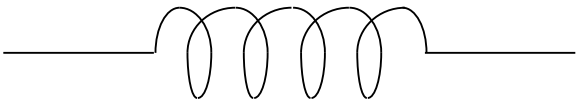
Name: _____

PHY 232 Summer 2016 Class Work

Class 34. Inductance



Consider a 500 turns solenoid, 5cm in length and has a circular cross section of 1cm in radius.

(a) Calculate the inductance of this coil.

$\mathrm{L} = \mu_0 \mathrm{nNA}$

$\mathrm{N} = 500$

$\mathrm{n} = \dfrac{\mathrm{N}}{\mathrm{L}} = \dfrac{500}{0.05} = 10000\ /\mathrm{m}$

$\mathrm{A} = \pi\, \mathrm{r}^2 = \pi \times (0.01)^2 = 3.1416 \times 10^{-4}\ \mathrm{m}^2$

$\mathrm{L} = (4\pi \times 10^{-7})(10000)(500)(3.1416 \times 10^{-4}) = \underline{\underline{1.974 \times 10^{-3}\,\mathrm{H\ or\ 1.974\ mH}}}$

(b) If a constant current of 10A is passing through the solenoid, what is the emf across the solenoid?

$\mathrm{I} = \text{constant} \Rightarrow \dfrac{\mathrm{dI}}{\mathrm{dt}} = 0$

$\therefore \text{emf} = \mathrm{L}\dfrac{\mathrm{dI}}{\mathrm{dt}} = \underline{\underline{0}}$

(c) What is the energy stored in the solenoid?

$\mathrm{U} = \dfrac{1}{2}\mathrm{LI}^2 = \dfrac{1}{2}(1.974 \times 10^{-3})(10)^2 = \underline{\underline{0.0987\mathrm{J}}}$

(d) If the 10A current diminishes to 0A in 0.1s, what is the average emf across the solenoid during this period of time?

$\left|\dfrac{\mathrm{dI}}{\mathrm{dt}}\right| = \dfrac{10}{0.1} = 100\ \mathrm{A/s}$

$\therefore \text{emf} = \mathrm{L}\dfrac{\mathrm{dI}}{\mathrm{dt}} = (1.974 \times 10^{-3}) \times 100 = \underline{\underline{0.1974\mathrm{V}}}$