Inductance

1. A solenoid with 50 windings per centimeter has a radius of 2.50 cm and a length of 15.0 cm.
   a. What is the magnitude of the magnetic field inside the solenoid when it carries a current of 1.0 A?

   b. What is the absolute value of the magnetic flux through one winding of the solenoid when it carries a current of 1.0 A?

   c. What is the total magnetic flux through all the turns of the solenoid when it carries a current of 1.0 A?

   d. If the current through the solenoid decreases from 1.0 A to zero in 1.0 s, what emf does the solenoid generate?

   e. What is the formula for the power output of the solenoid while its current decreases?

   f. What is the total work done by the solenoid in decreasing its current from 1.0 A to zero?

2. The inductance L of a coil is defined as the voltage required to change the current I through the inductor at a rate of 1 A/s: $V = L\, dI/dt$.

   What is the inductance of the solenoid of Question 1?

3. What is the instantaneous power consumption of an inductor of inductance L whose instantaneous current I is changing at the rate dI/dt?

4. How much energy is consumed by an inductor of inductance L as the current increases from zero to I?

5. What is the energy density (J/m^3) of the solenoid in Question 1 when it carries a current of 1.0 A?