Physics 3204

Unit 2: Electromagnetism

Worksheet7: Magnetic Force on a Moving Charge

PART A: Multiple Choice

1. An electron is projected perpendicularly into a magnetic field with a velocity of 3.3×10^{7} m/s and experiences a force of 1.3×10^{-13} N. What is the magnitude of the magnetic field?

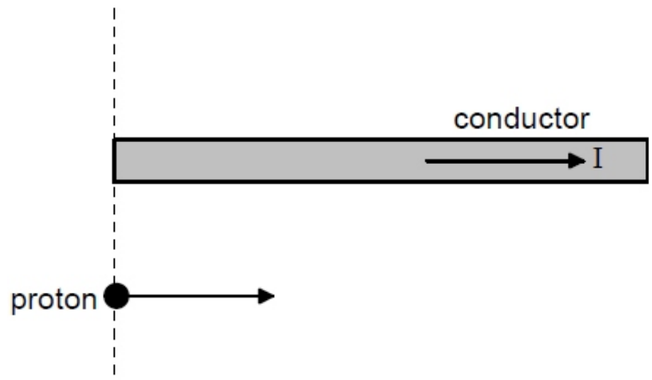
   (A) 6.9×10^{-25} T
   (B) 2.5×10^{-2} T
   (C) 4.1×10^{1} T
   (D) 2.7×10^{13}

2. Which occurs when protons and electrons enter a magnetic field that is parallel to their direction of motion?

   (A) Both protons and electrons are deflected.
   (B) Neither protons nor electrons are deflected.
   (C) Only electrons are deflected.
   (D) Only protons are deflected.

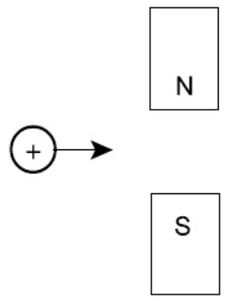
3. A proton moves parallel to a long straight current-carrying conductor as shown. In which direction will the proton be deflected?

   (A) into the page
   (B) out of the page
   (C) towards bottom of page
   (D) towards top of page



4. A proton is shot through a magnetic field as shown below. In what direction will the proton be deflected?

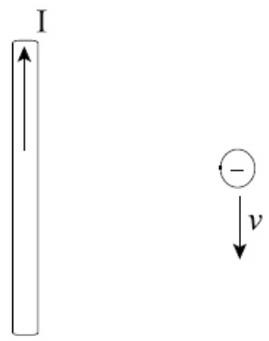
   (A) into the page
   (B) out of the page
   (C) towards the top of the page
   (D) towards the bottom of the page



5. An electron moving at 2.00×10^{6} m/s through a 1.50 T magnetic field, experiences a force of 2.40×10^{-13} N. What is the angle between the electron's path and the magnetic field lines?

   (A) 0^{o}
   (B) 30.0^{o}
   (C) 60.0^{o}
   (D) 90.0^{o}

6. What is the direction of the magnetic force on an electron moving near a current-carrying wire as shown?



(A) left
(B) right
(C) into the page
(D) out of the page

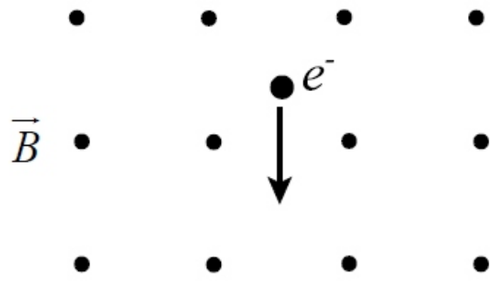
7. A charged particle of 1.35×10^{-7} C moves with a speed of 3.0×10^{4} m/s perpendicular to a uniform magnetic field of 0.40 T. What is the magnitude of the magnetic force on the charged particle?

(A) 1.6×10^{-3} N
(B) 2.5×10^{-3} N
(C) 4.3×10^{5} N
(D) 5.4×10^{5} N

8. An electron travelling at 1.9×10^{4} m/s is deflected with a force of 3.0×10^{-18} N in a direction perpendicular to a magnetic field. What is the strength of the magnetic field?

(A) 9.1×10^{-33} T
(B) 1.6×10^{-22} T
(C) 9.9×10^{-4} T
(D) 1.0×10^{3} T

9. An electron in a uniform magnetic field, is moving downward as shown below. What is the direction of the force on the electron?



(A) towards the bottom of the page
(B) towards the left side of the page
(C) towards the right side of the page
(D) towards the top of the page

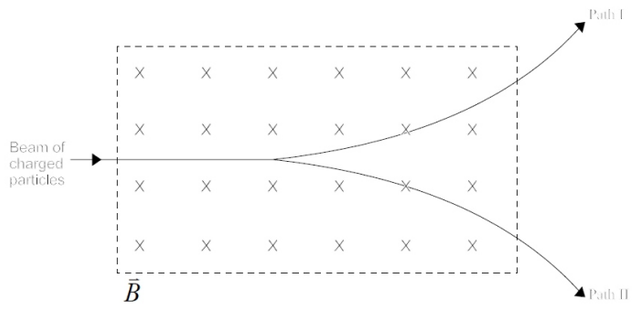
10. A proton is shot into a magnetic field at a right angle with a speed of 2.0×10^{5} m/s. What is the strength of a magnetic field required to keep the proton in a horizontal circular orbit, if the radius of the orbit is 1.0 cm?

(A) 1.1×10^{-6} T
(B) 1.1×10^{-4} T
(C) 2.1×10^{-3} T
(D) 2.1×10^{-1} T

11. A proton moving at 1.2×10^{6} m/s enters a magnetic field at a 90.0˚ angle where it experiences a force of 5.4×10^{-14} N. What is the magnetic field strength?

(A) 0.28 T
(B) 0.40 T
(C) 2.5 T
(D) 3.6 T

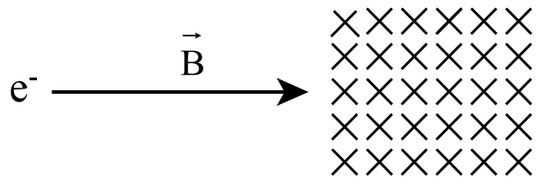
12. Which path illustrates the positively and negatively charged particles that pass through the magnetic field in the diagram below?



	Path of positive charges	Path of negative charges
(A)	I	|I
(B)	I	II
(C)	II	I
(D)	II	II

13. In which direction will the electron be deflected in the diagram below?

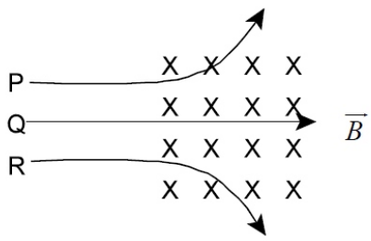
(A) down toward the bottom of page
(B) into the page
(C) out of the page
(D) up toward the top of page



14. An aircraft carries a static charge of 0.60 C. It travels at 2.4×10^4 m/s, perpendicular to a 1.5×10^{-4} T magnetic field. What magnetic force is exerted on the aircraft?

(A) 2.2×10^{-2} N
(B) 6.0×10^{-2} N
(C) 5.4×10^{-1} N
(D) 9.6×10^5 N

15. What are the charges on the three charged particles fired into the magnetic field as shown below?

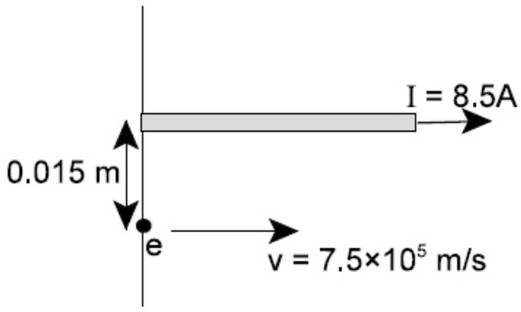


	P	Q	R
(A)	negative	negative	positive
(B)	negative	neutral	positive
(C)	positive	neutral	negative
(D)	positive	positive	negative

Part B: Written Response

1. An electron is projected perpendicularly into a 3.00×10^{-2} T magnetic field and travels in a circle with radius 7.5×10^{-3} m. Calculate the minimum velocity required to maintain the circular path. AUGUST 2009

2. An electron is moving parallel to a straight conductor that is carrying 8.5 A of current. The electron is 0.015 m away from the conductor and is moving at 7.5×10^{5} m/s, in the same direction as the current. Calculate the force on the electron (magnitude and direction). JUNE 2008



3. An electron is shot perpendicularly into a 3.25×10^{-4} T magnetic field. If the electron moves in a circular path of radius 12.0 cm, calculate the speed of the electron. AUGUST 2007

4. An electron travelling at 7.7×10^{6} m/s enters a uniform magnetic field at a right angle. When inside the field, the curved path of the electron has a radius of 3.5×10^{-2} m. Calculate the magnitude of the magnetic field. JUNE 2007

5. The diagram below shows a proton and an electron entering identical uniform magnetic fields. Describe two differences between the motions of the proton and electron after they enter the magnetic fields. AUGUST 2006

6. Using the diagram below, sketch the shape of the path taken by the proton and electron after they enter the magnetic fields. JUNE 2006

Proton | Electron

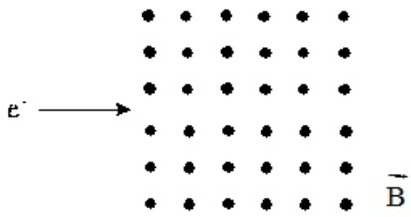
7. A proton moves with a speed of 3.6×10^{5} m/s at right angles to a uniform 0.75 T magnetic field. What is the radius of curvature for the motion of the proton? JUNE 2006

8. An electron travels in a path perpendicular to a 1.00×10^{-3} T magnetic field. If the radius of the circular path is 2.0 cm, how fast must the electron be travelling? AUGUST 2005

9. An electron travelling at 7.7×10^{6} m/s enters into a uniform magnetic field at a right angle. It is deflected in a circular path with a radius of 3.5×10^{-2} m. **JUNE 2005**

   (i) What is the magnitude of the magnetic field it experiences?

10. If the electron is shot east, as in the diagram below, into the magnetic field that is directed out of the page, sketch the path of the electron in the magnetic field. JUNE 2005



11. An electron shot into a magnetic field of 0.020 T at 5.6×10^{6} m/s, has a force of 8.96×10^{-15} N. At what angle does the electron enter the field? JUNE 2005

12. An electron travels with a speed of 2.00×10^{6} m/s in a plane perpendicular to a 1.00×10^{-3} T magnetic field. What is the radius of the electron's path? JUNE 2004

13. a) What is the magnitude of the force exerted on a alpha particle (q = +2e) moving at 5.0×10^{6} m/s at an angle of 25˚ to a magnetic field of strength 0.17 T?

    b) What is the magnitude of the force exerted on a proton (q = +e) moving at 3.0×10^{6} m/s at an angle of 50˚ to a magnetic field of strength 0.0135 T?

The direction of the force can be determined using LHR #3 (see p.640)

14 Calculate the magnitude and direction of the force acting on each of the particles below.

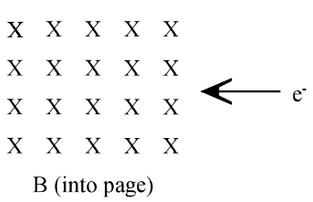
   a) an electron moving at 6.0×10^{6} m/s [right] in a magnetic field of 0.15 T [out of the page]

   b) an electron moving at 2.8×10^{6} m/s [down] in a magnetic field of 0.35 T [right]

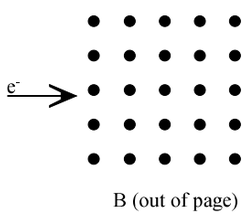
   c) an electron moving at 5.5×10^{6} m/s [out of the page] in a magnetic field of 0.50 T [down]

15. Determine the direction of the force acting on each particle below. Remember to reverse your answer if the particle is a positive.

a)



b)



c)