BADJI MOKHTAR UNIVERSITY -ANNABA
FACULTY OF TECHNOLOGY
SCIENCES AND TECHNOLOGY DEPARTMENT (ST) - 1st year LMD 2024/2025

Physics 2: Series 2

Electric dipole and continuous charge distribution

Exercise 1

Consider an electric dipole having a dipole moment $\vec{p}$ and a the distance between its two charges $-q$ and $+q$ (Figure 1).

1. Calculate the electric potential V and field $\vec{E}$ produced by the dipole at point M ($\overrightarrow{OM} = \vec{r}$) as a function of p, θ and r, knowing that $a \ll r$.
2. Find the equation of equipotential surfaces and the equation of field lines.

Exercise 2

We consider a wire $F'F$ of length $2d$ charged with a constant linear density $\lambda > 0$.

1- Calculate the field $\vec{E}$ and the potential V created at a point M of the axis OY located at a distance y from the wire (figure 2).

2. Deduce E and V when M is in the mediating plane of the wire $F'F$.
3. Deduce E when the wire $F'F$ is of infinite length.

Exercise 3

A disk with center O and radius R carrying a constant and positive surface charge σ.

1. Calculate $\vec{E}$ and V created at a point M of its axis OX, located at a distance x from the disk (figure 3).
2. Check the relationship between the field and the potential: : $\vec{E} = -\overrightarrow{grad}V$.
3. What becomes to the field E when the radius of the disk R tends towards infinity?

Exercise 4

We consider a uniformly charged ring with center O, radius R and positive linear charge λ (Figure 3).

1. Calculate the total charge Q of the ring.
2. Calculate the field $\vec{E}_{tot}$ and the potential V created at point M located on its axis OY such that OM = y.
3. Find the potential V using the relationship between the field and the potential.

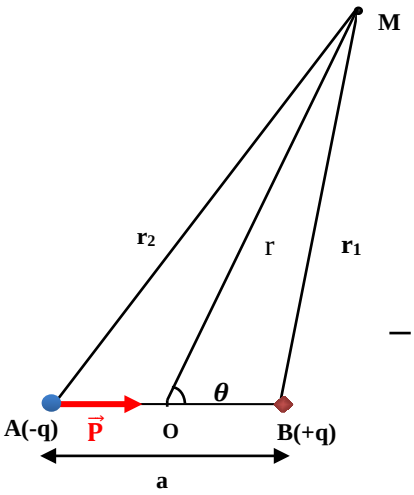

Figure 1

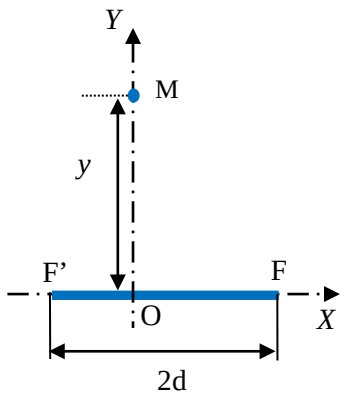

Figure 2

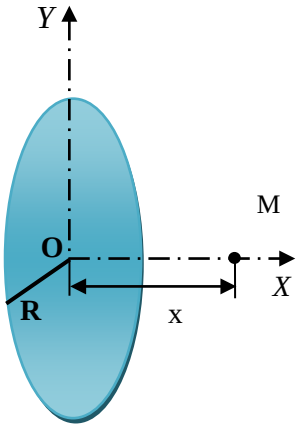

Figure 3

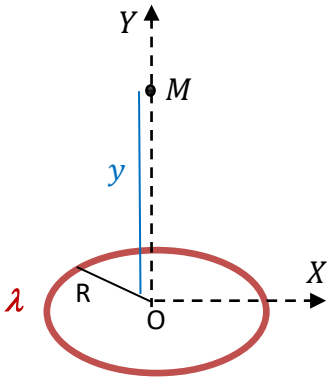

Figure 4

$$\int \frac{dx}{\sqrt{x^2+a^2}} = \ln\left(x+\sqrt{x^2+a^2}\right)+c \qquad \int \frac{x.dx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2}+c$$

$$\int \frac{dx}{(x^2+a^2)^{3/2}} = \frac{x}{a^2\sqrt{x^2+a^2}}+c \qquad \int \frac{x.dx}{(x^2+a^2)^{3/2}} = \frac{-1}{\sqrt{x^2+a^2}}+c$$