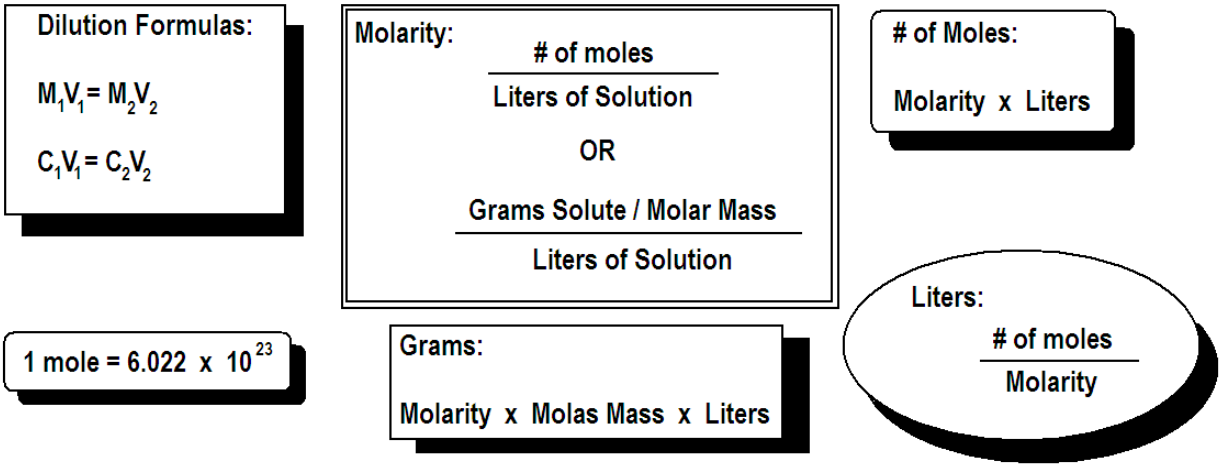
Grams and Liters Molarity Calculations Worksheet

Name _____ Period _____

Molarity is the number of moles of solute dissolved in one liter of solution. The units, therefore are **moles per liter**, specifically it's **moles of solute** per **liter of solution**. Rather than writing out moles per liter, these units are abbreviated capitol **M.**



Example 1: What is the Molarity of a 3L solution containing 5.00 moles of NaOH?

M = Moles
liter of solution

M = 5.00 moles
3 liters of solution

M = 1.67 moles/liter

Example 2: What is the Molarity of a 10L solution containing 5.00 moles of Na_2CO_3?

M = Moles
liter of solution

M = 5.00 moles
10 liters of solution

M = .5 moles/liter

Problems:

Solution Description	**Molarity:**
1. 4.67 moles of Li_2SO_3 dissolved to make 2.04 liters of solution.	
2. 0.629 moles of Al_2O_3 to make 1.500 liters of solution.	
3. 8.00 moles of EDTA to make 7.56 liters of solution	

We can also determine the moles of solute in a solution if we know the volume and the Molarity.

<u>Example 3:</u> How many moles of Na_2CO_3 are there in 10.0 L of 2.0 M solution?

moles = liter of solution x Molarity

moles = 10.0 L x 2.0 M

moles = 20

Problems:

Solution Description	**# Moles:**
1. How many moles of $Cu(NO_3)_2$ are in 3.35 liters of a 2.00 M $Cu(NO_3)_2$ solution?	
2. How many moles of $MgCO_3$ are in 3.00 liters of a 1.50 M $MgCO_3$ solution?	
3. How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?	
4. How many moles of $Cu(NO_3)_2$ are contained in 2.35 liters of a 2.00 M solution?	
5. How many moles of $Pb(NO_3)_2$ are contained in 160.0 mL of a 0.415 Molar solution?	
6. How many moles of $MgCO_3$ are contained in 3.00 L of a 0.500 M solution?	
7. How many moles of Na_2O are contained in 6.20 L of a 3.76 Molar solution?	

We can also determine the number of liters of a solution to use if we know the number of moles needed and the Molarity of the solution

<u>Example 4:</u> What volume (in mL) of 18.0 M H_2SO_4 is needed to contain 2.45 moles H_2SO_4?

$$\text{liters of solution} = \frac{\text{moles of solute}}{\text{Molarity}}$$

$$\text{liters of solution} = \frac{2.45 \text{moles}}{18.0 \text{ M}}$$

liters of solution = .136 = 136 mL

Problems:

Solution Description	**# Liters:**
1. What will be the final volume of a solution containing 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution?	
2. What will be the final volume of a solution containing 4.907 moles of Al_2O_3 to make a 0.500 M solution?	

We can substitute Moles in the equation and use the following:

$$\textbf{Liters of solution} = \frac{\textbf{grams of solute} \div \textbf{molar mass}}{\textbf{Molarity}}$$

Example 5: What will be the final volume of a solution containing 45.7 g of NaOH to make a .5 M solution?

liters of solution = $\frac{45.7 \text{ g} \div 39.99 \text{ g/mole}}{0.50 \text{ M}}$

liters of solution = 2.29 L

Problems:

Solution Description	# Liters:
1. What will be the final volume of a solution containing 0.783 grams of Na_2CO_3 to make a 34.8 M solution?	
2. What will be the final volume of a solution containing 8.97 grams of $(NH_4)_2CO_3$ to make a 0.250 Molar solution?	
3. What will be the final volume of a solution containing 48.00 grams of $PbCl_2$ to form a 5.0 Molar solution?	

We can also determine the Molarity of a solution if we know the number of grams and the volume of the solution.

$$\textbf{M} = \frac{\textbf{grams of solute} \div \textbf{molar mass}}{\textbf{liter of solution}}$$

Example 6: What is the Molarity of a 3L solution containing 5.00 g of NaOH?

M= $\frac{\text{grams of solute} \div \text{molar mass}}{\text{liter of solution}}$

M= $\frac{5.00 \text{ grams} \div 39.99 \text{ g/mole}}{3 \text{ liters of solution}}$

M= .042 moles/liter

Problems:

Solution Description	Molarity:
1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?	
2. What is the molarity of a solution containing 5.30 g of Na_2CO_3 dissolved in 400.0 mL solution?	
3. What is the molarity of a solution containing 5.00 g of NaOH dissolved in 750.0 mL of solution?	
4. What is the molarity of a solution containing 4.783 grams of Na_2CO_3 dissolved in 1.00 liters of solution?	
5. What is the molarity of a solution containing 8.97 grams of $(NH_4)_2CO_3$ dissolved in 250 mL of solution?	
6. What is the molarity of a solution containing 0.348 grams of $PbCl_2$ dissolved in 45.0 mL of solution?	

Rearranging the equation above we can easily calculate the amount of chemical needed in grams for a solution of a given final volume and Molarity.

grams of chemical = M x molar mass x liter of solution

Notice that the units cancel and you are left with grams.

Example 7: How many grams of $Cu(NO_3)_2$ are needed to make 0.289 liters of a 0.0300 M $Cu(NO_3)_2$ solution?

Grams = M x molar mass x liter of solution

Grams = 0.0300 moles/liter x 187.57g/mole x 0.289 liters

Grams = 1.63

Problems:

Solution Description	Grams
1. How many grams of $Pb(NO_3)_2$ are needed to make 16.00 milliliters of a 5.90 Molar $Pb(NO_3)_2$ solution?	
2. How many grams of NaF are needed to make 508 mL of a 2.75 Molar NaF solution?	
3. How many grams of Na_2O are needed to make 6.20 L of a 3.76 Molar Na_2O solution?	
4. How many grams of KCl are needed to make 0.500 L of a 1.00 M KCl solution?	
5. How many grams of $CaCl_2$ are needed to make 4.35 L of a 3.50 M $CaCl_2$ solution?	
6. How many grams of $Ca(OH)_2$ are needed to make 100.0 mL of 0.250 M solution?	
7. What weight (in grams) of KCl is there in 2.50 liters of 0.50 M KCl solution?	

Grams Calculation

Grams/Moles Calculations: Given the following, find the number of grams. (Molar Mass X Moles):

Problem:	Grams:	Problem:	Grams:
1) 4 moles of $Cu(CN)_2$		5) 9.3×10^{-3} moles of SmO	
2) 5.6 moles of C_6H_6		6) 6.6 moles of ZnO	
3) 21.3 moles of $BaCO_3$		7) 5.4 moles of K_2SO_4	
4) 1.2 moles of $(NH_4)_3PO_3$		8) 88.4 moles of NI_3	

Determine the grams of solute to prepare these solutions:

Problem:	Grams:	Problem:	Grams:
a) 0.289 liters of a 0.00300 M $Cu(NO_3)_2$ solution.		d) 6.20 L of a 3.76-molar Na_2O solution.	
b) 16.00 milliliters of a 5.90-molar $Pb(NO_3)_2$ solution.		e) 0.500 L of a 1.00 M KCl solution.	
c) 508 mL of a 2.75-molar NaF solution.		f) 4.35 L of a 3.50 M $CaCl_2$ solution.	

Determine the final volume of these solutions:

Problem:	**Liters:**	**Problem:**	**Liters:**
a) 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution.		d) 8.97 grams of $(NH_4)_2CO_3$ to make a 0.250-molar solution.	
b) 4.907 moles of Al_2O_3 to make a 0.500 M solution.		e) 48.00 grams of $PbCl_2$ to form a 5.0-molar solution.	
c) 0.783 grams of Na_2CO_3 to make a 0.348 M solution.			

Summary Problems:

Use what you know about the molarity problems we have figured out so far to answer the following problems:

Problem:	**Answer:**
1) Find the number of moles of the solute of 2.5 L of a 4.6 M Ag_2SO_4 solution.	
2) Find the number of moles in 0.5 L of a 2.1 M NaOH solution.	
3) Find the volume of 5.3 moles of NaCl dissolved to make a .51 M solution.	
4) What is the volume (in liters) of 4.67 moles of KCl dissolved to make a 3.7 M solution?	
5) Find the Molarity given 3.48 moles of CH_3COOH in 14.3 L.	
6) Given 22.98 g of HBr in 8.4 L, what is the Molarity?	
7) 247.3 g of $C_6H_{12}O_6$ 9.9 L Using this information, find the Molarity.	
8) Find the number of grams needed to make 3.08 L of a .27 M KCN solution.	

Grams/Moles Calculations – Answer Key *Given the following, find the number of moles:*

1) 30 grams of H_3PO_4 **0.31 moles**

2) 25 grams of HF **1.25 moles**

3) 110 grams of $NaHCO_3$ **1.31 moles**

4) 1.1 grams of $FeCl_3$ **0.0068 moles**

5) 987 grams of $Ra(OH)_2$ **3.80 moles**

6) 564 grams of copper **0.11 moles**

7) 12.3 grams of CO_2 **0.28 moles**

8) 89 grams of $Pb(CH_3COO)_4$ **0.20 moles**

Given the following, find the number of grams:

9) 4 moles of $Cu(CN)_2$ **462 grams**

10) 5.6 moles of C_6H_6 **436.8 grams**

11) 21.3 moles of $BaCO_3$ **4202.5 grams**

12) 1.2 moles of $(NH_4)_3PO_3$ **159.6 grams**

13) 9.3×10^{-3} moles of SmO **1.5 grams**

14) 6.6 moles of ZnO **537.2 grams**

15) 5.4 moles of K_2SO_4 **941.2 grams**

16) 88.4 moles of NI_3 **34679.3 grams**