

Possibly Useful Information: $\mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2$ $e = 1.60 \times 10^{-19} \text{ C}$ $c = 3.00 \times 10^8 \text{ m/s}$

Problem 1 Multiple Choice (3 points each)

_____ [i] How will the coil move due to the magnet? (a) to left (b) to right (c) to top (of page) (d) to bottom (e) rotate clockwise (f) rotate counterclockwise (g) cannot be determined

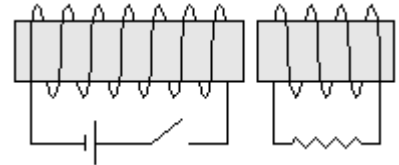
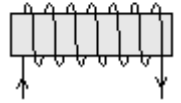
_____ [ii] What is the direction of the magnetic field due east of a horizontal wire from the north to the south with a current to the south?

(a) north (b) south (c) east (d) west (e) up (f) down (g) cannot be determined

_____ [iii] A conducting cube is dropped in the earth's magnetic field. Which face of the cube is at highest voltage? (a) north (b) south (c) east (d) west (e) top (f) bottom

_____ [iv] What is the direction of the current through the resistor when the switch is closed and then opened? (a) left then left (b) left then right (c) right then left (d) right then right (e) cannot be determined

_____ [v] In a demonstration of Lenz's law, a bar magnet is dropped down a conducting tube. It takes a time T for the magnet to pass through the tube. If the tube is heated, raising its resistance, and the demonstration is repeated, then what is the result? (a) It falls in the same time as if in free-fall. (b) It takes longer than free-fall but is faster than T. (c) It takes the same time, T. (d) It takes longer than T. (e) It cannot be determined.

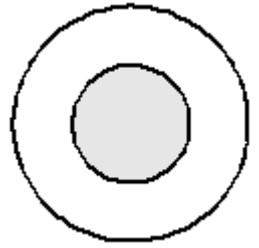


Problem 2 A solenoid has a 3cm×3cm square cross-section, 1800 turns, a length of a 75cm and carries a 12A current. (6 points each)

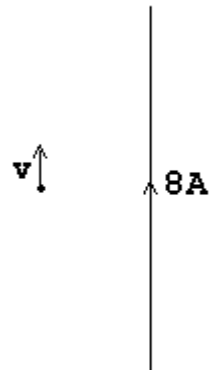
(a) What is the magnetic field inside the solenoid?

(b) What is the maximum torque on this solenoid if it sits in a uniform magnetic field of 5 mT?

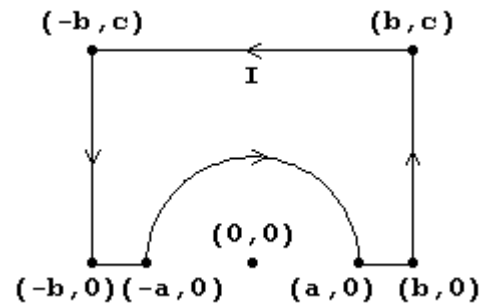
Problem 3 A coaxial cable has an inside wire of radius a and an outside conductor of negligible thickness at radius b . The inside wire carries a uniform current I , that returns in the outside conductor. What is the magnetic field a distance r from the center? (Include $r < a$, $a < r < b$ and $r > b$.) (7 points)



Problem 4 What is the force on an electron moving at 8×10^5 m/s parallel to and 3 mm from a long wire carrying an 8 A current? Specify the direction of the force relative to the wire. (7 points)



Problem 5 What is magnetic field at the origin? Specify the direction relative to the page. The wire consists of a half circle and three line segments. The current is I . (7 points)



Problem 6 A 2m long conducting rod is held at one end and rotated in a plane perpendicular to a constant magnetic field of 8mT. If it makes one complete rotation every 3s then what is the voltage difference between the inside and outside. (6 points)

Problem 7 A long solenoid has a square cross-section with sides of length ℓ , n turns per length has the z-axis as its central axis. Suppose this sits entirely inside a flat circular coil of radius R with N turns in the xy-plane. A counterclockwise current through the solenoid decreases at the rate of $dI/dt = -\alpha$.

(a) What is the magnitude of the induced EMF in the loop? (4 points)



Flat Coil

(b) What is the direction of the induced EMF in the loop? (Answer clockwise or counterclockwise.) (4 points)