Answer on question #61334, Physics, Electromagnetism

A sphere of radius a is made of insulating material and has charge distributed uniformly throughout its volume. The charge density is ρ. Find the field due to the charge for r≤a.

a) rρ3ϵ0
b) 2rρϵ0
c) rρπϵ0
d) rρ3πϵ0

Solution:

Electric field intensity E of a uniformly charged solid sphere is directly proportional to the distance from the centre of the sphere, when this distance ***r*** less then sphere radius ***a***

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{a^3} \cdot r$$

The charge density is

$$\rho = \frac{Q}{V}$$

Where

$$V = \frac{4}{3}\pi a^3$$

Wherefrom,

$$Q = \rho V = \frac{4}{3}\pi\rho a^3$$

Then,

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{4\pi\rho a^3}{3a^3} \cdot r$$

$$E = \frac{\rho r}{3\varepsilon_0}$$

Answer: ρr/3ε$_0$

A galvanometer of resistance 120Ω a full scale deflection with a current of 0.0005A. How would you convert it to an ammeter that reads a maximum current of 5A?

a) connect 2000Ω in parallel to it
b) connect 200.12Ω in series to it
c) connect 20.10Ω in series to it
d) connect 0.012Ω in parallel to it

Solution:

Since galvanometer is a very sensitive instrument therefore it can't measure heavy currents. In order to convert a galvanometer into an ammeter, a very low resistance known as shunt resistance is connected in parallel to galvanometer. Value of shunt is so adjusted that most of the current passes through the shunt. In this way a galvanometer is converted into ammeter and can measure heavy currents without fully deflected.

$$I_g = \frac{V_g}{R_g}$$

Wherefrom,

$$V_g = I_g R_g$$

Then current through shunt:

$$I_s = I - I_g$$

Potential difference on the shunt:

$$V_s = I_s R_s$$

Then,

$$V_s = (I - I_g)R_s$$
$$V_s = V_g$$
$$(I - I_g)R_s = I_g R_g$$

Finally,

$$R_s = \frac{I_g}{I - I_g} R_g$$
$$R_s = \frac{0.0005A}{5A - 0.0005A} \cdot 120\Omega = 0.012\Omega$$

Answer: 0.012Ω in parallel to it