calculations.

Station 1 – Determine the number of molecules in a mouthful of water

= show your work!!

1. Obtain a cup of water and record its mass here: _____ g
2. Drink one mouthful of water, then take the mass of the cup again and record here: _____ g

Calculations:

1. How many grams of water did you drink?

mass before drinking − mass after drinking = [___ g]

2. Determine the molar mass of water.

H_2O $2 \times 1.0 = 2.0$, $1 \times 16.0 = 16.0$, $+$ = [18.0 g/mol]

3. How many moles of water did you swallow?

$$\frac{\text{___ g} \mid 1 \text{ mol}}{18.0 \text{ g}} = \text{[___ moles]}$$

4. How many molecules of water are in 1 mole?

[6.02×10^{23} molecules]

5. How many molecules of water did you swallow?

$$\frac{\text{___ mol} \mid 6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = \text{[___ molecules]}$$

6. Why DON'T you need to find the mass of the cup without the water to solve the above problems?

Because you only need to know the difference in water

Station 2 – Determine the number of chalk molecules required to draw a picture.

1. Obtain a piece of chalk and record its mass here: _____ g
2. Use the chalk to draw a picture on a piece of paper, then take the mass of the chalk again and record here: _____ g

Calculations:

1. How many grams of chalk did you use?

Initial mass − final mass = [___ g]

2. Determine the molar mass of chalk ($CaCO_3$).

$1 \times Ca \rightarrow 40.1$ g/mol $+$
$1 \times C \rightarrow 12.0$ g/mol $+$
$3 \times O \rightarrow 48.0$ g/mol $=$ [100.1 g/mol]

3. How many moles of chalk did you use?

$$\frac{\text{\_\_\_\_ g}}{} \left| \frac{1 \text{ mol}}{100.1 \text{ g}} \right. = \text{\_\_\_\_ moles}$$

4. How many molecules of chalk are in 1 mole?

6.02×10^{23} molecules

5. How many molecules of chalk did you use to draw the picture?

$$\frac{\text{\_\_\_\_ moles}}{} \left| \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right. = \text{\_\_\_\_ molecules}$$

Station 3 – Determine the identity of an unknown metal

1. Obtain a pre-measured sample of 1 mole of an unknown metal and record its mass here: ____ g
2. Transfer the unknown metal to an empty beaker, then take the mass of the initial beaker and record it here: ____ g

Calculations:

1. How many grams of unknown metal do you have?

Initial mass - mass of beaker = ~65.3 g

2. Knowing that this amount is equal to one mole, how can you determine what metal you have?

Find the mass that is equivalent on the periodic table

3. What is the identity of the unknown metal?

Zinc

Station 4 – Determine the identity of an unknown metal

3. Obtain a pre-measured sample of 1 mole of an unknown metal and record its mass here: ____ g
4. Transfer the unknown metal to an empty beaker, then take the mass of the initial beaker and record it here: ____ g

Calculations:

4. How many grams of unknown metal do you have?

Initial mass - mass of beaker = ~121.8 g

5. Knowing that this amount is equal to one mole, how can you determine what metal you have?

6. What is the identity of the unknown metal?

Antimony

Station 5 – Determine the identity of an unknown compound – is it lithium chloride or potassium chloride?

1. Obtain a pre-measured sample of 1 mole of the compound and record its mass here: _____ g
2. Transfer the unknown compound to an empty beaker, then take the mass of the initial beaker and record it here: _____ g

Calculations:

1. How many grams of unknown compound do you have?

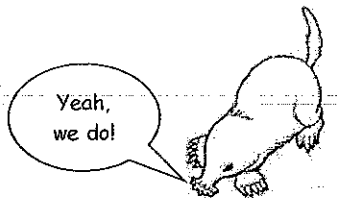
Initial mass - mass of beaker = ~74.6 g

2. Knowing that this amount is equal to one mole, how can you determine what compound you have?

add up the molar masses of LiCl & KCl and compare to value above

3. Is your unknown compound potassium or lithium chloride?

KCl



Station 6– Determine the number of molecules of sugar in a gumball.

1. Obtain a gumball and record its mass here: _____ g
2. Chew the gumball for a few minutes until it tastes like there is no sugar left and record the new mass here: _____ g

Calculations:

1. How many grams of sugar are in the gumball?

Initial mass - final mass = _____ g

2. Determine the molar mass of sugar $C_{12}H_{22}O_{11}$

$12 \times 12.0 = 144.0$ g/mol
$22 \times 1.0 = 22.0$ g/mol
$11 \times 16.0 = 176.0$ g/mol
+ = 342.0 g/mol

3. How many moles of sugar did you swallow?

$$\frac{\text{\_\_\_\_ g} \mid 1 \text{ mol}}{342.0 \text{ g}} = \text{\_\_\_\_ mol}$$

4. How many ~~molecules of sugar~~ are in 1 mole?

6.02×10^{23} molecules

5. How many molecules of sugar did you swallow?

$$\frac{\text{\_\_\_\_ mol} \mid 6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = \text{\_\_\_\_ molecules}$$

Station 7 – Determine the number of molecules of sugar in a snickers bar.

1. Obtain a snickers bar and record the grams of sugar it has here: 27g

Calculations:

1. Record the determined molar mass of sugar ($C_{12}H_{22}O_{11}$) from the previous problem here:

342 g/mol

2. How many moles of sugar are in the snickers bar?

$$27\text{g} \left| \frac{1\text{ mol}}{342\text{g}} \right. = 0.08\text{ mol}$$

3. How many molecules of sugar are in the snickers bar?

$$0.08\text{ mol} \left| \frac{6.02\times10^{23}\text{ molecules}}{1\text{ mol}} \right. = 4.8\times10^{22}\text{ molecules}$$

Station 8 – Complete the following problems at your desk on a separate piece of paper to show your work:

1. What is the volume occupied by each of the following gases at STP?
   a. 10.0g of $H_2S_{(g)}$
   b. 15.0mg of $SbH_{3(g)}$
   c. 5.0×10^{20} molecules of $BrF_{(g)}$
   d. 8.5×10^{25} molecules of $B_2H_{6(g)}$

2. What is the mass of each of the following?
   a. 1 atom of Au
   b. 1.5×10^{15} molecules of AgCl
   c. 250.0mL of $C_3H_{6(g)}$ at STP
   d. 2.00L of $SF_{6(g)}$ at STP

3. How many moles are in each of the following?
   a. 5.00g of $C_{10}H_8$
   b. 525mg of K_3PO_4
   c. 6.00L of $NO_3F_{(g)}$ at STP
   d. 1.00mL of O_3 at STP
   e. 4.55×10^{12} atoms of Pt
   f. 6.022×10^{16} molecules of PCl_5

4. What is the molar mass of each of the following?
   a. A protein molecule having a mass of 1.25×10^{-17}g
   b. 0.179 mol of a substance having a mass of 74.0g
   c. a molecule of anthracene having a mass of 2.96×10^{-22}g
   d. $Na_2S_2O_3 \cdot 5H_2O$
   e. 0.0229 mol of a substance having a mass of 2.13g
   f. $Co_2Fe(CN)_6$

KEY

Moles lab Station 8

(1)

a) $10.0\ g\ H_2S \times \frac{1\ mol}{34.1\ g} \times \frac{22.4\ L}{1\ mol} = \boxed{6.57\ L}$ (2+32.1)

b) $0.015\ g\ SbH_3 \times \frac{1\ mol}{124.8\ g} \times \frac{22.4\ L}{1\ mol} = \boxed{0.0027\ L}$ (3+121.8)

c) $5.0\times10^{20}\ molecules \times \frac{1\ mol}{6.02\times10^{23}\ molecules} \times \frac{22.4\ L}{1\ mol} = \boxed{0.019\ L}$

d) $8.5\times10^{25}\ molecules \times \frac{1\ mol}{6.02\times10^{23}\ molecules} \times \frac{22.4\ L}{1\ mol} = \boxed{3162.8\ L}$

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(2)

a) $1\ atom\ Au \times \frac{1\ mol}{6.02\times10^{23}\ atoms} \times \frac{197.0\ g}{1\ mol} = \boxed{3.3\times10^{-22}\ g}$ (197.0)

b) $1.5\times10^{15}\ molecules\ AgCl \times \frac{1\ mol}{6.02\times10^{23}\ molecules} \times \frac{232.5\ g}{1\ mol} = \boxed{5.8\times10^{-7}\ g}$ (107.0 + 35.5 = 232.5)

c) $.250\ L\ C_3H_6 \times \frac{1\ mol}{22.4\ L} \times \frac{42.0\ g}{1\ mol} = \boxed{0.47\ g}$ (12×3=36+6=42)

d) $2.00\ L\ SF_6 \times \frac{1\ mol}{22.4\ L} \times \frac{146.1\ g}{1\ mol} = \boxed{13.0\ g}$ (32.1+(6×19.0)=134.1)

(3)

a) $5.00\,g\ C_{10}H_8 \left| \frac{1\ mol}{128.0\ g} \right. = 0.04\ mol$ ($12\times10=120+8=128$)

b) $.525\,g\ K_3PO_4 \left| \frac{1\ mol}{212.3\ g} \right. = 0.002\ mol$ ($(39.1\times3)+31.0+(4\times16)=$)

c) $6.00\,K \left| \frac{1\ mol}{22.4\ K} \right. = 0.27\ mol$

d) $.001\,K \left| \frac{1\ mol}{22.4\ K} \right. = 4.5\times10^{-5}\ mol$

e) $4.55\times10^{12}\ atoms \left| \frac{1\ mol}{6.02\times10^{23}\ atoms} \right. =$

$7.6\times10^{-12}\ mol$

f) $6.022\times10^{16}\ molecules \left| \frac{1\ mol}{6.02\times10^{23}\ molecules} \right. = 1.0\times10^{-7}\ mol$

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(4)

a) N/A

b) $\frac{74.0\,g}{0.179\ mol} = 413.4\ g/mol$

c) N/A

d) $[(23.0\times2)+(32.1\times2)+(3\times16.0)]\times(5\times\underset{H_2O}{18.0}) = 14238.0\ g/mol$

e) $\frac{2.13\,g}{0.0229\ mol} = 93.0\ g/mol$

f) $(59.0\times2)+56.0+(6\times12.0)+(6\times14.0) = 330.0\ g/mol$