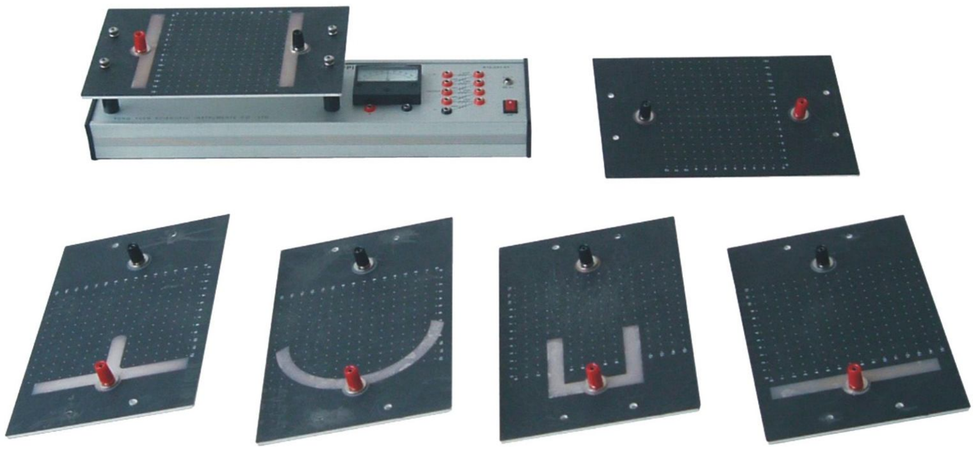
Experiment: Equipotential Lines and Electric Field Experiment



Purpose

To study the scope of the electric field.

Theory

Coulomb's Law states that the magnitude of the Electrostatics force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distances between them.

$$\vec{F}_e = k\frac{Qq}{r^2} \qquad k = 9\times10^9\frac{Nm^2}{C^2} \qquad \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

Q, q are the quantity of two electric charges. r is the distance of the two charge. k is Coulomb constant. When Q generates an electric field, q will be affected by the electric field. So,

$$\vec{E} = \frac{\vec{F}_e}{q} = k\frac{Q}{r^2} \qquad \cdots\cdots\cdots\cdots\cdots\cdots (2)$$

From the above equation, we know the work of q is related to *r* but not to its path, so the equation can be written as

$$W = \vec{F}_e \cdot \vec{r} = q\vec{E} \cdot \vec{r} = q\Delta V \qquad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

ΔV is the potential difference of two points before and after moving. By the above equation (1), (2), (3), we obtain

$$\Delta V = \vec{E} \cdot \vec{r}$$

The potential of any position can be defined as:

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

Instrument

NO	Accessory	Quantity
1	Experimental Base	1
2	Two-point Charge Electrode Carbonaceous Board	1
3	Galvanometer	1
4	Connecting Wire	4

Procedure

1 Fix the carbonaceous board on the experimental base. Then put the drawing paper is placed on the table.

2. Connect the carbonaceous board to the DC power supply, and put the end of positive pole of the galvanometer at any point of the board. Turn on the DC power supply, and then find the spot that does not make the galvanometer deflect using the negative pole of the wire. These spots are the same potential as the positive pole of the galvanometer.

3. Draw the points on the paper and connect them into a line, this line is the equipotential line

4. Change the position of the positive pole of the wire on the carbonaceous board and repeat step 2 to find each equipotential line.

5. Draw the dotted lines to represent the power lines perpendicular to the equipotential lines

Experimental Record

Draw the diagram on the experimental result paper.

Questions and Discussions

1. Can different equipotential lines cross each other? Can different power lines cross each other?

2. Assume a metal ball with electricity Q and radius a. Describe the potential and the electric field, when its location is greater or smaller than the radius.

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