Answer on Question #40667, Physics, Electromagnetism

TWO CONCENTRIC SPHERES OF RADII R AND r HAVE SIMILAR CHARGES WITH EQUAL SURFACE CHARGE DENSITIES (σ). WHAT IS THE ELECTRIC POTENTIAL AT THEIR COMMON CENTRES?

1. σ/ϵ0(R+r) 2. σ/ϵ0(R+r)3. σR/ϵ0 4. σr/ϵ0

Solution

Let q_1 and q_2 be the respective charges distributed over two concentric spheres of radii r and R.

As surface densities are given to be equal, therefore $\sigma_1 = \sigma_2 = \sigma$ or

$$\sigma = \frac{q_1}{4\pi r^2} = \frac{q_2}{4\pi R^2}.$$

The potential V_1 at common center due to charge q_1 is given by

$$V_1 = \frac{q_1}{4\pi\epsilon_0 r} = \frac{\sigma r}{\epsilon_0}.$$

The potential V_2 at common center due to charge q_1 is given by

$$V_2 = \frac{q_2}{4\pi\epsilon_0 R} = \frac{\sigma R}{\epsilon_0}.$$

Net potential at common center,

$$V = V_1 + V_2 = \frac{\sigma r}{\epsilon_0} + \frac{\sigma R}{\epsilon_0} = \frac{\sigma(r+R)}{\epsilon_0}.$$

Answer: $\frac{\sigma(r+R)}{\epsilon_0}$.