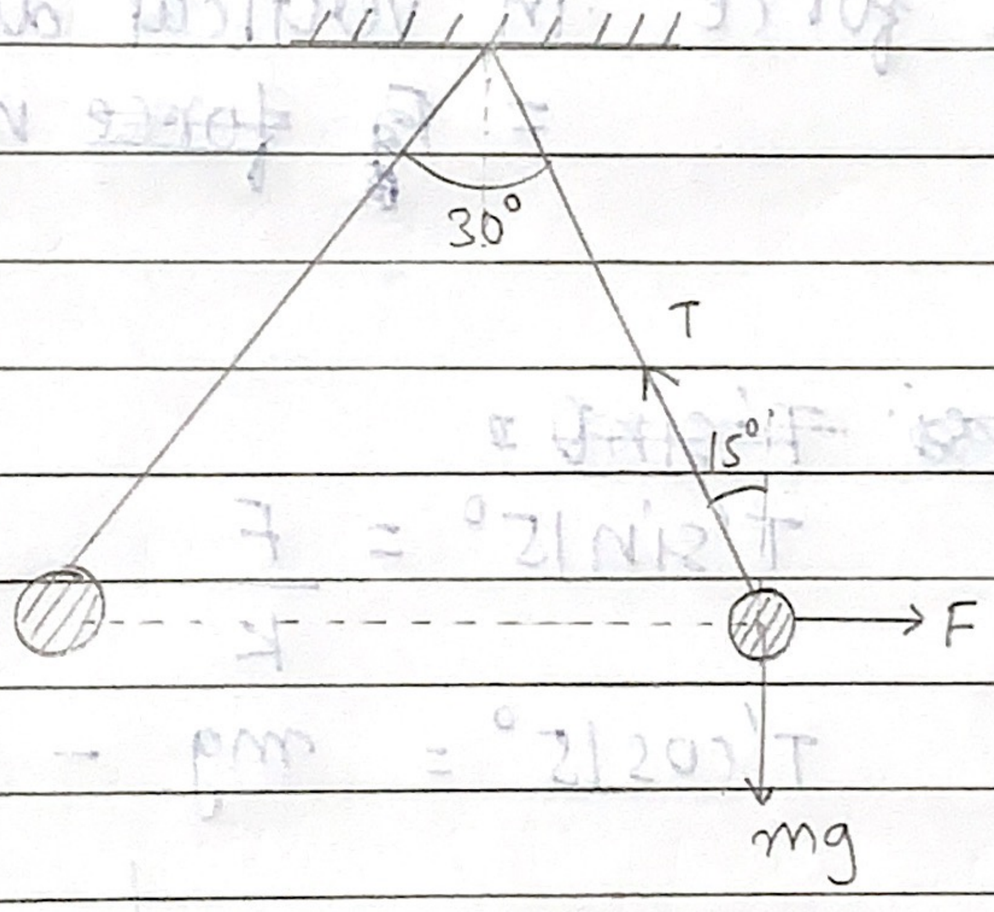
Question for Tutorial

Date / /

Ques:- Two identically charged spheres are suspended by strings of equal length. The strings make an angle of 30° with each other. When suspended in a liquid of density 0.8 gm/cc, the angle remains same. What is the dielectric constant of liquid. [Density of sphere = 1.6 gm/cc].



When two charged objects are surrounded by a medium, the net force on each object becomes $\frac{1}{K}$ times, where 'K' is the dielectric constant of the medium

$\Rightarrow$ In air, we have $T\cos 15^\circ = mg$ — (1)

$T\sin 15^\circ = F$ — (2)

from (1) and (2)

$\tan 15^\circ = \frac{F}{mg}$ — (3)

Date / /

⇒ Now after immersing the medium in liquid,

Felectric would reduced to $\frac{F}{K}$

Hence force in horizontal direction $\frac{F}{K}$

and force in vertical direction

= ~~force~~ wt − Bouyant Force

~~tan15° = F'sinθ~~

$$T'\sin 15^\circ = \frac{F}{K}$$

$$T'\cos 15^\circ = mg - \rho_l V g$$

$$= mg\left[1 - \frac{\rho_l}{\rho_s}\right]$$

$$\tan 15^\circ = \frac{F/K}{mg\left[1 - \frac{\rho_l}{\rho_s}\right]} \quad \text{— (4)}$$

from (3) and (4)

$$\frac{\cancel{F}}{\cancel{mg}} = \frac{F/K}{\cancel{mg}\left[1 - \frac{\rho_l}{\rho_s}\right]}$$

$$\frac{\rho_s}{K[\rho_s - \rho_l]} = 1 \Rightarrow \frac{1.6}{K[1.6 - 0.8]} = 1$$

$$\Rightarrow \boxed{K = 2}$$

⇒ Hence dielectric constant is 2