Math Diversion Problem 893

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Theory like mist on eyeglasses — obscures facts.
— Charlie Chan

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Source: https://www.youtube.com/watch?v=9fSiy7-JurA
       video time stamp 46:05
 Title: Working with the amu (atomic mass unit)
  Presenter: The Organic Chemistry Tutor
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Definitions:

FW = Formula weight = molar mass
ppt = precipitate
At wt = atomic weight

1 Problem

Calculate the [average] mass of 25 carbon atoms in amu (atomic mass units) and in grams.

2 Solution

We begin with the definition of the amu: In the modern definition of amu, it is defined as 1/12 the mass of a single ^{12}C atom. Now, I interjected the word 'average' into the question because the author of this question is using the periodic table to get the molar mass of carbon, which is itself an average over all carbon isotopes.

Let's first solve for the mass of 1 carbon atom in terms of amu. Let R stand for the following ratio:

$$R = \frac{\text{mass of one C atom [amu]}}{\text{mass of one } ^{12}\text{C atom [amu]}} = \frac{\text{mass of one C atom}}{12\,\text{amu}}\,. \tag{1}$$

But the ratio of the mass of carbon to mass of ^{12}C is independent of the units used. Hence, we can employ moles of atoms instead of individual atoms, to get:

$$R = \frac{\text{mass of 1 mole C atoms [g]}}{\text{mass of 1 mole } ^{12}\text{C atoms [g]}} = \frac{12.01\text{g}}{12\,\text{g}} = 1.0008\,. \tag{2}$$

On equating the R's from the last two equations and then solving for the mass of one carbon atom, we get

$$\text{mass of one C atom} = (1.0008)(12\,\text{amu}) = 12.01\,\text{amu}\,. \tag{3}$$

So, what I've accomplished is to prove what the YouTube author takes for granted as his starting point in solving this problem. Anyway, the mass of 25 carbon atoms (again, on the average) is 300.25 amu.

The (average) mass in grams of 25 carbon atoms is

$$\begin{aligned} \text{mass} &= 25 \times 12.01\,\text{g}\cdot\text{mol}^{-1} \times \frac{1\text{ mole}}{6.022\ \times 10^{23}\ [\text{particles}]} \\ &= 4.99 \times 10^{-22}\,\text{g}\,. \end{aligned} \tag{4}$$