1. Aim of the experiment

The objective of the experiment is to be able to determine the field lines and equipotentials surfaces.

2. Notions and preparatory work

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

$$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\vec{u}_r \,,\ \varepsilon_0 \text{ is the permittivity of free space.}$$

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.

$$\vec{E} = -\overrightarrow{grad}V \Rightarrow V = -\int \vec{E}d\vec{l}$$

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

dl :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 on a surface with a distribution σ.

They create an electric field given by the following relation:

$$\vec{E} = \int \frac{dq}{4\pi\varepsilon_0 r^2}\vec{u}_r = \int \frac{\sigma dS}{4\pi\varepsilon_0 r^2}\vec{u}_r$$

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

1. Demonstrate that each plane, assumed to be a disk of infinite radius R, has a field: $E = \dfrac{\sigma}{2\varepsilon_0}$

....
....
....
....
....
....
....
....

………
………
………
………

Note: 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 (one carries positive charges and the other carries negative charges), demonstrate that the uniform field which reigns between them is of intensity $E = \frac{\sigma}{\varepsilon_0}$ and direction fixed (from the plate that carries negative charges to the plate which carries positive charges, as shown in the figure opposite).

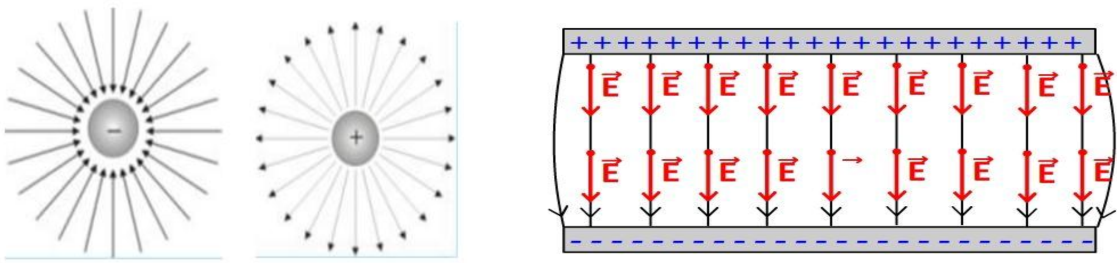

Figure 1

………
………
………
………

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

$$\int_{V_0}^{V} VdV = -\int_{x_0}^{x} Edx \Rightarrow V - V_0 = -E\left(x - x_0\right)$$

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: $V(x) = -Ex + V_0$

3. **Practice**

- Perform the assembly 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 assembly as shown in the figure.

- Find the coordinates x and y for 5 points which have the same potential (a central point and two points on either side).
- Repeat the same thing for different potentials.

Potential (V)														
$P_1(x_1,y_1)$		4		4		4		4		4		4		4
$P_2(x_2,y_2)$		2		2		2		2		2		2		2
$P_3(x_3,y_3)$		0		0		0		0		0		0		0
$P_4(x_4,y_4)$		-2		-2		-2		-2		-2		-2		-2
$P_5(x_5,y_5)$		-4		-4		-4		-4		-4		-4		-4

1. Complete the table above.
2. Join the points of the same potential (figure 3).
3. What do these curves represent? How do they appear?
   ………………………………………………………………………………………
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

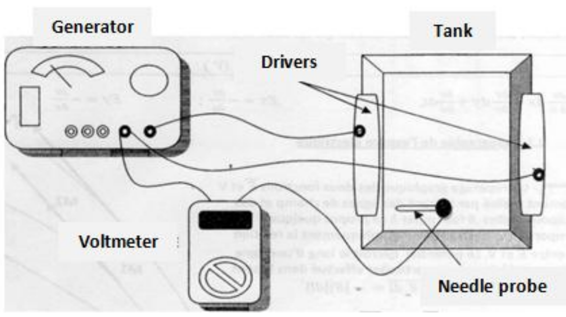

Figure 2

Conclusion

……
……
……
……

……………………

Abscissa scale

- :…….. Cm

Ordinate scale

- :…….. Cm

……………………

Figure : 3

……………………

Abscissa scale

- :…….. Cm

Ordinate scale

- :……….. V

……………………

Figure : 4