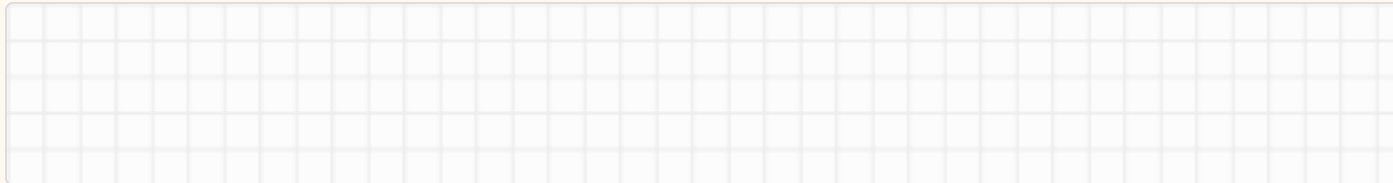


ELECTRICITY DAY 13: LAB L10.3 - FIELD & EQUIPOTENTIAL MAPPING

CED 10.5 · Skills 3.A/1.A · FRQ: ED · target: field lines cross equipotentials, not follow them

RETRIEVAL - NO DEMO

A map shows a 9 V contour beside a 6 V contour. Draw the local electric-field direction and state the angle at which it crosses each contour.



QUESTION AND MEASUREMENT PLAN

Question: How can measurements of $V(x,y)$ be used to construct equipotential contours and electric-field lines?

Measured quantity: potential relative to the 0 V electrode. **Position convention:** record x and y from the marked origin.

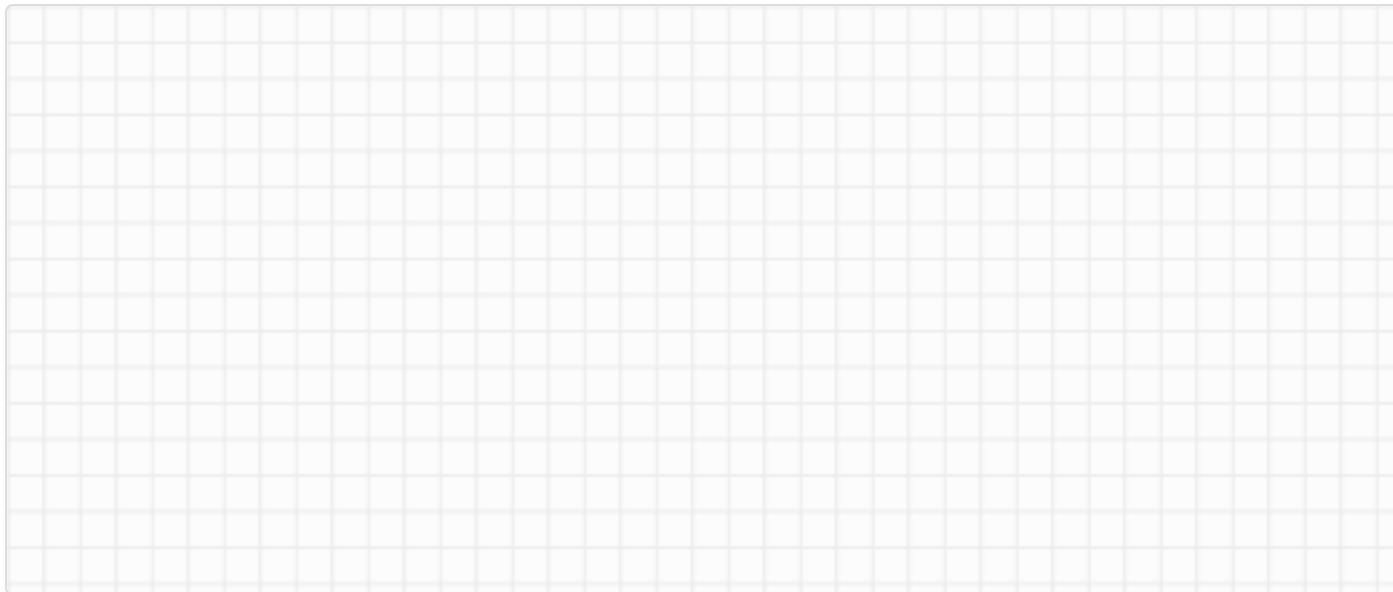
SUPPLIES

Conductive paper, electrode paint, 0–12 V DC supply, digital multimeter, probes, ruler, and leads. Keep the supply at 12 V or below and switch it off before changing leads.

No-equipment route: PhET *Charges and Fields*, using the voltage tool/equipotential pen and the same coordinate grid. Record this as simulation data.

PREDICTION

Sketch the expected contours and field direction for your electrode shape before collecting data.



PROCEDURE

- 1. Trace the electrode positions and mark a coordinate origin on the map.
- 2. Connect the high-potential electrode to +12 V and the reference electrode to 0 V. Verify the electrode voltages.
- 3. Measure V at every marked grid point without moving the electrodes or changing the supply.
- 4. Repeat at least four grid points. Record both readings; investigate differences larger than 0.2 V.
- 5. Switch off the supply after measurements are complete.

VOLTAGE GRID

y \ x	0 cm	2 cm	4 cm	6 cm	8 cm	10 cm
8 cm						
6 cm						
4 cm						
2 cm						
0 cm						

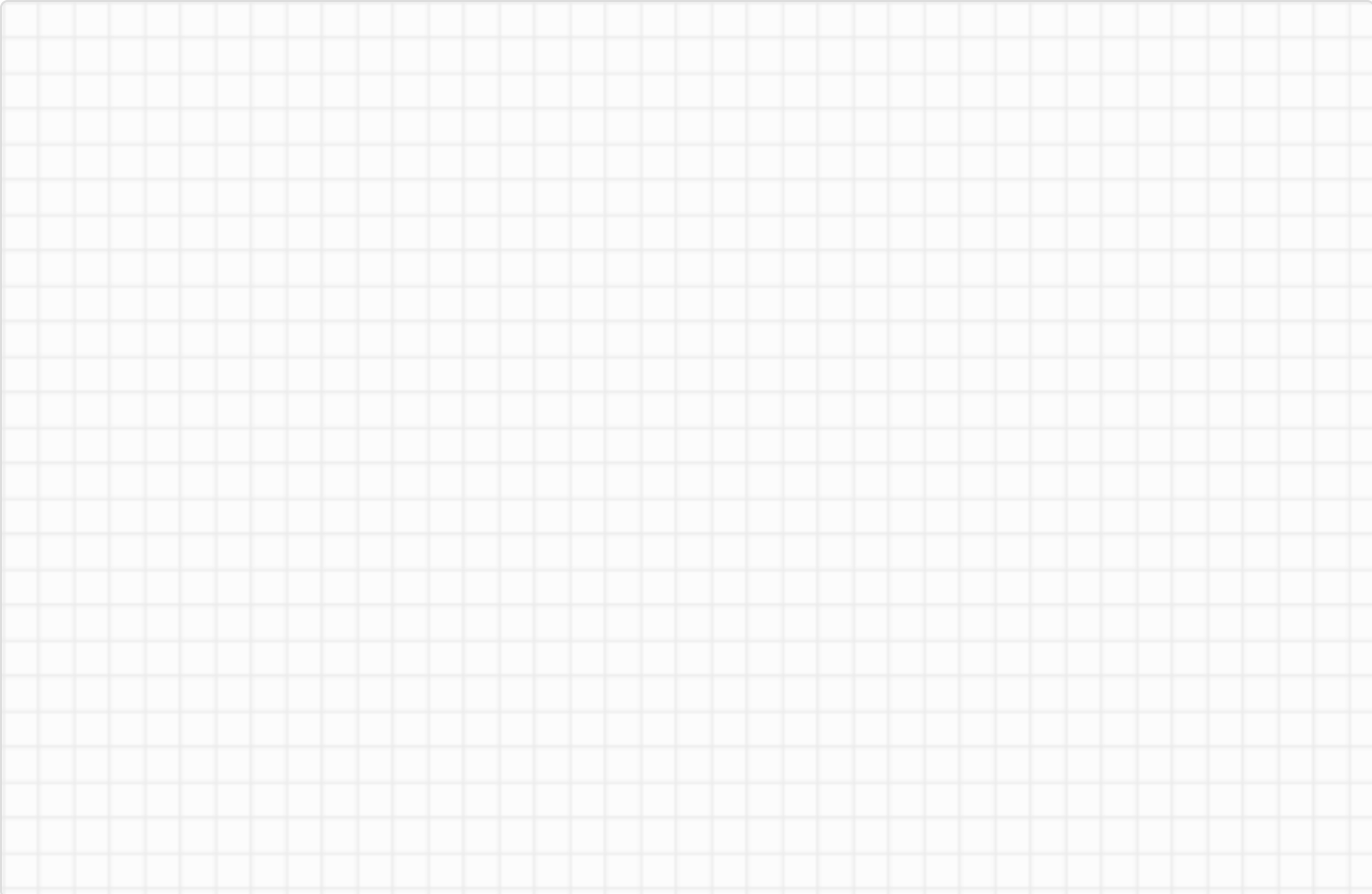
REPEAT CHECK

Point (x,y)	V ₁	V ₂	difference

CONSTRUCT THE MAP

- 1. Mark each measured value at its coordinate.
- 2. Interpolate and draw at least five smooth equipotential contours. A contour cannot cross itself or another contour.
- 3. Draw at least five field lines. Each must cross every contour at 90° and point toward lower V.
- 4. Use arrow spacing only as a qualitative strength cue; do not claim a numerical field without a distance measurement.

MAP



FIELD ESTIMATE

$$E_n \approx -\Delta V / \Delta n$$

Use the distance Δn measured perpendicular to adjacent contours.

location	Vhigh	Vlow	Δn m	E magnitude V/m	direction
A					
B					

ANALYSIS AND CER

1. Where is the field strongest on your map? Cite contour spacing as evidence.

2. Compare your two E estimates. Is the field approximately uniform? Support the claim with numbers.

3. Explain why field lines must cross equipotentials at 90° .

4. Identify one measurement limitation and explain its likely effect on contours or E.

Claim: Describe how the field varies across the mapped region.

Evidence and reasoning: cite the map and both numerical estimates.

Required lab record: prediction, raw grid, repeat checks, constructed map, E estimates, and CER remain together.