People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

Mohamed Boudiaf University of M'sila

Faculty of Sciences

Common Trunk of Matter Sciences

1st year - 2nd semester

Practical works - Physics 2

2nd Practical Work
Equipotential surfaces and field lines

Experiment date: ………/………/…………

Corrector professor : ……………………………………

Report prepaded by :

First name	Family name	Group	Sup-group	Preparation mark	Final mark
				/5,00	/20,00
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Academic year : 2023/2024

Purpose of the experiment

1- The goal of this experiment is to be able to determine the field lines and equipotential surfaces.

2- Theoretical Part

If a positive or negative electric charge « q » is at rest, it creates around itself an electric field defined by Coulomb's law

$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\vec{u}_r$, ε_0: is the vacuum permittivity

r : is the distance between the charge and the place where the field is evaluated.
If there is a field at a point in space, we know that it derives from a potential, i.e.

$$\vec{E} = -\overrightarrow{grad}V \ \Rightarrow V = \int \vec{E}\,\overrightarrow{dl}$$

V : is the potential created by the charge at the point considered.

$d\ l$: is the elementary displacement of the electric field vector along the curve C.

There are points in space all around the charge where the value of the potential is constant. The geometric locus of these points constitutes an equipotential surface. If we take a set of charges distributed over a surface with a distribution « σ », they create an electric field given by the following relation:

$$\vec{\mathrm{E}} = \int \frac{\mathrm{dq}}{4\pi\varepsilon_0 \mathrm{r}^2}\vec{\mathrm{u}}_\mathrm{r} = \int \frac{\sigma\mathrm{ds}}{4\pi\varepsilon_0 \mathrm{r}^2}\vec{\mathrm{u}}_\mathrm{r}$$

If we take two large parallel plates in front of the distances between charges, we can assimilate them to infinite planes.

Demonstrate that each plane, assumed to be a disk of infinite radius R, has a field:

$E = \frac{\sigma}{2\varepsilon_0}$.

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Remark : the field is independent of the distance which separates the two plates.

1- If we take these two plates and power them with opposite charges opposées (one carries negative charges the other carries charges positives), demonstrate that uniform field which rigns between them is of intensity $E = \frac{\sigma}{\varepsilon_0}$ and fixed direction (from the plate that carries positive charges to the plate that carries negative charges, as shown in the opposite figure.)

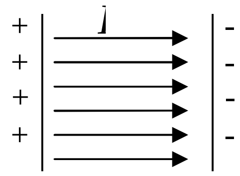

Figure-1

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Each of the two distinct points x_0 and x has a potential V_0 et V respectively and the potential difference “p.d” between these two points is given by:

$$\int_{V_0}^{V} dV = -\int_{x_0}^{x} E\,dx \Rightarrow V - V_0 = -E(x - x_0)$$

If we take $x_0 = 0$ as an origin which corresponds to a potential V, then the dependence of The potential on the distance x is a straight line given :by by n by $V(x) = -Ex + V_0$

3-Practical work

-Perform the experimental setup shown in the opposite figure.

-Place the tank filled with distilled water on graph paper

- Place the two bars parallel to the limits of the tank, and locate the negative terminal as the origin of the potential mark V_0.
- Power the setup as shown in the figure.
- Find the coordinates x and y for 5 points that have the same potential (a central point and two points on either side). Repeat the same thing for different potentials.

Potential (V)												
$P_1(x_1,y_1)$												
$P_2(x_2,y_2)$												
$P_3(x_3,y_3)$		0		0		0		0		0		0
$P_4(x_4,y_4)$												
$P_5(x_5,y_5)$												

1°- Complete the above table.

2°- Join the points of the same potential (figure 3).

3°- What do these curves represent? What do they look like?

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4°- Take the middle points for which the “y” component is zero. Draw the curve $V = F(x)$ (figure 4).

5°- From the graph, calculate the electric field that reigns inside. E=…….V/Cm

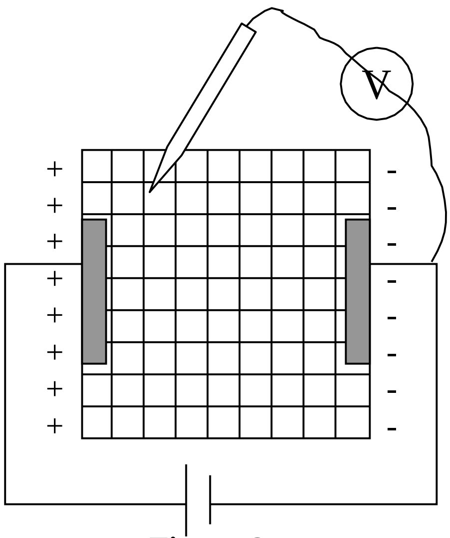

Figure-2

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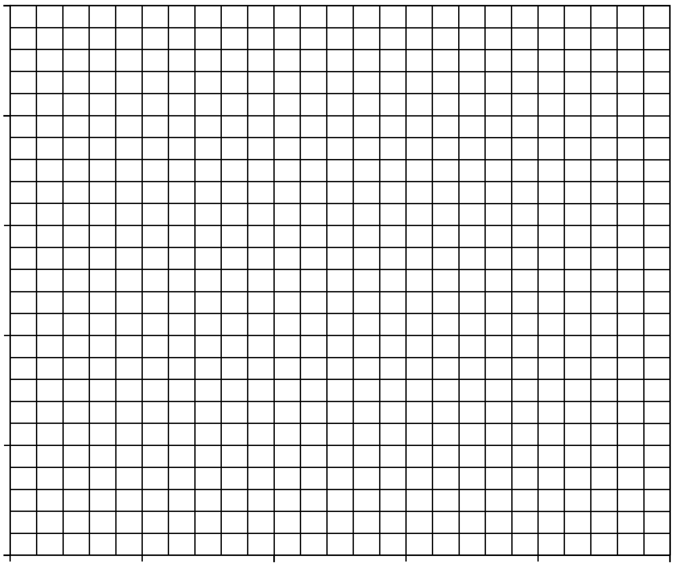

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Abscissa scale
━ ; …………. **Cm**

Ordinate scale
━ ;………..**Cm**

Figure; 3

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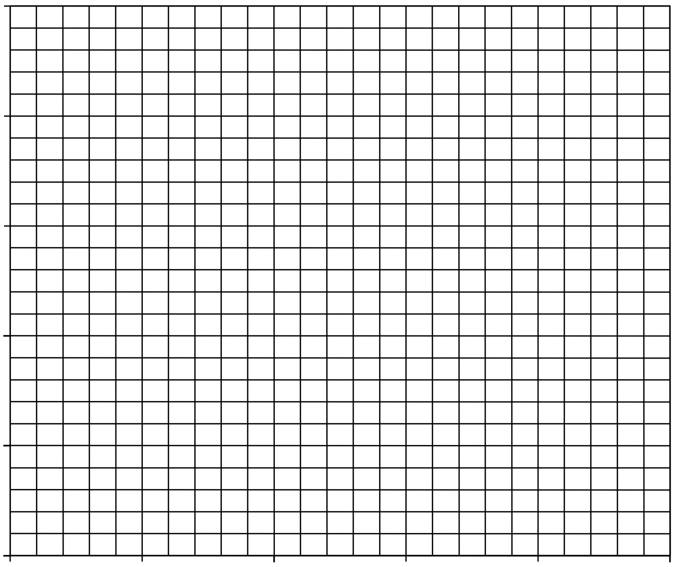

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Abscissa scale
━ ; …………. **Cm**

Ordinate scale
━ ;…………..**V**

Figure; 4