**Recitation 1**

**Exercise 1**

A glass rod is rubbed with silk. During the process, $40.10^{12}$electrons transfer from the glass to the silk. Before the process, both the silk and the glass are assumed to be neutral.

- What is the charge carried by the glass and the silk after the process? $e^{-} = -1.602.10^{-19}C$.

**Exercise 2:**

Two identical conductive spheres carry charges $q_1$ and $q_2$ respectively. They are brought into contact and then separated.

- Calculate the new charges $q_1'$ and $q_2'$ of the two spheres after contact. Specify the direction of electron transfer each case.

Consider the following cases:

- $q_1 = 4.10^{-9}c$ ; $q_2 = 0\ C$
- $q_1 = 4.10^{-9}c$ ; $q_2 = 8.10^{-9}$ C
- $q_1 = 2.10^{-9}c$ ; $q_2 = -8.10^{-9}$C

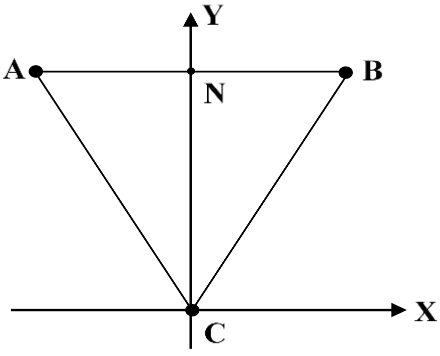
**Exercise 3:**

Two point charges $q_A = 10^{-9}C$ and $q_B = -2\ 10^{-9}C$ are placed respectively at two points (A) and (B), with a distance of $d$=3mm.

1- Calculate the electric field created by $q_A$ at point B. Represent this field.
2- Deduce the force exerted on the charge $q_B$. Represent this force.
3- Calculate the electric field created by $q_B$ at point A. Represent this field.
4- Deduce the force exerted on the charge $q_A$. Represent this force.
5- Retrieve the values of both forces by applying Coulomb's law.

**Exercise 4:**

Let $q_A$, $q_B$ and $q_C$ be three point charges are located at the corners of an equilateral triangle ABC with side $a = 10cm$ ,see the figure opposite.




1- Find the electric potential $V_N$ at point N.
2- Find the electric force $\vec{F}_C$ acting on the charge $q_C$.
3- Now, take the charge $q_C$ and place it at point N; it moves along the segment AB.

Find the equilibrium position of the charge $q_C$

Given: $q_A = -3q, q_B = q_C = -2q; \quad q = 1\mu C$

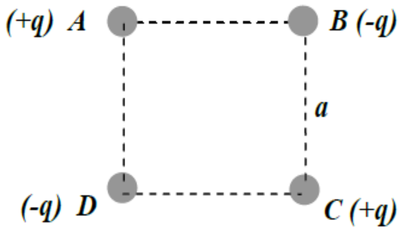
**Exercise 5:**

Consider four point charges $q_A$, $q_B$ , $q_C$ and $q_D$ placed at the corners of a square with side $a$ as indicated in figure below,

Given: $q_A = q_C = q, q_B = q_D = -q; \quad q = 1nC$ , a = 10cm

1- Find and draw the electric field $\vec{E}_D$ created by the three charges $q_A$, $q_B$ and $q_C$ at point D.
2- Deduce and draw the electrical force $\vec{F}_D$ acting on $q_D$.

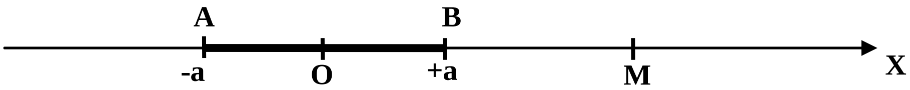
3- Calculate the electric potential $V_D$ at point D created by the three charges $q_A$, $q_B$ and $q_C$.
4- Deduce the electrical potential potential energy $E_p$of the charge $q_D$.




**Exercise 6:**

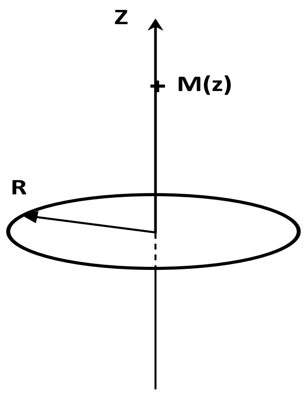
Positive charge Q is uniformly distributed along a wire AB, positioned on the Ox axis as show in figure below.

- Find the expression of electric field and potential at a point M, such that OM = X > a, in terms of Q, a, and X.




**Exercise 7** :

Consider a circular ring of radius R and center O, uniformly charged with linear charge density λ. See a opposite figure.



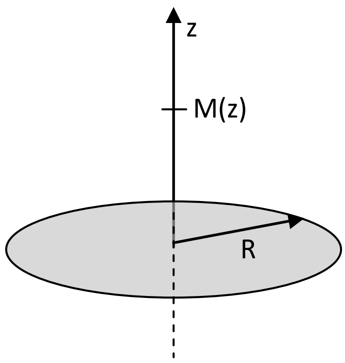

1- Find the total charge of the ring?
2- Find the expression for the electric field $\vec{E}(z)$ produced by the ring at a point M located on the oz axis.
3- Find the expression for the potential $V(z)$ at point M, using:

a. Direct calculation.

b.The expression for the electric field $\vec{E}(z)$, assuming the potential is zero at infinity.

**Exercise 8:**

Consider a disc of radius R uniformly charged on its surface with density $\sigma>0$.



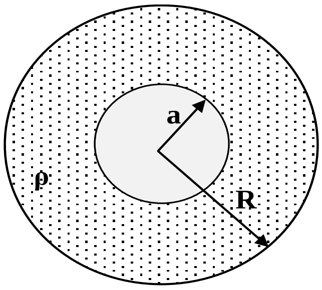

1- Find the expression $\vec{E}$ at point M on the axis of the disc.
2- If $R\to\infty$ (tend towards infinity), deduce the expression for the electric field $\vec{E}$ in this case.

**Exercise 9:**

Consider a longer cylinder of radius $R$ and length h uniformly charged in volume with a density $\rho>0$.

1- Find the electric field and potential at any point in space, we take V(0)=0V.
2- Plot the graphs of these two quantities.

**Exercise 9:**




A sphere of radius $R$ has a cavity of radius $a$, and a charge $Q$ is uniformly distributed within the volume bounded by $a$ and $R$.

- Calculate and plot $E(r)$ and $V(r)$ throughout space.

**Exercise 10 :**

A sphere of radius $R$ carries a positive charge with a volumetric charge density that depends only on the distance from its center, given by $\rho = \rho_0 (1 - \frac{r}{R})$ where $\rho_0$ is a constant.

- Find the electric field $\vec{E}$ throughout space and find the distance $r_m$ at which this field is maximum.