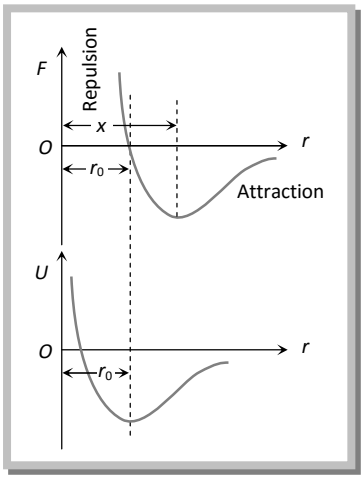
Interatomic Forces.

The forces between the atoms due to electrostatic interaction between the charges of the atoms are called interatomic forces. These forces are electrical in nature and these are active if the distance between the two atoms is of the order of atomic size i.e. 10–10 meter.

(1) Every atom is electrically neutral, the number of electrons (negative charge) orbiting around the nucleus is equal to the number of proton (positive charge) in the nucleus. So if two atoms are placed at a very large distance from each other then there will be a very small (negligible) interatomic force working between them.

(2) When these two atoms are brought close to each other to a distance of the order of 10–10 m, the distances between their positive nuclei and negative electron clouds get disturbed, and due to this, attractive interatomic force is produced between two atoms.

(3) This attractive force increases continuously with decrease in r and becomes maximum for one value of r called critical distance, represented by x (as shown in the figure). Beyond this the attractive force starts decreasing rapidly with further decrease in the value of r.



(4) When the distance between the two atoms becomes r0, the interatomic force will be zero. This distance r0 is called normal or equilibrium distance.

(r0 = 0.74 Å for hydrogen).

(5) When the distance between the two atoms further decreased, the interatomic force becomes repulsive in nature and increases very rapidly with decrease in distance between two atoms.

(6) The potential energy U is related with the interatomic force F by the following relation.

$$F = \frac{-dU}{dr}$$

(i) When two atoms are at very large distance, the potential energy is negative and becomes more negative as r is decreased.

(ii) When the distance between the two atoms becomes r0, the potential energy of the system of two atoms becomes minimum (i.e. attains maximum negative value). As the state of minimum potential energy is the state of equilibrium, hence the two atoms at separation r0 will be in a state of equilibrium.

($U_0 = -7.2 \times 10^{-19}\ Joule$ For hydrogen).

(iii) When the distance between the two atoms is further decreased (i.e. $r < r_0$) the negative value of potential energy of the system starts decreasing. It becomes zero and then attains positive value with further decrease in r (as shown in the figure).