PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2016

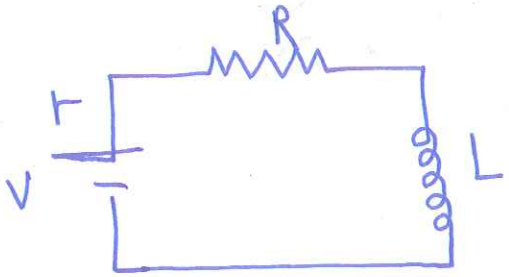
College of Sciences

Section 1 Quiz 10 05 May 2016

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A battery V with an internal resistance r, a resistor R, and an inductor L with negligible resistance are all connected in series with an open switch. The switch is suddenly closed. How long after closing the switch will the current through the inductor reach one-half of its maximum value?



The total resistance in the circuit $R_T = R + r$

in R-L circuit

$$i = I_0 e^{-\left(\frac{R_T}{L}\right)t}$$

we want $I_0\left(1 - e^{-\left(\frac{R_T}{L}\right)t}\right) = \frac{I_0}{2}$

$$\Rightarrow \left(1 - e^{-\left(\frac{R_T}{L}\right)t}\right) = \frac{1}{2} \Rightarrow \boxed{e^{-\left(\frac{R_T}{L}\right)t} = \frac{1}{2}} \quad (*)$$

by taking the Logarithm of (*) we find

$$-\left(\frac{R+r}{L}\right)t = \ln\left(\frac{1}{2}\right) \Rightarrow \left(\frac{R+r}{L}\right)t = \ln(2)$$

$$\boxed{t = \frac{L\ln(2)}{R+r}}$$

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Section 3 Quiz 10 05 May 2016

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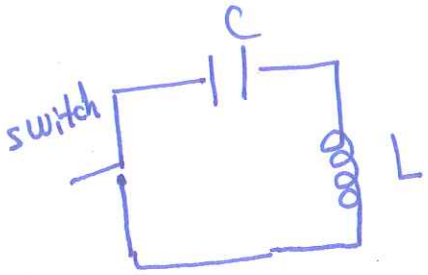
Name: **Student ID:** **Signature:**

A capacitor C and an inductor L with negligible resistance are connected in series with an open switch. The capacitor is initially charged with Q. The switch is suddenly closed. How long after closing the switch will the current through the inductor reach one-half of its maximum value?



in L-C circuit

$q = Q\cos(\omega t + \phi)$, ϕ is some phase

$i = I_0 \sin(\omega t + \phi)$

at $t=0$ $\begin{cases} q = Q \\ i = 0 \end{cases} \Rightarrow q = Q\cos\phi \Rightarrow \phi = 0$

$i = \frac{I_0}{2} \Rightarrow I_0 \sin(\omega t) = \frac{I_0}{2} \Rightarrow \sin\omega t = \frac{1}{2}$

$\Rightarrow \omega t = \frac{\pi}{6}$

$$\boxed{t = \frac{\pi}{6\omega}}$$

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Section 4 Quiz 10 05 May 2016

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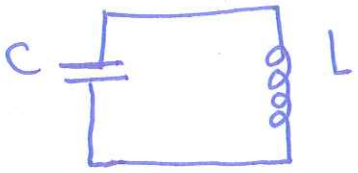
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A capacitance C is initially charged to a total potential of V, and then it is connected in series with an inductor L. What is the total energy stored in this circuit? What is the maximum current in the inductor? What is the charge on the capacitor plates at the instant the current in the inductor is maximal?



$$U = \frac{1}{2}Li^2 + \frac{q^2}{2C} = \frac{q_{max}^2}{2C} = \frac{1}{2}CV_{max}^2$$

$$\boxed{U = \frac{1}{2}CV^2}$$ total energy stored in the circuit

$$U = \frac{1}{2}Li_{max}^2 \Rightarrow i_{max} = \sqrt{\frac{2U}{L}} = \sqrt{\frac{2}{L}\cdot\frac{1}{2}CV^2} = \sqrt{\frac{C}{L}}\,V$$

$$\boxed{i_{max} = \sqrt{\frac{C}{L}}\,V}$$

$q = 0$ when $i = i_{max}$.