Work done in Forming a Liquid Drop

- Work done in forming a liquid drop of radius r, surface tension S is, $W = 4\pi r^2 S$.
- Work done in forming a soap bubble of radius r, surface tension S is,
  $$W = 2 \times 4\pi r^2 S = 8\pi r^2 S.$$
- Work done in increasing the radius of a liquid drop from r_1 to r_2 is
  $$W = 4\pi S\left(r_2^2 - r_1^2\right).$$
- Work done in increasing the radius of a soap bubble from r_1 to r_2 is
  $$W = 8\pi S\left(r_2^2 - r_1^2\right).$$

Formation of a Bigger Drop by a Number of Smaller Drops

- When n number of smaller drops of a liquid, each of radius r, surface tension S are combined to form a bigger drop of radius R, then
  $$R = n^{1/3} r$$
- The surface area of bigger drop $= 4\pi R^2 = 4\pi n^{2/3} r^2$. It is less than the sum of areas of n smaller drops.
- Work done in breaking a liquid drop of radius R into n equal small drops
  $$W = 4\pi R^2 (n^{1/3} - 1) S$$
  where S is the surface tension.

Excess Pressure

- The pressure on the concave side of the liquid surface is always greater than the pressure on the convex side. The difference of pressure is called as excess pressure.
- Excess pressure inside a liquid drop is given by
  $$P = \frac{2S}{r}.$$
- Excess pressure inside a soap bubble is given by
  $$P = \frac{4S}{r}.$$
- Excess pressure inside an air bubble in a liquid is given by
  $$P = \frac{2S}{r}.$$
- When an air bubble of radius r is at depth h below the free surface of liquid of density ρ and surface tension S, then the excess pressure inside the bubble,
  $$P = \frac{2S}{r} + h\rho g.$$
- If r_1 and r_2 are the radii of curved liquid surface, then excess pressure inside the liquid surface is given by
  $$P = S\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$
- When two bubbles of different sizes are in communication with each other, air passes from smaller one to larger one and larger one grows at the expense of smaller one. This happens due to pressure inside the smaller bubble being higher than that inside the larger bubble.
- When two soap bubbles of radii r_1 and r_2 coalesce to form a new soap bubble of radius r, under isothermal conditions then $r = \sqrt{r_1^2 + r_2^2}$.
- When two soap bubbles of radii r_1 and r_2 ($r_1 < r_2$) are in contact with each other and r is the radius of the interface, then $r = \frac{r_1 r_2}{r_2 - r_1}$.
- If a small drop of water is squeezed between two parallel glass plates so that a very thin layer of large area is formed then the pressure inside the water layer is less than the pressure on the plates by ($2S/d$) (where d is the distance between the plates).

ANGLE OF CONTACT

- The angle between the tangent to the liquid surface at the point of contact and the solid surface inside the liquid is called the angle of contact for a given pair of solid and liquid.
- The angle of contact remains the same whether the liquid is contained in a glass vessel or a glass plate is inserted in the liquid or a drop of given liquid rests on the glass plate. In other words, the angle of contact does not depend on the manner of contact.
- The angle of contact depends upon
  - the nature of solid and the liquid in contact
  - the given pair of the solid and the liquid
  - the impurities.
- The value of angle of contact is acute *i.e.* less than 90° for those liquids which wet the walls of container (*e.g.* water and glass) and the value of angle of contact is obtuse *i.e.* greater than 90° for those liquid which do not wet the walls of the container (*e.g.* mercury and glass).
- The value of angle of contact for pure water and glass (without grease) is zero.
- Angle of contact increases with increase in the temperature of the liquid.
- Angle of contact decreases on adding soluble impurity to a liquid.

Shape of Meniscus

- The curved surface of the liquid is called the meniscus of the liquid.
- If a liquid wet the sides of the vessel containing liquid, the shape of the liquid meniscus is concave upwards. In this case the force of cohesion between liquid molecules is less than the force of adhesion between liquid and vessel molecules.
- If a liquid does not wet the sides of the vessel containing the liquid, the shape of liquid meniscus is convex upwards. In this case, the force of cohesion between liquid molecules is greater than the force of adhesion between liquid and vessel molecules.