Name_Professor S.K. Sinha_

$\mu = 4.\pi.10^{-7} = 1.26.10^{-6}$ N/A2

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question

Situation 31.1

An 18 mH solenoid inductor is wound on a form 0.80 m in length and 0.10 m in diameter. A coil is tightly wound around the solenoid at its center. The coil resistance is 5.0 ohms. The mutual inductance of the coil and solenoid is 60 μH. At a given instant, the current in the solenoid is 300 mA, and is decreasing at the rate of 2.5 A/s.

1) In Situation 31.1, at the given instant, the magnetic energy of the solenoid, in μJ, is closest to

A) 500 B) 800 C) 600 D) 400 E) 700

$\frac{1}{2}LI^2 = \frac{1}{2}18\times10^{-3}\cdot(.3)^2 = 8.1\times10^{-4} = 810\ \mu J$

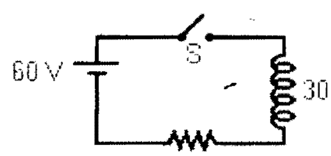
2) In Situation 31.1, at the given instant, the induced current in the coil is closest to

A) 40 μA B) 25 μA C) 30 μA D) 35 μA E) 45 μA

$\mathcal{E}_c = M\frac{dI_1}{dt} = 60\times10^{-6}\cdot2.5$

$I = \frac{\mathcal{E}_c}{R} = \frac{60\times10^{-6}\cdot2.5}{5} = 30\times10^{-6}$ Amps

Figure 31.1



An R-L circuit has a 60 V battery, a 30 H inductor, a 12 ohm resistor, and a switch S, in series, as shown. Initially, the switch is open, and there is no magnetic flux in the inductor. At time t= 0 s, the switch is closed.

3) In Figure 31.1, when the resistor voltage is equal to the inductor voltage, the current in the circuit is closest to

A) 2.5 A B) 1.5 A C) 1.0 A D) 2.0 A E) 3.0 A

$V_R = I(t)R$

$V_L = I'(t)L$

$\mathcal{E} - \mathcal{E}e^{-R/L\,t} = \mathcal{E}e^{-R/L\,t}$

$\frac{1}{2} = e^{-R/L\,t}$

$\ln 2 = R/L\,t$

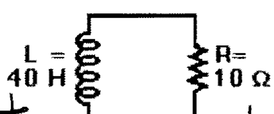
$I(t) = I(\infty) - (I(\infty) - I(0))e^{-R/L\,t}$

$= \frac{\mathcal{E}}{R} - \frac{\mathcal{E}}{R}e^{-R/L\,t}$

$t = \frac{L}{R}\ln 2 = 1.73$ sec

$\Rightarrow I(t) \approx 2.5$

Figure 31.2



An R-L circuit is shown, with a 10 ohm resistor and an ideal 40 H inductor, that has zero resistance. At time t= 0 s, there is a 12A current in the circuit.

4) In Figure 31.2, when the current is decreasing at the rate of 2.0 A/s, the time t is closest to

A) 2.8 s B) 1.2 s C) 2.4 s D) 1.6 s E) 2.0 s

$I(t) = I_0e^{-R/L\,t}$

$I'(t) = -\frac{R}{L}I_0e^{-R/L\,t} = -2.0$

$e^{-R/L\,t} = \frac{2L}{RI_0} \Rightarrow \frac{R}{L}t = \ln\left(\frac{RI_0}{2L}\right)$

$t = \frac{L}{R}\ln\left(\frac{RI_0}{2L}\right) = 1.62$