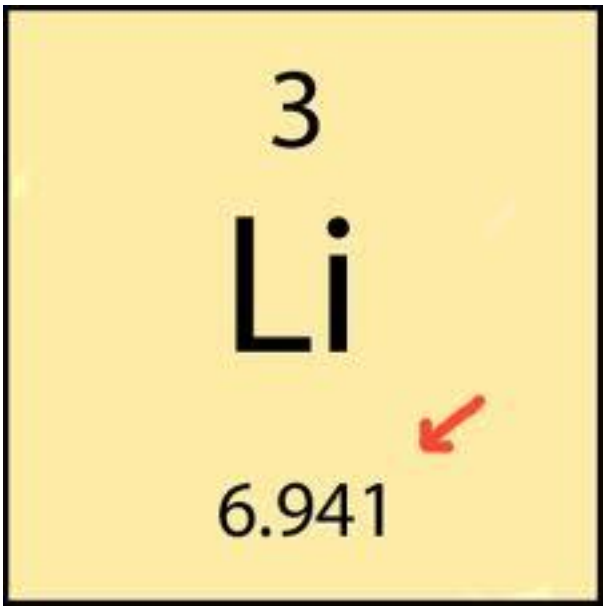
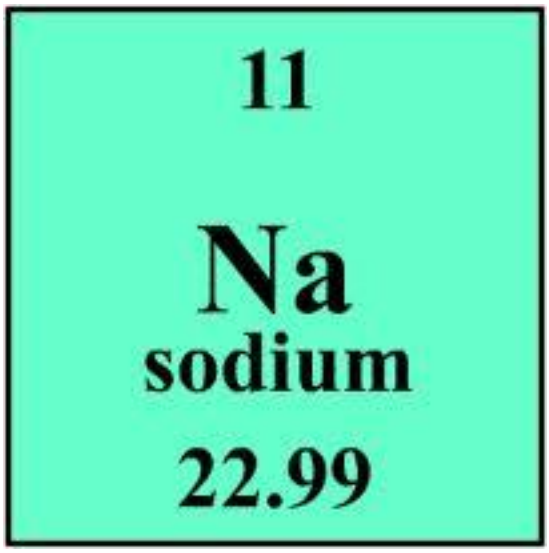
Avagadro's number

Scientists were finding that elements combine in ratios of the elements by mass to form molecules. The periodic chart becomes a handy reference tool to look up the atomic mass of an element and predict how much of it is needed to mix with another element.



Lithium has an atomic number of 3…it has 3 protons.
It has an atomic mass (red arrow) (sometimes called atomic weight) of 6.941



Sodium has an atomic number of 11…it has 11 protons.
It has an atomic mass (sometimes called atomic weight) of 22.99

Chlorine has an atomic number of 17…it has 17 protons.
It has an atomic mass (sometimes called atomic weight) of 35.45

Scientists, through experiments, found that based on atomic weights some elements combines in a 1:1 ratio BY ATOM. This is true for sodium (Na) and Chlorine (Cl). Since sodium has less mass than chlorine they found they needed to weigh out more chlorine…but how much?

BY MASS they combine on a 22.99 gram to 35.45 gram ratio.

The atomic masses of many elements were discovered by mixing different amounts of elements and finding out how much was need to make molecules.

This was more complicated than it seems. In some cases the elements combined in a 1:1 ratio of atoms e.g., Na + Cl → NaCl (table salt) but some elements combined in unexpected atom to atom ratios…Mg + 2Cl → $MgCl_2$ … here there are two chlorines in the final product for every one magnesium…TRICKY…it took quite a while to realize what was going on.

Eventually they realized the periodic chart could help predict such combinations, depending on what GROUP (vertical column) an element was in.

After a long series of debates, scientists decided to give carbon a weight of exactly 12 and compare everything to this element. This is a simplification of the debate but for our level of work it works fine.

The atomic mass of an element (or molecule) in grams is ONE MOLE of that element (or molecule). This means that 1 gram of H is a mole of H; 12 grams of C is a mole of C; 23.0 grams (round 22.99 to 23) of Na is a mole of Na; 35.5 grams of chlorine is 1 mole of Cl; 58.5 grams of chlorine is a mole of NaCl …23.0 grams for Na and 35.5 grams for Cl added together gives 58.5. If we mixed 58.5 grams of NaCl in a liter of water we would have a mole of NaCl per liter.

ONE MOLE of any element has 6.023×10^{23} atoms of that element. Therefore 1 mole or 22.99 grams of Na = 6.023×10^{23} atoms of Na. Avogadro's Number is 6.023×10^{23}. How many molecules of NaCl are in 58.5 grams of NaCl?