Principal Radii Of Curvature:

A three dimensional body is to be cut, by drawing a plane, passing through a given point on its surface & ⊥r. to the surface. This can be done by drawing infinite no of such planes & for each plane, we get a curved section, having a radius of curvature at that point. Thus out of these infinite no of radii of curvature obviously one is maximum and one is min^m. These two extreme values of radii are known as principal radii of curvature.

For a sphere, the two principal radii of curvature are same.

Principle Of Virtual Work:

Let us consider a system of particles in equilibrium

$$\sum F_i = 0$$

let us now assume the system to undergo a small virtual displacement δr_i (A virtual displacement is that in which the resultant force and the conditions of constrains remain unchanged due to the displacement & hence is different from real displacement.)

The work done due to the virtual displacement

$$\delta W = \sum \vec{F_i}\, \vec{\delta r_i} = 0$$

Since work done due to the displacement is stored as change in P.E, hence the change in P.E due to the virtual displacement is zero.

Hence at the point B ; a force acts on the system which must be along $\vec{BA}$, the direction of decreasing P.E & this force brings the system back to its original position A. Hence A is the position of equilibrium. In other words the position of minimum P.E is the position of equilibrium.

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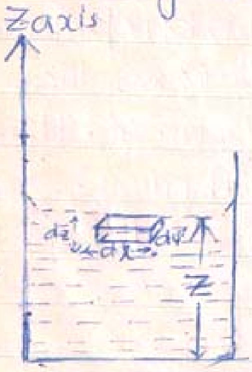
Excess Pressure on a curved liquid surface by using the principle of virtual work:-

Statement: If a system of particles is in equilibrium and if the system receives or is imagined to receive a virtual displacement; the work done due to the virtual displacement is zero and hence the corresponding change in P.E of the system is zero i.e the potential energy of the system, in the position of equilibrium is minimum.

Application of principle of virtual work to the equilibrium of a homogeneous liquid in contact with solid:



Given:

ρ = density of the liquid.

S_1 = Surface tension of the liquid

The total energy of the system consists of four parts:-

① The g.P.E of the liquid:

Let us consider an elementary volume $dx\,dy\,dz$ of the liquid on the free surface.

The g.P.E of that element of liquid = $dx\,dy\,dz\,\rho g z$

Hence the total g.P.E of the liquid = $\iiint dx\,dy\,dz\,\rho g z \rightarrow$ ①

② The free surface energy of the liquid-air surface $= S_1 \times A \rightarrow$ ② Where A is the area of the

Hence at the point B ; a force acts on the system Which must be along $\overrightarrow{BA}$, the direction of decreasing P.E & this force brings the system back to its Original position A. Hence A is the position of Equilibrium. In other words the position of minimum P.E is the position of Equilibrium.