Name:_______________________
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Chemistry 11
Calculating Mixed Mole Problems

Amedeo Avogadro **(1776 - 1856)**, a famous lawyer-turned-mathematician-physicist, proposed that **1 mole of a substance** is the number of atoms of ^{12}carbon in 12.0 grams of ^{12}carbon. Scientists have now calculated that the number of atoms in 12.0 grams of ^{12}carbon to be **6.02 x 10^{23}** atoms; this value is referred to as **"Avogadro's Number".**

HOW BIG IS A MOLE?

- **The mole is just a number**
- **We all know the numerical equivalent to 1 dozen = 12 "anything"**
- **So, 1 mole = 6.02 x 10^{23} "anything"!**

So we can use this to establish a number of unit conversions:

- **1 mole of Ag means there are 6.02 x 10^{23} atoms**

1 mole Ag	**OR**	**6.02 x 10^{23} atoms Ag**
6.02 x 10^{23} atoms Ag		**1 mole Ag**

- **1 mole of AgCl means there are 6.02 x 10^{23} moleclules AgCl**

1 mole AgCl	**OR**	**6.02 x 10^{23} molecules AgCl**
6.02 x 10^{23} Molecules AgCl		**1 mole AgCl**

RECALL FROM our previous lessons that:

- 1 mole of Ag is known to have a mass of 107.9 grams (Periodic Table)

1 mole Ag	OR	107.9 g Ag
107.9 g Ag		1 mole Ag

- 1 mole of AgCl means there are 143.4 g AgCl (sum of values from PT)

1 Ag = 1 (107.9) = 107.9 g
1 Cl = 1 (35.5) = 35.5 g
143.4 g/mole

1 mole AgCl	OR	143.4 g AgCl
143.4 g AgCl		1 mole Ag

- 1 mole of any gas at STP occupies 22.4 L

1 mole gas	OR	22.4 L
22.4 L		1 mole gas

NEW!!!!:

If you have a molecule then it contains a specific number of atoms:

1 molecule of C_6H_{14} has:

6 atoms of C, 14 atoms of H or 20 atoms in 1 molecule

1 molecule C_6H_{14}	6 atoms C	or	1 molecule C_6H_{14}	14 atoms H	or	1 molecule C_6H_{14}	20 atoms
6 atoms C	1 molecule C_6H_{14}		14 atoms H	1 molecule C_6H_{14}		20 atoms	1 molecule C_6H_{14}

Mole Diagram:

Mixed mole calculations:

Here are sample calculations that you will be asked, calculate the:

A. **mass** of a substance when given either the volume (at STP), number of atoms (if an element) or number of molecules (if a compound)
B. **volume** of a gas at STP when given either the mass, number or atoms (if an element) or number of molecules (if a compound)
C. **number of atoms (if an element) or number of molecules (if a compound)** when given either the mass, or volume of a compound at STP.

Example A: How many **grams** are in 50.0 L of Oxygen gas at STP?

1st: identify that you have the **volume of a gas** at STP and must use **22.4 L/ mole**
2nd: you are asked to **determine mass**:calculate the **molar mass** of oxygen(O_2)

2 O = 2 (16.0) = **32.0 g/mol**

Then set up your expression to allow for unit conversions:

50.0 L O_2 (g)	1 mole	32.0 g	= 71.4 g O_2 (g)
	22.4 L O_2 (g)	1 mole O_2	

Example B: How **much volume** does 9.03 x 10^{24} molecules of Carbon dioxide gas at STP?

1st: identify that you are **given molecules** so **6.02 x 10^{23} molecules in 1 mole**
2nd: identify that you are asked to **determine volume** at STP so use: **22.4 L/ mole**

Then set up your expression to allow for unit conversions:

9.03 x 10^{24} m.c CO_2	1 mol CO_2	22.4 L CO_2	= 336 L CO_2 (g)
	6.02 x 10^{23} m.c. CO_2	1 mol CO_2 (g)	

Example C: How many **Carbon atoms** are there in 435.0 g of $C_6H_{12}O_6$?

1st: identify that you have a **mass** and must calculate the molar mass of $C_6H_{12}O_6$

6 C = 6 (12.0) = 72.0 g
12 H = 12 (1.0) = 12.0 g
6 O = 6 (16.0) = **96.0 g**
180.0 g/ mol

2nd: identify that you have a molecule that contains atoms so need two conversions:

1 mol $C_6H_{12}O_6$	and	1 molecule $C_6H_{12}O_6$
6.02 x 10^{23} m.c. $C_6H_{12}O_6$		6 atoms C

Then set up your expression to allow for unit conversions:

435.0 g $C_6H_{12}O_6$	1 mole $C_6H_{12}O_6$	6.02 x 10^{23} m.c. $C_6H_{12}O_6$	6 atoms C	= 8.73 x 10^{24} atoms C
	180.0 g	1 mole $C_6H_{12}O_6$	1 m.c $C_6H_{12}O_6$	

Seatwork/ Homework Ex: 22-24 pgs 86 & 87