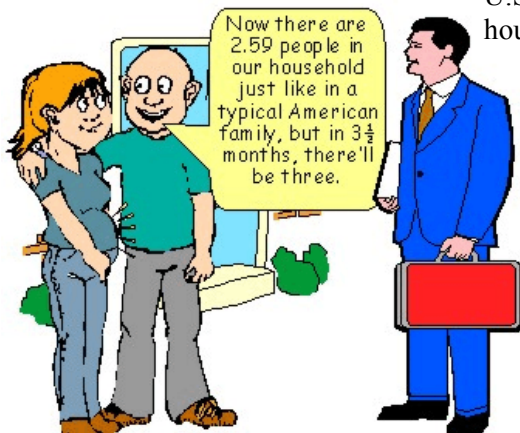


## Average Atomic Mass

According to the *Periodic Table*, carbon has a mass of 12.0111 *amu*. The mass of an atom comes from its protons and neutrons. Carbon has 6 protons. Subtracting the number of protons from the mass to get the number of neutrons gives 6.0111. This result is impossible! There are no fractions of neutrons!! Nonsensical numbers

such as these exist elsewhere. For example, the U.S. Census reports 2.59 people per household in 2000. You can count on the fact that there is no household with 2.59 people. This number is an average.



The average mass is determined by the procedure illustrated in the box to the right. The mass of each isotope is multiplied by its percentage. Then these products are added to find the average.

**Use this procedure to find the average mass for each of the examples below.**

### KEY

Atomic Mass	→	12.0111	-4
Symbol	→	<b>C</b>	+2
Atomic Number	→	<b>6</b>	+4
Electron Configuration	→	2-4	

Likewise, there is no such thing as a carbon atom with a mass of 12.0111 *amu*. The atomic mass listed on the *Periodic Table* is the average mass of the isotopes of carbon. Carbon has two naturally occurring stable isotopes. The large majority of carbon atoms, 98.89%, are  $^{12}\text{C}$ , while only 1.108% are  $^{13}\text{C}$ . That is why the average mass is so close to 12.

### Average Atomic Mass

$$m_{\text{avg}} = p_1m_1 + p_2m_2 + \dots p_nm_n$$

$m_{\text{avg}}$  – average mass;  $p_1$  – percentage of isotope 1;  
 $m_1$  – mass of isotope 1;  $p_2$  – percentage of isotope 2;  
 $m_2$  – mass of isotope 2;  $p_n$  – percentage of isotope  $n$ ;  
 $m_n$  – mass of isotope  $n$ ;  $n$  – the number of isotopes

#### Example

What is the average mass of chlorine if a sample consists of 77.35% Cl-35 and 22.65% Cl-37?

$$\begin{aligned} m_{\text{avg}} &= (0.7735)(35) &+& (0.2265)(37) \\ &= 27.07 &+& 8.381 \\ &= 35.45 \end{aligned}$$

1. An element recently discovered in Spring Valley High School called “valleyum” occurs in the following proportions: 81.75% Vm-500 and 18.25% Vm-502
2. A new element, “schoolium,” found only in schools occurs in the following proportions: 9.750% SI-750 and 90.25% SI-752
3. A new element “newium” has been discovered which occurs in the following proportions: 25.25% Nw-300; 15.25% Nw-301; and 59.50% Nw-302
4. A new element found in the science department office called “departmentium” is found in the following proportions: 11.78% Dt-800; 1.850% Dt-801; and 86.37% Dt-803