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

PHYS 102 General Physics II – Midterm 2

20 November, 2019 Wednesday 19:00 -20:40

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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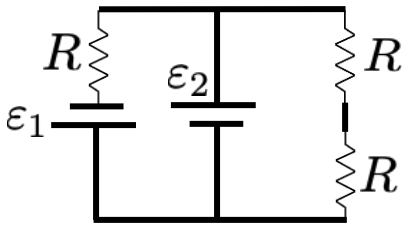
1- (25 pts) Consider the circuit shown in the figure. Assume each resistor has resistance $R = 10\,\Omega$. Batteries have different emfs given by $\varepsilon_1 = 9\,V$ and $\varepsilon_2 = 6\,V$. Find the current in each three branches in the circuit.



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

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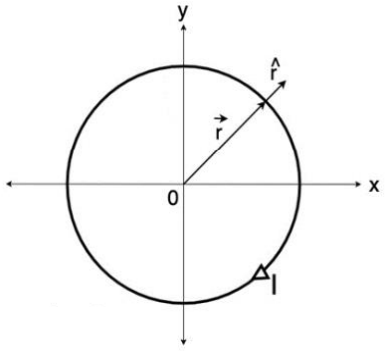
2- (25 pts) A conducting ring of radius R lies in the xy plane with its center at the coordinate origin. The ring carries a clockwise current I. If the external magnetic field in the xy plane is given by $\overrightarrow{B} = a\vec{r} + b\hat{j}$, where $\vec{r} = r\hat{r}$ is the position from the origin, $\hat{j}$ is a unit vector along the $+y$ axis, and a and b are positive constants:



(a-15pts) Calculate the magnitude and direction of the net force on the ring.

(b-10pts) Calculate the magnitude and direction of the net torque on the ring.

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

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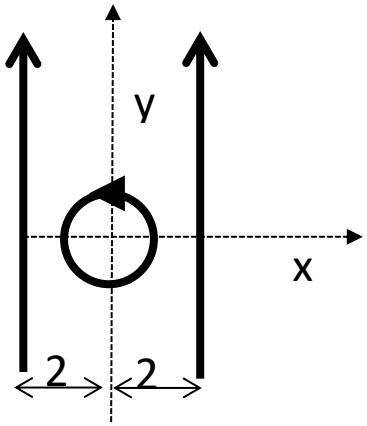
3- (25 pts) Two infinite wires are parallel to the y-axis and they carry currents I as shown with the arrows.



a) Find the magnetic field $\vec{B}$ (all three components) on the x-axis as a function of the coordinate x. Ignore the circular current loop in the figure in this part.

b) We put a circular current loop of radius a centered at the origin on the $x-y$ plane also carrying a current I, as shown in the figure. What is the magnetic field $\vec{B}$ (all three components) at the point $(x, y, z) = (0, 0, 2a)$?

c) What is the magnetic dipole moment **vector** $\vec{\mu}$ of the current loop in part (b)?

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

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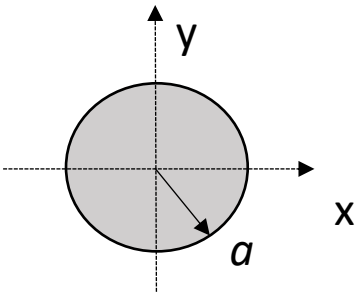
4- (25 pts) An infinitely long insulating cylinder of radius a lies along the z-axis (the cross section is in the figure). The cylinder has uniform volume charge density ρ, and is moving in the $+z$ direction with speed v as a whole. This system is equivalent to a wire of the same cylindrical shape, carrying an electric current I.



(a) Calculate the magnetic field $\vec{B}$ (all three components) at the point $(x, y, z) = (2a, 0, 0)$ in terms of I, a and the fundamental physical constants.

(b) Calculate the magnetic field $\vec{B}$ (all three components) at the point $(x, y, z) = (\frac{a}{2}, \frac{a}{2}, 0)$ in terms of I, a and the fundamental physical constants.

(c) Express I in terms of ρ, v and a.

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