Name:	Signature:
Surname:	Student ID Number:

PHYS 102 General Physics II – Final

5 January 2018, Friday 18:15 -19:45

Please read!

- Count to make sure that there are 5 pages in the question booklet
- Check your name and surname on front page, and student ID number on each page, and sign each page.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct!).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are not allowed to use calculators during this exam.
- Only the answers in the boxes will be graded and NO partial credit will be given. No points will be given to unjustified answers. Incomplete calculations will not be graded

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1	2	3	4	TOTAL

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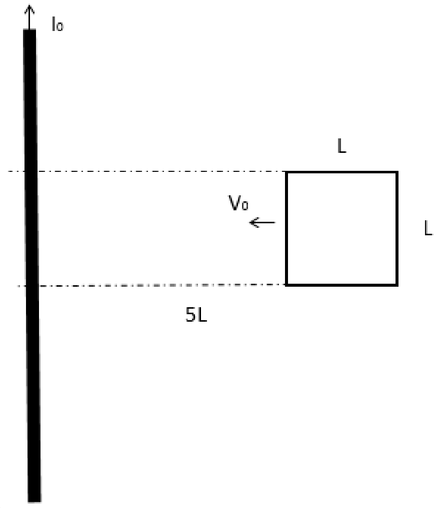
1- (25 pts) A cylindrical and infinitely long cable with a radius $\mathbf{r_0}$ carries a current $\mathbf{I_0}$. The current is uniformly distributed over the cross sectional area and the cable is held in a stationary position. A square wire loop of resistance **R** is projected toward the cable with initial velocity $\mathbf{V_0}$. The total mass of the loop is $\mathbf{m_0}$. Assume that initially the wire is located at the distance **5L** away from the center of the cable.



a) Calculate the total magnetic flux penetrating through the square loop.

$\Phi_B =$

b) Calculate the induced emf $\mathcal{E}$ in the loop.

$\mathcal{E}=$

c) Calculate the induced current I_{ind} in the loop and show the **direction** of the current.

$I_{ind}=$

d) Calculate the total force applied on the loop

F=

e) In order to place **the wire** to the position **L** away from the cable, calculate the initial velocity $\mathbf{V_0}$ of the wire. (Assume that **L** > **r**)

$\mathbf{V_0}=$

Solution continues on the back side of the page **Yes** □ **No** □

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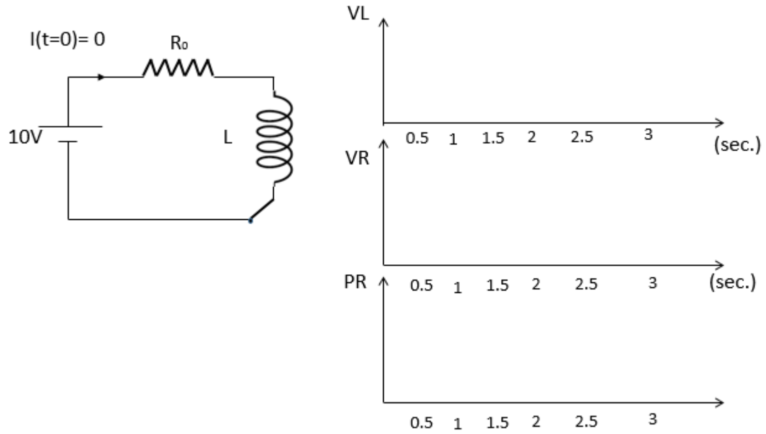
2- (25 pts) As shown in the figure, a simple RL circuit (L = 1H , R =2 ohm) is powered by a **10 V** batterey. The initial current in the circuit is zero. (e^{-1}=0.367, e^{-2}=0.135, e^{-3}=0.049, e^{-4}=0.018, e^{-5}=0.006)



time (sec)	VL (Volt)	VR (Volt)
0		
0.5		
1		
1.5		
2		

a) Calculate the time constant of the RL circuit.

τ=

b) Calculate and plot the VR(t) voltage across the resistor R0, as a function of time

VR(t)=

c) Calculate and plot V_L(t) and voltage across the inductor as a function of time.

V_L(t)=

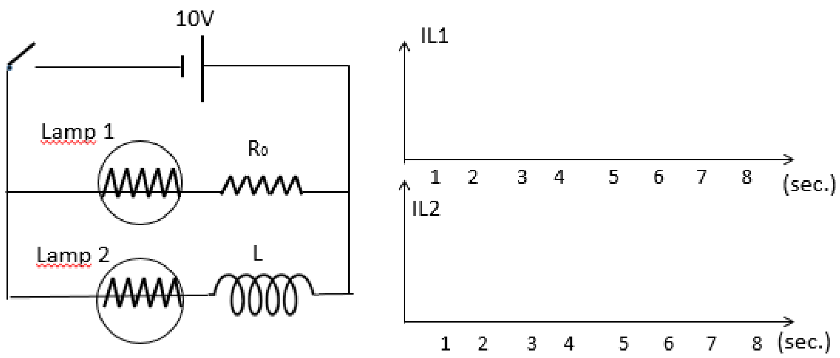
d) Calculate and plot **P(t)** the power disipation on the resistor.

P(t)=

e) Calculate the total energy stored in the inductor when the circuit reachs the saturation.

E=

f) As given in the figure below if we attached lamps with constand internal resistance (Rin=1 Ohm) to the circuit, schematically plot the brightness (IL) of the lamps as a fuction of time after turning the switch on.



Solution continues on the back side of the page **Yes** □ **No** □

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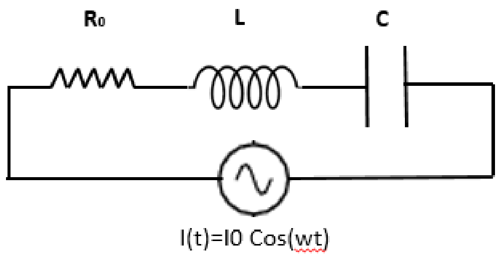
3-(25 pts) As shown in the figure, A simple RLC circuit is driven by a AC current supply. The RMS value of the current source I_{rms} = 1.4 Amp. R_0 = 15 Ω, L=0.5 H, C= 5x10^{-3} F. (Take $\sqrt{2} = 1.4$, π = 3).



a) What is the resonance frequency *f* of the circuit in terms of Hz?

f=

b) When the source operates at ***f***=6.6 Hz, calculate the $V_R(t)$, $V_L(t)$, $V_C(t)$ and $V_T(t)$ total voltage of the circuit.

$V_R(t)$=

$V_L(t)$=

$V_C(t)$=

$V_T(t)$=

c) Calculate the average power P(ave) over a cycle of the circuit.

P(ave)=

 Solution continues on the back side of the page **Yes** □ **No** □

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4 (25 pts) A typical microwave oven is based on a super positon of two forward (E^+) and backward (E^-) propagating electromagnetic waves having a wavelength of 12 cm. Assume that E_0 is the max amplitude of the electric field (speed of light C=3x10^8 m/sec).

a) What is the frequency *f* of the electromagnetic wave.

f=

b) Write the electric field vector (E^+) of sinusoidal electromagnetic wave **freely propagating** in +X but oscillating in Z directions.

E^+ =

c) Write the electric field vector (E^-) of sinusoidal electromagnetic wave **freely propagating** in -X and but oscillating in Z direction.

E^- =

d) Write the electric field vector of a **standing** electromagnetic wave formed by the superposition of ($E^+ + E^-$).

($E^+ + E^-$) =

e) Calculate the first four minimum possible lengths of a microwave oven. (Consider only one dimension X).

L_1 =

L_2 =

L_3 =

L_4 =

Solution continues on the back side of the page **Yes** □ **No** □