

Answer on Question#38259, Physics, Other

Question:

Two charged spheres of equal radii when kept at a certain distance attract each other by a force of F . The charges are touched with each other and placed at the same separation again. They now repel each other by a force of $F/4$. Find the ratio of the charges

Answer:

Coulomb's law states that the electrical force between two charged objects is directly proportional to the product of their charges (and inversely proportional to the square of the distance between them):

$$F(r) = k \frac{q_1 q_2}{r^2}$$

For initial charges (spheres attract, therefore $q_1 q_2 < 0$):

$$F = -\frac{k q_1 q_2}{r^2}$$

When spheres are touched with each other their charges equals:

$$q' = \frac{q_1 + q_2}{2}$$

Therefore:

$$\frac{F}{4} = \frac{k(q_1 + q_2)^2}{4r^2}$$
$$-q_1 q_2 = (q_1 + q_2)^2$$

Ratio of the charges equals:

$$\left(\frac{q_1}{q_2}\right)^2 + 3\frac{q_1}{q_2} + 1 = 0$$

$$\frac{q_1}{q_2} = \frac{-3 \pm \sqrt{5}}{2}$$

Answer: $\frac{q_1}{q_2} = \frac{-3 \pm \sqrt{5}}{2}$