University of Tlemcen
Faculty of Sciences
Department of Mathematics

U.Y: 2023/2024
1st year LMD-MI

SW N° 01 of Electricity

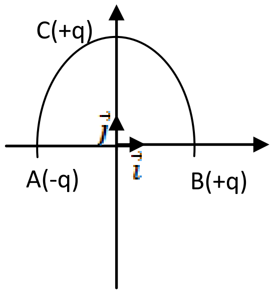
Electrostatic

Part 1 : Point charges

Exercise 1 :

Consider three point charges q_A, q_B and q_C placed at three points A, B and C such that :
$q_A = -q$, $q_B = q_C = +q$ and OA=OB=OC=R. (Fig1)

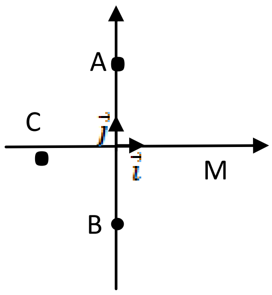
1. Calculate the potential at point O.
2. Calculate the electric field at point O.
3. Place a charge q' = (+q) at point O. Deduce the resultant of the electrostatic forces acting on this charge.



Exercise 2 :

Three point charges (+q), (+q) and (-2q) are placed at three points A, B, C such that: OA=OB= a , OC=b . (Fig2)

1. Find the expression of the electric force exerted on the charge (+q) located at A.
2. Calculate the resultant of the force acting on a positive test charge (+q) placed at point M with OM=x.
3. Deduce the expression of the electric field at point M.
4. Find the expression of the potential using the direct method.



Exercise 3:

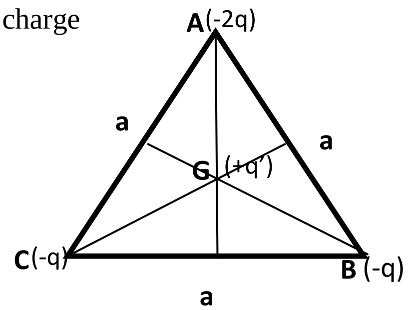
Consider three negative electric charges (qC=qB= -q and qA= - 2q) located at the apex of an equilateral triangle, and a fourth positive charge (+q') located at the center of gravity G of the triangle. (Fig3).

1- Calculate the resultant of the electrostatic forces exerted on the charge (+q') located at G and represent this force.

2- Deduce the electrostatic field at point G.

3- Calculate the potential at point G.

Let's say that: AG=BG=CG=$\frac{a}{\sqrt{3}}$



Exercise 4:

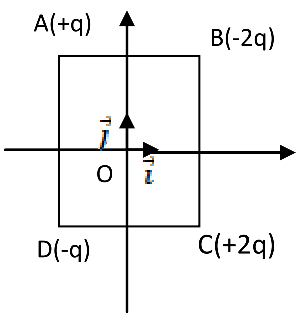
Four point charges are placed at the vertices ABCD of a square with side a=1m, and center O, origin of an orthonormal reference frame Oxy of unit vectors. (Fig4)

1. Calculate the resultant of the electrostatic forces exerted on the charge (-q) located at D.

2. Determine the electric field at center O of the square. Specify the direction and norm of this field.

(fig.4)

3. Express the potential V at O created by the four charges.



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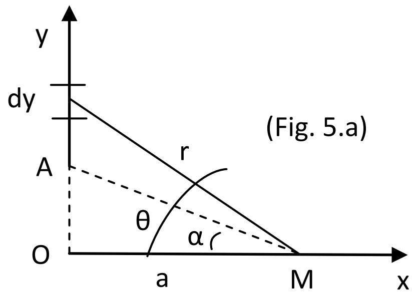
Part 2 : Continuous charges distributions

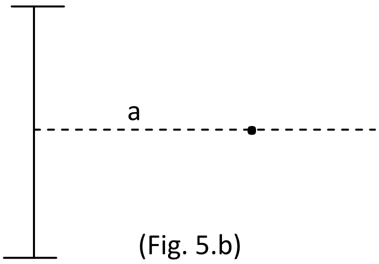
Exercise 1:

Consider a straight wire (Ay), carrying a linear density of charge, and a point M in space defined by distance OM=a and angle $\alpha = (\overrightarrow{OM}, \overrightarrow{MA})$(Fig 5.a).

1. Express the electric field components dEx and dEy resulting from the charge in the elementary element of length dy defined by the angle θ.
2. Deduce the Ex and Ey components of the electric field created by the wire (Ay) and its modulus.
3. Deduce the expression of the electric field at point M equidistant from the ends of the wire of length 2L (Fig.5.b).
4. Deduce the expression for the electric field created by an infinite rectilinear wire



(Fig. 5.a)



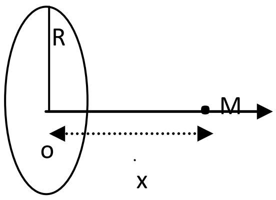
(Fig. 5.b)

Exercise 2 :

A linear charge (λ>0) is distributed uniformly over a turn (ring) of radius R.

1. Calculate the electrostatic field produced by the coil at point M located on axis (Ox) at distance x from center O.

2. Calculate the electrostatic potential at point M.



Exercise 3 :

Consider a circular disk of radius R, center O, carrying a surface charge density.

1. Determine the electrostatic potential at point M on axis (Oy), with y=OM, as a function of σ, R and y.
2. Deduce the electrostatic field strength at point M.
3. What happens to the field as the disk radius R tends towards infinity?