Answer on Question #55644, Physics Other

A sphere of radius 1 m is given 1 mC charge. How much charge will leak in air?

Solution:

It depends on the pressure and air humidity.

However, we assume that the conditions are normal.

The sphere will be discharged until the field near it will be more than 30 kV / cm.

$$E(R)=\frac{Q}{4\pi\varepsilon_0 R^2}=\frac{1\cdot10^{-3}C}{4\pi\cdot8.85\cdot10^{-12}F/m\cdot(1m)^2}=8.99\cdot10^6V/m$$

where Q is initial charge of the sphere; R is the radius of the sphere; $\varepsilon_0=8.85\cdot10^{-12}F/m$ is the vacuum permittivity.

$$\Delta Q=Q-4\pi\varepsilon_0R^2\cdot3\cdot10^6V/m=1\cdot10^{-3}C-4\pi\cdot\left(8.85\cdot10^{-12}F/m\right)\cdot(1m)^2\cdot3\cdot10^6V/m=6.7\cdot10^{-4}C=0.67mC$$

Answer: $\Delta Q=Q-4\pi\varepsilon_0R^2\cdot3\cdot10^6V/m=0.67mC$