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Surface Tension

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Surface Tension

Molecular forces:

- **Surface tension is a molecular phenomenon. Hence, we should have the idea about molecular forces.**
- **Forces exists between molecules are called molecular forces.**
- **There are two types**
- **Cohesive force:** It is the force of attraction between molecules of the same substance.

- **Adhesive force:** It is the force of attraction between the molecules of different substances.

- This force is different for different pairs of substances.

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- The molecular force is different from the ordinary gravitational force

- The molecular force does not obey inverse square law. This force varies inversely as the eighth power of the distance between two molecules and thus decreases rapidly with distance.

- These forces are effective only when the distance between the neighbouring molecules is extremely small i.e. of the order of 10^{-7} cm.

- **Molecular range:** The maximum distance up to which the molecules can attract each other is called molecular range.

- **Sphere of influence:** A sphere having a radius equal to the molecular range, with the molecules as the centre, is called the sphere of influence.

- The molecule is attracted by all other molecules within the sphere of influence.

Surface Tension

- Surface tension is the property of a liquid by which the free surface of a liquid behaves like a stretched membrane. Because of this property, rain drops, small quantity of mercury placed on a clean glass plate always assume the spherical shape.
- For a given volume, a sphere has the least surface area. Thus a liquid always tends to minimise its surface area since the surface of a liquid behaves like an elastic skin or membrane.

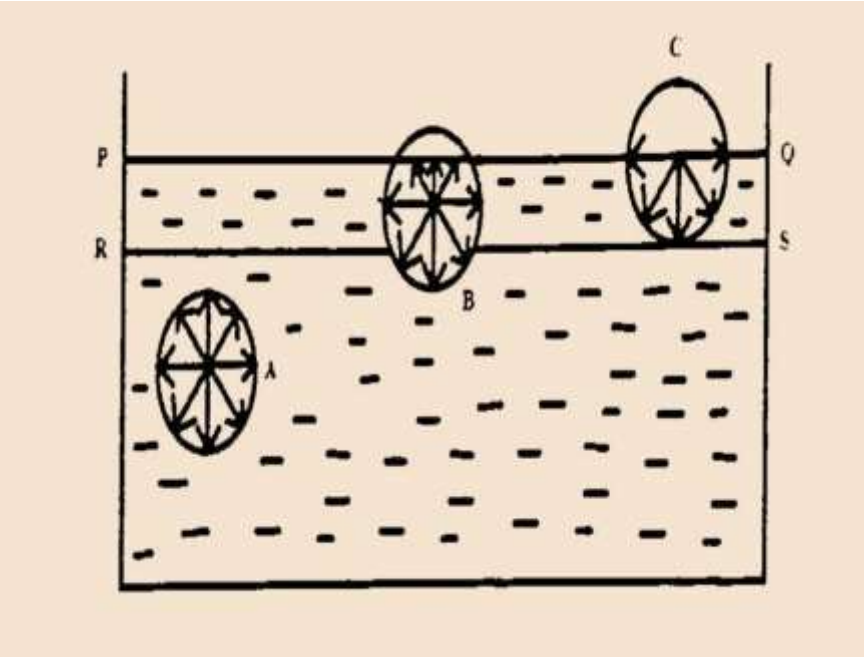
Definition of surface tension

- Surface tension is defined as the force per unit length of an imaginary line drawn on the liquid surface acting perpendicularly to it and tending to pull the surface away from the line.

- Unit of surface tension is Nm^{-1}.

Explanation of surface tension on the basis of molecular theory:

- The sphere of influence of A lies completely inside the liquid. The molecule is attracted equally in all directions and resultant cohesive force is zero.
- The sphere of influence of B lies partly outside. Number of molecules in the lower half is more and there is a resultant downward force on it.
- Half of the sphere of influence of C is outside. It is attracted downward with maximum force perpendicular to the surface.



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- Draw a plane RS parallel to liquid surface at a distance equal to molecular range. Then the layer of the liquid between free surface PQ and plane RS is called surface film. All molecules in the surface film are pulled downward.
- If a molecule is brought from inside of the liquid to the surface film, work has to be done against downward cohesive force and its potential energy increases. Potential energy of the molecules lying within the surface film is greater. To have minimum potential energy, area of the film must be least. Therefore free surface always tries to contract.

Examples of surface tension:

- Take a metal ring dip it in soap solution; keep a moistened loop of cotton thread over the film. The loop has an irregular shape.
- Break the soap film inside the loop. The thread takes a circular shape. Every point on the thread experiences a force radially outwards.
- Place a pin gently on the surface of water. It floats. There is a depression on the surface of water and the surface behaves like a stretched membrane. Press the needle with the finger. The layer due to surface tension breaks and the needle sinks.

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- Take a paint brush. Dip it in water. Take the brush out. The hairs of the brush come closer.
- The falling rain drops are spherical in shape due to surface tension.
- Lead shots are manufactured in factories based on the property of surface tension. The molten lead drops assume spherical shape due to surface tension.
- Oil rises up in a cotton wick in spite of gravity is due to surface tension.
- Sap and water rise up to the top of the leaves of the tree.

THANK YOU TO ALL