Name: Key
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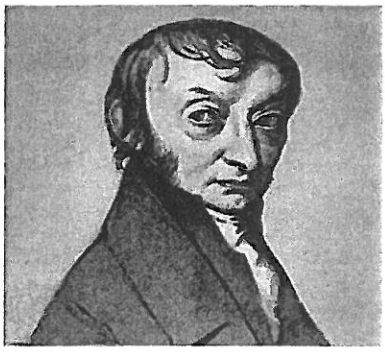
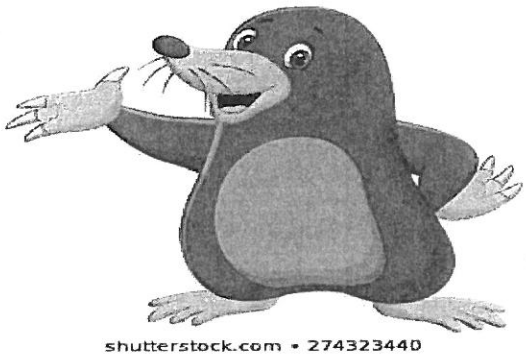
Chemistry 11
Calculating Mixed Mole Problems

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 $6.02 \cdot 10^{23}$ atoms; this value is referred to as "Avogadro's Number"





matter
↙ Pure Substances ↘
Elements | Compounds
Molecules

HOW BIG IS A Mole ?

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

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

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

1 mol Ag / $6.02 \cdot 10^{23}$ atoms Ag	**OR**	$6.02 \cdot 10^{23}$ atoms Ag / 1 mol Ag

- **1 mole of AgCl means there are $6.02 \cdot 10^{23}$ molecules AgCl**

1 mol AgCl / $6.02 \cdot 10^{23}$ m.c AgCl	**OR**	$6.02 \cdot 10^{23}$ m.c AgCl / 1 mol AgCl

Atoms in a molecule

mass

Molecules

The mole

Mole Diagram:

Atoms of Element

Volume

RECALL FROM our previous lessons that:

- **1 mole of Ag is known to have a mass of** 107.9 g Ag

1 mol Ag	OR	107.9 g Ag
107.9 g Ag		1 mol Ag

- **1 mole of AgCl means there are** (sum of values)

1 Ag = 107.9
1 Cl = 35.5
143.4 g / 1 mol

1 mol AgCl	OR	143.4 g AgCl
143.4 g AgCl		1 mol AgCl

- **1 mole of any gas at STP occupies** 22.4 L

1 mol	OR	22.4 L
22.4 L		1 mol

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 C_6H_{14}**

6 atoms C	1 m.c C_6H_{14}	or	14 atoms H	1 m.c C_6H_{14}
1 m.c C_6H_{14}	6 atoms C		1 m.c C_6H_{14}	14 atoms H

20 atoms	1 m.c C_6H_{14}
1 m.c C_6H_{14}	20 atoms

Mixed mole calculations:

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

A C. **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, D. **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 / 1 mol

2nd: you are asked to **determine mass**:calculate the **molar mass** of oxygen(O_2)

$2(16.0) = 32.0$ g / 1 mol O_2

Then set up your expression to allow for unit conversions:

50.0 L	1 mol O_2 / 22.4 L	32.0 g / 1 mol O_2	= 71.4 g O_2

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

1st: identify that you are **given molecules** so $6.02 \cdot 10^{23}$ m.c CO_2 / 1 mol

2nd: identify that you are asked to **determine volume** at STP so use: 22.4 L / 1 mol

Then set up your expression to allow for unit conversions:

$9.03 \cdot 10^{24}$ m.c CO_2	1 mol / $6.02 \cdot 10^{23}$ m.c CO_2	22.4 L / 1 mol	= $3.36 \cdot 10^{2}$ L

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

$6\ C = 6(12.0) = 72.0$

$12\ H = 12(1.0) = 12.0$

$6\ O = 6(16.0) = 96.0$

180.0 g / 1 mol

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

1 mol / $6.02 \cdot 10^{23}$ m.c	and	6 atoms C / 1 m.c $C_6H_{12}O_6$

Then set up your expression to allow for unit conversions:

435.0 g	1 mol / 180.0 g	$6.02 \cdot 10^{23}$ m.c / 1 mol	6 atoms C / 1 m.c	= $8.73 \cdot 10^{24}$ atoms C

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