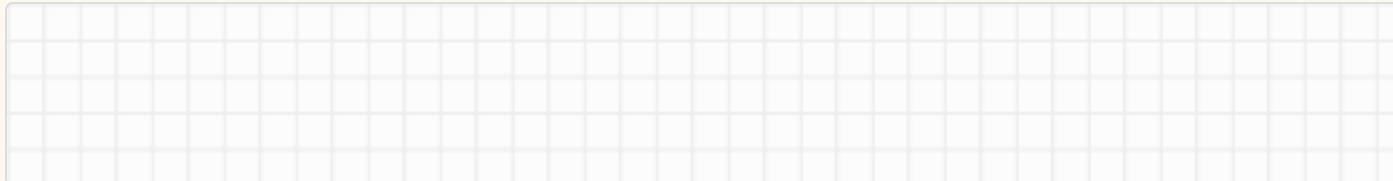


ELECTRICITY DAY 12: EQUIPOTENTIALS - RELATING E AND V

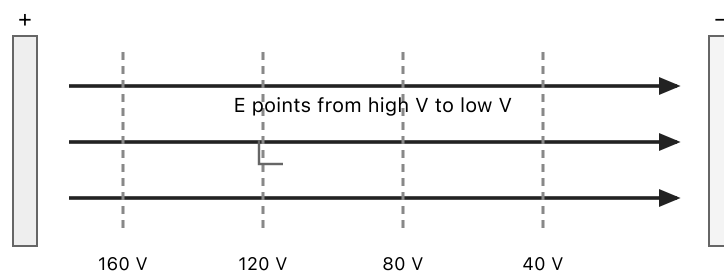
CED 10.5 · Skill 1.A · FRQ: TBR · target: zero work along an equipotential does not imply zero field

PREDICT FROM FIELD ARROWS

Uniform electric-field arrows point right. Predict the equipotential orientation: **horizontal / vertical / 45° / curved**. Draw two candidate lines before revealing the map.



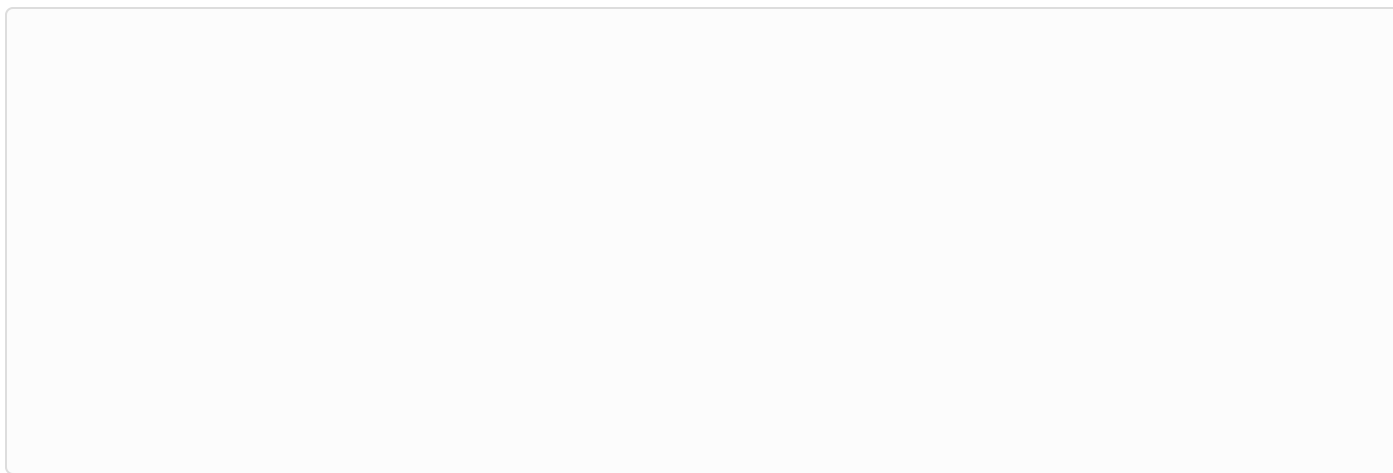
FIELD AND EQUIPOTENTIAL OVERLAY



EQUIPOTENTIAL MEANING

- Every point on one equipotential has the same V .
- Equipotentials cross E at 90° wherever E is nonzero.
- Moving along one equipotential gives $\Delta V = 0$, so $\Delta U = q\Delta V = 0$.
- Closer equipotential spacing indicates greater field magnitude.

QUICK State the electric work for moving any charge along one equipotential and explain using both ΔV and angle.



FIELD FROM A VOLTAGE CHANGE

$$E_x \approx -\frac{\Delta V}{\Delta x}$$

The minus sign means E points toward decreasing potential.

WE DO Potential decreases from 180V at $x = 0$ to 0V at $x = +0.060\text{m}$. Find E_x .

YOU DO On another map, potential rises from 20V to 80V as x increases by 0.020m. Find E_x , including sign and direction.

Use meters. V/m and N/C are equivalent electric-field units.

ENERGY AND WORK ON THE MAP

WE DO A $+2.5\mu\text{C}$ charge moves from the 120V contour to the 40V contour. Find ΔU , work by the field, and quasistatic external work.

COMPARE The same charge moves the same distance along the 120V contour. Find the three energy/work quantities.

DIRECTION A positive charge is released from rest. Does it initially accelerate toward higher or lower V ? What about a negative charge?

PRACTICE

1. Parallel equipotentials differ by 50V and are 1.5cm apart. Find E magnitude and state its direction relative to the labels.

2. Along $+x$, V changes from 30V to 90V over 4.0cm . Find signed E_x .

3. A $-1.8\mu\text{C}$ charge moves from 200 V to 80 V . Find ΔU and work by the field.

4. Correct the claim: "The field is zero everywhere on an equipotential because no work is done along it."