PHY1308 - Homework 10

Expectations for the quality of your handed-in homework are available at http://www.physics.smu.edu/sekula/phy1308/homework.pdf. Failure to meet these guidelines will result in loss of points as detailed in that document. **This assignment is due on Tuesday, April 19 by 9:30am.**

Reading Assignment

- Chapter 26.8-27.3

Practice Problems

These are not required; they are odd-numbered problems from Wolfson that may help you to warm up for the required problems.

- CH27-20 (the answer is 3.2mH)
- CH27-23
- CH27-25
- CH27-29

A Note on Significant Figures

Wolfson's representation of numbers can often make interpreting the number of significant figures very difficult. Here are some rules you can follow and to which the solutions will adhere:

1. If an integer number has a trailing zero (e.g. 50 or 100), but no decimal point to indicate that zero is significant, TREAT THE TRAILING ZEROS AS SIGNIFICANT.
    a) Example: 100 will have three significant figures. 50 will have two.
2. If an integer less than 10 is given, assume it is INFINITELY SIGNIFICANT
    a) Example: 2 has infinite precision, and should be treated like 2.0000000...

Required Problems

- SS-18 [60 Points]

Problem SS-16: Using Inductors and Inductance

You wind a solenoid using 100.0 meters of copper wire. The wire has a thickness of 0.50mm. This yields a solenoid with 3183 turns, with each turn pressed up against the next one.

Part (a): Calculate the self-inductance of this solenoid.

Part (b): The solenoid is connected to a 120V battery. What is the maximum current that can be driven through the copper wire in the solenoid?

Part (c): How long does it take for the current in this battery+resistor+inductor circuit (remember: the copper wire has resistance so it's like putting a resistor in series with a perfectly conducting inductor!) to reach 63.212% of the maximum current?

Part (d): At maximum current, what is the magnetic field strength inside the solenoid?

Part (e): When the magnetic field strength is at its maximum, what is the energy stored in the magnetic field?

Part (f): What is the energy density of this magnetic field?