Chapter G - Problems

Blinn College - Physics 2426 - Terry Honan

Problem G.1

A plane flies horizonally at a speed of 280 m/s in a position where the earth's magnetic field has a magnitude 6.0×10^{-5} T and is directed at an angle of 50 ° below horizontal. If the wingspan of the plane is 55 m then what is the induced voltage between the tips of the wings if the plane flies to the north? Which wing tip is at higher voltage, the right or the left? How would this result change if the plane flew to the east instead?

Problem G.2

A 1.6 m long conducting rod is oriented in the east-west direction while it is slid to the north at 3 m/s along parallel conducting rails separated by 1.6 m. A stationary 5 Ω resistance sits between the rails and there is a downward uniform magnetic field of 0.30 T.
(a) What is the current through the resistor?
(b) What is the rate that heat is lost in the resistor? (This is the power dissipated in the resistor.)
(c) What force is needed to move the rod at that constant speed?
(d) At what rate is work being done to slide the rod at that constant speed

Problem G.3

A circular conducting disk with a 30 cm radius sits in a uniform magnetic field of 40 mT. If it is rotated with an angular frequency of 15 rad/s then what is the magnitude of the voltage difference between the center and the rim of the disk?

Problem G.4

A 30 turn flat 12 cm × 9 cm rectangular coil is perpendicular to a uniform magnetic field that varies from 60 mT to 25 mT in 0.3 s. What is the magnitude of the average induced EMF in the coil?

Problem G.5

(a) A wire with a diameter d is formed into a single circular loop of radius R. The metal in the wire has a resistivity ρ. If this loop sits in a perpendicular field that varies with time by $B(t)$ then what is the current in the loop as a function of time?

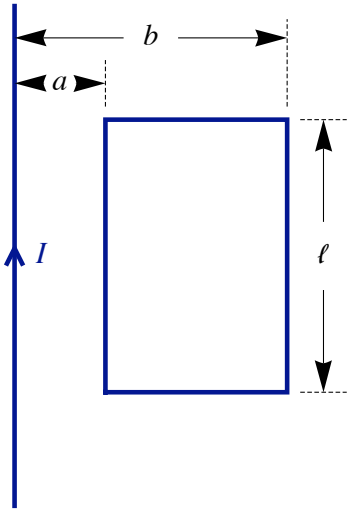
(b) A copper wire with a 1 mm diameter is formed into a single circular conducting loop with a 30 cm radius. If this sits perpendicular to a magnetic field that varies at the rate of $dB/dt = 20\ T/s$, then what is the induced current in the loop?

Problem G.6

A flat circular coil with a 30 cm radius and 200 turns sits in a uniform and constant (time independent) magneitc field of 40 mT.
(a) If the coil is initially in the plane of the field and then over a time of 3 s is rotated 90° until it is perpendicular to the field. What is the average induced EMF magnitude over this time?
(b) Suppose this coil is rotated about an axis parallel to the plane of the coil and perpendicular to the field. If it is rotated at a frequency of 15 Hz (15 times each second) then what is the peak EMF induced in the coil.

Problem G.7

Consider a long wire with a current I next to a single rectangular conducting loop as shown.



(a) What is the magnetic flux through the loop due to the current in the long wire?

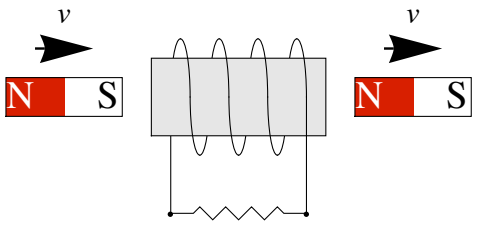
(b) Given $I(t)$ obtain an expression for the induced EMF in the loop due to the current.

(c) If the current is increasing, is this a clockwise or counterclockwire EMF?

(d) Suppose the current varies as $I(t) = I_0 \cos(\omega t + \phi)$. If the loop has a resistance R then what is the induced current as a function of time?

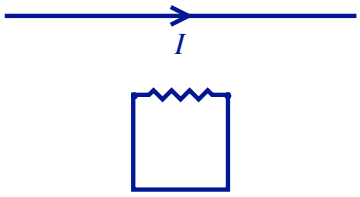
Problem G.8

A magnet is moved through a solenoid as shown. What is the direction of the induced current through the resistor as the magnet enters and then leaves.

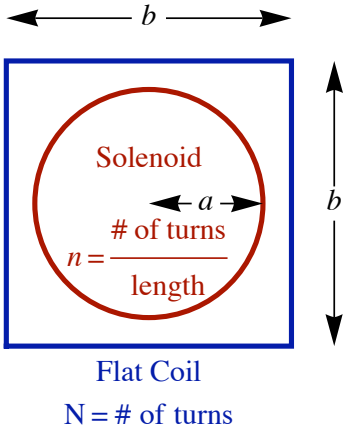


Problem G.9

A square loop with a resistor is moved next to a wire with a constant current I. What is the direction of the current through the resistor
(a) when the loop is moved to the top of the page (toward the wire),
(b) when moved to the left,
(c) when moved to the bottom of the page and
(d) when moved to the right?



Problem G.10



A long solenoid with n turns/length and with a circular cross-section of radius a sits with its axis perpendicular to the page. Sitting outside of the solenoid is a square flat coil (entirely in the plane) with N turns, with sides of length b $(b > 2\,a)$ and with a total resistance R. A current of I_1 flows through the solenoid.

(a) What is the magnetic flux through the flat coil due to the current in the solenoid?

(b) If the current through the solenoid varies at a rate of $\frac{dI_1}{dt}$ then what is I_2, the induced current through the coil?

(c) If the current I_1 is clockwise and decreasing then what is the direction of I_2?

Problem G.11

A solenoid with a circular cross-section with a radius R and has n turns per length. It sits with a vertical axis; take the positive z direction to be upward. A varying current of $I(t)$ flows through the solenoid, where a positive I represents a counterclockwise current.
(a) What is the magnetic field as a function of time and r, the perpendicular distance from the central axis of the solenoid?
(b) What is the electric field as a function of time and r?