Answer on Question # 74237, Physics -Electric Circuits:

Question: Two spheres with equal but opposite charges experience a force of 7.5 $\times 10^6$ N when they are placed 4 cm apart in a medium of relative permittivity 6. Determine the charge on each sphere.

Solution: Let, charge of one sphere = Q_1 = q Coulomb

And another sphere of charge = Q_2 = - q Coulomb

Distance between two sphere = r = 4 cm = 0.04 m

Relative permittivity of medium is ε_r = 6

Force = F = 7.5 $\times 10^6$ N

Now we know force, F = $\frac{1}{4\pi\varepsilon_r\varepsilon_0} \frac{(q)\times(-q)}{r^2}$ ....(1)

Put the value of F, r and ε_r in equation (1), we get,

$$q^2 = -\frac{[7.5 \times 10^6 \times(0.04)^2 \times 6]}{9\times10^9}$$ (Consider, $\frac{1}{4\pi\varepsilon_0}$ = 9×10^9)

$$\text{Or, } q^2 = -8 \times 10^{-6}$$

$$\text{Or, q} = \pm 2.83 \times 10^{-3} \text{ C}$$

So, Q_1 = + 2.83 $\times 10^{-3}$ C and Q_2 = - 2.83 $\times 10^{-3}$ C.

Answer: Charge on each sphere = $\pm 2.83 \times 10^{-3}$ C.