Dickie - Magnetism - Forces & Fields

Physics 30 Worksheet #10 : *Magnetism From Electricity*

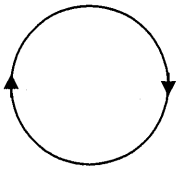
1. Draw the magnetic field surrounding the wire showing electron current below.

2. Draw the magnetic field surrounding the wire showing electron current below.

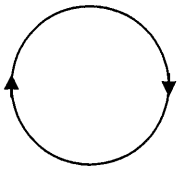
3. Find the direction of the magnetic field surrounding the wire showing electron current below. Indicate the direction of the field above the wire, below the wire, in front of the wire, and behind the wire.

4. Find the direction of the magnetic field surrounding the moving alpha particle below. Label the direction of the field to the left of the particle, to the right of the particle, in front of the particle, and behind the particle.

5. The diagram below shows the magnetic field surrounding a moving electron. Indicate the direction of motion of the electron.



6. The diagram below shows the magnetic field surrounding a moving alpha particle. Indicate the direction of motion of the alpha particle.



Physics 30 Worksheet # 11: *Charged Particles in Magnetic Fields*

1. An electron travels to the right of the page through a magnetic field that points into the page. Which way does the magnetic force point?

2. An electron travels into the page through a magnetic field that points to the left of the page. Which way does the magnetic force point?

3. An alpha particle travels toward the top of the page through a magnetic field that points out of the page. Which way does the magnetic force point?

4. An alpha particle travels to the North through a magnetic field that points to the West. Which way does the magnetic force point?

5. An electron travels to the North through a magnetic field that points to the North. Which direction does the magnetic force point?

6. An alpha particle travels out of the page through a magnetic field that points into the page. Which direction does the magnetic force point?

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7. An electron traveling to the East experiences a magnetic force to the North. In which direction does the magnetic field point?

8. An alpha particle traveling into the page experiences a magnetic force to the right of the page. In which direction does the magnetic field point?

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9. An alpha particle is traveling at 5.00×10^{5} m/s through a perpendicular magnetic field of value 2.00×10^{1} T. Calculate the magnetic force acting on the alpha particle.

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10. An electron is traveling at 6.00×10^{5} m/s through a perpendicular magnetic field of value 5.00×10^{-1} T. Calculate the magnetic force acting on the electron. Calculate the initial acceleration of the electron.

11. An electron is traveling through a perpendicular magnetic field of value 3.00×10^{-1} T. If the magnetic force that it experiences is 4.50×10^{-14} N, how fast is the electron moving?

12. An alpha particle initially accelerates at a rate of 8.00×10^{13} m/s^2 through a magnetic field of 3.00×10^{-1} T. Calculate the initial speed of the alpha particle?

Physics 30 Worksheet # 12: *Charged Particles in Magnetic Fields (2)*

1. What is the radius of curvature of an alpha particle moving at a speed of 2.5×10^{6} m/s through a magnetic field of 1.0×10^{-1} T?

2. How fast must an electron be traveling through a magnetic field of strength 3.0×10^{-3} T if it follows a circular path of radius 6.5×10^{-2} m?

3. What is the magnetic field strength required to make a proton with a speed of 5.0×10^{5} m/s follow a circular path of radius 2.0×10^{-2} m?

4. What is the kinetic energy, in Joules and electronvolts, of an alpha particle that moves through a magnetic field of strength 1.0×10^{-1} T and follows a circular path of radius 0.025 m?

5. How does the radius of curvature of an electron compare to the radius of curvature of an alpha particle moving through the same magnetic field at the same speed?

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Physics 30 Worksheet # 13: *Conductors in Magnetic Fields*

1. A 10.0 cm long wire carries a current of 0.500 A through a magnetic field of strength 0.100 T. Calculate the strength of the magnetic force acting on the wire.

2. The magnetic force acting on a wire is 0.0300 N. If the wire has a current of 1.00 A and a length of 20.0 cm, what is the strength of the magnetic field?

3. Calculate the initial acceleration of a 50.0 g, 20.0 cm wire that carries a current of 0.600 A if it is exposed to a magnetic field of 0.500 T.

4. A 15.0 cm long wire carrying a current of 0.200 A is exposed to an external magnetic field of 0.300 T. If the wire is suspended, what must its mass be?

5. Calculate the mass of a 20.0 cm long suspended wire that carries a current of 0.100 A through a magnetic field of 3.00×10^{-1} T.

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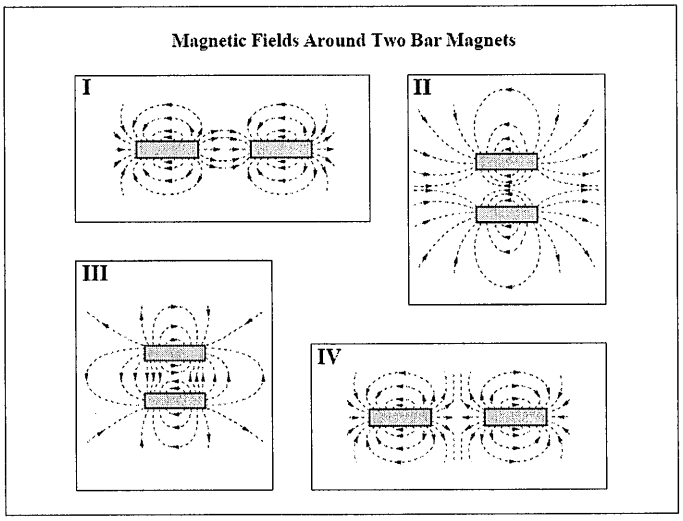
Diploma Review Questions

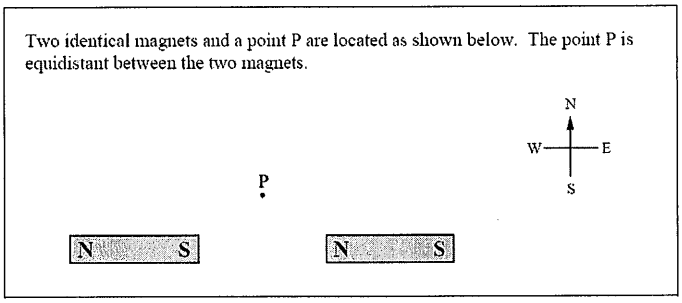
Use the following information to answer the next question.



66. Given the magnetic fields illustrated above, the magnets will repel in diagrams

A. I and II only
B. II and III only
C. I and IV only
D. II and IV only

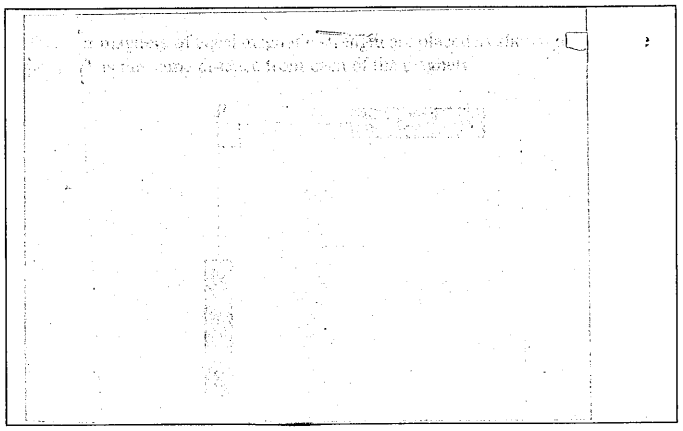
Use the following information to answer the next question.

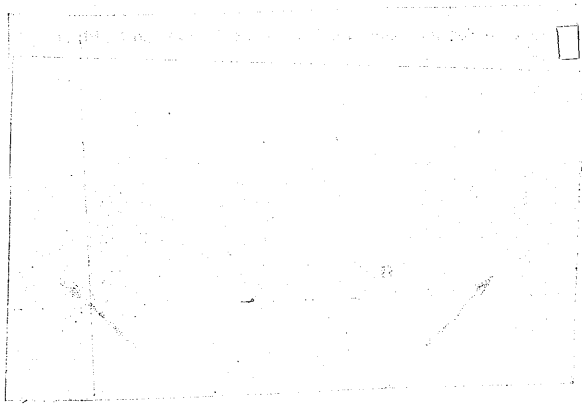


67. The two bar magnets cause the net magnetic field at P to be in the direction

A. east
B. west
C. north
D. south

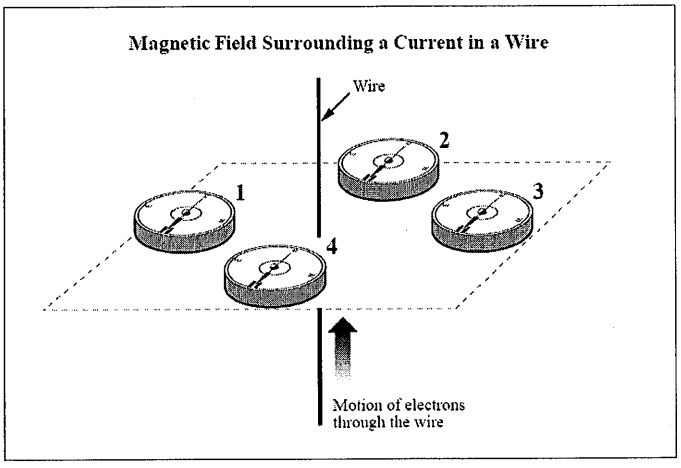
Use the following information to answer the next question.





Magnetic Fields Produced by Electric Current

Use the following information to answer the next question.



69. The compass that correctly indicates the direction of the magnetic field produced by a wire conducting electrons is numbered

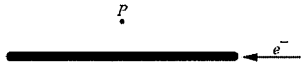
A. 1
B. 2
C. 3
D. 4

70. An automobile's battery delivers a steady DC current to a headlight. The electric current in the wire produces a circular

A. electric field around the wire
B. magnetic field around the wire
C. gravitational field around the wire
D. electromagnetic field around the wire

Use the following information to answer the next question.

Electrons move through a wire as shown below.



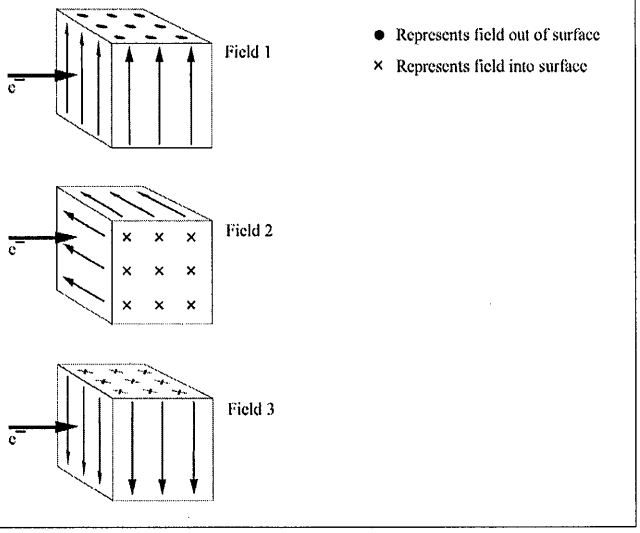
71. What is the direction of the magnetic field at point P?

A. Into the page
B. Out of the page
C. Toward the top of the page
D. Toward the bottom of the page

Moving Charges in External Magnetic Fields

Use the following information to answer the next question.

Moving electrons can be deflected by electric fields, gravitational fields, and magnetic fields. One electron is allowed to enter each type of field, as shown below.



72. If the electron is deflected downward in each field, then field 1, field 2, and field 3 are, respectively,

A. electric, magnetic, and gravitational
B. gravitational, magnetic, and electric
C. magnetic, gravitational, and electric
D. magnetic, electric, and gravitational

Use the following information to answer the next question.

Photon–Matter Interactions

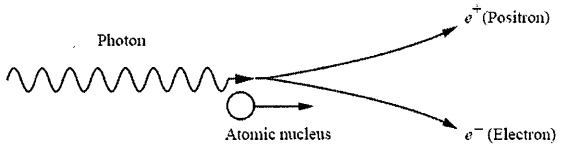
When a photon passes through matter, it interacts with the atoms and their electrons. There are four important interactions with matter that a photon can undergo.

I. The photon may be scattered by an electron and in the process lose some energy, transferring momentum and energy to the electron.

II. The photon may move an electron out of an atom, and in the process, the photon disappears (the photoelectric effect).

III. The photon may move an electron to a higher energy state in the atom, and in the process, the photon disappears.

IV. A photon may actually create matter. The most common process, called pair production, is the production of an electron and a positron. A positron has the same mass as an electron, but it has the opposite charge. In addition, a massive particle, such as an atomic nucleus, must gain some of the photon's initial momentum. (See the diagram below.)



77. The curved paths of the particles in the pair production diagram result from the electron and positron moving through an external magnetic field. In this diagram, the direction of the magnetic field causing these paths to curve is

A. into the page
B. out of the page
C. to the left
D. to the right

78. During pair production, the speed of the electron or of the positron can be calculated by measuring the radius of the circular path it travels within the magnetic field. The speed of a charged particle moving in a circular path in a uniform magnetic field is given by

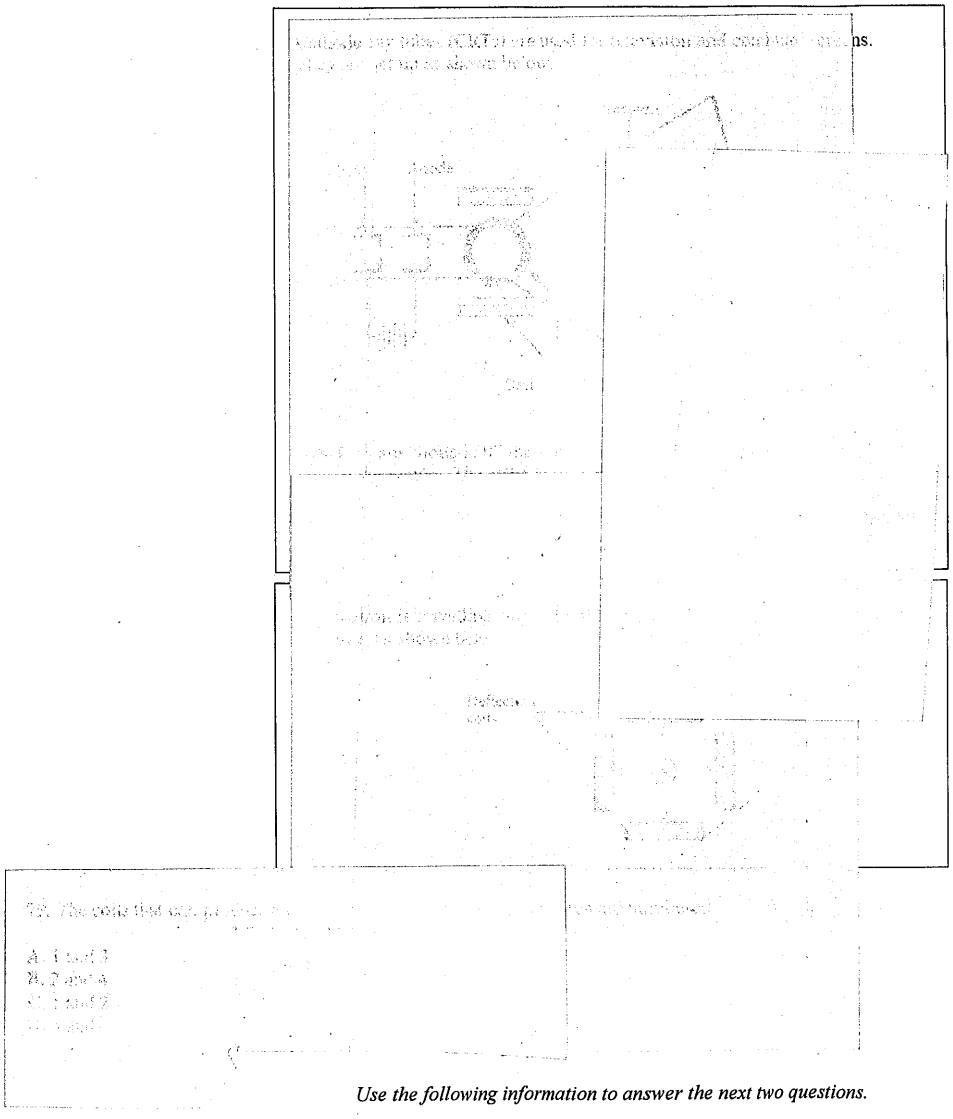
A. $v = \frac{B_{mag} qr}{m}$

B. $v = B_{mag} qrm$

C. $v = \frac{m}{B_{mag} qr}$

D. $v = \frac{rB_{mag}}{qm}$

Use the following information to answer the next question.



Use the following information to answer the next two questions.

A proton with an energy of 894 eV travels perpendicular to a magnetic field and moves in a circular path with a radius of 3.60×10^{-4} m.

80. The speed of the proton is

A. 4.14×10^{5} m/s
B. 1.77×10^{7} m/s
C. 1.71×10^{11} m/s
D. 3.14×10^{14} m/s

81. The strength of the magnetic field, expressed in scientific notation, is $a.bc \times 10^{d}$ T. The values of *a*, *b*, *c*, and *d* are _____, _____, _____, and _____.

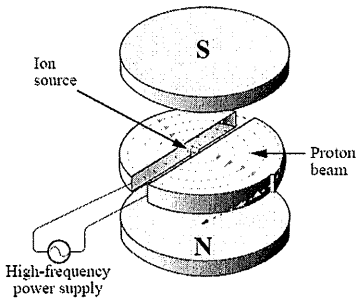
(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

82. A proton and an alpha particle have identical circular orbits in a magnetic field. The proton has a speed of 4.4×10^{5} m/s. The speed of the alpha particle is

A. 1.1×10^{5} m/s
B. 2.2×10^{5} m/s
C. 4.4×10^{5} m/s
D. 8.8×10^{5} m/s

Use the following information to answer the next two questions.

A cyclotron uses a magnetic field to move charged particles in a circular path. It also uses a high frequency power supply to repeatedly accelerate the particles.



Ernest Lawrence was the first person to use a cyclotron. His cyclotron accelerated protons to a maximum energy of 8.0×10^{4} eV. With this energy, the protons moved in a circular path with a radius of 6.5×10^{-2} m.

83. The maximum speed of the protons in Lawrence's cyclotron was

A. 1.5×10^{13} m/s
B. 1.7×10^{8} m/s
C. 3.9×10^{6} m/s
D. 9.8×10^{15} m/s

84. The magnitude of the magnetic field used by Lawrence was

A. 6.3×10^{-1} T
B. 2.7×10^{1} T
C. 2.4×10^{6} T
D. 1.6×10^{9} T

Electric Current in an External Magnetic Field

85. A 50.0 cm length of wire has a weight of 0.389 N and a current of 0.250 A. The wire remains suspended when placed perpendicularly across a magnetic field. The strength of the magnetic field is _____ T.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

86. A wire that is 75.0 cm long carries a current of 6.00 A. The wire is at right angles to a uniform magnetic field and experiences a magnetic force of 0.350 N. The magnitude of the magnetic field, expressed in scientific notation, is $b \times 10^{-w}$ T. The value of b is _____.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

87. XXXX

Magnetism Review Questions

Use the following information to answer the next three questions.

Diagrams **1** and **2** below each show an electron as it enters a field. The fields are different but the electrons enter them with the same instantaneous velocity, $\vec{v}_{inst}$.

Diagram 1

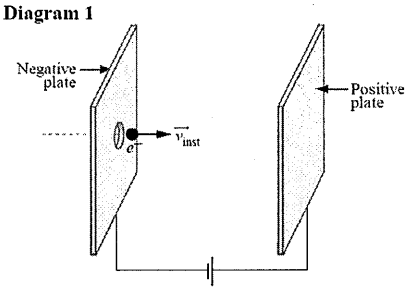
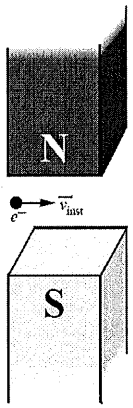


Diagram 2



Statements About the Motion of the Charged Particles as They Travel Through the Fields

I The speed of the particle remains constant.
II The speed of the particle increases.
III The direction of the particle's motion remains constant.
IV The direction of the particle's motion changes.

88. The statements that describe the motion of the charged particle in diagram **1** are

A. I and III
B. I and IV
C. II and III
D. II and IV

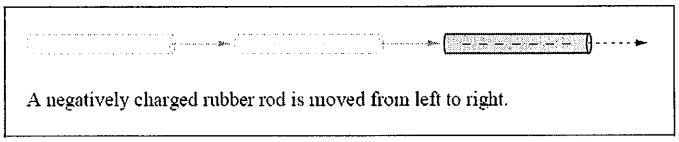
89. The statements that describe the motion of the charged particle in diagram **2** are

A. I and III
B. I and IV
C. II and III
D. II and IV

90. The direction of the uniform magnetic field in diagram **2** is

A. toward the top of the page
B. toward the bottom of the page
C. to the left of the page
D. to the right of the page

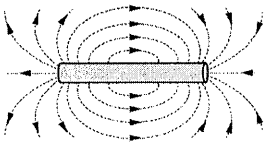
Use the following information to answer the next question.



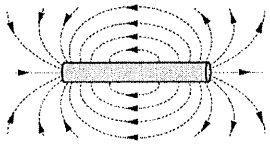
A negatively charged rubber rod is moved from left to right.

91. The magnetic field induced around the rubber rod as it moves is represented by

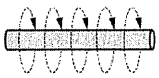
A.



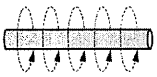
B.



C.



D.



92. An alpha particle travels at 1.08×10^5 m/s perpendicularly through a magnetic field of strength 1.12×10^{-3} T. The magnitude of the magnetic force on the alpha particle is $b \times 10^{-19}$ N. The value of b is _____.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

93. A copper wire is connected to a battery so that it has a current in it. A segment of the wire is perpendicular to a horizontal 1.5 T magnetic field. The length of the wire in the magnetic field is 3.0 cm, and the mass of the wire affected by the magnetic field is 20 g. In order to suspend the segment of wire, the minimum current in the wire must be

A. 0.044 A
B. 0.23 A
C. 4.4 A
D. 44 A

Use the following information to answer the next question.

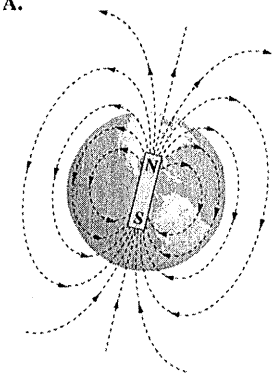
A student holds a compass near the top of a filing cabinet and observes the direction that the needle points. When the student holds the compass near the bottom of the filing cabinet, the student observes that the compass needle is deflected 180° from its direction at the top of the cabinet.

94. A possible explanation for the deflection of the compass needle is that the

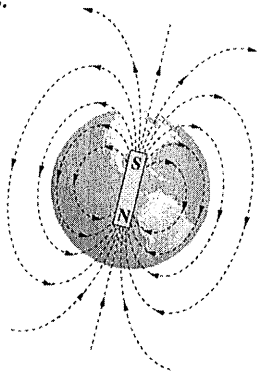
A. bottom of the filing cabinet is positively charged
B. bottom of the filing cabinet is negatively charged
C. induced magnetic polarity of the bottom of the filing cabinet is opposite to that at the top of the filing cabinet
D. bottom of the filing cabinet is closer to Earth so it is more strongly magnetized than the top of the filing cabinet

95. If the source of Earth's magnetic field were a bar magnet, then the **best** diagram to show this field would be

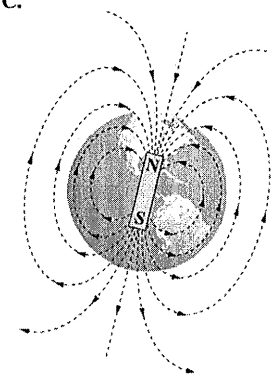
A.



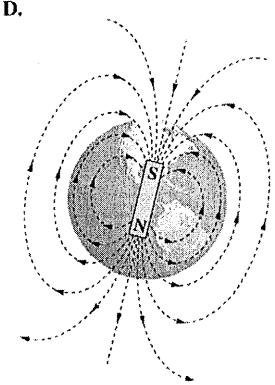
B.



C.



D.



Use the following information to answer the next question.

A proton enters a magnetic field at a right angle to the field. An alpha particle enters the same field at the same angle but with **twice** the speed. Once in the magnetic field, both particles move in a circular path.

96. The ratio of radius of the alpha particle's path to the radius of the proton's path is

A. 1 : 1
B. 2 : 1
C. 4 : 1
D. 8 : 1