Name, Surname:	Signature:
Exam Room:	Student ID Number:

PHYS 102 General Physics II – Final
Fall 2019
3 January, 2020 Friday, 08:30-10:10

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.

Useful Trigonometry Formulas:

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

P102_Index:

1	2	3	4	TOTAL

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1- (25 pts) Consider a square loop of flexible iron wire with initial perimeter (sum of the lengths of the sides of the square) of 26 cm. Its perimeter is decreasing at a constant rate of 2 cm/s. The loop remains in a constant uniform magnetic field of magnitude 1 T, which is oriented perpendicular to the plane of the loop. Assume that you are facing the loop and magnetic field points into the loop.

(i) Find the magnitude of the induced emf in the loop after exactly time 1 s has passed since the perimeter of the loop started to decrease. Express your answer in volts.

(ii) What is the direction of the induced current in the loop? Justify your answer.

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

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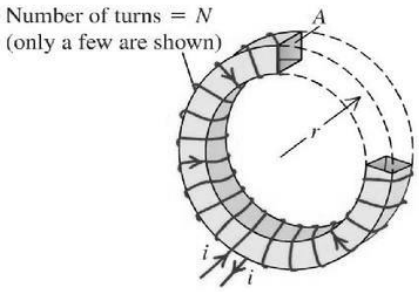
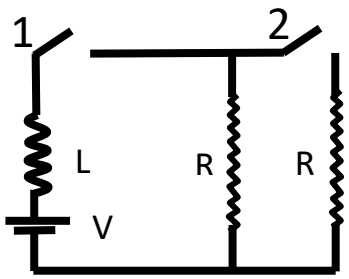
2- (25 pts) a) A *very thin* toroidal solenoid has N windings and radius r. The cross sectional area of the torus is A. What is the self inductance L of this device?



b) Consider the circuit in the figure with two resistors, an inductor and a battery. We close switch 1 while keeping switch 2 open. What are the currents on the inductor right after we close switch 1, and a long time after? Make sure to explain your reasoning.



c) We close switch 2 a very long time after part (b) (switch 1 is kept closed). What is the current on the inductor as a function of time? Define the time switch 2 is closed as $t = 0$.

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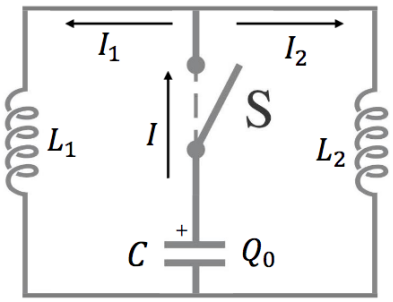
3- (25 pts) Consider the circuit shown in the figure, where the capacitor is initially charged with charge Q_0. After the switch S is closed at time *t = 0*:



a) Find the charge *Q(t)* on the capacitor as a function of time.

b) Find the current $I_1(t)$ as a function of time.

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4- (25 pts) A plane electromagnetic wave has electric field $\vec{E} = \hat{\jmath}E_0 \sin(kx) \sin(\omega t)$.

a) Find the magnetic field $\vec{B}$ of the wave.

b) Find the total energy density u as a function of (x, t).

c) If this wave represents a standing wave between two perfect conducting planes, what are the possible positions of the planes?