

Answer on Question #43354, Physics, Electrodynamics

two identical 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 8g/cm^3 , the angle remains the same. If density of the material of sphere is 16g/cm^3 , dielectric constant of the liquid is?

Solution

The balance of gravitational and electrostatic forces while in air is

$$\rho_{\text{sphere}} V g \sin 30^\circ = \frac{1}{4\pi\epsilon_0} \frac{q^2}{r^2}$$

In the liquid gravitational forces is decrease due to buoyant force and electrostatic force is decreased due to increase of relative permittivity. But as the angle and distance are the same we can write balance again as

$$(\rho_{\text{sphere}} - \rho_{\text{liquid}}) V g \sin 30^\circ = \frac{1}{4\pi\epsilon_0\epsilon} \frac{q^2}{r^2}$$

Dividing these two equalities gives us

$$\epsilon = \frac{\rho_{\text{sphere}}}{\rho_{\text{sphere}} - \rho_{\text{liquid}}} = 2$$

Dielectric constant of liquid is 2.