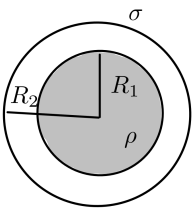
Electro-Magneto Static

Tutorials

Tutorial 2 : Electrostatics 2

Exercise 1.

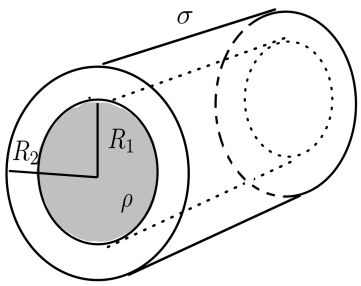
Let there be two charge distributions ($\rho > 0$ and $\sigma > 0$) such that The first charge distribution ρ is located in the region bounded by O and R_1 and the second distribution is located on surface with radiusR_2.



1. Find the expression for the electric field at any point in space.
2. Determine the resulting potential, if the potential is V_0 as r approaches ∞.

Exercise 2.

A cylinder is uniformly charged by two charge distributions ($\rho > 0$ and $\sigma < 0$). ρ is given between O and R_1 and σ on R_2.



1. Find the expression for the electric field at any point in space.
2. Find its potential, when it is given $V = 0$ when $r = 0$.

Exercise 3.

I. A metallic sphere with a radius of $0.45\,m$ carries a charge of $Q = 0.25\,nC$. Find the value of the electric field ;
   * at $0.1\ m$ from the surface of the sphere,
   ** and at $0.35\ m$ from the center of the sphere.

II. How many electrons must be added to an isolated spherical conductor with a diameter of $32\ cm$ to produce an electric field equivalent to $1150\ N/C$ on the surface of the conductor?

Exercise 4.

I. Consider a solid cylinder (Cy_1) with a volume charge distribution ($\rho < 0$). The radius of the cylinder is $R_1 = 1\ cm$ and its length is $L = 15\ cm$.
   a. Find the expression for the electric field at any point in space.
   b. Calculate the electric charge contained in this cylinder if $\rho = -0,106\ C/m^3$.

II. We now envelop the cylinder (Cy_1) with a hollow metallic cylinder (Cy_2) with inner radius $R_2 = 1,2\ cm$ and outer radius $R_3 = 1,5\ cm$, the length of the cylinder is $L = 15\ cm$.
   a. Quantify the new charge distribution of the system.
   b. Give the expression for the electric field at any point in space.
   c. Calculate the electric potential in all regions of the system if the potential is zero at $r = 0$.
   d. What will be the charge density on the outer surface of the cylinder (Cy_2)?

Exercise 5.

Consider a cylindrical capacitor composed of two cylindrical conductors, where the inner cylinder has a radius of $r_1 = 0.25\ cm$, and is covered by another cylinder with a radius of r_2 to be determined. The capacitance of this capacitor is 36.7 pF and the length of the cylindrical capacitor is 12 cm.

Exercise 6.

I. Consider a solid metallic sphere (S_1) with a radius of $R_1 = 3$ cm, with a uniform charge distribution.
   1. Give the expression for the electric field inside, outside, and on the surface of the sphere.
   2. Determine the electric potential inside and outside the sphere, if the potential at $r = 0$ is equal to $\sigma R_1/\varepsilon_0$.

II. We now envelop the sphere (S_1), which carries an initial charge equivalent to $+5q$, , with a hollow conductive sphere (S_2) with internal radius R_2 and external radius $R_3 = 5$ cm, carrying an initial electric charge of $-5q$.
   1. Find the new charge distribution of the two spheres.
   2. Will the expression for the electric field change in the regions $0 < r < R_1$ and $R_1 < r < R_2$? Justify.
   3. Calculate the internal radius R_2 if the capacitance of this capacitor is $C = 10\ pF$.
   4. Calculate the charge densities of the two spheres (S_1) and (S_2) if we are given $q = 8\ nC$ and $\varepsilon_0 = 8,85\ 10^{-12}\ C/(V.m)$.

mail to: *rafik.benallal@essa-tlemcen.dz*