SP212 Quiz 10

Name: Dr. Wilson

1) A 12 H inductor carries a 2.0 A current. At what rate must the current be changed to produce a 60 V emf in the inductor?

- a) 2.5 A/s
- b) 3.0 A/s
- c) 4.2 A/s
- d) 5.0 A/s
- e) 5.9 A/s

\[ \varepsilon_L = -L \frac{dI}{dt}, \quad \frac{|dI|}{dt} = \frac{-\varepsilon_L}{L} = \frac{60 V}{12 \, \text{H}} = 5.0 \, \frac{A}{s} \]

2) After being hooked up to a battery, the current in an RL circuit builds to 0.9 times its asymptotic value in \( t = 2.5 \, \text{s} \). The inductor in the circuit has inductance \( L = 0.75 \, \text{H} \). What is the resistance of the resistor in the circuit?

- a) 0.58 \, \Omega
- b) 0.64 \, \Omega
- c) 0.69 \, \Omega
- d) 0.81 \, \Omega
- e) 0.90 \, \Omega

\[ i = \frac{E}{R} \left(1 - e^{-t/R\cdot L}\right) \quad e^{-2.5 \cdot R/0.75} = 0.1 \]

\[ 0.9 \frac{E}{R} = \frac{E}{R} \left(1 - e^{-t/R\cdot L}\right) \quad R = 0.69 \, \Omega \]

\[ e^{-t/R\cdot L} = 0.1 \]

3) What must be the magnitude of a uniform electric field if it is to have the same energy density as that possessed by a 0.62 T magnetic field (choose the closest answer)?

- a) \( 1.9 \times 10^8 \, \text{V/m} \)
- b) \( 1.9 \times 10^8 \, \text{V/m} \)
- c) \( 1.9 \times 10^8 \, \text{V/m} \)
- d) \( 1.9 \times 10^8 \, \text{V/m} \)
- e) \( 1.9 \times 10^8 \, \text{V/m} \)

\[ U_E = \frac{1}{2} \varepsilon_0 E^2 \]

\[ a_B = \frac{B^2}{2 \mu_0} \]

\[ \frac{1}{2} \varepsilon_0 E^2 = \frac{B^2}{2 \mu_0} \]

\[ E^2 = \frac{B^2}{\mu_0 \varepsilon_0} \]

\[ E = \frac{B}{\mu_0 \varepsilon_0} \]