EPITA-S3
2018/2019

Exercise sheet n°4

Gauss' theorem

Exercise 1

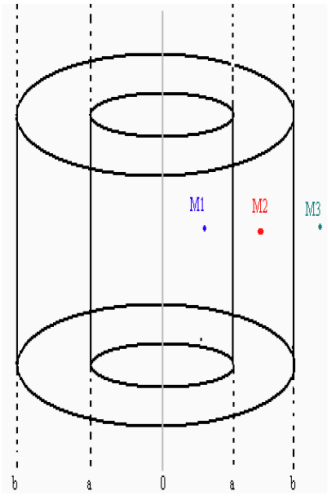
Consider a charged wire, whose length *L* is infinite, with a constant positive lineic charge λ.

1- Use the symmetries to determine the direction of the electric field. Then, use the invariances to deduce the relevant coordinate dependence of the electric field.

2- Use Gauss' theorem to get the expression of the electric field created at any point M outside the wire.

Exercise 2

Two hollow coaxial cylinders made of metal, of respective radii a and b, have the respective charges +Q and Q. The cylinders have an infinite length *l*.



1) Use the symmetries and the invariances to find the direction and the dependences of the electric field.

2) Using the Gauss theorem, express the electrostatic field generated in the domains

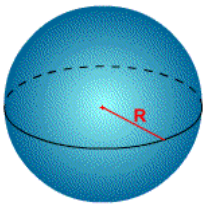
$$r < a \ ; \ a < r < b \ ; \ r > b$$

3) Deduce the expressions of the electric potential in those domains.

4) Recover the expression of the capacitance of this system, which reads: $C = \dfrac{Q}{V_a - V_b}$

Exercise 3

Consider a hollow sphere of radius R with a surfacic charge density σ, constant and positive.



1- Use the symmetries and the invariances to find the direction and the dependences of the electric field.

2- Express the electrostatic field for $r < R$ and $r > R$ using Gauss' theorem.

3- Deduce the expressions of the potential. Is given $V(\infty) = 0$.

4- Consider the same questions when the sphere is charged with a volumic density ρ, constant and positive.