University of M 'sila

Faculty of: Technology **Common Base**

Second Series Of Exercises - Phys 02

Exercise 01: Fig.01

In the figure below, bodies are charged with different charge distributions.

Calculate the whole charge for

1/ *A half thin ring of radius* $\boldsymbol{R}$ *with line distribution of linear charge density* $\boldsymbol{\lambda} = \boldsymbol{\lambda_0}\ \boldsymbol{sin}(\boldsymbol{\theta})$

2/ *A cylinder of radius* $\boldsymbol{R}$ *and Hight* $\boldsymbol{H}$ *with uniform surface distribution of charge density* $\boldsymbol{\sigma}$**.**

3°/ *A Cone of radius* $\boldsymbol{R}$*,Hight* $\boldsymbol{H}$ *with uniform volume distribution of charge density* $\boldsymbol{\rho}$

4°/ *A sphere of radius* $\boldsymbol{R}$*, with a volume distribution of density of charge density* $\boldsymbol{\rho} = \frac{\boldsymbol{a}}{\boldsymbol{r}}$.

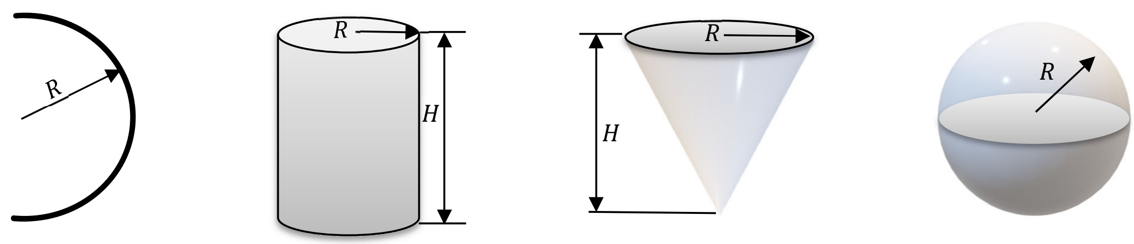


fig.01

Exercise 02: Fig.02

Two point charges ' $\boldsymbol{Q_1} = \boldsymbol{9}\ \boldsymbol{\mu C}$ *and* $\boldsymbol{Q_2} = \boldsymbol{-1}\ \boldsymbol{\mu C}$ *aligned and separated by a distance '* $\boldsymbol{d} = \boldsymbol{10}\ \boldsymbol{cm}$ *'*

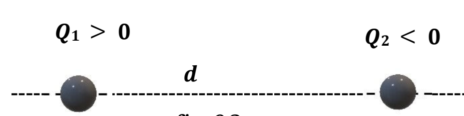


fig.02

1 - *What is the force exerted by each of these charges on the other?*

2° - $\boldsymbol{a}$ – *Sketch, in which zone (left to* $\boldsymbol{Q_1}$*,or between* $\boldsymbol{Q_1}$*and* $\boldsymbol{Q_2}$*, or right to* $\boldsymbol{Q_2}$*) a* 3^{rd} *charge* $\boldsymbol{Q_0} > \boldsymbol{0}$ *to be placed such that it be in equilibrium*

$\boldsymbol{b}$ – *Determine this distance '* $\boldsymbol{x}$ *' from the charge* $\boldsymbol{Q_2}$.

3° - *If one of them have a charge* $\boldsymbol{Q}$*, what is the charge of the second one, such that the force between these two charges will be maximal?*

Exercise 03:

Three point charges, $Q_1\,(0,0,0) = 2\mu C$, $Q_2\,(0,a,0) = 8\mu C$ *and* $Q_3\,(0,0,a) = -4\,\mu C$ *(the unit of distance is cm), are placed at the vertices of an isosceles right triangle of side "*a*".*

1°*- What is the force due to* Q_1, Q_2, *and* Q_3 *on* $Q_4\,(0,a,a) = -6\,\mu C$ *?*

2°*- What is the field due to these 4 charges at the center of the square formed?*

Exercise 04:

A ring of radius R *has a uniform distribution of charge of density* λ*.*

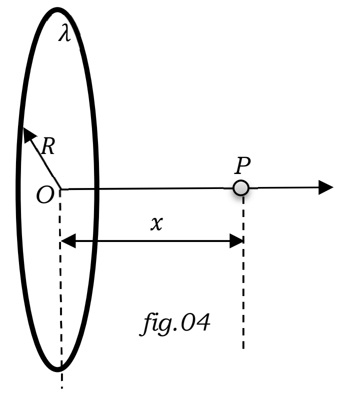


fig.04

1°*- What is the force exerted by this ring on the charge* $-Q$ *located at the distance* x *from the center and along its axis?*

2°*- What is the force if the charge* $-Q$ *is at the center of the ring?*

3°*- What is the nature of the motion of the charge –* Q *if it is moved away from the center by a small distance* x *along the axis compared to its radius* R $(x << R)$*?*

Exercise 05: (Additional)

Two identical copper pieces, each with a mass $m = 2.5\,g$*, containing* $N = 2022$ *atoms. We remove* n *electrons from each piece, then one is placed on a horizontal table and the other just above it at a distance* $d = 1\,m$ *where it remains at rest.*

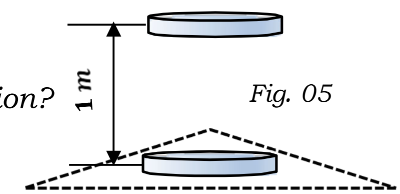


Fig. 05

1°*- What is the charge* Q *of each piece maintaining this configuration?*

2°*- What is the number* n *of electrons removed from each piece?*

3°*- What is the portion of copper whose atoms have lost their electrons (assuming each atom loses only one electron)?*

Exercise 06: (Additional)

Four identical point charges ' $-Q$ *' placed at the vertices '*A*', '*B*', '*C*' and '*D*' of a square of side '*a*'. Another charge '* $Q_0 > 0$ *' fixed at the center '*O*' of this square.*

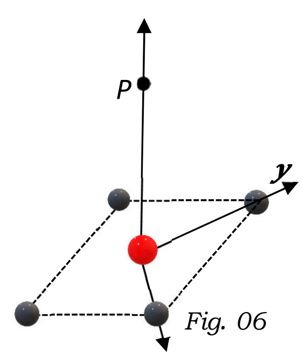


Fig. 06

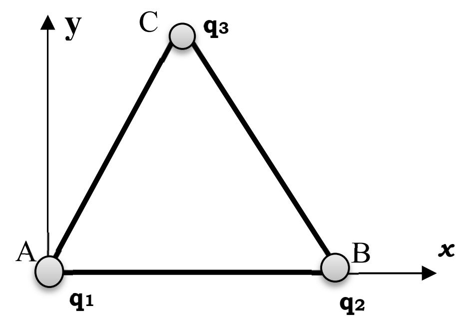
1°/ *Express* Q_0 *in terms of the charge* Q *such that the system will be in electrostatic equilibrium (the total force acting on each of the charges is zero).*

If we move the charge Q_0 *and then fix it at point* $P\,(0,0,a\sqrt{2})$ *just above the center '* O*'.*

2°/ *What is the force exerted by the charges at the vertices on the charge* $\boldsymbol{Q_0}$ *at point '**P**'?*

3°/ *Deduce the electric field created by the* **4** *charges at the vertices at point 'P'.*

Exercise 07 **(Additional)**



Three charges $\boldsymbol{q_1 = Q}$, $\boldsymbol{q_2 = 3Q}$ *and* $\boldsymbol{q_3 = +2Q}$ *are arranged on the vertices of an equilateral triangle of side* $\boldsymbol{a}$.

Given $\boldsymbol{Q = +2 \times 10^{-6} C}$ and $\boldsymbol{a = 3 \times 10^{-2}\, m}$ *in the base* $(\vec{i}, \vec{j})$

1. *Write the position vectors for each charge*
2. *Write the unit vectors for the lines joining the charges*
3. *Represent and determine the electric forces applied by each of these charges on the charge* $\boldsymbol{q_3}$.
4. *Determine the total force acting on* $\boldsymbol{q_3}$.
5. *Deduce the components of the electric field vector* $\vec{\mathbf{E}}$ *and its intensity.*

Exercise 08: (*HW*)

Three particles each of mass $\boldsymbol{m = 1\, g}$, *carrying a charge* $\boldsymbol{q}$. *Are suspended from a common point* $\boldsymbol{P}$, *by three insulating massless strings, each* $\boldsymbol{l = 10\, cm}$ *long.*

If the particles are in equilibrium and located at the corners of an equilateral triangle of side length $\boldsymbol{a = 3\, cm}$

Calculate the charge $\boldsymbol{q}$ *of each particle.*

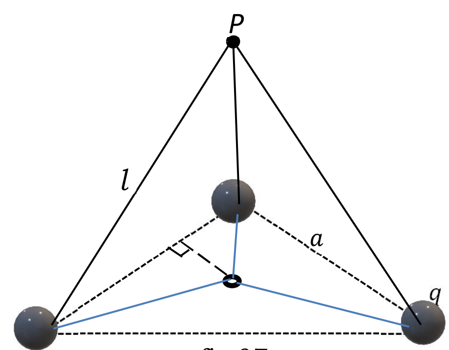


fig.07