

Forces on currents and moving charges in magnetic fields

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers magnetic force on wires and charges, circular orbits and velocity selectors. Show formulas, substitutions and units. Use $e = 1.60 \times 10^{-19} \text{ C}$ and proton mass $1.67 \times 10^{-27} \text{ kg}$. Calculators are allowed.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB D.3

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Defining the tesla (2 marks)

Define the tesla in terms of the force on a wire.

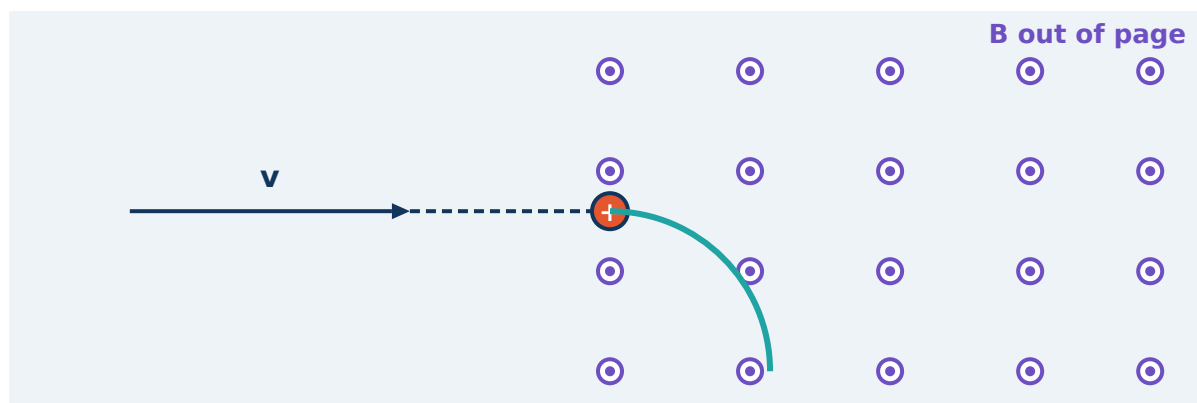
Question 2 Force on a rail wire (3 marks)

A 0.60 m metal bar carries 5.0 A at right angles to a field of 0.30 T.

- Calculate the force on the bar. (2 marks)
- State the force when the current is reduced to zero. (1 mark)

Question 3 Direction of a path (3 marks)

A positive ion enters a field that points out of the page, moving to the right as shown.



The ion curves downwards inside the field.

- Explain why the ion curves downwards. (2 marks)
- State what happens to its speed. (1 mark)

Question 4 Radius of a proton (3 marks)

A proton moves at 2.5×10^6 m/s perpendicular to a 0.35 T field. Calculate the radius of its circular path.

Question 5 Why circular? (2 marks)

Explain why a charged particle moving perpendicular to a uniform magnetic field travels in a circle and not in a straight line.

Question 6 Velocity selector (3 marks)

Particles pass undeflected through crossed fields $E = 6.0 \times 10^3$ V/m and $B = 0.025$ T.

- Calculate their speed. (2 marks)
- State whether the answer depends on the particle's charge. (1 mark)

Question 7 Comparing proton and electron (2 marks)

A proton and an electron enter a field at the same speed. State which has the larger orbit and explain why.

Question 8 Force on a wire at an angle (2 marks)

A 0.30 m wire carrying 8.0 A lies at 40° to a 0.15 T field. Calculate the force.