

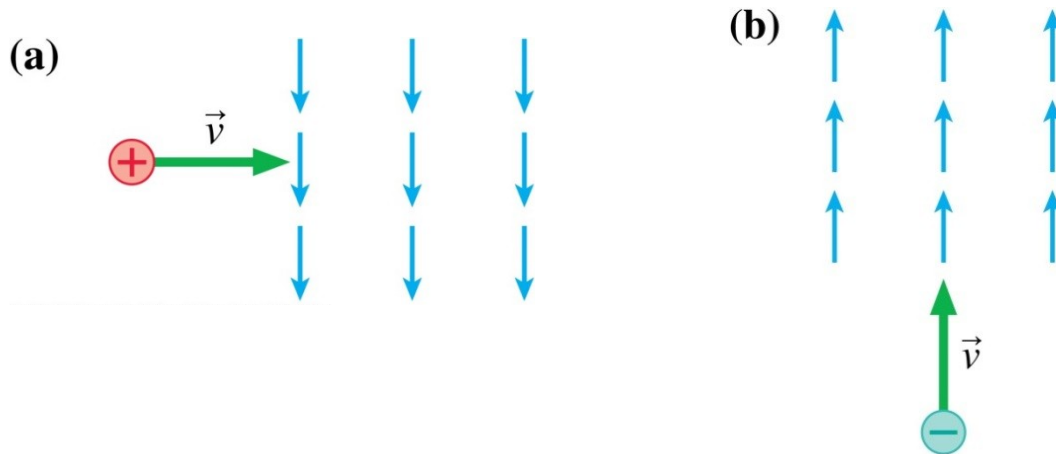
PHYC10007 Physics for Biomedicine
Tutorial Sheet 10

Magnetic fields

Last updated: 24/12/2019

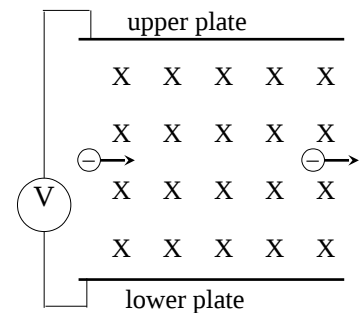
1. A hydrogen nucleus is moving East, parallel to the Earth's surface, in a region where a magnetic field is also parallel to the surface, directed from South to North.
 - a) Is that the correct orientation of the Earth's magnetic field?
 - b) Is this happening nearer one of the geographical poles, or nearer the equator?
 - c) Which direction will the path of the hydrogen nucleus be deflected?
 - i) Up
 - ii) Down
 - iii) North
 - iv) South
 - v) Not at all.

2. What is the initial direction of deflection for charged particles entering the magnetic fields shown in (a) and (b) below? The magnetic field direction is shown by the blue arrows.

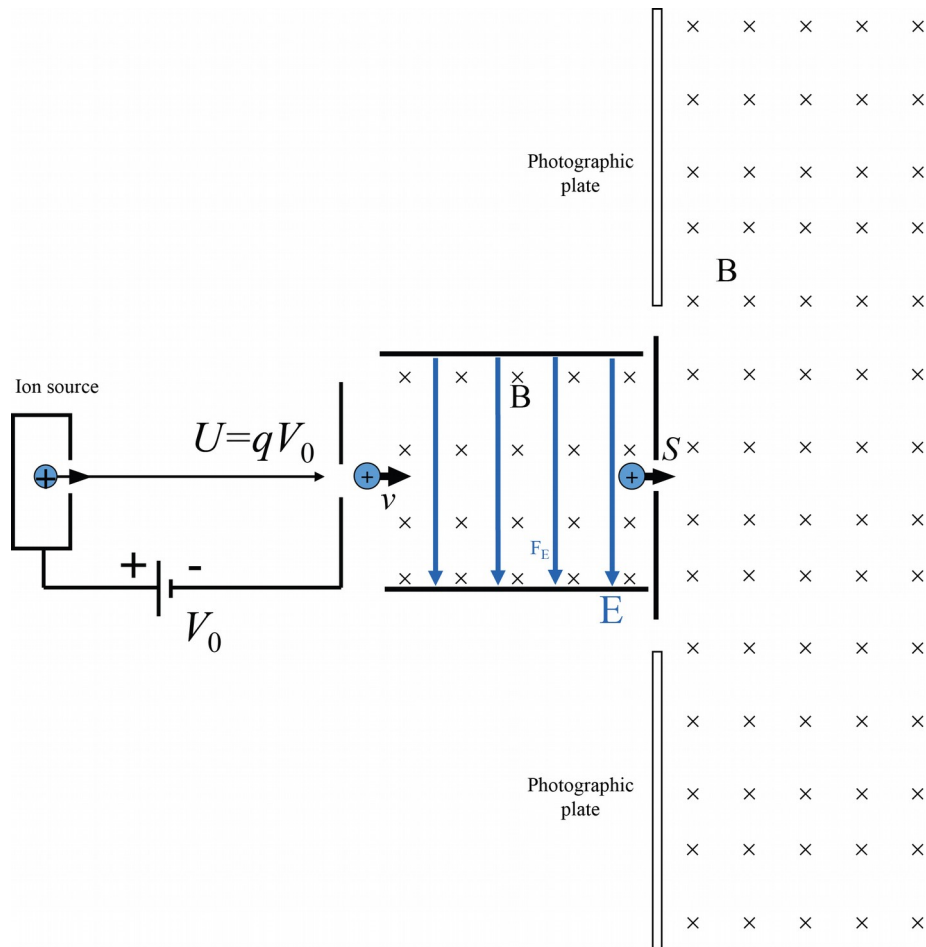


3. A uniform magnetic field is directed into the page. A charged particle, moving in the plane of the page, follows a clockwise spiral of decreasing radius. A reasonable explanation is:
 - a) the charge is positive and slowing down
 - b) the charge is negative and slowing down
 - c) the charge is positive and speeding up
 - d) the charge is negative and speeding up
 - e) none of the above

4. Consider an ion velocity filter, with electric and magnetic fields adjusted such that electrons are not deflected by the combination of the two fields (see figure). What electric field is required to balance the magnetic deflection if the magnitude of the magnetic force is 1.0×10^{-12} N?



5. A mass spectrometer as shown below has a source which produces singly charged ions. The ions are oxygen 16amu, carbon 12amu, and an unknown element. The carbon and oxygen lines are separated by 2.25 cm on the photographic plate and the unknown element makes a line between them 1.16 cm from the carbon line.



- (a) Show that all ions entering the slit S have the same velocity.
 (b) What path will the ion trace out after entering S?
 (c) Which element gives rise to the line on the photographic plate furthest from the slit?
 (d) Calculate the mass of the unknown element and identify it.
6. Two long straight wires are parallel and carry equal current in opposite directions. At a point midway between the wires, the magnetic field they produce is:
- a) zero
 b) non-zero and along a line connecting the wires
 c) non-zero and parallel to the wires
 d) non-zero and perpendicular to the plane of the two wires
 e) none of the above

Answers:

1. (a) yes; (c) up
 2. (a) into page; (b) no deflection.
 3. (a)
 4. 6.3×10^6 V/m
 5. (b) anticlockwise circular; (c) heaviest, O^{16} ; (d) 10.5amu.
 6. (d)