

Bonus Warm Up! Unit 5, Electromagnetism

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1 Memory Bank

- Permittivity of free space: $\epsilon_0 = 8.85 \times 10^{-12}$ F/m
- Permeability of free space: $\mu_0 = 4\pi \times 10^{-7}$ T A⁻¹ m
- The *inductance* L of a system that induces an emf ϵ given a change in current $\Delta I/\Delta t$ is

$$\epsilon = -L \frac{\Delta I}{\Delta t} \quad (1)$$

- The energy stored in a capacitor with capacitance C and voltage V is

$$U = \frac{1}{2} CV^2 \quad (2)$$

- The energy stored in an inductor with inductance L and current I is

$$U = \frac{1}{2} LI^2 \quad (3)$$

2 There is only one form of energy ...

1. How much energy is stored in a capacitor with $C = 1\mu\text{F}$, at a voltage of 12 V?
2. How much energy is stored in an inductor with $L = 1\mu\text{H}$ (micro-Henries), at a current of 2 A?
3. What voltage is induced in an inductor with $L = 1\mu\text{H}$ (micro-Henries), if the current changes at a rate of 0.1 A/s?
4. Recall that the formula for capacitance of a parallel plate capacitor is $C = \epsilon_0 A/d$, where A is the plate area, d is the separation between the plates, and ϵ_0 is the permittivity of free space. What is the capacitance of a capacitor with area $A = 1 \text{ cm}^2$ and plate separation 1 mm?