

# Physics 222

Quiz 7 – Magnetic Force (On Moving Charged Particles), Form: **A**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Questions 1–5: Two coils (shown in the plane of the page) are used to create a region of approximately uniform magnetic field between the coils. An electron is at the location shown and moving in the direction shown. The coils are connected to voltage sources (not shown) such that current flows clockwise in each coil.

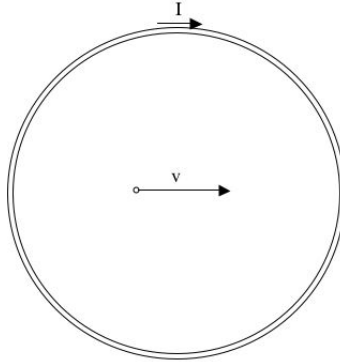


Figure 1:

To indicate directions, use the vectors shown below. Note that  $e$  points out of the page (in the  $+z$  direction) and  $f$  points into the page (in the  $-z$  direction).

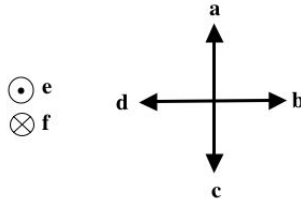


Figure 2:

1. What is the direction of the magnetic field due to the coils at the location of the electron?
  - (a) a
  - (b) b
  - (c) c
  - (d) d
  - (e) e
  - (f) f
  - (g) None of these because the magnetic field due to the coils is zero.

2. What is the direction of  $\vec{v} \times \vec{B}$ ?
- (a) a
  - (b) b
  - (c) c
  - (d) d
  - (e) e
  - (f) f
  - (g) None of these because  $\vec{v} \times \vec{B}$  is zero.
3. What is the direction of the force of the magnetic field on the electron?
- (a) a
  - (b) b
  - (c) c
  - (d) d
  - (e) e
  - (f) f
  - (g) None of these because the magnetic force on the electron is zero.
4. As the electron moves in this region of uniform magnetic field, its path will be along a circle. If you increase the magnetic field, the radius of its circular path will
- (a) increase
  - (b) decrease
  - (c) remain constant
5. The mass of an electron is  $9.11 \times 10^{-31}$  kg. Its charge is  $1.6 \times 10^{-19}$  C. If its speed when entering the field is  $3 \times 10^7$  m/s, what magnetic field will cause it to travel in a circular path with radius 4 cm?
- (a)  $4.3 \times 10^{-5}$  T
  - (b)  $4.3 \times 10^{-3}$  T
  - (c)  $1.7 \times 10^{-4}$  T
  - (d)  $6.8 \times 10^{-6}$  T
  - (e)  $6.8 \times 10^{-4}$  T

(Questions 6–8) A *slidewire generator* is made with a wire that can make good contact, yet slide over two conducting rails, as shown in Figure 3. The rails are connected to a resistor. You can neglect any resistance of the wires themselves. You can imagine the apparatus as sitting on an insulating table. There is a uniform magnetic field into the page throughout the region of the apparatus. You pull the wire with a constant force in the direction shown, and the wire moves with a constant velocity (since the net force on it is zero).

Use the directions in Figure 2 to answer some of the questions.

6. The slidewire will act like a battery in that an emf (motional emf) will do work on mobile charge carriers to raise their electric potential energy as they are moved from one side of the slide wire to the other. Which end of the slide wire will be positively charged?
- (a) the left end
  - (b) the right end
  - (c) both ends will be positively charged
  - (d) neither end will be positively charged

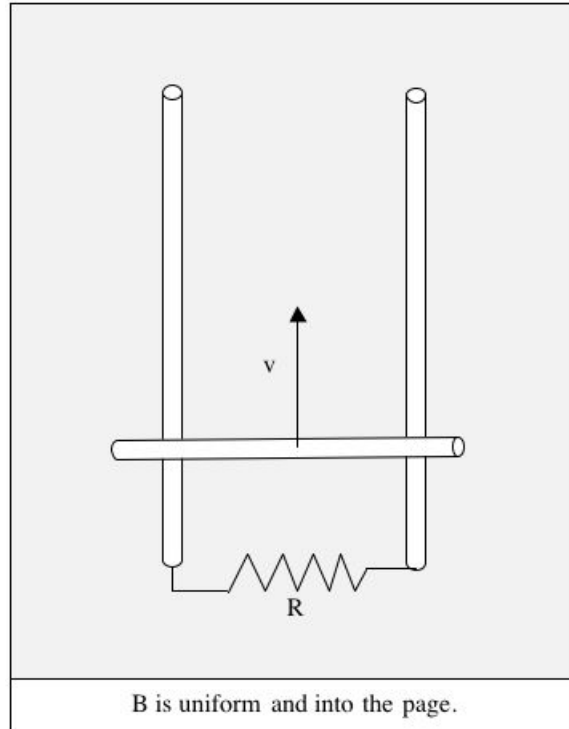


Figure 3:

7. What is the direction of current (conventional) in the slidewire?
  - (a) to the left
  - (b) to the right
  - (c) None of these because the current in the slidewire is zero.
8. What is the direction of the magnetic force of the magnetic field on the slidewire?
  - (a) a
  - (b) b
  - (c) c
  - (d) d
  - (e) e
  - (f) f
  - (g) None of these because the magnetic force on the slidewire is zero.

In question 1, an electron was moving between two coils. Suppose that you wanted the net force on the electron to be zero so that it would move in a straight line. Thus, you set up two, oppositely charged plates, in order to create an electric field in such a direction that the electric force on the electron is equal in magnitude and opposite in direction to the magnetic force on the electron.

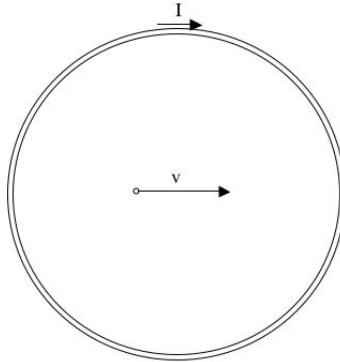


Figure 4:

Suppose the speed of the electron is  $1 \times 10^7$  m/s and the magnetic field strength is  $1 \times 10^{-4}$  T.

9. Sketch the orientation of the plates and indicate which one should be positively charged and which one should be negatively charged.

10. What should be the electric field between the plates?

11. If the plates are separated a distance of 10 cm, what should be the potential difference across the plates?

# Answer Key for Exam A

1. (f)

5. (b)

2. (a)

6. (a)

3. (c)

7. (a)

4. (b)

8. (c)

9.  $\vec{F}_{elec}$  must be upward. Since the particle is an electron, then the positively plate must be above the negatively charged plate.

10.  $E = vB = 1000 \text{ N/C}$

11.  $\Delta V = E\Delta x = 100 \text{ volt}$