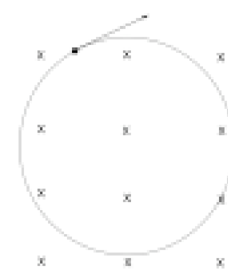
Physics 2401 Summer 2, 2008
Exam III

e = 1.60×10^{-19} C, m(electron) = 9.11×10^{-31} kg, $\varepsilon_0 = 8.845\times10^{-12}$ C^2/Nm^2,
$k_e = 9.0\times10^9$ Nm^2/C^2, m(proton) = 1.67×10^{-27} kg. n = nano = 10^{-9}, μ = micro = 10^{-6}, m = milli = 10^{-3}

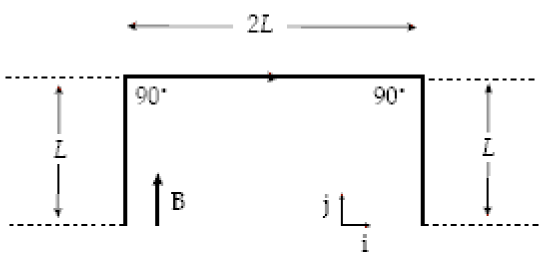
1. A charged particle is in a region of non-zero magnetic field. If it feels no force
a) it is moving perpendicular to the field b) it is not moving at all
c) it is moving parallel to the field d) a or b e) b or c

2. An electron has a velocity of 6.0×10^6 m/s in the positive x direction at a point where the magnetic field has the components $B_x = 3.0$ T, $B_y = 1.5$ T, and $B_z = 2.0$ T. What is the magnitude of the acceleration of the electron at this point?
a. 2.1×10^{18} m/s^2
b. 1.6×10^{18} m/s^2
c. 2.6×10^{18} m/s^2
d. 3.2×10^{18} m/s^2
e. 3.7×10^{18} m/s^2

3. The particle in the diagram on the right has an instantaneous velocity shown by the arrow. It is
a) negatively charged b) positively charged



4. A straight wire is bent into the shape shown. Determine the net magnetic force on the wire when the current I travels in the direction shown in the magnetic field **B**.



a. $2IBL$ in the $-z$ direction
b. $2IBL$ in the $+z$ direction
c. $4IBL$ in the $+z$ direction
d. $4IBL$ in the $-z$ direction
e. zero

5. What is the magnetic force on a 2.0-m length of (straight) wire carrying a current of 30 A in a region where a uniform magnetic field has a magnitude of 55 mT and is directed at an angle of 20° away from the wire?
a. 1.5 N
b. 1.3 N
c. 3.1 N
d. 1.7 N
e. 1.1 N

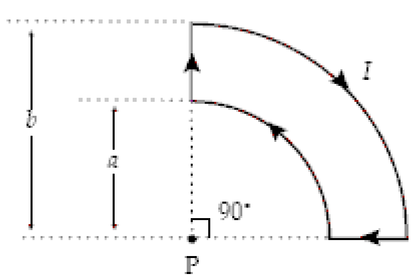
6. A rectangular coil (0.20 m × 0.80 m) has 200 turns and is in a uniform magnetic field of 0.30 T. When the orientation of the coil is varied through all possible positions, the maximum torque on the coil by magnetic forces is 0.080 N · m. What is the current in the coil?
a. 8.3 mA
b. 1.7 A
c. 5.0 mA
d. 1.0 A
e. 42 mA

7. A 500-eV electron and a 300-eV electron trapped in a uniform magnetic field move in circular paths in a plane perpendicular to the magnetic field. What is the ratio of the radii of their orbits?
a. 2.8
b. 1.3
c. 1.7
d. 4.0
e. 1.0

8. A current I moves in the –y direction. The direction of the magnetic field at a point on the positive x axis is in the
a) +x direction b) – z direction c) –x direction d) +z direction

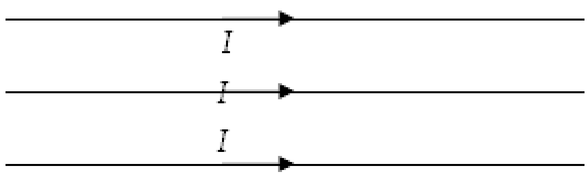
9. Two long parallel wires separated by 4.0 mm each carry a current of 24 A. These two currents are in the same direction. What is the magnitude of the magnetic field at a point that is between the two wires and 1.0 mm from one of the two wires?
a. 4.8 mT
b. 6.4 mT
c. 3.2 mT
d. 9.6 mT
e. 5.3 mT

10. If a = 1.0 cm, b = 3.0 cm, and I = 30 A, what is the magnitude of the magnetic field at point P? (answers on next page)



a. 0.62 mT
b. 0.59 mT
c. 0.35 mT
d. 0.31 mT
e. 0.10 mT

11. Three coplanar parallel straight wires carry equal currents I to the right as shown below. Each pair of wires is a distance a apart. The direction of the magnetic force on the middle wire



a. is up out of the plane of the wires.
b. is down into the plane of the wires.
c. is in the plane of the wires, directed upwards.
d. is in the plane of the wires, directed downwards
e. cannot be defined, because there is no magnetic force on the middle wire.

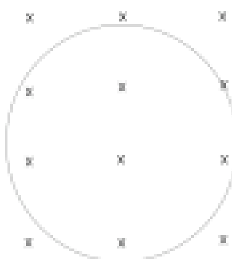
12. Two current loops are coaxial and coplanar. One has radius a and the other has radius $2a$. Current $2I$ in the outer loop is antiparallel to current I in the inner loop. The magnitude of the magnetic field at the center of the two loops is
a. 0.
b. $\dfrac{\mu_0 I}{4a}$.
c. $\dfrac{\mu_0 I}{2a}$.
d. $\dfrac{\mu_0 I}{a}$.
e. $\dfrac{2\mu_0 I}{a}$.

13. A toroid is made of 2000 turns of wire of radius 2.00 cm formed into a donut shape of inner radius 10.0 cm and outer radius 14.0 cm. When a 30.0-A current is present in the toroid, the magnetic field at a distance of 11.0 cm from the center of the toroid is
a. 0.0857 T.
b. 0.109 T.
c. 0.120 T.
d. 0.600 T.
e. 0.685 T.

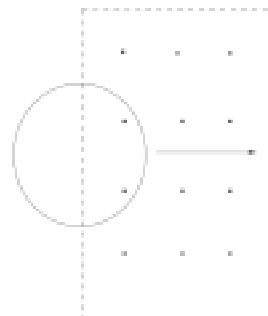
14. By using a compass to measure the magnetic field direction at various points adjacent to a long straight wire, you can show that the wire's magnetic field lines are
a. straight lines in space that go from one magnetic charge to another.
b. straight lines in space that are parallel to the wire. (more answers next page)

c. straight lines in space that are perpendicular to the wire.
d. circles that have their centers on the wire and lie in planes perpendicular to the wire.
e. circles that have the wire lying along a diameter of the circle.

15. In the diagram on the right, the magnetic field is decreasing. The direction of the induced current in the loop is
a) clockwise b) counterclockwise



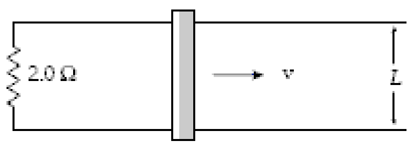
16. The loop on the right is being pushed into a magnetic field pointing of the paper. The field outside of the dotted region is zero. The directio the induced current in the loop is
a) counterclockwise b) clockwise



17. A flat coil of wire consisting of 20 turns, each with an area of 50 cm^2, is positioned perpendicularly to a uniform magnetic field that increases its magnitude at a constant rate from 2.0 T to 6.0 T in 2.0 s. If the coil has a total resistance of 0.40 Ω, what is the magnitude of the induced current?
a. 0.70 A
b. 0.60 A
c. 0.50 A
d. 0.80 A
e. 0.20 A

18. A long solenoid (n = 1500 turns/m) has a cross-sectional area of 0.40 m^2 and a current given by $I = (4.0 + 3.0t^2)$ A, where t is in seconds. A flat circular coil (N = 300 turns) with a cross-sectional area of 0.15 m^2 is inside and coaxial with the solenoid. What is the magnitude of the emf induced in the coil at t = 2.0 s?
a. 2.7 V
b. 1.0 V
c. 6.8 V
d. 0.68 V
e. 1.4 V

19. In the arrangement shown, a conducting bar of negligible resistance slides along horizontal, parallel, frictionless conducting rails connected as shown to a 2.0-Ω resistor. A uniform 1.5-T magnetic field is perpendicular to the plane of the paper. If L = 60 cm, at what rate is thermal energy being generated in the resistor at the instant the speed of the bar is equal to 4.2 m/s?



a. 8.6 W
b. 7.8 W
c. 7.1 W
d. 9.3 W
e. 1.8 W

20. An electric field of 4.0 μV/m is induced at a point 2.0 cm from the axis of a long solenoid (radius = 3.0 cm, 800 turns/m). At what rate is the current in the solenoid changing at this instant?
a. 0.50 A/s
b. 0.27 A/s
c. 0.60 A/s
d. 0.70 A/s
e. 0.40 A/s