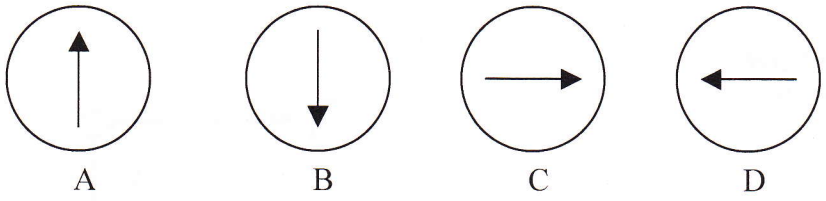
PHYS 51W – Workshop - March 23-April 5

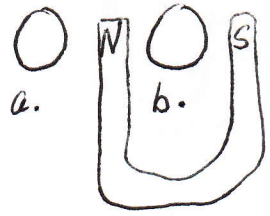
These problems are associate with the content of Chapter 27, Magnetic Field and Magnetic Forces.

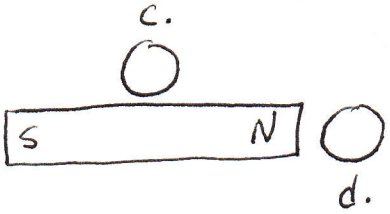
1. In the situations shown below, compasses has been placed at various locations. The following are possible orientations of the compass needle. (The compass needle points in the direction of the magnetic field.)



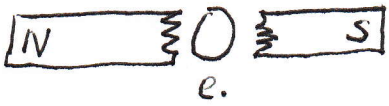
A B C D

Which of the above orientations are suitable for compasses placed at the following loctions?

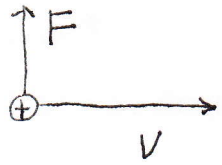




The magnet above is broken, and a compass placed between the two halves.



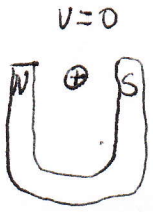
2. This question involves charges, moving and at rest.

a. 

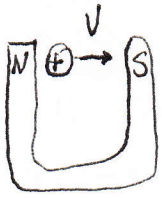
What is the direction of the magnetic field?

b. 

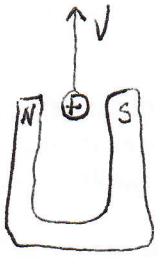
What is the direction of the magnetic field?

c. 

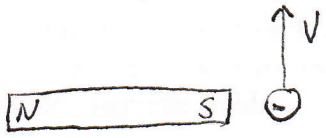
What is the direction of the force?

d. 

What is the direction of the force?

e. 

What is the direction of the force?

f. 

What is the direction of the force?

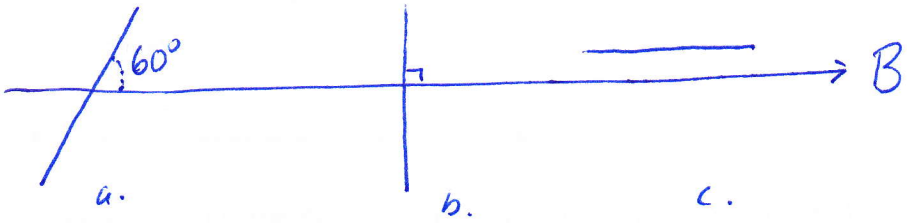
3. A magnetic field is $\vec{B} = 3.5T\ \hat{x}$. An electron moving in this field has a velocity

$\vec{v} = 4.0\times10^{6}\frac{m}{s}\ \hat{y}$.

a. What is the direction and magnitude of the force on the electron?

b. What is the magnitude and direction of the acceleration of the electron?

4. In the region shown below, the magnetic field is 3.5 T to the right. A loop measures 10 cm x 20 cm. The top of the loop (10 cm long) is shown in three orientations below. Determine the flux of the magnetic field through the loop for each of these cases.



5. Earth's magnetic field is about 5.0×10^{-5} T.

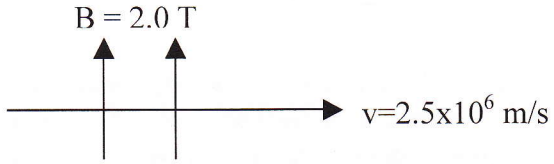
a. What is the cyclotron frequency of an electron moving in earth's field?

b. If the velocity of the electron is 4.0×10^{5} m/s perpendicular to the magnetic field, what is the radius of the electron's motion?

c. Answer the same questions if the particle in question is a proton.

($q = 1.6 \times 10^{-19}$ C; me = 9.11×10^{-31} Kg/ mp = 1.67×10^{-27} kg.)

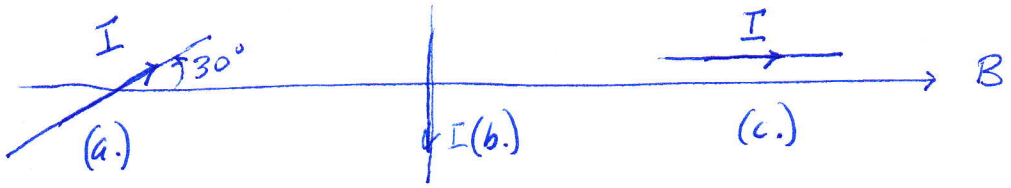
6.



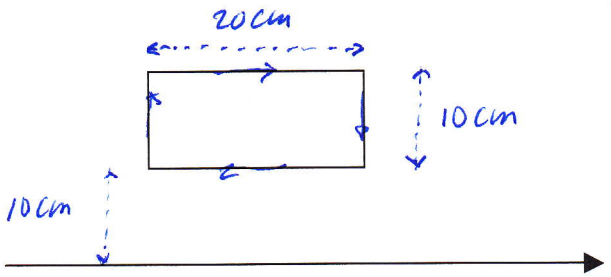
a. An electron is moving to the right as shown. Although there is a magnetic field as shown, there is also an electric field in the same region, and the electron experiences no net force. What is the magnitude and direction of the electric field?

b. Now forget about the electric field. A beam of uranium ions is moving in the magnetic field above at the velocity shown. The uranium ions have the charge $+92 \times 1.6 \times 10^{-19}$ C. There are two isotopes of uranium: U-235 and U-238 in the beam. (You can find the mass of each ion) by multiplying the isotope number (235 or 238) by 1.67×10^{-27} kg. Compare the radii of the paths followed by the two isotopes as they move in the magnetic field.

7. A 1.5-m long wire caries 2.3 A of current. The wire is in a region where the magnetic field is 0.013 T to the right. The picture below shows three different orientations of the wire. Determine the magnitude and direction of the force on the wire for each orientation.

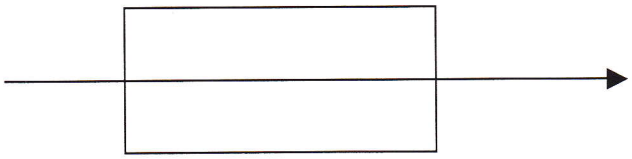


8.



In the picture above, a long straight wire carries a current of 1.2 A to the right. Above the wire is a rectangular loop, measuring 10 cm x 20 cm. The rectangular loop carries a clockwise current of 2.0 A. The nearest edge of the loop is 10 cm from the wire. Find the magnitude and direction of the force exerted on the loop by the wire.

9.



In the picture above is a 10 cm x 20 cm rectangular loop of wire carrying a clockwise current of 2.0 A. The loop is in a region where the magnetic field is 0.015 T to the right.

Calculate the magnitude and direction of the force exerted on the loop. The the magnitude and direction of the torque exerted on the loop.