

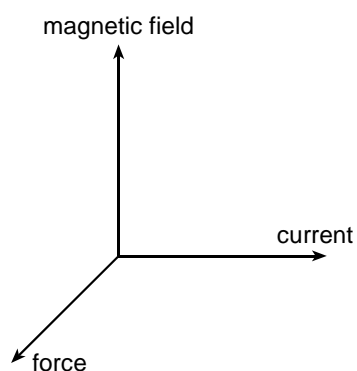
## TAP 413-3: Deflection with electric and magnetic fields

### Instructions and information

Write your answers in the spaces provided. Use these data:

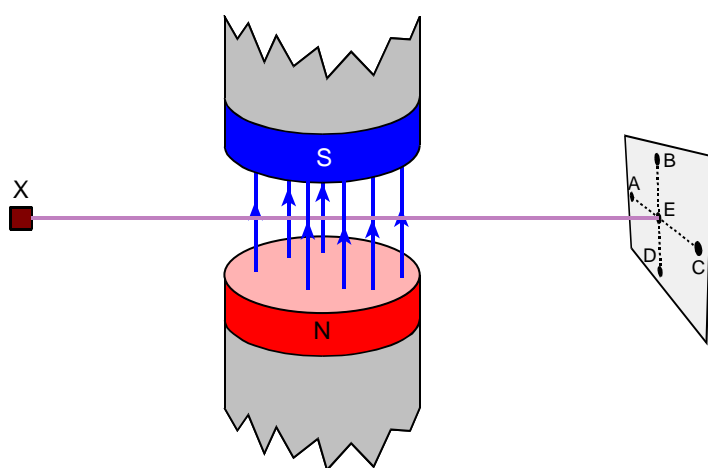
- magnitude of the electronic charge =  $1.6 \times 10^{-19}$  C
- mass of electron =  $9.1 \times 10^{-31}$  kg

The force on an electric current in a magnetic field is perpendicular to both the current and the field. This diagram may help you.



### Questions

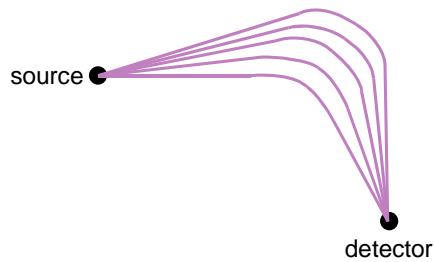
A beam of particles passes in a straight line from a source X, to a spot, E, on a fluorescent screen. When the electromagnet shown is switched on, the beam hits the screen at one of the spots A, B, C, D or E.



1. In which direction does the beam bend if the particles are positively charged?
2. Where does it go if the particles are neutral?

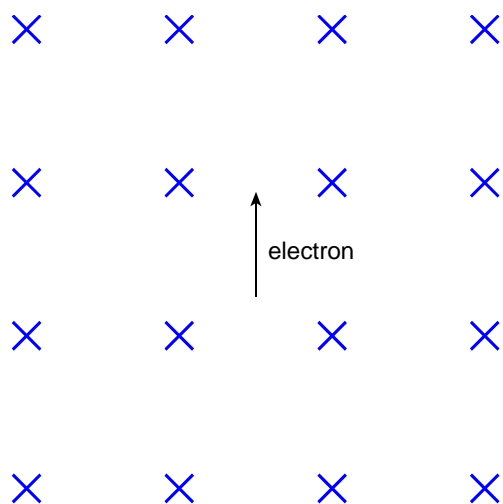
3. What happens to the positively charged particles if the magnetic field is reversed?

In one form of mass spectrometer, charged ions in the beam fan out, moving in the paths shown in the diagram. Parts of the paths include a magnetic field whose direction is perpendicular to the plane of the paper.



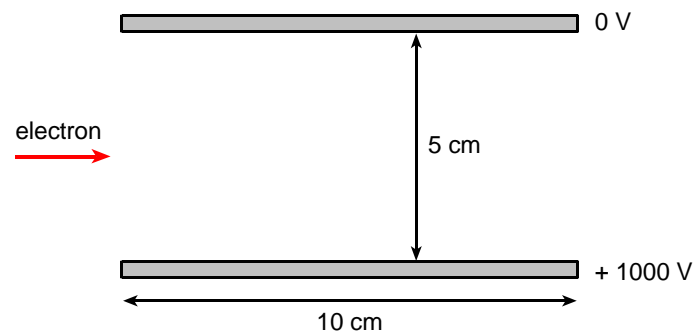
4. Indicate places where there must be no magnetic field in the direction suggested. Do not use shading.
5. Shade the area where there must be a magnetic field.
6. What is the shape of the path followed by a proton that is projected into a uniform magnetic field at right angles to its velocity? Justify your answer.

The diagram shows the initial path of an electron fired into a uniform magnetic field. The magnetic field is at right angles to the direction of the electron and is directed away from the reader.



7. Add a labelled arrow to show the direction of the force on the electron.
8. Draw the subsequent path of the electron.

A uniform electric field is produced by maintaining a potential difference of 1000 V across a pair of parallel plates 5 cm apart. An electron enters the field at right angles as shown with a velocity of  $4.0 \times 10^7 \text{ m s}^{-1}$  and emerges from the plates without hitting them.



9. Draw in the path of the electron on the diagram.
10. What name is given to this type of path?

### Hints

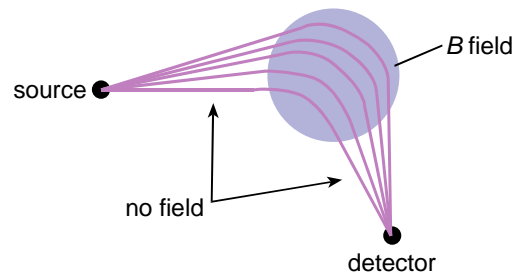
1. Remember that the left-hand motor rule works for conventional current.
2. Remember that the left-hand motor rule works for conventional current.

## Practical Advice

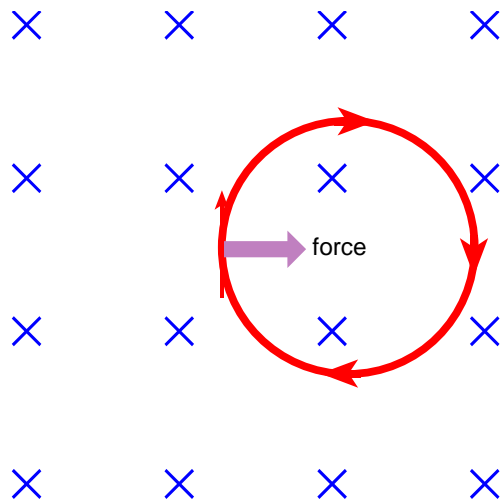
These questions are intended to be straightforward, to reinforce understanding and to build confidence. Students will be required to understand the independence of vertical and horizontal motions, and also motion where the acceleration is constant.

## Answers and worked solutions

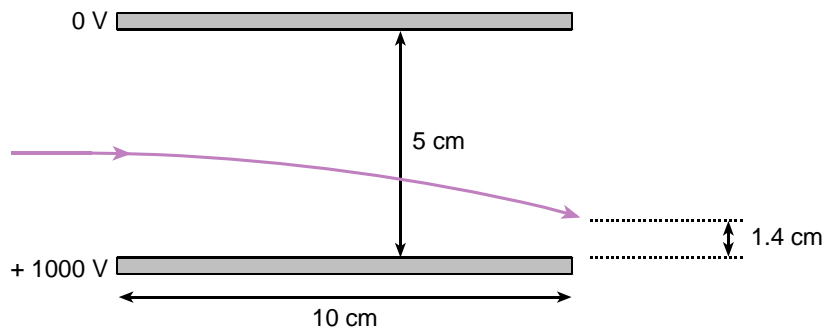
1. A
2. E
3. The force is reversed C.
- 4.



5. See the solution for question 4.
6. Circular since the proton experiences a force of constant magnitude at right angles to its path regardless of its direction.
- 7.



8. See the solution for question 7.
- 9.



10. Parabola since the force is constant and remains in the same direction

### External reference

This activity is taken from Advancing Physics chapter 16, 90S