

Field maps, voltage and energy per unit charge

AP Physics 2 (algebra-based) · Lab

Name: _____ Date: _____ Class: _____

How does electric potential change between two parallel electrodes, and what does that tell us about the field? You measure the potential at several points on conducting paper, plot a graph, and use the gradient to find the electric field strength. You then compare it with V/d .

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 10

Aim

To map the potential between two parallel electrodes on conducting paper and use it to find the electric field.

Equipment

- Sheet of conducting (carbon-coated) paper with two parallel bar electrodes 10.0 cm apart
- 6.0 V DC supply or battery pack
- Digital voltmeter and a probe
- Ruler and cork board with drawing pins
- Connecting leads

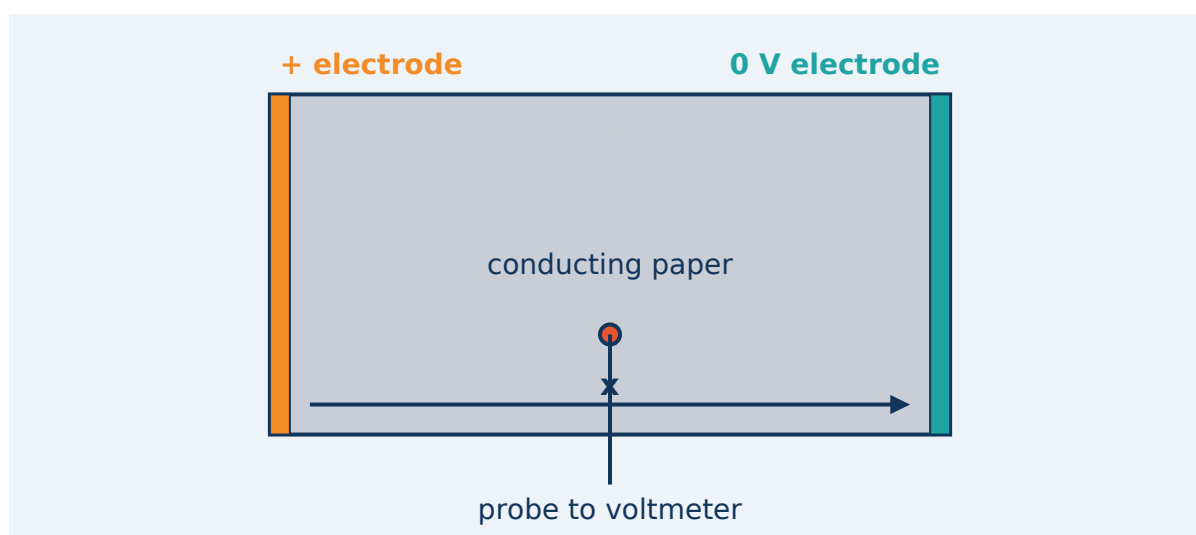
Safety

Safety

The voltage is low and safe, but the paper and leads can warm up if a short circuit forms. Switch off between readings, never connect the electrodes with a lead, and keep drinks away from the equipment.

Method

1. Pin the paper to the board and connect one electrode to the positive terminal and the other to the negative terminal of the 6.0 V supply.
2. Connect the voltmeter negative lead to the negative electrode and use the positive lead as a probe.
3. Touch the probe at $x = 0, 2, 4, 6, 8$ and 10 cm from the negative electrode along the centre line and record the potential.
4. Find three points with the same reading and mark them to draw one equipotential line.
5. Sketch the field direction perpendicular to your equipotentials.



A probe connected to a voltmeter measures the potential at different positions on the paper.

Results

Sample readings from Mei's group in Singapore are shown.

x from negative electrode (cm)	0	2.0	4.0	6.0	8.0	10.0
Potential V (V)	0.00	1.21	2.42	3.58	4.80	6.00

Analysis questions

Question 1 Plot and describe

Plot V (vertical) against x (horizontal) and describe the line.

Question 2 Gradient and field

Calculate the gradient from the first and last points and use it to find the field strength in V/m.

Question 3 Compare with V/d

Calculate V/d for the whole paper and find the percentage difference from your gradient.

Question 4 Energy of a charge

A $1.0 \mu\text{C}$ charge is moved across the paper from the negative to the positive electrode. Calculate the work done.

Question 5 Equipotentials and field lines

Describe the shape of the equipotential lines and how field lines relate to them.

Question 6 Voltmeter resistance

Explain why a voltmeter with a very high resistance is used.

Question 7 Edge effects

Near the edges of the paper the equipotential lines curve. Explain why and say how you would reduce the effect.