1.4: Mole

According to our present state of knowledge, a mass of 12 grams of the ^{12}C isotope of carbon contains $6.022\ 141\ 99 \times 10^{23}$ atoms. This number is called Avogadro's number. A mole of an element is the amount of that element that has the same number of atoms as there are atoms in 12 grams of ^{12}C, and a mole of a compound is the amount of that compound that has the same number of molecules as there are atoms in 12 grams of ^{12}C. Likewise a mole of geese is $6.022\ 141\ 99 \times 10^{23}$ geese and a mole of baseball caps is $6.022\ 141\ 99 \times 10^{23}$ baseball caps.

Why do we define Avogadro's number in terms of 12 grams of carbon-12? This is a long story involving the history of physics and chemistry. None of us was born with a complete knowledge of physics and chemistry and it took a long time to reach our state of knowledge today. We did not always proceed along our path with complete logic, and doubtless, if we did, we might have defined Avogadro's number differently. I am not going to go into the history of how we arrived at this particular definition. Suffice it to say that, if you know that the molecular weight of nitrogen gas (a diatomic molecule) is 28, then 28 grams of nitrogen has Avogadro's number of molecules in it. Indeed the phrase "molecular weight" is not a happy one; it would be better to call it the "molar mass", which is 28 grams.

We might note, however, that when we are doing "SI" calculations, based on MKS units, we shall usually use the kilomole, which is $6.022\ 141\ 99 \times 10^{26}$ molecules.