FREE REVISION PACK

# Charged Particles in Magnetic Fields

AQA A-level Physics · 7408 · Specification 3.7.5.2

Easy | Medium | Multiple choice · past-paper questions

| 4 | 4 | ≈ 5 min |
|---|---|---|
| QUESTIONS | TOTAL MARKS | SUGGESTED TIME* |

## Contents


| Q | LEVEL | FOCUS | SOURCE | MARKS |
|---|---|---|---|---|
| 1 | Easy | Radius with half the speed and four times the field | AQA June 2019 · A-level Paper 2 · Q13 | 1 mark |
| 2 | Medium | Speed after two different fields | AQA June 2018 · A-level Paper 2 · Q26 | 1 mark |
| 3 | Medium | Two isotopes in the same field | AQA June 2023 · A-level Paper 2 · Q21 | 1 mark |
| 4 | Medium | Circuits per second in a magnetic field | AQA June 2024 · A-level Paper 2 · Q16 | 1 mark |


**Key ideas to have ready**

- Force on a charge moving at right angles to a field: F = BQv, at right angles to both B and v (Fleming's left-hand rule; reverse it for negative charges).
- The force is always perpendicular to the velocity, so it does no work: the speed and kinetic energy stay the same, and the path is a circle.
- BQv = $mv^2$ / r, so the radius r = mv / (BQ). Heavier or faster particles move in bigger circles.
- Period T = 2πm / (BQ) and frequency f = BQ / (2πm): neither depends on the speed (the cyclotron principle).

**How to use this pack**

1. The questions are grouped into levels (Easy and Medium). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

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## Easy

Definitions and one-step ideas. Most students get these right.

Question 1

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

AQA June 2019 · A-level Paper 2 · Q13

**1** When an electron is moving at a speed $v$ perpendicular to a uniform magnetic field of flux density $B$, it follows a path of radius $R$.

A second electron moves at a speed $\frac{v}{2}$ perpendicular to a uniform magnetic field of flux density $4B$.

What is the radius of the path of the second electron?

**[1 mark]**

**A** $\frac{R}{8}$ ⬭

**B** $\frac{R}{4}$ ⬭

**C** $2R$ ⬭

**D** $8R$ ⬭

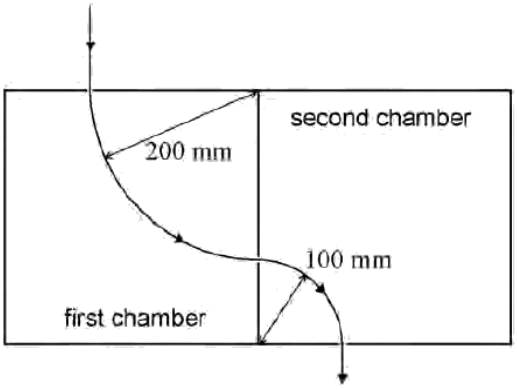
## Medium

Two or three steps. Roughly a third to a half of students get these right.

Questions 2–4

AQA June 2018 · A-level Paper 2 · Q26

**2** Different magnetic fields are present in the two chambers shown. A particle enters the first chamber at a velocity of $80\ \text{m s}^{-1}$ and is deflected into a circular path of radius $200\ \text{mm}$
In the second chamber it follows a circular path of radius $100\ \text{mm}$




The particle leaves the second chamber at a speed of

**[1 mark]**

**A** $20\ \text{m s}^{-1}$ ⬭

**B** $40\ \text{m s}^{-1}$ ⬭

**C** $80\ \text{m s}^{-1}$ ⬭

**D** $160\ \text{m s}^{-1}$ ⬭

AQA June 2023 · A-level Paper 2 · Q21

**3** A beam consists of ionised atoms of two isotopes of an element.
When the beam enters a uniform magnetic field, the ions move in circular paths.
The ions have the same charge and travel at the same speed when they enter the magnetic field.

Which statement is true?

**[1 mark]**

**A** The force acting on an ion is different for each isotope. ⬭

**B** The radius of the path followed by an ion is different for each isotope. ⬭

**C** The kinetic energy of an ion increases for both isotopes. ⬭

**D** The acceleration of an ion is the same for both isotopes. ⬭

AQA June 2024 · A-level Paper 2 · Q16

**4** An electron enters a uniform magnetic field at right angles to the field.
The flux density of the field is $B$.
The electron moves with a non-relativistic speed $v$ in a circular path of radius $r$.

What is the number of circuits completed by the electron in one second?

**[1 mark]**

**A** $\frac{2\pi m_e}{Be}$ ⬭

**B** $\frac{2\pi r}{v}$ ⬭

**C** $\frac{v}{\pi r}$ ⬭

**D** $\frac{Be}{2\pi m_e}$ ⬭

**End of questions.** Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition:
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