Name: _____
Student ID#: _____

EXAM RULES

Please follow all the instructions listed below.

1. Please make sure that you are in the correct exam room, and sitting at the assigned seat.
2. ***Place your student ID card on your desk***, and make it available to the exam proctors at all times during the exam.
3. Exam is **90 minutes** long. There are **6 problems**. Please check the exam booklet when you are told to do so. Make sure that you have all the pages, and they are printed correctly.
4. Make sure that you **write your name and student ID** to the top left corner of every page of the exam.
5. ***SHOW ALL YOUR WORK.*** Write your answers ***neatly*** in the space provided below each problem. Cross out or erase any work that you do not want to be graded.
6. All written responses must be in English.
7. Unless otherwise indicated, the diagrams in this exam are not drawn to scale.
8. ***Calculators, mobile phones and electronic devices are not allowed***.
9. ***Formula sheets, books, dictionaries, written notes, lecture notes, or extra sheets of blank paper are not allowed***.
10. You are allowed to bring in pens, pencils, erasers, and sharpeners.
11. No eating and drinking during the exam.
12. ***You may not leave the exam room during the exam.*** You will be allowed to submit your final work and leave the exam room after the first 30 minutes of the exam. Once you leave the exam room, you will not be allowed to reenter.
13. At the end of the exam, please stop writing and submit your work to the exam proctor(s).

During the exam:

- Do not borrow any stationery, supplies and/or equipment from someone else.
- Do not talk to, communicate with, or do anything to disturb other students.
- Do not read or copy another student's work.
- Do not use your mobile phone or any other electronic device.

IF YOU HAVE ANY QUESTIONS DURING THE EXAM, PLEASE RAISE YOUR HAND, AND ONE OF THE PROCTORS WILL ASSIST YOU.

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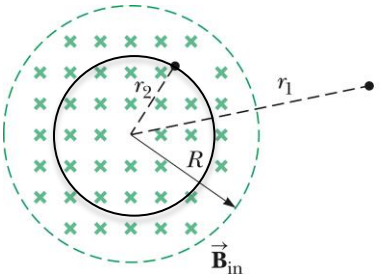
Problem 1. The magnetic field in a solenoid of radius R varies with time as $B=B_o(1-e^{-\alpha t})$ where α is a constant. A circular loop of radius r_2 is located inside the solenoid. a. Determine the induced emf in the circular loop.



b. Determine the direction of the induced current in the loop.

c. Determine the induced electric field at point r_1.

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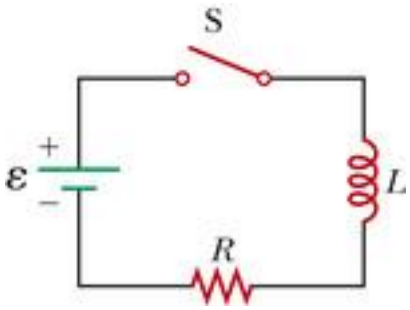
Problem 2. In the circuit shown in the figure, the switch S is closed at t=0.



(a) Find $I(t)$ for $t > 0$. Derive the working equations.
(b) Determine I for t→ ∞.

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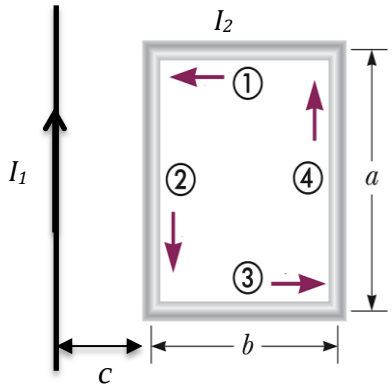
Problem 3. An infinitely long wire carries current I_1. At a distance c from the wire is a rectangular loop of length a and width b, carrying current I_2 as shown in the figure.

a. Determine the magnitude and the direction of the force on each side of the loop.

b. What is the net force on the loop?



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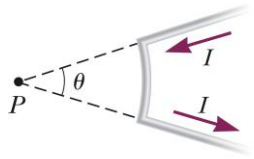
Problem 4. A current (I) shaped as shown in the figure produces a magnetic field at P, the center of the arc. If the arc subtends an angle of θ=30° and the radius of the arc is R, what is the magnitude and the direction of the field produced at P?



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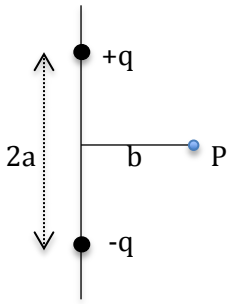
Problem 5. Consider the two charges of *+q* and *–q*, fixed in space and separated by a distance 2a from each other.

a. Determine **the electric field vector** at a distance *b* from the midpoint between these two charges (i.e. on the perpendicular bisector at point P).

b. What is the value of the electric field is b>>a?

c. What is the potential at point P?



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Problem 6. A closed surface with dimensions a, b and c (a box) is located as shown in the figure. The electric field throughout the region is nonuniform and is given by $\boldsymbol{E} = (3 + 2x^2)\hat{\imath}$ N/C where x is in meters.

a. Calculate the net electric flux leaving the closed surface.
b. What net charge is enclosed by the surface?