Name:	Signature:
Surname:	Number:

KOÇ UNIVERSITY

College of Sciences
PHYS 102 General Physics 2
Spring Semester 2017
Midterm Exam 2
April 22, 2017 Saturday, 16:15-17:55

Please read.

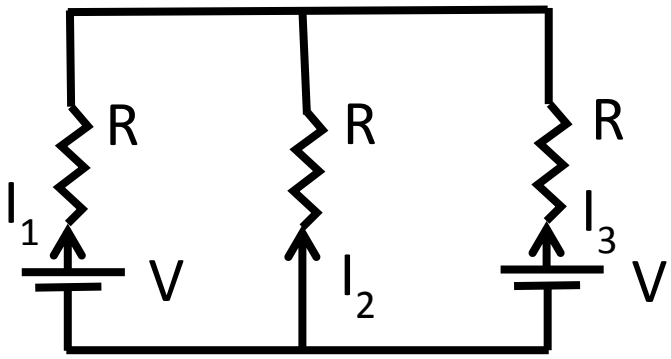
- Count to make sure that there are 5 pages in this question booklet
- Check your **name, number, on front page, and student ID on each page.**.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks 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.
- Turn off your mobile phones, and put away.
- You are not allowed to leave the class during the first 15 minutes, and last 15 minutes.
- Answer the following questions. Show your calculations. Unjustified answers will not be given any score. Write your answers in the boxes; answers outside the boxes will not be given any score.

P102_Index:

1	2	3	4	Total

ExamRoom:	P101_Index:
Student ID Number:	Signature:

1- (25 Points) Consider the circuit in the figure with two identical e.m.f. sources V and resistances R in the right and left arms. Another resistance of the same value R is in the middle arm. Current on each arm is defined in the directions shown by the arrows in the figure.



a) Express I_2 in terms of the other currents.

b) Find a relationship between I_1 and I_3 using the symmetry of the circuit.

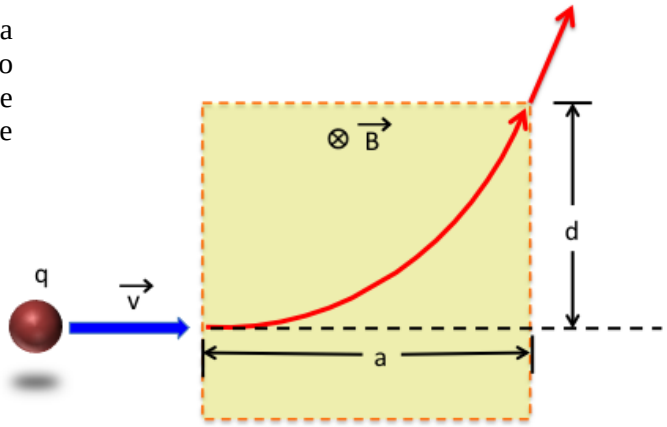
c) Calculate I_1, I_2, I_3 in terms of V and R.

d) Consider the circuit where the resistor in the middle arm is removed and a capacitor of capacitance C is connected at its place, without changing the rest of the circuit. If the capacitor has no charge at t=0, calculate its charge as a function of time.
Hint: Note that the circuit is still symmetric.

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

ExamRoom:	P101_Index:
Student ID Number:	Signature:

2-(25 Points) A particle of charge q enters a region of uniform magnetic field **B** (pointing into the page). The field deflects the particle a distance d above the original line of flight, as shown in the figure.



i) Is the charge positive or negative?

ii) The particle would undergo a uniform circular motion in the field region. Why?

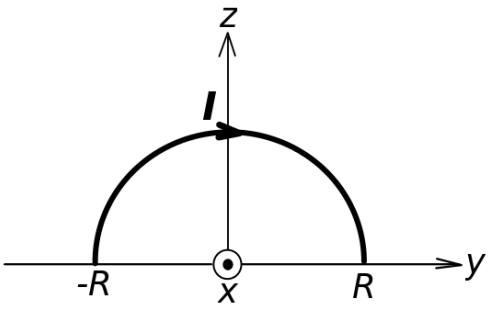
iii) Find the radius of the circular motion in terms of a and d using the Pythagorean theorem.

iv) Find the magnitude of the momentum of the particle, in terms of a, d, B, and q, when it exits the field region.

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

ExamRoom:	P101_Index:
Student ID Number:	Signature:

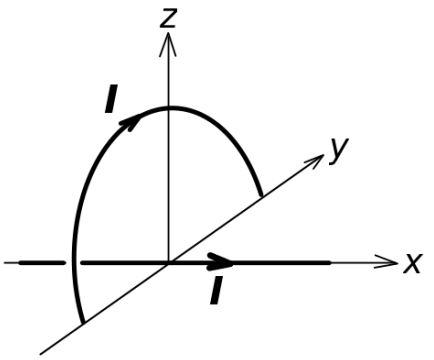
3-(25 Points) A semicircular wire with radius *R* and carrying a current *I* is located on the yz-plane as shown in the upper figure.



a) Using the Biot-Savart Law, write down an integral expression for the magnetic field vector <u>at the origin</u> due to the current on the wire.

b) Evaluate the integral in part (a) to calculate the resulting magnetic field vector at the origin. (No credit for the correct answer if you do not show your work.)

c) A second wire carrying a current *I* in the +x direction is placed on the x-axis symmetrically with respect to the origin (lower figure). Indicate which Cartesian component(s) of the following vectors are <u>nonzero</u>:



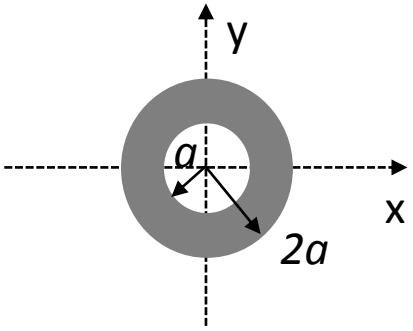
$\vec{B}$ = the magnetic field at a point (other than the origin) on the second wire,
$\vec{F}$ = magnetic force at a point (other than the origin) on the second wire,
$\vec{\tau}$ = net torque on the second wire.

In part (c), stating your reasoning without explicit calculations is sufficient.

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

ExamRoom:	P101_Index:
Student ID Number:	Signature:

4- (25 Points) 4) An infinitely long, partially hollow, insulating cylinder of inner radius *a* and outer radius *2a* lies along the *z*-axis (cross section 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 hollow cylindrical shape, carrying an electric current *I*.



a) Calculate the magnetic field vector $\vec{B}$ (all three components) on the *y*-axis for *y>2a* in terms of *I*, *a* and fundamental physical constants.

b) Calculate the magnetic field vector $\vec{B}$ (all three components) on the *y*-axis for *2a>y>a* in terms of *I*, *a* and fundamental physical constants.

c) Calculate the magnetic field vector $\vec{B}$ (all three components) on the *y*-axis for *a>y>0* in terms of *I*, *a* and fundamental physical constants.

d) Express *I* in terms of ρ, *a* and *v*.

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