

Bellringer: 4/24/2017

1. Use a reference table and determine the value of Avogadro's number.
2. STOTD

****You need a calculator today**

Updates & Reminders:

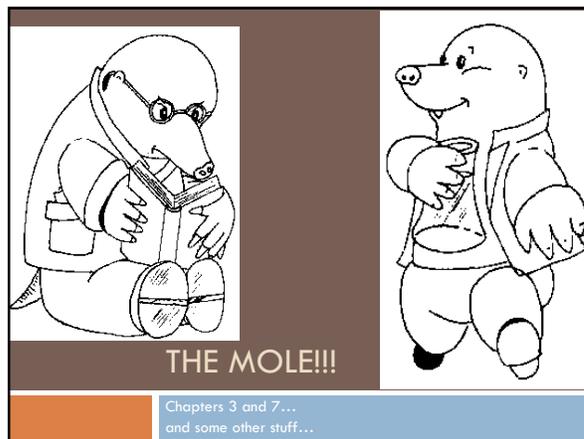
Monday: Start Unit 7: The Mole! Dimensional Analysis & 1 step Conversions

Tuesday: Unit 7: 2 Step Conversions & % Composition

Wednesday: Unit 7: Empirical & Molecular Formulas

Thursday: Unit 7: Practice Problems. Aquarium Field Trip

Friday: Unit 7: **MOLE QUIZ/TEST**



What is a Mole?

- Definition:
 - ▣ A small burrowing animal
 - ▣ A small blemish on the human skin, normally dark in color
 - ▣ *The molecular weight of a substance expressed in grams*

Measurement

- Dimensional Analysis
 - ▣ Method to solve problems focused on the units
 - ▣ Works using conversion factors
 - ▣ 1000 m = 1 km or 100 cm = 1 m
 - ▣ Having conversion factors allows us to cancel units

Conversion Factors

- Examples of Conversion factors

$$\frac{100\text{centimeters}}{1\text{meter}} = \frac{1\text{meter}}{100\text{centimeters}}$$

$$\frac{1000\text{mm}}{1\text{m}} = \frac{12\text{inches}}{1\text{foot}} = \frac{1\text{min}}{60\text{s}}$$

$$\frac{365\text{days}}{1\text{year}} = \frac{24\text{hr}}{1\text{day}} = \frac{60\text{min}}{1\text{hr}}$$

Measurements

- Convert the following:
 - 5.712 g = ___ kg
 - 4.8 cm = ___ m
 - 4 days = ___ s
- Scientists also must convert more than 1 unit at once
 - ▣ Convert:
 - 36 m/s = ___ km/hr
 - 25 000 mm/hr = ___ m/s

Counting Atoms

- Counting individual atoms is ANNOYING!
 - ▣ They are really small!
 - ▣ Lots of them!
- We count atoms in groups (like a dozen) known as a **Mole (mol)**, using Avogadro's number as a conversion factor:
 - ▣ Avogadro's Number = $\frac{6.022 \times 10^{23} \text{ particles}}{1 \text{ mole}}$

end

How?

- When doing mole conversions:
 1. Write down what you have (the number given to you)
 2. Decide what conversion factor to use
 3. Use dimensional analysis determine the answer
 4. Make sure your units cancel!

****You must include units in ALL calculations for this Unit.**

Counting Atoms

- How many molecules of sucrose are in 3.50 mol of sucrose?
- How many moles of zinc contain 4.50×10^{24} atoms of Zn?
- How many molecules of carbon dioxide are in 15.7 mol?
- 9.22×10^{23} atoms of Fe contain how many moles?

end

Conversion Factor: Molar Mass

Average Atomic Mass, on the Periodic Table

- ▣ Given in Atomic Mass Units (amu)
- ▣ Molar Mass
 - ▣ Mass in grams of 1 mol of any element
 - ▣ On the Periodic Table
 - ▣ Units are g/mol
 - ▣ 12.011 g of C = 1 mol of C = 6.022×10^{23} atoms of C

How the conversion factor is written:

$$\frac{12.011 \text{ g}}{1 \text{ mol}} \quad \text{OR} \quad \frac{1 \text{ mol}}{12.011 \text{ g}}$$

end

Molar Mass

- How many moles of Cu are in a roll of wire that has a mass of 848 g?
- What is the mass of 0.625 mol of Ca?
- How many moles are found in 6.89 g of antimony?
- What is the mass of 0.070 mol of Se?

end

Moles of Compounds

- The subscripts of a formula tell you the number of moles of each element in 1 mol of the compound
 - ▣ 1 mol of NH_3
 - ▣ 1 mol of N
 - ▣ 3 mol of H
- Add up the molar masses of each element to get the Molar Mass of the Compound
 - ▣ NH_3

end

Moles of Compounds

□ What is the molar mass of the following:

- KCl
- KMnO_4
- Na_2SO_4
- $(\text{NH}_4)_3\text{PO}_4$

end

Bellringer:

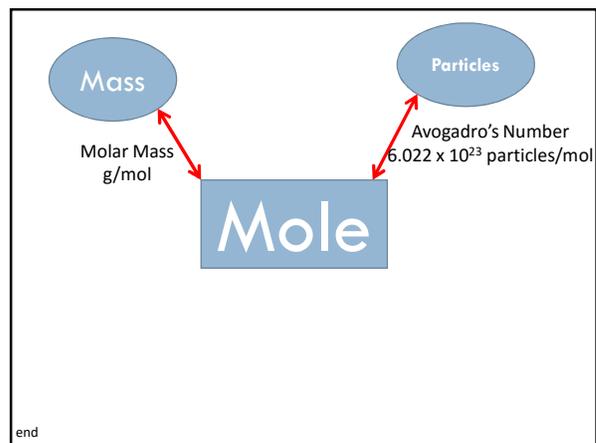
1. Get out your Significant figures worksheet and answer 11-15 on both sides.
2. What is the purpose of Avogadro's number?
3. STOTD

Bellringer:

□ What is the molar mass of the following:

1. KCl
2. KMnO_4
3. Na_2SO_4
4. $(\text{NH}_4)_3\text{PO}_4$

□ STOTD



end

Molar Mass

□ Use moles to get from particles to mass

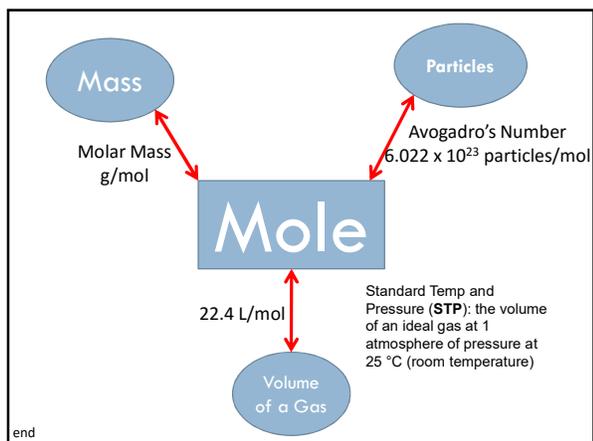
- How many atoms of Pb are in 4.77 g?
- What is the mass of 3.67×10^{30} atoms of Na?
- 56.9 g of Hafnium contain how many atoms?
- 4.33×10^{12} atoms of B make up how many moles?

end

Moles of Compounds

- How many moles of water are in 1000. g of water?
- What is the mass of 34.2 mol of H_2SO_4 ?
- How many moles of benzene (C_6H_6) are found in 17.2 g?
- How many molecules are found in 25.9 g of NH_4NO_3 ?

end



Moles of Compounds

- What volume will the following gases will occupy:
 - 3.20 mol O_2
 - 0.750 mol N_2
 - 5.0 g H_2
 - 60. g of CO_2

Percent Composition

- Percent Composition
 - Percent **by mass** of each element in a compound

$$\% \text{ composition} = \frac{\text{mass of element in 1 mol of compound}}{\text{molar mass of compound}} \times 100$$

end

Percent Composition

- Determine the percent composition of each element in CaCl_2 .
- Determine the percent composition of each element in Be(OH)_2 .
- Determine the percent composition of each element in Al_2O_3 .
- Determine the percent composition of each element in $\text{Mg(NO}_3)_2$.

end

Bellringer:

1. Determine the percent composition of each element in Al_2O_3 .
2. How many molecules are found in 25.9 g of NH_4NO_3 ?
3. STOTD

****UPDATE: Mole Quiz on WEDNESDAY Nov 30**

Empirical Formulas

- Percent Composition data is used to identify unknown compounds
- Empirical Formula
 - Simplest whole number ratio of elements in a compound

end

Empirical Formulas

Steps to writing Empirical Formulas:

1. Convert "%" into grams
Adds up to 100 g
2. Convert grams of each element to moles
3. Divide by the smallest number of moles
4. Write Subscripts

end

Empirical Formulas

Find the empirical formula of:

- An unknown compound has a % composition of 38.43% Mn, 16.80% C, and 44.77% O.
- Acetic acid has a % composition of 40.00% C, 6.71 % H, 53.29% O.

end

Molecular Formulas

To determine the Molecular Formula:

- Divide the **Molecular Formula mass** by the **Empirical Formula mass**

$$\frac{\text{Molecular Formula Mass}}{\text{Empirical Formula Mass}} = \text{Molecular Formula Integer}$$

- Multiply the subscripts in the empirical formula by the integer to get the new subscripts for the molecular formula

end

Practice

- Earlier we found the empirical formula for Acetic Acid, in this problem: Acetic acid has a % composition of 40.00% C, 6.71 % H, 53.29% O.
- Notice that Acetic Acid's Empirical Formula is NOT the correct formula you already know, which is $C_2H_4O_2$
- If Acetic Acid's molar mass is 60.052 g/mol, what is the Molecular Formula?

Molecular Formulas

- The empirical formula of trichloroisocyanuric acid is $OCNCl$. If the molar mass is 232.41 g/mol, what is the molecular formula?
- The composition of maleic acid 41.39% C, 3.47% H and 55.14 % O. What are the empirical and molecular formulas if the molar mass of maleic acid is 116.1 g/mol?
- The composition of silver oxalate is 71.02% silver, 7.91% carbon, and 21.07% oxygen. If the molar mass is 303.8 g/mol what is the molecular formula?

end

More Practice

- #1-5 on page 56 in packet