Intermolecular Forces.

The forces between the molecules due to electrostatic interaction between the charges of the molecules are called intermolecular forces. These forces are also called Vander Waal forces and are quite weak as compared to inter-atomic forces. These forces are also electrical in nature and these are active if the separation between two molecules is of the order of molecular size i.e. ≈ 10–9 m.

(1) It is found that the force of attraction between molecules varies inversely as seventh power of the distance between them i.e.

$$F_{att} \propto \frac{1}{r^7} \text{ or } F_{att} = \frac{-a}{r^7}$$

The negative sign indicates that the force is attractive in nature.

(2) When the distance between molecules becomes less than r0, the forces becomes repulsive in nature and is found to vary inversely as ninth power of the distance between them i.e.

$$F_{rep} \propto \frac{1}{r^9} \text{ or } F_{rep} = \frac{b}{r^9}.$$

Therefore force between two molecules is given by $F = F_{att} + F_{rep} = \frac{-a}{r^7} + \frac{b}{r^9}$

The value of constants a and b depend upon the structure and nature of molecules.

(3) Intermolecular forces between two molecules has the same general nature as shown in the figure for interatomic forces.

(4) Potential Energy: Potential energy can be approximately expressed by the formula $U = \frac{A}{r^n} - \frac{B}{r^m}$

Where the term $\frac{A}{r^n}$ represents repulsive contribution and term $\frac{B}{r^m}$ represents the attractive contribution. Constants A, B and numbers m and n are different for different molecules.

For majority of solids n = 12 and m = 6.

So potential energy can be expressed as $U = \frac{A}{r^{12}} - \frac{B}{r^6}$