Avogadro's Number and the Atomic Mass Unit

Prepared by Dr. Matthew Rowley, 2019

Our last quiz question dealt with the relationship between the Atomic Mass Unit (AMU), Avogadro's number (6.022×10^{23}), and the gram.

Avogadro's number is the same as the mol, just like the number 12 is the same as a "dozen"

i.e. $6.022 \times 10^{23} = 1\,mol$ like $12 = 1\,dozen$

A dozen is a useful quantity just because it is a good number of things to have (such as doughnuts).

A mol is a useful quantity because it relates the Atomic Mass Unit to the gram.

$6.022 \times 10^{23}\,AMU = 1\,mol\,AMU = 1\,g$

This relationship is why atomic weights and molar masses can equally use units of AMU *or* $\frac{g}{mol}$

The third question asked:

If a sample weighs $6.34 \times 10^{26}\,AMU$, how many $moles$ of $AMUs$ does it weigh?

Answer: $\frac{6.34 \times 10^{26}\,AMU}{} \left| \frac{1\,mol}{6.022 \times 10^{23}} \right. = 1050\,mol\,AMU$

How many $grams$ does the sample weigh?

Answer: $\frac{1050\,mol\,AMU}{} \left| \frac{1\,g}{1\,mol\,AMU} \right. = 1050\,g$

We can consider the atomic weight of an element to be the conversion factor between grams of a sample and moles of atoms in that sample.

How many g would a $1.75\,mol$ sample of C weigh?

Answer: $\frac{1.75\,mol\,\text{C}}{} \left| \frac{12.011\,g\,\text{C}}{1\,mol\,\text{C}} \right. = 21.0\,g\,\text{C}$

How many moles are in a $12.5\,g$ sample of Fe?

Answer: $\frac{12.5\,g\,\text{Fe}}{} \left| \frac{1\,mol\,\text{Fe}}{55.845\,g\,\text{Fe}} \right. = 0.224\,mol\,\text{Fe}$