

Electric and magnetic fields · supported focus

International Baccalaureate · IB Diploma · Physics · HL

Scope and prerequisites

Supported HL focus. First assessment 2025; full Physics guide acquired (84 PDF pages). Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

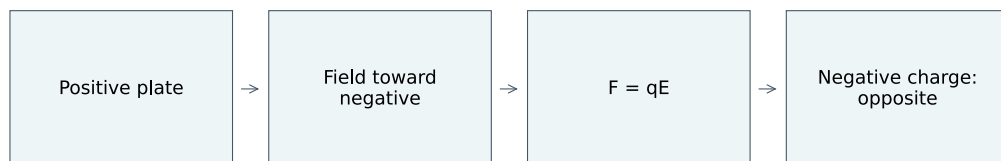
Electric fields: force and a positive test charge

■ What would explain this observation?

- A negatively charged particle moves opposite to the direction of the electric field. Field direction is defined using a positive **test charge**.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ Build the model

- **Electric field strength** is force per unit positive test charge. Like charges repel and unlike charges attract. Field lines point away from positive charges and toward negative charges. Closely spaced lines represent a stronger field within a consistently drawn diagram.
- electric field strength: Electric force per unit positive test charge; test charge: A small charge used to probe an electric field.



■ Choose evidence that can test it

- In a uniform field between ideal parallel plates, $E = V/d$ away from edge effects. The force is $F = qE$, so its direction reverses for a negative charge. Coulomb force between ideal point charges decreases with separation squared.
 - Sketch labelled plate polarities, field arrows and the charge before calculating. Convert separation to metres. In school, use simulations or approved low-voltage electrostatic models rather than exposed high-voltage equipment.
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■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: plate potential difference is 120 V and separation is 0.020 m. $E = V/d = 6,000 \text{ V/m}$. A +2.0 microcoulomb charge experiences $F = qE = 0.012 \text{ N}$ along the field; a -2.0 microcoulomb charge experiences the same magnitude opposite to it.

Example:

Use $E = V/d$. Find E for 100 V across 0.025 m. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Field strength is a vector. Potential difference is energy per charge and is not the same quantity. A field-line drawing is a model, not a set of physical threads.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Every charged particle experiences a force along the electric field direction. This claim is false: Field strength is a vector. Potential difference is energy per charge and is not the same quantity. A field-line drawing is a model, not a set of physical threads.

Key:

Electric fields: force and a positive test charge: In a uniform field between ideal parallel plates, $E = V/d$ away from edge effects. The force is $F = qE$, so its direction reverses for a negative charge. Coulomb force between ideal point charges decreases with separation squared.