

Motion in electromagnetic fields · supported focus

Supported focus · HL

Supported scope

- Supported HL focus. First assessment 2025; full Physics guide acquired (84 PDF pages). Remaining guide, assessment and practical requirements retain their recorded holds.
- State model conditions and distinguish fictional data from measurements.

Charged Motion · 1.1

Reasoning

A charged particle curves in a uniform magnetic field. Its direction changes although the magnetic force alone does not increase its kinetic energy. Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

Charged Motion · 2.1

Reasoning

The magnetic force magnitude is $F = |q|vB \sin\theta$. It is perpendicular to velocity and magnetic field, with direction determined by charge sign. For perpendicular entry into a uniform field, it can provide the centripetal force for circular motion. magnetic force: Force due to a magnetic field on a moving charge or current; momentum : Mass multiplied by velocity in the classical model.

Charged Motion · 3.1

Reasoning

Equate magnetic force with mv^2/r to obtain $r = mv/(|q|B)$ for perpendicular motion. A stronger field makes a smaller radius at fixed momentum. Parallel entry gives zero magnetic force in this model. Draw velocity, field and force as separate arrows using stated into/out-of-page conventions. Use supplied beam data or a simulation. Do not treat a current-carrying wire direction as identical to electron-motion direction.

Charged Motion · 4.1

Reasoning

State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution. Known: a particle has $m = 2.0 \times 10^{-27}$ kg, $v = 3.0 \times 10^6$ m/s, $|q| = 1.0 \times 10^{-19}$ C and $B = 0.20$ T. $r = mv/(|q|B) = 0.30$ m. The calculation assumes non-relativistic motion and perpendicular entry.

Charged Motion · 4.2

Reasoning

Use $r = mv/(|q|B)$. For $m=2\times 10^{-27}$ kg, $v=2\times 10^6$ m/s, $|q|=1\times 10^{-19}$ C and $B=0.20$ T, find r . Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

Charged Motion · 5.1

Reasoning

A magnetic force can change momentum direction without doing work. Adding an electric field can change the energy, so conclusions about a magnetic field alone do not cover every combined-field apparatus. Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Charged Motion · 5.2

Reasoning

A magnetic force alone continuously increases the kinetic energy of a charged particle. This claim is false: A magnetic force can change momentum direction without doing work. Adding an electric field can change the energy, so conclusions about a magnetic field alone do not cover every combined-field apparatus.

Charged Motion · 5.3

Reasoning

Magnetic forces: turn velocity without increasing speed: Equate magnetic force with mv^2/r to obtain $r = mv/(|q|B)$ for perpendicular motion. A stronger field makes a smaller radius at fixed momentum. Parallel entry gives zero magnetic force in this model.

Charged Motion · diagram



- Original teaching diagram: Magnetic forces: turn velocity without increasing speed
- Use the labels and the stated model together.

Charged Motion · original transfer

Your turn

At fixed perpendicular speed and field, reverse charge sign with mass and charge magnitude fixed. Compare radius, curvature direction and magnetic work.

Charged Motion · transfer reasoning

Method and interpretation

Radius is unchanged; curvature reverses because q changes sign. Magnetic force is perpendicular to velocity and does no work. Oblique entry requires the perpendicular velocity component.

Check yourself

- Explain magnetic force using the stated model.
- Explain momentum using the stated model.
- Change one value in the original transfer; explain which assumption still matters.