QUES 04:-

Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is 6.5×10^{-7} C? Suppose the spheres A and B have identical sizes. A third sphere of the same size but uncharged is brought in contact with the first, then brought in contact with the second, and finally removed from both. What is the new force of repulsion between A and B?

Sol. Distance between the spheres, A and B, r = 0.5 m

Initially, the charge on each sphere, $q = 6.5 \times 10^{-7}$ C

When an uncharged sphere is brought near the charged sphere, the charge is induced on the uncharged sphere. Thus in the given question,

When sphere A is touched with an uncharged sphere C, $\frac{q}{2}$ the amount of charge from A will transfer to sphere C. Hence, charge on each of the spheres, A and C, is $\frac{q}{2}$.

When sphere C with charge $\frac{q}{2}$ is brought in contact with sphere B with charged, total charges on the system will divide into two equal halves given as,

$$\frac{\frac{q}{2}+q}{2} = \frac{3q}{4}$$

Each sphere will share each half. Hence, charge on each of the spheres, C and B, is $\frac{3q}{4}$.

Force of repulsion between sphere A having charge $\frac{q}{2}$ and sphere B having charge

$$\frac{3q}{4} = \frac{\frac{q}{2} \times \frac{3q}{4}}{4\pi\epsilon_0 r^2} = \frac{3q^2}{8 \times 4\pi\epsilon_0 r^2}$$

$$= 9 \times 10^9 \times \frac{3 \times \left(6.5 \times 10^{-7}\right)^2}{8 \times (0.5)^2}$$

$= 5.703 \times 10^{-3}$ N

Therefore, the force of attraction between the two spheres is 5.703×10^{-3} N.