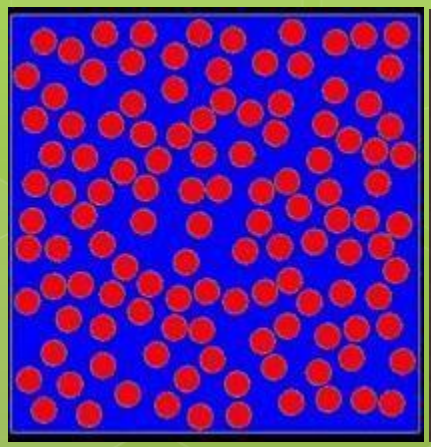


Medical Physics

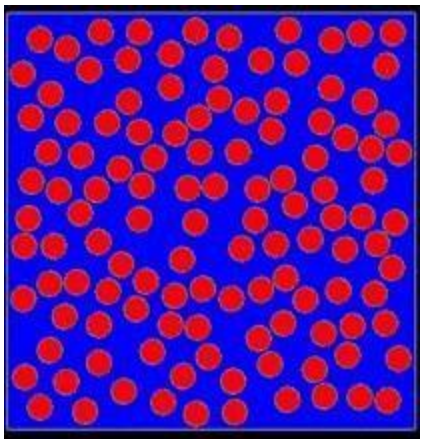
Lab

Sedimentation and Centrifugation

Dr. Fatima Abbas

What is sedimentation:

- Sedimentation is the tendency for particles in suspension to settle out of the fluid in which they are entrained, and come to rest against a barrier.

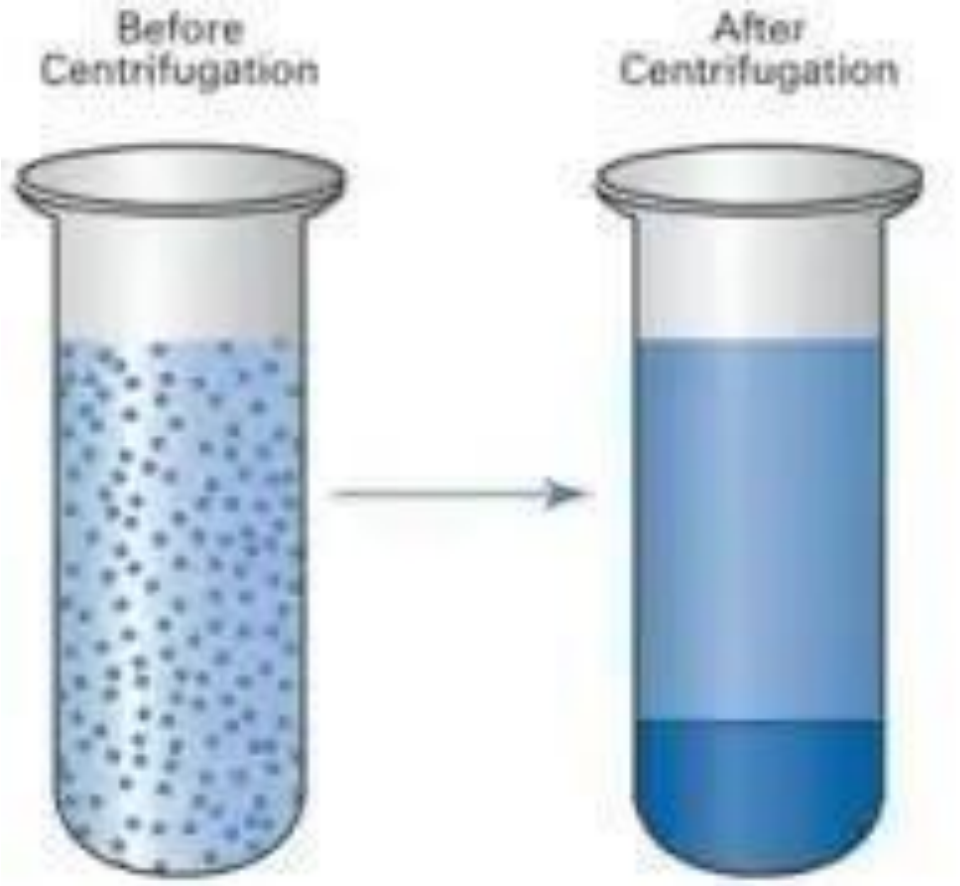


This is due to their motion through the fluid in response to the forces acting on them: these forcescan be due to gravity, centrifugal acceleration or electromagnetism

Define centrifugation:

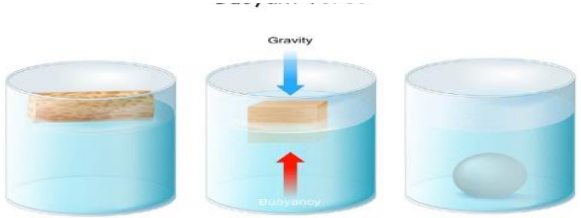
- is the process where a mixture is separated through spinning.
- It is used to separate skim milk from whole milk, water from your clothes, and blood cells from your blood plasma.

- Consider a spherical particle of radius(r)and density (ρ) moving with terminal velocity (v) in a liquid of viscosity (η) and density (ρ)



The particle is acted upon by threeforces:

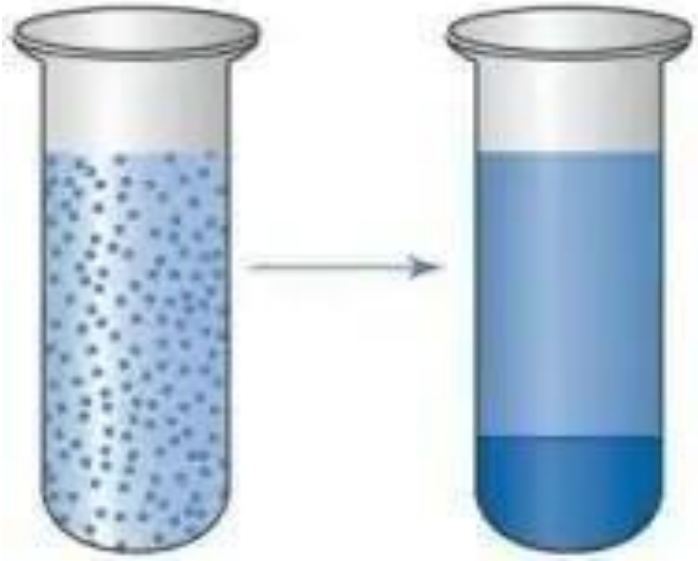
- Downward gravitational force: the force acted on the particle by the gravity pull.
- Upward buoyant force: is the force with which the particles must displace the liquid media into which they sediment.



- Retarding force (frictional force): force generated by the particles as they migrate through the solution.

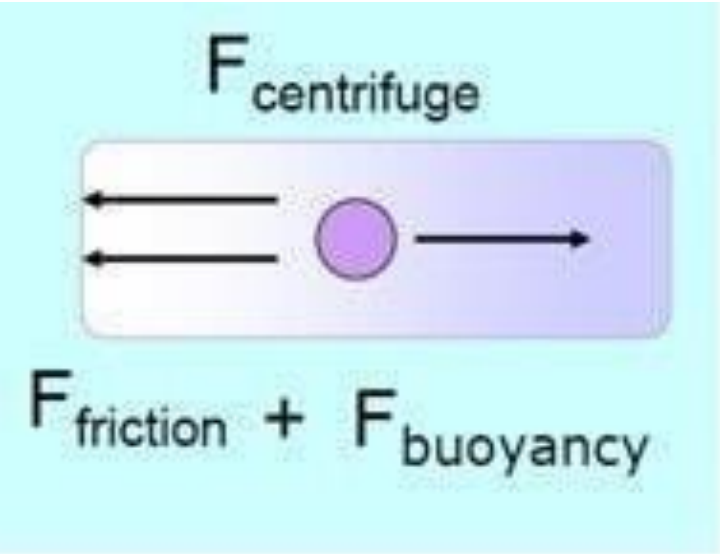
- In a solution, particles whose density is higher than that of the solvent sink (sediment), and particles that are lighter than it float to the top.

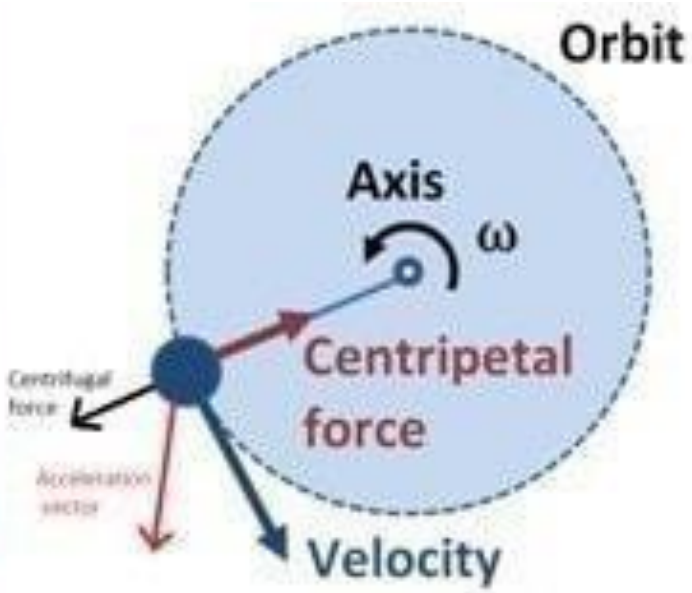
- The greater the difference in density, the faster they move. If there is no difference in density (isopyknic conditions), the particles stay steady.



The particle is acted upon by three forces:

- The velocity is constant when thethree forces are in equilibrium from which the expression for the terminal(sedimentation) velocity is obtained.





Svedberg constant or S value

- the value for a molecule's (or organelle's)

sedimentation velocity in a centrifugal

$$S = \frac{v}{\omega^2 r} = \frac{M(1 - \bar{v}\rho_{sol})}{N_{AV} f}$$

M = molecular weight ($m \times N_{AV}$)

s = svedberg coefficient

vρ = partial specific volume of the molecule

N = Avogadro's number

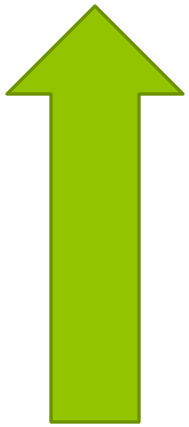
f = frictional coefficient

s = sedimentation coefficient (units: 1 Svedberg = 10-13 sec)

- The above equation depends on the volume of the molecule (m), and the shape of the molecule plays an important role in its behavior under centrifugal force.

Application of Sedimentation:

- In some diseases (rheumatic fever, rheumatic heart disease and gout) the red blood cells (RBC's) clump together and the effective radius increases; thus,
  the sedimentation velocity (rate) is faster than normal.



Application of Sedimentation:

- In other diseases: (hemolytic jaundice and sickle cell anemia), the RBCs change shape or break. The radius decreases; thus, the rate of sedimentation is slower than normal.

- The normal range is between 0 and 22 mm/hour for men and between 0 and 29 mm/hour for women.

Determining the RBCs sedimentation rate is a simple and routine clinical laboratory test that enables the hematologist to diagnose the above mentioned blood diseases.


Thanks
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