Here in last episode of theoretical region of Fluids we take a look of next topics

Next is Viscosity : in other words it is liquid friction. The difference between solid friction and liquid friction is only that, liquid friction does depend on area, While solid friction does not depend on area.

For the students of medical examination i,e, students preparing for NEET the dimensions of viscosity is very important.

Viscosity depends upon temperature as well. Increasing the temperature usually decreases the viscosity.

This viscosity only finalizes whether, the flow of liquid will be laminar of turbulent.

Streamlines: or Velocity profile: It is that straight or curved path tangent to which at any point gives instantaneous direction of velocity of particle at that point.

Laminar Flow : when the streamlines do not intersect, it is termed as Laminar Flow.

Turbulent Flow : When streamlines intersect, it is termed as turbulent, obviously it is at high speed

Now due to viscosity we get DRAG force, for a spherical body, drag force at terminal velocity is fixed.

With the help of buoyant force and drag force upwards, along with weight downwards the net force becomes zero.

We solve and get the terminal velocity. Formula is what we have already derived.

Now in competition questions we come across few drops joining together and we are to calculate new terminal velocity. Since terminal velocity depends on radius as well. We have to calculate the new radius.

REMEMBER if two sphere of radius R join, new radius is NOT 2R. new R is calculated by equating the total volume. In fact with such calculation if we join ‘n’ number of drops of radius ‘r’

The new radius $R = n^{1/3}r$

$$\frac{4}{3}\pi r^3 \times n = \frac{4}{3}\pi R^3 \Rightarrow R = n^{1/3} r$$

After the terminal velocity please be careful in getting the excess pressure in a drop. Difference between excess pressure inside and drop should be clearly understood.

Here one must keep in mind that if drop is of liquid and air is outside, we have excess pressure but if otherwise, if air is inside and liquid is outside, we have reduction in pressure.

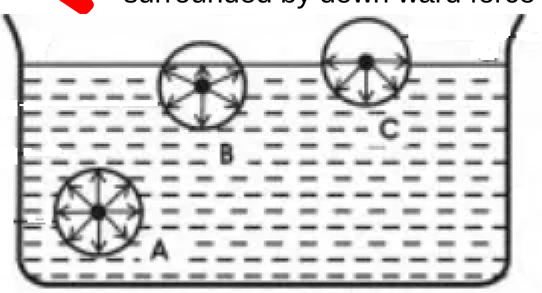
Then it is important to understand the basis of angle of contact, It depends upon the relative cohesive and adhesive forces. Liquid molecules are bounded by cohesive (Same molecule) force while with container (Solid & Liquid) we have adhesive forces.

If cohesive forces are stronger than the adhesive we have obtuse angle of contact. Otherwise it is acute angle. Now remember between glass and water angle of contact is acute, between mercury and glass the angle is obtuse. In a special case between silver and alcohol the angle is 90°.

Then finally we reach the capillary rise, if the angle is acute we have capillary rise and if the angle is obtuse then there is depression in height.

Do remember one more thing that if the capillary is of less height, still the water will not overflow.

Every molecule of surface of the liquid is under some sort of tension, As the molecules of top are nor surrounded by down ward force due to liquid



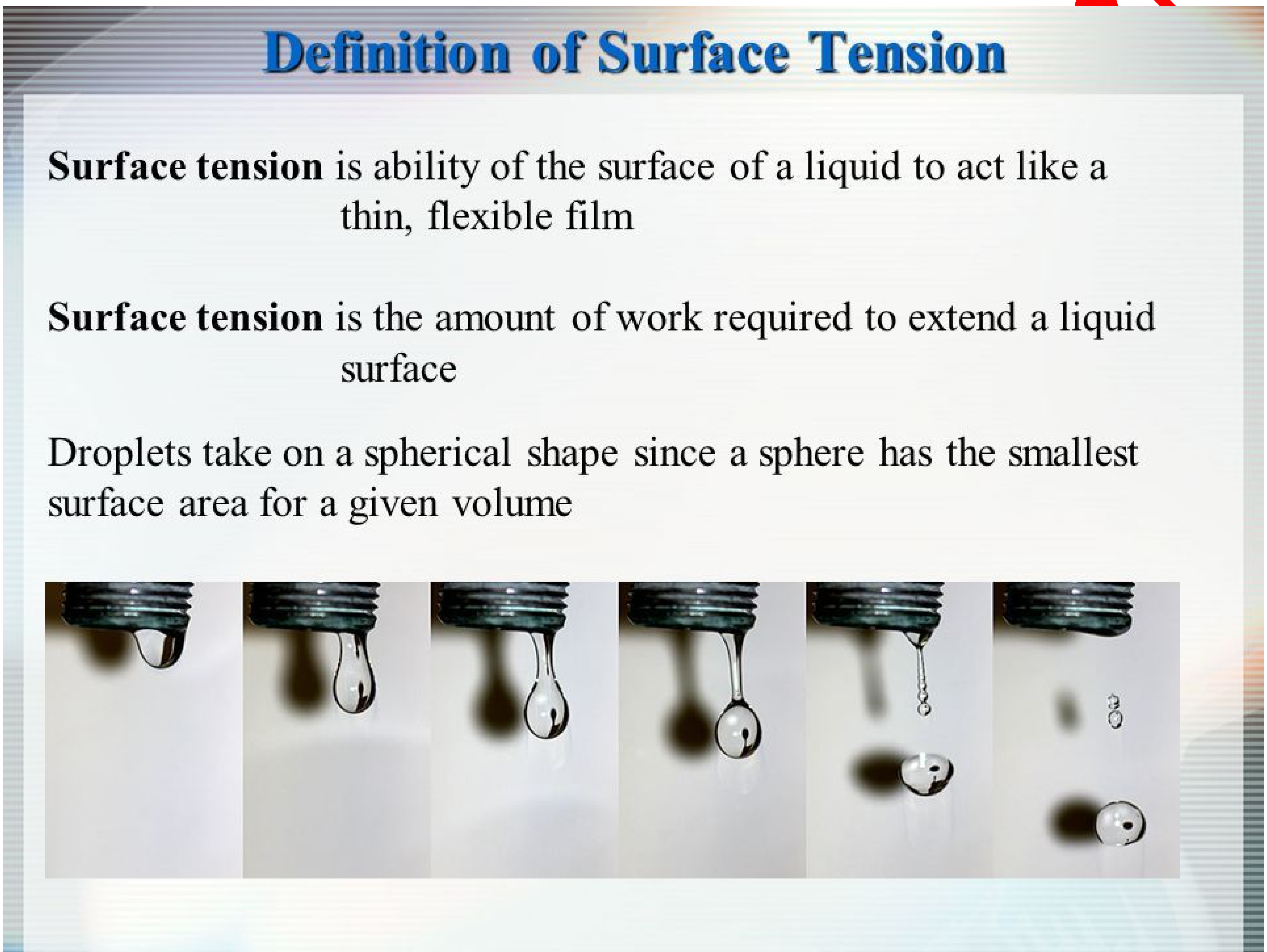
In molecule A all the surrounding molecules are applying attractive cohesive forces, Now in molecule B upper forces are reduced and in case of molecule

C upper forces are almost absent as there is no molecule. Hence the molecule want to come down and it is acted upon by a tension called surface tension.

It is defined as force per unit length. So its dimensions are MT^{-1}

You can have too many examples of surface tension.

Small drops to become spherical, as for given volume the sphere has minimum area. And as per the principal of potential energy every liquid surface tends to acquire minimum area.



NCERT QUESTIONS

10.17 A U-shaped wire is dipped in a soap solution, and removed. The thin soap film formed between the wire and the light slider supports a weight of 1.5×10^{-2} N (which includes the small weight of the slider). The length of the slider is 30 cm. What is the surface tension of the film ?

10.18 Figure 10.24 (a) shows a thin liquid film supporting a small weight = 4.5×10^{-2} N. What is the weight supported by a film of the same liquid at the same temperature in Fig. (b) and (c) ? Explain your answer physically.

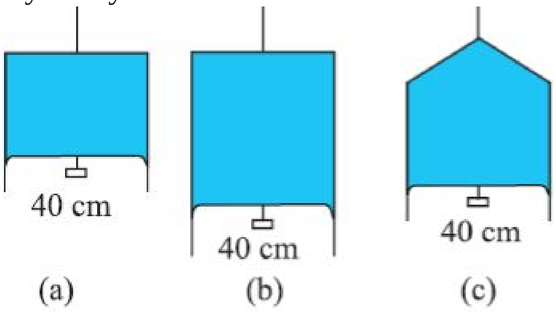


Fig. 10.24

10.19 What is the pressure inside the drop of mercury of radius 3.00 mm at room temperature ? Surface tension of mercury at that temperature (20 °C) is 4.65×10^{-1} N/ m. The atmospheric pressure is 1.01×10^{5} Pa. Also give the excess pressure inside the drop.

10.20 What is the excess pressure inside a bubble of soap solution of radius 5.00 mm, given that the surface tension of soap solution at the temperature (20 °C) is 2.50×10^{-2} N/m ? If an air bubble of the same dimension were formed at depth of 40.0 cm inside a container containing the soap solution (of relative density 1.20), what would be the pressure inside the bubble ? (1 atmospheric pressure is 1.01×10^{5} Pa).

10.29 Mercury has an angle of contact equal to 140° with soda lime glass. A narrow tube of radius 1.00 mm made of this glass is dipped in a trough containing mercury. By what amount does the mercury dip down in the tube relative to the liquid surface outside ? Surface tension of mercury at the temperature of the experiment is 0.465 N m–1. Density of mercury = 13.6×10^{3} kg m^{-3}.

10.30 Two narrow bores of diameters 3.0 mm and 6.0 mm are joined together to form a U-tube open at both ends. If the U-tube contains water, what is the difference in its levels in the two limbs of the tube ? Surface tension of water at the temperature of the experiment is 7.3×10^{-2} N/m. Take the angle 0 and density of water 1000 kg/m^{3}