

An easy way to Physics: 06 Electric Charges and Atoms

Electric charges

There are electric charges that cause attraction and repulsion between bodies.

There are two kinds of electric charges: Positive charges (+) and negative charges (-).

Two positive charges repel each other, $\leftarrow (= (+) \quad (+) \Rightarrow$

two negative charges repel each other, and $\leftarrow (= (-) \quad (-) \Rightarrow$

a positive charge and a negative charge attract each other. $(+) \Rightarrow \leftarrow (= (-)$

The closer both charges are together, the stronger is the force:

distance x 2 force x 1/4 distance x 1/2 force x 4

distance x 3 force x 1/9 distance x 1/3 force x 9

distance x 4 force x 1/16 distance x 1/4 force x 16

distance x 10 force x 1/100 distance x 1/10 force x 100

The electric force of a charge goes through the whole universe, but far away it becomes very weak.

Each electric charge acts on all other electric charges in the whole universe.

If both charges are very close, the electric force between them becomes very strong.

Atoms

All matter consists of atoms. Atoms are spherical and a bit elastic, like a ball. There are a bit more than 100 kinds of atoms. These kinds of atoms are called elements. Atoms are very small. The smallest of them is the Hydrogen atom. It has a diameter of $0,6 \cdot 10^{-10}$ m. That means, that into a distance of 1mm you can put more than 16 millions of these atoms side by side. The other atoms are 2 times to 9 times as big as the Hydrogen atom.

Atoms consist of a very small nucleus, that has nearly all the mass of the atom and has a positive electrical charge, and of light electrons that move outside of the nucleus. The nucleus has a diameter, that is $1 / 10\ 000$ or $1 / 100\ 000$ of the diameter of an atom, that means 10 000 to 100 000 nucleuses or nuclei side by side are as long as the diameter of an atom..

The electrons have all the same electric negative charge. As this charge is very small, the unit of the electric charge is 1 C [Coulomb] and it is the charge of $6,24 \cdot 10^{18}$ electrons. Normally atoms don't attract or repel electric charges, we say they are electrically neutral. In this case the number of electrons determines the kind of the atom: An atom with one electron only is a Hydrogen atom (symbol H), with 2 electrons is a Helium atom (He), with 6 electrons a Carbon atom (C), with 8 electrons an Oxygen atom (O) and with 92 electrons an Uranium atom (U). For each electron an atom has in its nucleus a particle called proton (p) whose mass is nearly 1836 times the mass of the electron and a positive electric charge, that is precisely as big as the negative charge of the electron. As an electron has a negative charge, its symbol carries a small minus sign: e^- , and the proton carries a small + sign: p^+ . The electric charge q_e of an electron is $q_e = - 1,602 \cdot 10^{-19}$ C. The electric charge of a proton is $q_p = + 1,602 \cdot 10^{-19}$ C.

All atoms except the hydrogen atoms have additional particles in the nucleus, called neutrons. A neutron has no electric charge, but approximately the same mass as a proton: $m_{\text{neutron}} \approx m_{\text{proton}} = 1,673 \cdot 10^{-27}$ kg. Atoms with the same number of protons, but different numbers of neutrons are called isotopes. Hydrogen has 3 isotopes: The H-atom without neutrons, Deuterium with one neutron and Tritium with 2 neutrons.

For this txt I used: Christen, H. R.: Grundlagen der allgemeinen und anorganischen Chemie. Frankfurt am Main, 1969²