Experiment No: M1

Experiment Name: *"Coulomb constant k"*

Objective:

1. Determine how the conductive sphere is loaded and unloaded,
2. To measure the potential of a charged sphere,
3. Comparing the theoretical and experimental Coulomb constant k_e.

Keywords:

Coulomb constant, Coulomb's Law, electric charge, electrostatic force, radius, charge

Theoretical Information:

Named after the French physicist Charles-Augustin de Coulomb (1736–1806) who introduced Coulomb's law, this constant is the Coulomb constant, the electric force constant, or the electrostatic constant (denoted $\boldsymbol{k_e}$, $\boldsymbol{k}$,or $\boldsymbol{K}$). It is a proportionality constant in electrostatics equations.
The theoretical value of the Coulomb constant ($\boldsymbol{k_e}$) is approximately:

$$k \approx 8.9875 \, x \, 10^9 \, Nm^2/C^2$$

A point charge (Q) creates an electrical potential in the space around it. Electric potential (V) refers to the potential energy of a charge at a point. Electric potential can be calculated in space up to infinite distance from the location of the charge, and this potential decreases as the distance from the charge increases. The electrical potential created by a point charge is expressed as follows:

$$V = k \, \frac{Q}{r} \qquad (1)$$

V, represents electrical potential.

k is the constant known as Coulomb's constant.

Q, refers to the magnitude of the point charge.

r, indicates the distance of the point where the electrical potential is calculated from the load.

A spherical surface charge (q) is an electric charge distributed uniformly on the surface of a sphere. This surface charge is characterized by a charge density that covers the entire surface of the sphere.

To calculate the electrical potential on a sphere with a spherical surface charge, Gauss's surface integral theorem can be employed. This theorem states that if the electric field is homogeneous and the geometry is spherically symmetric, the electrical potential at any point inside the surface is equal to the electrical potential at any other point on the surface.

Therefore, on a sphere with a spherical surface charge, the electrical potential on the surface is the same as the electrical potential at the point where the charge is located. In other words:

$$V_{sphere} = k_e \frac{q}{r_{sphere}} \qquad (2)$$

V_{sphere}, represents the electrical potential on the sphere's surface.

q denotes the magnitude of the spherical surface charge.

r_{sphere}represents the radius of the sphere.

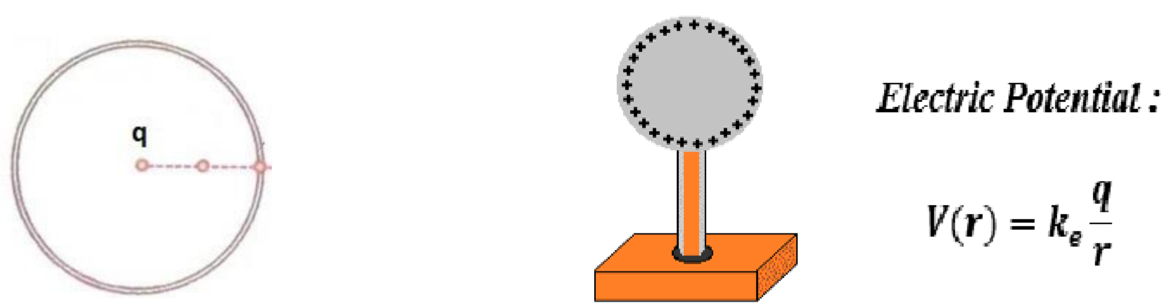

Figure 1: *Electric Potential*

As a result, the relationship between a point charge and a spherical surface charge in terms of electrical potential shows that the potential on the sphere's surface depends on the magnitude of the charge and the radius of the sphere. This relationship is important in analyzing electrostatic interactions between charges and calculating potential energy.