Ministry of Higher Education and Scientific Research

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Department of Computer Science

General Electricity

Problems & Exercises (of Chap 1)

Electrostatics

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Exercise 1

Find the total charge for each of the following distributions:

1. Linear charge λ_0, uniformly distributed along the perimeter of a square with side a.
2. Surface charge σ_0, uniformly distributed over a ring-shaped region bounded by two concentric circles with radii a and b (where $b>a$).
3. Volume charge ρ_0, uniformly distributed between two spheres with radii a and b (where $b>a$).
4. Volume charge ρ_0, uniformly distributed between two coaxial cylinders with radii a and b (where $b>a$) and height h.

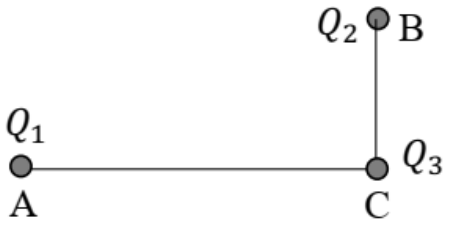
Exercise 2

Three charges Q_1, Q_2, and Q_3 are arranged as shown in the figure below.

Given: $Q_1 = 1.5 \times 10^{-3}C, AC = 1.2m,$

$Q_2 = -0.5 \times 10^{-3}C,\ Q_3 = 0.2 \times 10^{-3}C,\ BC = 0.6m.$

Calculate the resultant force exerted by charges Q_1 and Q_2 on charge Q_3.

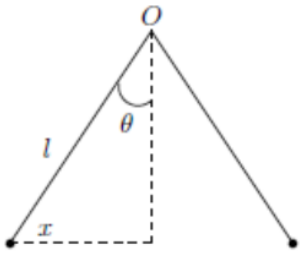


Exercise 3

Two identical conducting spheres with mass m = **10 g** carry charges q_1 and q_2. They are brought into contact and then separated.

1. Calculate the charges q_1' and q_2' they acquire in the following cases:
   a) $q_1 = +4 \times 10^{-8}\ C\ et\ q_2 = 0\ C.$
   b) $q_1 = +3 \times 10^{-8}\ C\ et\ q2 = +8 \times 10^{-8}\ C.$
   c) $q_1 = +3 \times 10^{-8} C\ et\ q2 = -8 \times 10^{-8} C.$

Specify the direction of electron transfer each time.

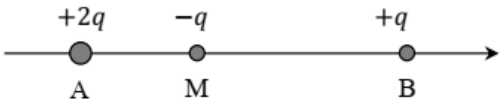


2. Both masses are suspended at the same point O by two identical Nylon threads of length l = **80 cm** (figure).
   Neglecting the mass of the threads, calculate the distance $2x$ separating the two spheres for the three previous cases (assuming the angle θ is sufficiently small and g = **10 m/s²**).

Given: $K = 9 \cdot 10^9$ **S.I**

Exercise 4

Below is the charge distribution:



The two charges placed at **A** (origin of the abscissa) and **B** are fixed;

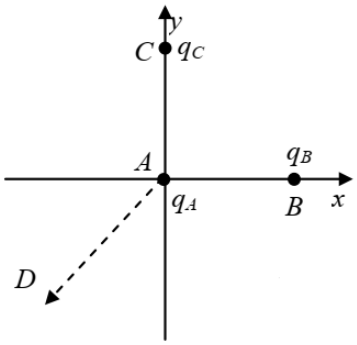
however, the charge placed at **M** is movable along the segment **AB**.

What is then the equilibrium position of the charge placed at **M**, if it exists?

Given **AB** = **d**.

Exercise 5

We place three charges $\mathbf{q_A = 10^{-7}\ C}$, $\mathbf{q_B = 2\ 10^{-7}\ C}$, and $\mathbf{q_C = -3\ 10^{-7}\ C}$ at points **A**, **B**, and **C** with respective Cartesian coordinates **A(0,0)**, **B(3,0)**, and **C(0,3)** in cm (figure).

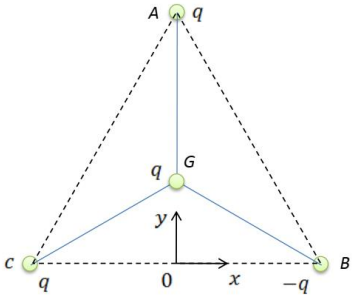


1. Calculate and qualitatively represent the electric field created by charges $\mathbf{q_B}$ and $\mathbf{q_C}$, at point **A**
2. Determine the force exerted on the charge $\mathbf{q_A}$.
3. Calculate the potential created by charges $\mathbf{q_B}$ and $\mathbf{q_C}$ at point **A**. Deduce the potential energy of the charge $\mathbf{q_A}$.
4. Calculate the work done by the electrostatic force when moving charge $\mathbf{q_A}$ from point **A** to point **D(-3,-3)** cm.

Additional Exercises

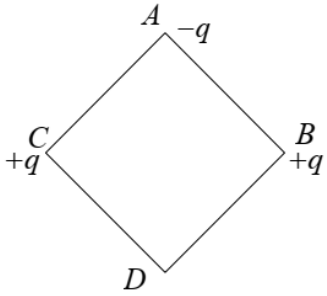
Exercise 6

Calculate the force exerted by three charges **1µC**, **-1µC**, and **1µC**, placed at the vertices of an equilateral triangle with a side length of **1cm**, on a charge of **1µC** located at the center of the triangle.



Exercise 7

Point charges occupy the vertices **A**, **B**, and **C** of a rhombus with side length ***a***, as shown in the figure below (there is no charge at **D**).



1/ Calculate the electric field produced by the three charges at vertex **D**; graphically represent this field.

2/ A charge **+2q** is placed at point **D**. Calculate the electric force exerted by the other charges on the center of the rhombus.