Question 34893

Let us use Gauss law to find the magnitude of the electric field, created by the point charge Q : $\operatorname{div}\vec{E}=\frac{\rho}{\varepsilon_0}$. Integrating the last expression, and using divergence theorem $\int \operatorname{div}\vec{E}\,dV=\oint_S \vec{E}\,d\vec{S}$, obtain $\oint \vec{E}\,d\vec{S}=\frac{1}{\varepsilon_0}\int \rho\,dV=\frac{Q}{\varepsilon_0}$. For a spherical surface of radius R this expression is the following: $4\pi R^2 E=\frac{Q}{\varepsilon_0}$, which yields $E=\frac{Q}{4\pi\varepsilon_0 R^2}\equiv\frac{kQ}{R^2}$, where $k=\frac{1}{4\pi\varepsilon_0}=8.99\cdot10^9\frac{N\,m^2}{C^2}$.

Hence, for $Q=10^{-4}C, R=0.3\,m$, $E=\frac{8.99\cdot10^9\frac{N\,m^2}{C^2}\cdot10^{-4}C}{(0.3)^2 m^2}=9.99\cdot10^6\frac{N}{C}$.