

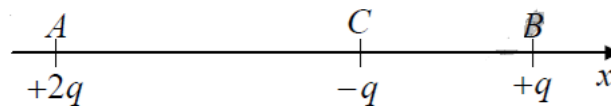


1st Set of exercises

Exercise 1:

Consider the charge distribution (of the order of a microcoulomb) shown below; $AB = d = 0.2$ m. The two charges placed at points A and B are fixed; however, the charge placed at point C is free to move along the line AB.

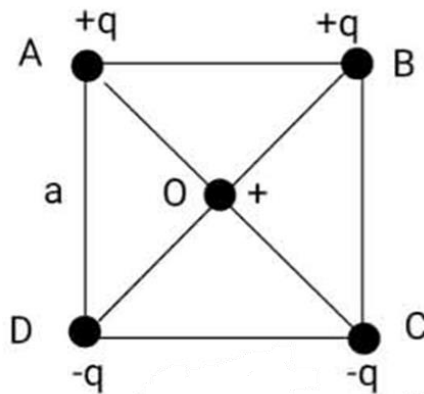
What is the equilibrium position of the charge placed at point C, if it exists?



Exercise 2:

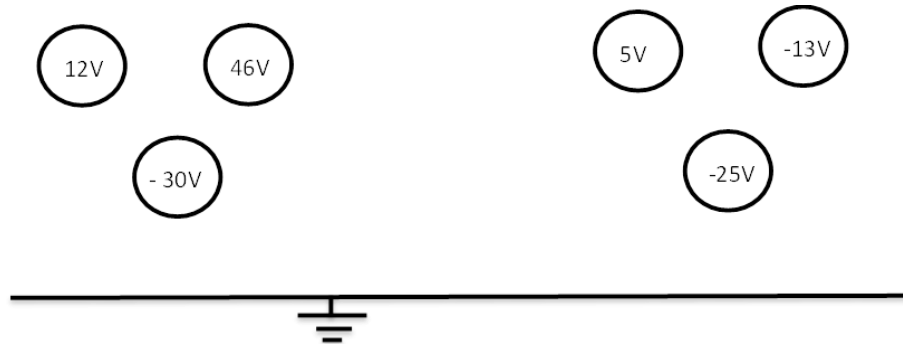
In vacuum, four point charges are placed at the vertices of a square ABCD of side length a .

- Calculate the magnitude of the electrostatic force \vec{F}_T acting on the charge $+q$ placed at the center of the square O due to the other charges, and then represent this force on the diagram.



Exercise 3:

Draw all the possible field lines in the two figures shown below, indicating their direction.



Exercise 4:

Let's take the scalar function

$$V(x, y, z)$$

And two vector functions

$$\vec{E}(x, y, z) = E_x \vec{i} + E_y \vec{j} + E_z \vec{k} \quad , \quad d\vec{r}(x, y, z) = dx \vec{i} + dy \vec{j} + dz \vec{k}$$

According to the following relationship

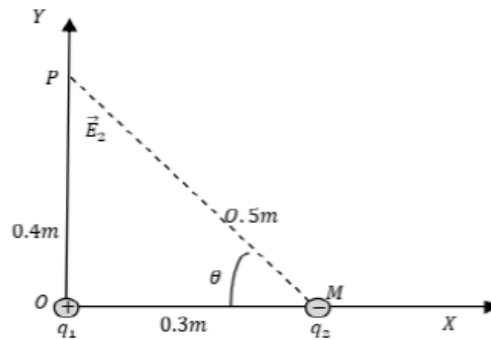
$$dV = -\vec{E} \cdot d\vec{r}$$

1. Find the expression of E_x , E_y , E_z as a function of V .
2. Deduce the relationship between the scalar function V and the vector function \vec{E} .

Exercise 5:

In orthonormal base OXY, a charge $q_1 = 7 \mu\text{C}$ was placed at the origin (0,0) and charge $q_2 = -5 \mu\text{C}$ at the point M (0.3, 0), (see the figure).

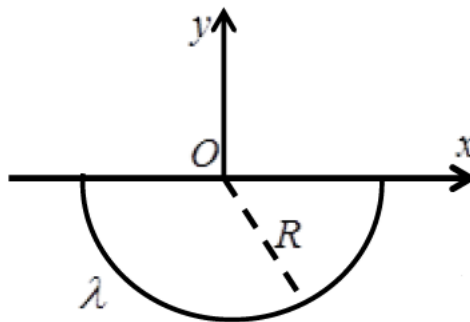
- 1- Find the electric field \vec{E} at the point P (0, 0.4).
- 2- Find the electric potential V at the point P (0, 0.4).



3- Calculate the electric potential energy of point charges q_1 and q_2 .

Exercise 6:

Consider the following charge distribution:



- Calculate the electric field and the electric potential at the center O of a semicircular wire of diameter R, carrying a constant and positive linear charge density λ .

Exercise 7:

Consider a positively charged segment AB with a uniform linear charge density λ , of length $2a$ and center O.

1- Demonstrate that the y-component of the electrostatic field vector \vec{E}_y is identically zero.

2- Determine the electrostatic field at a point M located on the axis of symmetry Ox, where $OM=x$.

Exercise 8:

Find the electric flux through a sphere of radius r enclosing at its center:

(a) a positive charge q , and (b) a negative charge $-q$.

Exercise 9:

A solid sphere of radius R has a uniform volume charge density ρ and carries a total positive charge Q .

- Find and sketch the electric field at any distance r away from the sphere's center

Exercise 10:

A thin spherical shell of radius R has a total positive charge Q distributed uniformly over its surface.

- Find the electric field inside and outside the shell.