# Magnetic Fields 2

Learning Goals:

- Apply the equation F=BIL to some new situations
- Use the resolution of vectors in these situations where the current, and field pattern are not perpendicular.
- Observe the motion of charged particals travelling in a vacuum when a magnetic field is applied perpendicular to the motion
- Relate this motion to circular motion equations
- Use the equations:

$$F=BQv$$

$$BQv = {}^{1}/_{2}mv^{2}$$

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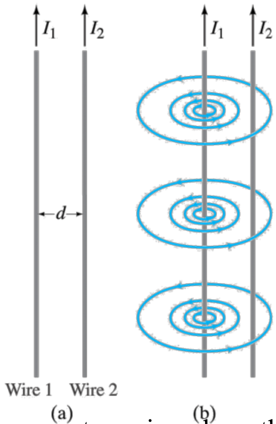
**Starter:**

Consider the experimental set up:




When the current passing along the two aluminium strips is in the same direction, what will happen to the strips?

This experiment is available to order:
Connect up the 2 aluminium strips to the large power supply (with the key)

Ensure the strips do not touch!

What will happen if the current is reverse in:

a) one of the strips?

b) both of the strips?

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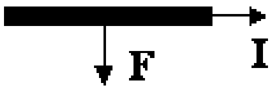
What force does a moving charge experience in a magnetic field?




You can think of a current in a wire as a series of moving charges.

F = BIL

I is the current and is the charge passing a point per second.

therefore:

F = BqL/t

L/t is the speed of the moving charges

therefore

**F = Bqv**

**(little v denotes velocity. Big V is the Voltage)**

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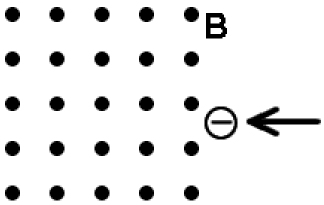
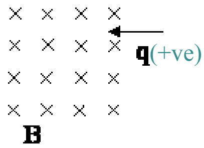
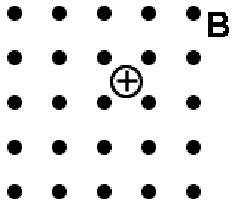
In each situation below, which way will the charge be forced?




Answers

# Problem:

An electron accelerated to 6.0 x10$^6$ m/s is deflected by a magnetic field of strength 0.82 T. What is the force acting on the electron? Would it be any different for a proton?

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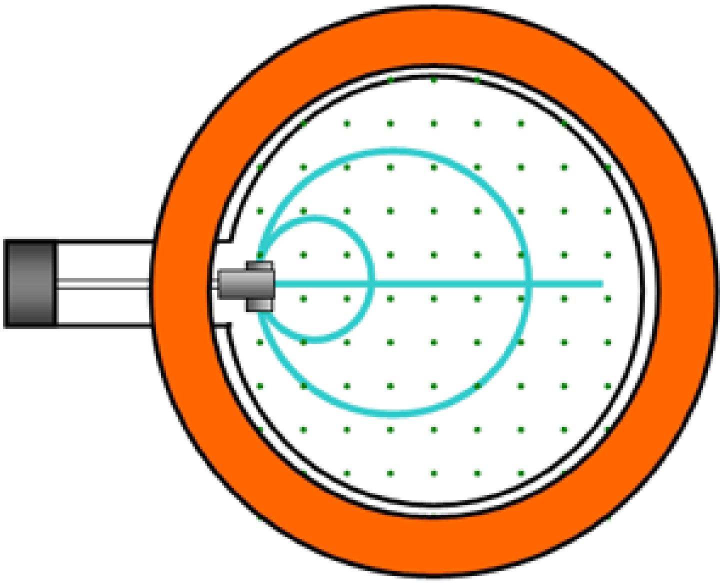

$$F = BQv = mv^2/r$$

As the charge moves in a circle, the magnetic force is providing the centripetal force.

What must the conditions inside be like if this is to be possible?

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1) An electron passes through a cathode ray tube with a velocity of $3.7 \times 10^7$ m/s. It enters a magnetic field of flux density 0.47 mT at a right angle. What is the radius of curvature of the path in the magnetic field?

2) In a particle physics experiment, a detector is place in a magnetic field of 0.92 T. A particle is found to produce a track of radius 0.5 m. Other experiments have shown that the particle carries a charge of $+1.6 \times 10^{-19}$ C and that its speed was $3.0 \times 10^{7}$ m/s. What is the mass of the particle? How does it compare to the mass of an electron ($9.11 \times 10^{-31}$ kg)?

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## What would happen in this situation?

Can you derive an equation that would govern this situation?

F = EQ
F = VQ/d

F = BQv

VQ/d = BQv
V/d = Bv