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Common Core in Science and Technology

جامعة محمد خيضر بسكرة
كلية العلوم والتكنولوجيا
الجذع المشترك لميدان العلوم والتكنولوجيا

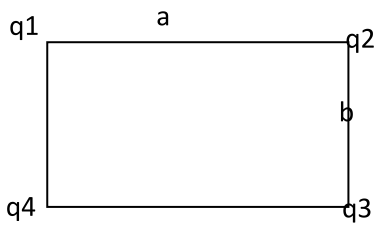
Physics 2

Tutorial N°2

Exercise1 :

Assuming there are four points charge $q_1 = 1C;\ q_2 = q_1;\ q_3 = -3q_1;\ and\ q_4 = 4q_1$ at the vertices of a rectangle with sides a=4m and b=3m.

1-Find the direction and magnitude of the force exerted on charge q_1 by the 3 charges.



Exercise2 :

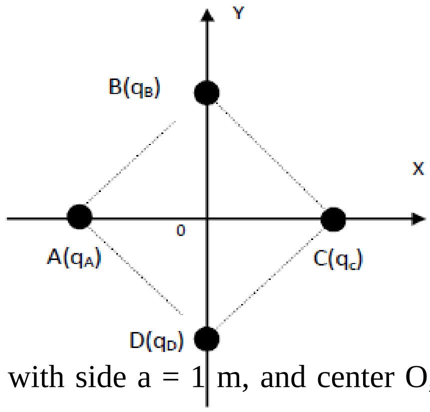
Given an orthonormal plane reference (x,o,y)figure (1).

At point (A) we place a charge $q_A = -q$; at point (B) a charge $q_B = +2q$; at point (C) a charge $q_C = +3q$; at point (D) a charge $q_D = -2q$; we take $OA = OB = OC = OD = 5cm\ and\ q = 10^{-9}C$.

1-Determine the total potential V_O at point (O) and calculate its value.

2- Determine the total electric field vector $\overrightarrow{E_O}$ at point (O) and calculate its modulus.

3- We place a charge $q' = \frac{-q}{2}$ at point O. What is the value of the resultant of the forces exerted on the charge q'. We take $K = 9.10^9\ SI$.



Exercise3 :

Four point charges are placed at the vertices of a square with side a = 1 m, and center O, origin of an orthonormal reference frame Oxy of unit vectors $\boldsymbol{i}$ and .

We give :$q_1 = q = 10^{-8}\ C;\ q_2 = -q_2;\ q_3 = 2q;\ q_4 = -q$

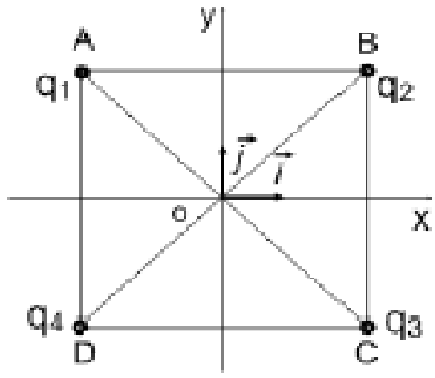
1-Determine the electric field at (O).

2-Determine the total potential V_O at point (O) and calculate its value.

3-Calculate the work required to bring a proton from infinity to point (o).

4- Calculate the total potential energy of system.

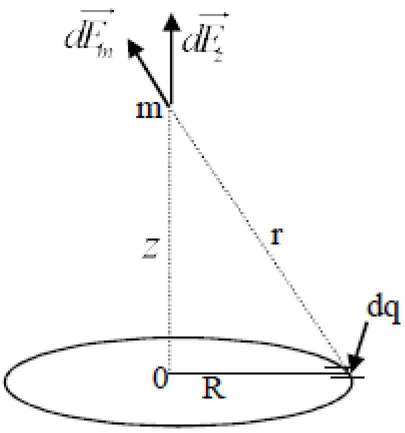
Physics 2



Exercise4 : A ring with center 0 and radius R carries a uniformly distributed charge q with density linéique λ>0.

1-Calculate the potential V at point M.

2-Deduce the field vector at M.

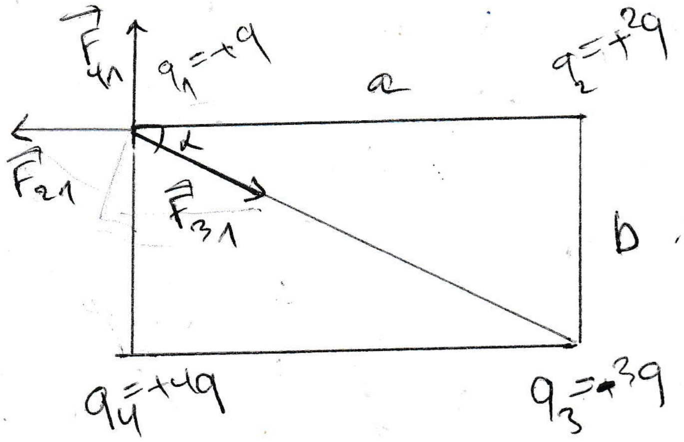


Exercise5 :

Exercise 01

Finding the direction and magnitude of the force exerted on charge q_1 by the 3 charges:

$$\vec{F}_1 = \vec{F}_{21} + \vec{F}_{31} + \vec{F}_{41} \rightsquigarrow (1)$$



where:

$$\begin{cases} F_{21} = \dfrac{k|q_1||q_2|}{a^2} = \dfrac{9.10^9}{16} = \dfrac{9}{16}.10^9 \text{ N} \\ F_{31} = \dfrac{k|q_1||q_3|}{a^2+b^2} = \dfrac{9.10^9.3}{25} = \dfrac{27}{25}.10^9 \text{ N} \\ F_{41} = \dfrac{k|q_1||q_4|}{b^2} = \dfrac{9.10^9.4}{9} = 4.10^9 \text{ N} \end{cases}$$

and

$$\begin{cases} \vec{u}_{21} = (-\vec{i}) \\ \vec{u}_{31} = \cos\alpha\, \vec{i} - \sin\alpha\, \vec{j} \;/\; \cos\alpha = \dfrac{4}{5},\ \sin\alpha = \dfrac{3}{5} \\ \vec{u}_{41} = \vec{j} \end{cases}$$

By substituting into the equation (1)

$$\vec{F}_1 = F_{21}(-\vec{i}) + F_{31}(\cos\alpha\, \vec{i} - \sin\alpha\, \vec{j}) + F_{41}(\vec{j})$$

$$= -\frac{9}{16}.10^9\vec{i} + \frac{27}{25}.\frac{4}{5}.10^9\vec{i} - \frac{27}{25}.\frac{3}{5}.10^9\vec{j} + 4.10^9\vec{j}$$

$$\vec{F}_1 = \underbrace{+0{,}301.10^9}_{F_x}\vec{i} + \underbrace{3{,}35.10^9}_{F_y}\vec{j}$$

$$F_1 = \sqrt{(0{,}301)^2 + (3{,}35)^2}.10^9 = 3{,}36.10^9 \text{ N}$$

(1)

Excercise 02:

1/ The potential V_0:

$V_0 = V_A + V_B + V_C + V_D$

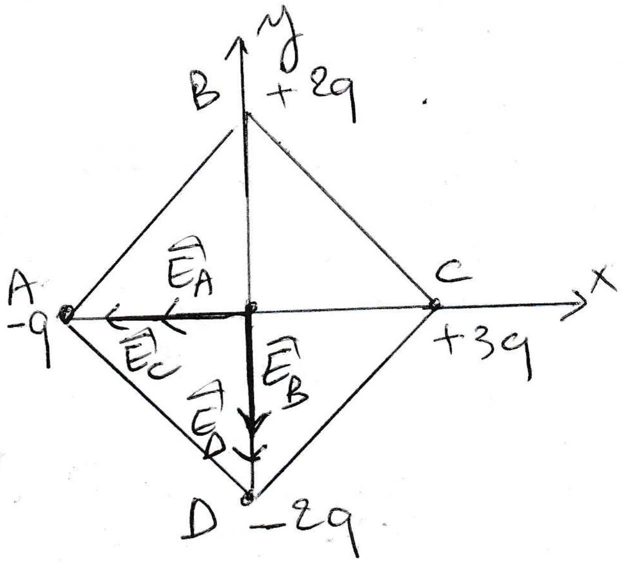
$= \frac{kq_A}{a} + \frac{kq_B}{a} + \frac{kq_C}{a} + \frac{kq_D}{a}$

$V_0 = \frac{k}{a}(-q + 2q + 3q - 2q) = \frac{k}{a}(2q)$

$V_0 = \frac{k2q}{a} = \frac{9.10^9 . 2.10^{-9}}{5.10^{-2}} = 3,6.10^2 V.$

2/ The total electric field vector $\vec{E_0}$ at point (O):

$\vec{E_0} = \vec{E_A} + \vec{E_B} + \vec{E_C} + \vec{E_D}$.



Where:

$\begin{cases} \vec{E_A} = \frac{k|q_A|}{a^2} \vec{u_A} \\ \vec{E_B} = \frac{k|q_B|}{a^2} \vec{u_B} \\ \vec{E_C} = \frac{k|q_C|}{a^2} \vec{u_C} \\ \vec{E_D} = \frac{k|q_D|}{a^2} \vec{u_D} \end{cases}$

Such as, $\begin{cases} \vec{u_A} = -\vec{i}, \quad \vec{u_B} = -\vec{j}. \\ \vec{u_C} = -\vec{i}, \quad \vec{u_D} = -\vec{j}. \end{cases}$

So: $\vec{E_0} = -\frac{k|q_A|}{a^2}\vec{i} - \frac{k|q_B|}{a^2}\vec{j} - \frac{k|q_C|}{a^2}\vec{j} - \frac{k|q_D|}{a^2}\vec{j}$

$= \frac{kq}{a^2}(-\vec{i} - 2\vec{j} - 3\vec{i} - 2\vec{j}) = -4\frac{kq}{a^2}(\vec{i} + \vec{j})$

$$\|\vec{E}_0\| = 4\sqrt{2}\,\frac{kq}{a^2}$$

$$= \frac{4\sqrt{2}\cdot 9\cdot 10^{9}\cdot 10^{-9}}{25\cdot 10^{-4}}$$

$$\|\vec{E}_0\| = 2\cdot 10^{4}\ V/m.$$

3) The force $\vec{F}$ at point (o) if $q' = -q/2$

$$\vec{F}_0 = q'\vec{E}_0 = q'\left(-4\frac{kq}{a^2}(\vec{i}+\vec{j})\right) = \frac{-q}{2}\left(-4\frac{kq}{a^2}(\vec{i}+\vec{j})\right).$$

$$\vec{F}_0 = \frac{2kq^2}{a^2}(\vec{i}+\vec{j}).$$

So: $$\|\vec{F}_0\| = \frac{2kq^2}{a^2}\,kq = \frac{2\sqrt{2}\cdot 9\cdot 10^{9}(10^{-9})^2}{(5\cdot 10^{-2})^2}$$

$$\|\vec{F}_0\| = 10^{-5}\ N.$$