PS#9 ≡ KEY ≡

Welcome to the homework page test1. If this isn't you then please go back to the homework login page.

You may log out and return later if you wish without losing any saved data. You will have **TEN** attempts for each assigned problem. Every unsuccessful attempt will lower that part of the problem's value by 5%.

For example, if you get it right on the first try, then you will receive 100% for that problem. If you are twice incorrect and submit the correct on the third try, then you will receive a 90% for that part of the problem. You will not recieve any points for that part of the problem after 10 attempts.

You do not have to answer all the problems during a single session or in any particular order. To answer a problem simply type the numerical value in the box provided, check the box to the right of the part(s) you want to answer, and then click the submit button. You can freely log in and out of the homework page without losing any submitted information so feel free to take breaks if necessary.

LET'S BEGIN!

Problem #1

$$L = \frac{\mu_0 N^2 A}{l_0} = \frac{(4\pi \times 10^{-7})(552)^2(\frac{\pi}{4}(.072)^2)}{0.33} = 0.0047$$

A wire is layed on a cylinder of length ℓ = 33.0cm of diameter d = 7.20cm. The wire is wound evenly over the full length of the cylinder, making an ideal solenoid of 552 turns of wire. (a) What is the inductance of the solenoid? (b) If the current in this solenoid increases at a rate of 4.10A/s, the what is the self-inductance emf in the solenoid?

$$V = L\frac{dI}{dt}$$

(a) 4.7 mH ☑ Answer part (a)

(b) 19.4 mV ☑ Answer part (b)

$V = (0.0047)(4.10)$

$V = 0.0194$

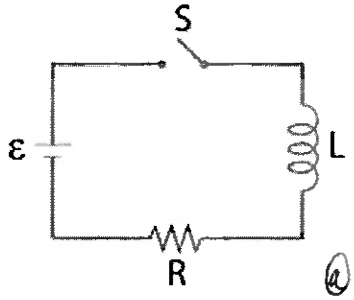
Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

Problem #2



a) $t_{IND} \equiv L/R = \frac{7 \times 10^{-3}}{4} = 1.75 \times 10^{-3}$ s

b) $I = \frac{\varepsilon}{R}\left(1 - e^{-tR/L}\right)$

$= \frac{10}{4}\left(1 - e^{-0.23/1.75}\right)$

@ $t = .23$ms $\rightarrow I = 0.308$ Amps

In the circuit shown above, let ε = 10.0V, L = 7.00mH, and R = 4.00Ω. (a) What is the inductive time constant of the circuit? (b) What is the current in the circuit 230μs after the switch is closed? (c) What is the value of the final steady-state current? (d) After what time interval does the current reach 75% of its maximum value?

c) $t \to \infty$

$I = \varepsilon/R = \frac{10}{4} = 2.5$ Amps

D) $\cancel{\frac{10}{4}} 0.75 = \cancel{\frac{10}{4}}\left(1 - e^{-t/1.75\text{ms}}\right)$

$e^{-t/1.75\text{ms}} = 0.25$

$t = -1.75 \ln(0.25) = 2.43$ ms

(a) 1.75 ms ☑ Answer part (a)

(b) 0.308 A ☑ Answer part (b)

(c) 2.5 A ☑ Answer part (c)

(d) 2.43 ms ☑ Answer part (d)

Submit

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

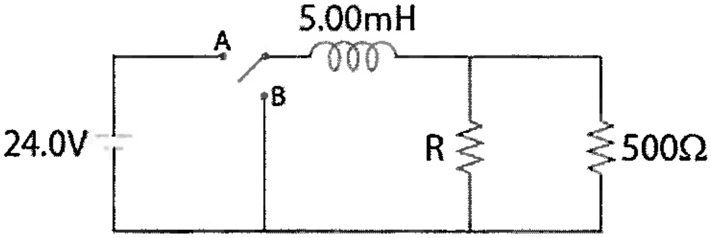
There have been no attempts to answer part (d)

Problem #3

a) $t = \frac{L}{R_T}$ $R_T = \frac{1}{\frac{1}{R} + \frac{1}{500}}$

$22\times10^{-6} = \frac{5\times10^{-3}}{R_T} \Rightarrow R_T = 227$ AND SOLVING

FOR R : $\frac{1}{R} = \frac{1}{227} - \frac{1}{500} \Rightarrow \boxed{R = 416\ \Omega}$



(a) When the switch is in position A, what value of the resistance R will the circuit have a time constant of 22.0μs? (b) After the current has reached a steady state in position A, it is then thrown to position B. What is the current in the inductor at the instant the switch is thrown to position B?

CAN'T CHANGE INSTANTANEOUSLY B/C $V = L\, dI/dt$ SO

INITIALLY (AT LONG TIMES) $I = V/R = \frac{24}{227} = 0.106$ AMPS

(a) 416 Ω ☑ Answer part (a)

(b) 0.106 A ☑ Answer part (b)

Submit

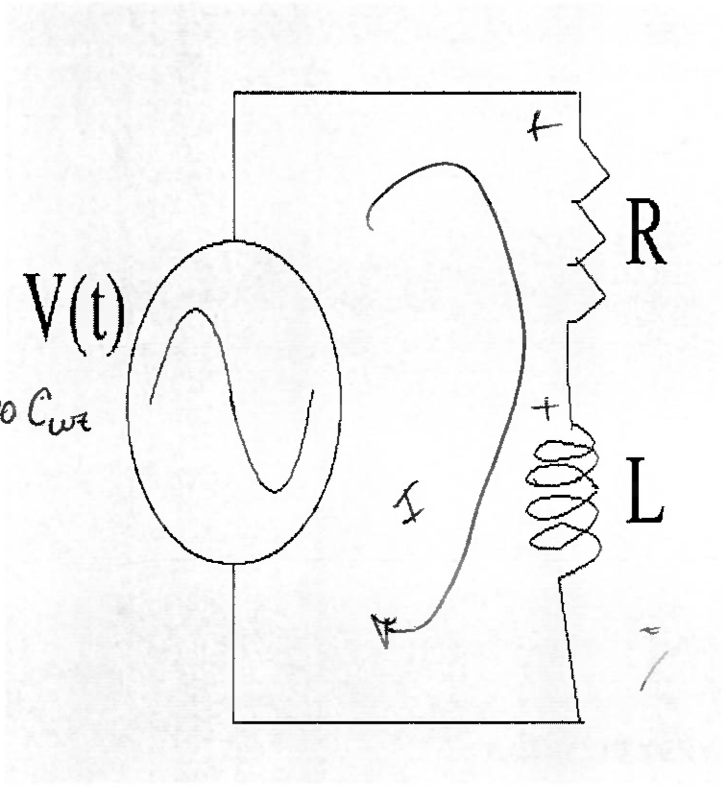
Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

Problem #4

$\omega = 2\pi f = 2\pi\,(2.7\times10^{3}) = 1.7\times10^{4}\ \frac{1}{s}$



$= 470\, C_{\omega t}$

$I = A C_{\omega t} + B S_{\omega t}$

$V_R = A R C_{\omega t} + B R S_{\omega t}$

$V_L = -A L\omega S_{\omega t} + B L \omega C_{\omega t}$

$V_{TOT} = V_R + V_L$

$470\, C_{\omega t} + 0\, S_{\omega t} = \underbrace{(AR + BL\omega)}_{=470} C_{\omega t} + \underbrace{(BR - AL\omega)}_{=0} S_{\omega t}$

$\Rightarrow \quad B = \frac{AL\omega}{R}$

$\therefore$ So $470 = A\left(R + \frac{L^2\omega^2}{R}\right)$

$\Rightarrow A = 0.17 \qquad B = 0.0856$

$I = \sqrt{A^2+B^2}\, C_{\omega t - \phi}$

This R-L circuit is subject to a 2.7 kHz cosine wave with maximum voltage of 470 volts. The inductance is 65 mH and let the resistance be 2.2 kOhms. Compute (a) the RMS current flowing through the circuit and (b) the RMS voltage across the inductor.

So a) $\text{RMS}_I = \sqrt{A^2+B^2}/\sqrt{2} = 0.135$ Amps

(a) 0.135 A ☑ Answer part (a)

$V_L = \sqrt{(AL\omega)^2 + (BL\omega)^2}\, C_{\omega t - \phi'}$

(b) 148.7 V ☑ Answer part (b)

$\text{RMS}_{V_L} = \frac{\sqrt{A^2+B^2}\, L\omega}{\sqrt{2}} = 0.135 L\omega$

$\text{RMS}_{V_L} = 148.7\ V$

Submit

Attempted part (a) 0 times and part (b) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

Problem #5

Two coils are concentric and intersect each other's magnetic flux. The first coil carries a current given by $I(t) = I_0e^{-bt}\sin(\omega t)$, where $I_0 = 5.20A$, $b = 0.0230s^{-1}$, and $\omega = 12.0rad/s$. At $t = 0.209s$, the emf measured across the second coil is 3.30V. What is the mutual inductance of the coils?

$B \propto I_1$

$$V_2 = M\frac{dI_1}{dt}$$

$$\frac{dI_1}{dt} = I_0e^{-bt}\omega \cos\omega t - I_0be^{-bt}\sin\omega t$$

65.8 mH ☑ Answer the question

Submit

so note @ $t = 0.209s$ $\left.\frac{dI}{dt}\right|_{0.209} = -50.12$ Amp/sec

Attempted the problem 0 times.

There have been no attempts to answer the problem

$$\Rightarrow M = \frac{V_2}{dI_1/dt} = \frac{3.3}{(50.12)} = \boxed{0.0658\ H}$$

Problem #6

Consider a series combination of a 11.0V battery, a 5.20Ω resistor, and a 9.80H inductor. After the current in the circuit has reached its maximum value, calculate (a) the power being supplied by the battery, (b) the power being delivered to the resistor, (c) the power being delivered to the inductor, and (d) the energy stored in the magnetic field of the inductor.

$\rightarrow I_{MAX} = \frac{V}{R} = \frac{11}{5.2} = 2.115$ Amps

(a) 23.27 W ☑ Answer part (a)

a) $P = IV = 11(2.115) = \boxed{23.27 \text{ WATTS}}$

(b) 23.27 W ☑ Answer part (b)

b) SAME: INDUCTOR HAS ENERGY IN FIELD BUT THAT IS NOT CHANGING SO NOT ABSORBING ANY POWER ⇒ ALL DISSIPATED BY RESISTOR

(c) 0 W ☑ Answer part (c)

c) SEE ABOVE

(d) 21.91 J ☑ Answer part (d)

d) $U = \frac{1}{2}LI^2 = \frac{1}{2}(9.8)(2.115)^2$

$U = 21.91$ Joules

Submit

Attempted part (a) 0 times, part (b) 0 times, part (c) 0 times, and part (d) 0 times.

There have been no attempts to answer part (a)

There have been no attempts to answer part (b)

There have been no attempts to answer part (c)

There have been no attempts to answer part (d)

Problem #7

CIRCUIT IS LC

IDEA HERE IS TO USE ENERGY CONSERVATION $U=\frac{1}{2}LI^2+\frac{1}{2}CV^2$

An LC circuit consists of a 19.0mH inductor and a 0.450μF capacitor. If the maximum instantaneous current is 0.110A, what is the greatest potential difference across the capacitor?

THIS HAPPENS WHEN V=0

$U=\frac{1}{2}LI^2+\frac{1}{2}C(0)^2$

$=\frac{1}{2}(19\times10^{-3})(0.11)^2$

$U=1.15\times10^{-4}$ J

HAPPENS WHEN $I=0$

$U=\frac{1}{2}CV^2$

SO $1.15\times10^{-4}=\frac{1}{2}(0.45\times10^{-6})V^2$

$\Rightarrow \boxed{V=22.6\text{V}}$

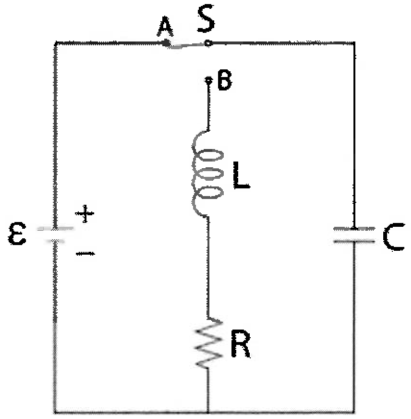
22.6 V ☑ Answer the question

Submit

Attempted the problem 0 times.

There have been no attempts to answer the problem

Problem #8



a) $f_{DAMPED}=\sqrt{\omega_0^2-\gamma^2}$

$=\sqrt{(3650)^2-(390)^2}$

$f_{DAMPED}=3630$ 1/s

$\gamma=R/2L$

$\gamma=\frac{3.9}{2(5\times10^{-3})}$

$\gamma=390$

$\omega_0=\frac{1}{\sqrt{LC}}$

$\omega_0=\frac{1}{\sqrt{(5\times10^{-3})(15\times10^{-6})}}$

$\omega_0=3650$ 1/s

b) CRITICAL DAMPING: WHEN $\gamma=\omega_0$

$R^*/2L=\frac{1}{\sqrt{LC}}$

$R^*=2\sqrt{L/C}$

$=2\sqrt{\frac{5\times10^{-3}}{15\times10^{-6}}}$

$\boxed{R^*=36.5\Omega}$

In the above diagram, let R = 3.90Ω, L = 5.00mH, and C = 15.0μF. (a) Calculate the frequency of the damped oscillation of the circuit when the switch is thrown to position B. (b) What is the critical resistance for damped oscillations?

(a) 3.630 kHz ☑ Answer part (a)

(b) 36.5 Ω ☑ Answer part (b)

Submit