The Mole and Its Applications **Name**_____

Molar Mass and More Mole Conversion Problems

Read from **Lesson 2: Quantitative Analysis of Compounds** in the **Chemistry Tutorial Section, Chapter 7** of **The Physics Classroom**:

Part a: Molar Mass Part b: Grams-Moles-Particles Relationship

Part 1: Molar Mass

1. The molar mass of a substance is the mass in grams of 1 mole of that substance. Calculate the molar mass of the following compounds.

   a. $C_6H_{12}O_6$ b. $(NH_4)_3PO_4$ c. tetraphosphorus pentaoxide

   d. vanadium (IV) permanganate e. iron (III) sulfate f. acetic acid

2. Hydrates are ionic compounds that contain water molecules as part of their crystal structure and are usually ionic salts. Copper (II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$, is a blue crystalline solid that can be used to control algae growth in swimming pools. To find the molar mass of $CuSO_4 \cdot 5H_2O$, the mass of the ionic salt, $CuSO_4$ (159.61 g/mol) is added to the mass of the five water molecules attached to it (90.1 g/mol) for a total of 249.71 g/mol.

   Calculate the molar masses of these hydrates.

   a. $Na_2CO_3 \cdot 2H_2O$ b. $CoCl_2 \cdot 6H_2O$ c. magnesium sulfate heptahydrate

Part 2: Whole-y Mole-y! More Mole Conversion Problems:

Remember to write out a mole statement before setting up the conversion factors in the calculations.

A mole statement is: **1 mole (of substance) = Avogadro's number of particles = molar mass (grams)**

Like: 1 mole of carbon dioxide = 6.022×10^{23} CO_2 molecules = 44.01 grams CO_2

1 mole of sodium carbonate = 6.022×10^{23} formula units Na_2CO_3 = 105.99 grams Na_2CO_3

1. Ellie Ment exhales 1.208×10^{22} carbon dioxide molecules per day.

   a. How many moles of carbon dioxide does she exhale each day?

   b. How many grams of carbon dioxide does she exhale each day?

   c. How many oxygen atoms does she exhale each day?

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2. The active compound in cocoa powder is theobromine, $C_7H_8N_4O_2$. A packet of hot chocolate contains 65 mg of theobromine.
   a. How many moles of theobromine are in a packet of hot chocolate?

   b. How many molecules of theobromine are in a packet of hot chocolate?

   c. How many carbon atoms does this represent?

3. Aluminum sulfate octadecahydrate, $Al_2(SO_4)_3 \cdot 18H_2O$, is used as a coagulating agent in water purification.
   a. How many atoms are in one formula unit of this hydrate?

   b. What is the molar mass of $Al_2(SO_4)_3 \cdot 18H_2O$?

   c. What is the mass of 3.14×10^{34} formula units of this hydrate?

   d. How many formula units are in one kilogram of this hydrate?

   e. How many oxygen atoms are in one kilogram of this hydrate?