Surface Tension – Intermolecular Force

Intermolecular Force: Every molecule attracts other molecules towards it, with a force which is short ranged force. The maximum distance up to which one molecule can attract other is known as Molecular range. It is of the order of 10^{-7} cm.

It can be divided into two:

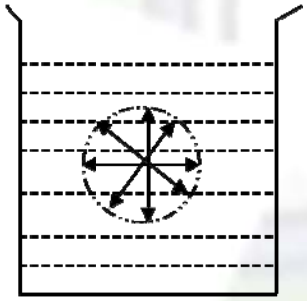
(i) **Cohesive force**: The force of attraction between two same types of molecules such as two water molecules or two glass molecules is known as cohesive force.

(ii) **Adhesive force**: The force of attraction between two different types of molecules is known as adhesive force.

Sphere of influence: Let us consider any molecules within the liquid with that molecule as center and molecular range as radius we can imagine a sphere. The molecules which lie outside the sphere being at a distance, greater than the molecular range can't attract the central molecule, but the molecules which lie within the imaginary sphere being within the molecular range can attract the central molecule. Hence this imaginary sphere is known as sphere of influence for that molecule. For every molecule we can imagine a sphere of influence.

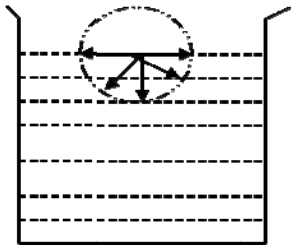
Let us now find the resultant cohesive force on a molecule

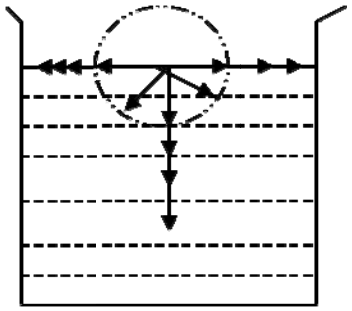
Case I: Consider a molecule well below the free surface of the liquid so that its sphere of influence filled up with the liquid molecules.



Since the molecules are symmetrically distributed about the center hence the cohesive forces due to diametrically opposite molecules will cancel out in pairs and hence the resultant cohesive force on that molecule is zero.

Case II: Let us now consider a molecule on or near free surface, the sphere of influence is not completely filled with the liquid molecules and obviously the resultant cohesive force can't be zero.





Resolving the cohesive forces into two mutually perpendicular direction along parallel and perpendicular to the surface of the liquid it can be shown that the resultant cohesive force perpendicular to the surface along inward direction.

Conclusion: The liquid molecules which lie well below the free surface are free from any resultant cohesive force, but the molecules which lie on or near the free surface are not free but bounded with the liquid surface by a resultant downward force perpendicular to the liquid surface.