During Class Invention

Atomic Mass Units and Mol

Name(s) with Lab section in Group

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1. According to our discussion in Chapter 2 the atomic mass unit (amu) is related to grams in the following way;

$$1 \text{ amu} = 1.66054 \times 10^{-24} \text{ g}$$

Using this relationship calculate the mass, in grams, of;

a) a gallium atom who has an isotopic mass of 62.96 amu;

$$\mathbf{62.96 \text{ amu} \left(\frac{1.66054 \times 10^{-24} \text{ g}}{1 \text{ amu}}\right) = 1.05 \times 10^{-22} \text{ g}}$$

b) a molecule of the element bromine;

$$\mathbf{159.8 \text{ amu} \left(\frac{1.66054 \times 10^{-24} \text{ g}}{1 \text{ amu}}\right) = 2.65 \times 10^{-22} \text{ g}}$$

c) one formula unit of KI.

$$\mathbf{166 \text{ amu} \left(\frac{1.66054 \times 10^{-24} \text{ g}}{1 \text{ amu}}\right) = 2.76 \times 10^{-22} \text{ g}}$$

2. Calculate the mass, in grams, of each of the following;

a) 1000 gallium atoms;

$$\mathbf{1000 \text{ Ga atoms} \left(\frac{1.05 \times 10^{-22} \text{ g}}{1 \text{ atom}}\right) = 1.05 \times 10^{-19} \text{ g}}$$

b) 6.023×10^{23} gallium atoms;

$$\mathbf{6.022 \times 10^{23} \text{ Ga atoms} \left(\frac{1.05 \times 10^{-22} \text{ g}}{1 \text{ atom}}\right) = 63.2 \text{ g}}$$

c) 6.023×10^{23} molecules of Br_2

$$\mathbf{6.023 \times 10^{23} \text{ Br}_2 \text{ molecules} \left(\frac{2.65 \times 10^{-22} \text{ g}}{1 \text{ molecule}}\right) = 159.6 \text{ g}}$$

d) 6.023×10^{23} formula units of KI

$$\mathbf{6.023 \times 10^{23} \text{ KI f.u.} \left(\frac{2.76 \times 10^{-22} \text{ g}}{1 \text{ f.u.}}\right) = 166 \text{ g}}$$

3. What is interesting about the answers you calculated in 2b, 2c and 2d with regard to the information in 1a, 1b and 1c respectively.

   Notice that the mass in grams for 6.023×10^{23} of a substance is the same number as the mass of the substance in amu's.

   The molar mass is the mass in grams of 1 mol of a substance, and 1 mol of a substance contains 6.023×10^{23} f.u.'s of that substance.

4. What is the mass of 6.023×10^{23} molecules of C_8H_{18}?

   6.023×10^{23} molecules of C_8H_{18} is the number of C_8H_{18} molecules in 1 mol of C_8H_{18}. So all we have to do is determine the molar mass of C_8H_{18}.

   So the mass can be determine by determining the mass of 1 molecule of in amu's (from the periodic table) and than substituting grams for amu's.

   $$\textbf{8 C atoms} \left(\frac{\textbf{12.01 amu}}{\textbf{1 C atom}}\right) = \textbf{96.08 amu}$$

   $$\textbf{18 H atoms} \left(\frac{\textbf{1.0078 amu}}{\textbf{1 H atom}}\right) = \textbf{12.09 amu}$$

   96.08 amu + 12.09 amu = 108.2 amu for the mass of 1 molecule of C_8H_{18}

   108.2 grams is the mass of 1 mol, or 6.023×10^{23} molecules of C_8H_{18}

5. Answer each of the following;

a) How many atoms of hydrogen in one molecule of H_2O?

$$\textbf{1 molecule of } \mathbf{H_2O} \left(\frac{\textbf{2 H atoms}}{\textbf{1 molecule } \mathbf{H_2O}}\right)$$

b) How many atoms of oxygen in one formula unit of $Pb(NO_3)_2$?

$$\textbf{1 formula unit of } \mathbf{Pb(NO_3)_2} \left(\frac{\textbf{6 O atoms}}{\textbf{1 f.u. } \mathbf{Pb(NO_3)_2}}\right)$$

c) How many atoms of carbon in 1 mol of $C_6H_{12}O_6$?

$$\textbf{1 mol of } \mathbf{C_6H_{12}O_6} \left(\frac{\textbf{6.023 x } \mathbf{10^{23}} \textbf{ molecules } \mathbf{C_6H_{12}O_6}}{\textbf{1 mol } \mathbf{C_6H_{12}O_6}}\right) \left(\frac{\textbf{6 C atoms}}{\textbf{1 molecule } \mathbf{C_6H_{12}O_6}}\right)$$