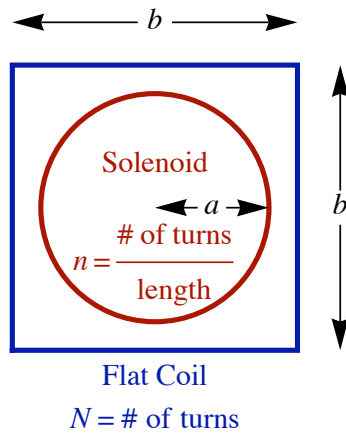# Chapter H - Problems

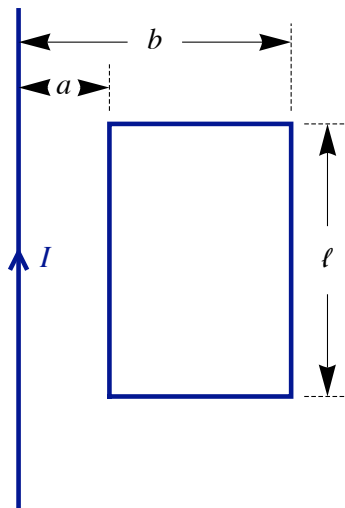**Blinn College - Physics 2426 - Terry Honan**

Problem H.1

Refer to **Problem G.9** where a $b \times b$ square flat coil with N turns sits outside of a long solenoid with n turns per length and a circular cross-section radius a. What is the mutual inductance between the solenoid and the flat coil?

Problem H.2

Refer to **Problem G.7** where we discussed a long wire next to a rectangular conduction loop. What is the mutual inductance between the long wire and the loop?

Problem H.3

What is the average induced EMF when the current through a coil with a 50 mH inductance varies from 5 A to 3 A in 0.04 s?

Problem H.4

The current through a 15 mH inductor varies as

$$I(t) = I_{max} \sin \omega t \quad \text{where } I_{max} = 6 \text{ A and } \omega = 200 \text{ s}^{-1}.$$

What is the EMF across the inductor as a function of time?

Problem H.5

A solenoid has 250 turns, a length of 40 cm and a diameter of 3 cm. The current through the solenoid varies as

$$I(t) = 15 t^3 - 40 t + 30 \quad \text{(in SI units)}.$$

(a) What is the inductance of the solenoid?
(b) What is the voltage drop across the solenoid at $t = 2$ s?
(c) What is the energy stored in the solenoid at $t = 2$ s?

Problem H.6

A typical electric field at the earth's surface is $100 \, V/m$ and a typical magnetic field value is 5×10^{-5} T. What are the electric and magnetic energy density, u_e and u_m.

Problem H.7

A 2 μF capacitor is given an initial charge of 6 μC and is then connected across a 15 kΩ resistor to discharge it.
(a) What is the charge on the capacitor 40 ms after the resistor is connected?
(b) What is the current through the resistor 40 ms after it is connected?
(c) What is the maximum magnitude current through the resistor?

Problem H.8

A 2 MΩ resistor and a 3 μC capacitor are connected across a 12 V battery. What is the timeconstant of the circuit. Express the charge and currents as functions of time.

Problem H.9

If a charging capacitor reaches 60% of its maximum charge after 0.90 s then what is the time constant of the circuit?

Problem H.10

A 2.5 H inductor is connected in a loop circuit with a DC voltage source and a resistor. If the current increases to 90% of its final value in 3 s then what is the resistance in the circuit?

Problem H.11

An inductance L and a capacitance C both have the same time constant when combined with the same resistance.
(a) What is the resistance and what is the value of the time constant?
(b) If $L = 12$ mH and $C = 30$ μF then what is R and what is the value of the time constant?

Problem H.12

A 1 μF capacitor is fully charged across a 40 V battery. It is then disconnected from the battery and connected actoss a 10 mH inductor inductor. What is the maximum current through the inductor during the LC oscillations?

Problem H.13

A 840 nF capacitor with an initial 105 μC is connected across a 3.30 mH inductor at $t = 0$.
(a) What is the energy in the capacitor at $t = 2$ ms?
(b) What is the energy in the inductor at $t = 2$ ms?
(c) What is the total energy?