University of Toronto
Faculty of Applied Science and Engineering
Department of Electrical and Computer Engineering

ECE110S – Electrical Fundamentals
Term Test 2 – March 20, 2014, 6:30 – 8:00 p.m.

($e = 1.6 \times 10^{-19}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, $\mu_0 = 4\pi \times 10^{-7}$ H/m, g = 9.81 N/kg)

ANSWER ALL QUESTIONS ON THESE SHEETS, USING THE BACK SIDE IF NECESSARY.

1. Non-programmable calculators (Casio FX-991MS & Sharp EL-520X) are allowed.
2. For full marks, you must show methods, state UNITS and compute numerical answers when requested.
3. Write in PEN. Otherwise, no remarking request will be accepted.
4. There is one extra blank page at the end for rough work.

Last Name: Answer Key

First Name: _____

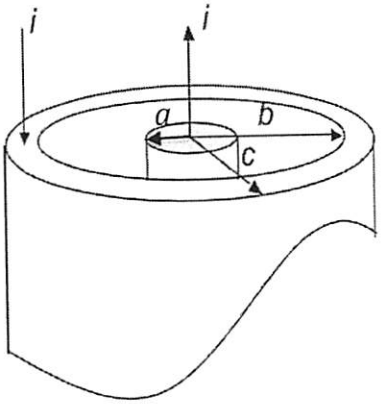
Student Number: _____

Tutorial Section:
(YOU LOSE ONE MARK FOR NOT MARKING YOUR TUTORIAL SECTION CORRECTLY)

- ☐ 01 WB342 Mon. 3-5 p.m.
- ☐ 02 GB304 Mon. 3-5 p.m.
- ☐ 03 SF3201 Tue. 4-6 p.m.
- ☐ 04 GB304 Tue. 4-6 p.m.
- ☐ 05 GB404 Wed. 4-6 p.m.
- ☐ 06 SF2202 Wed. 4-6 p.m.
- ☐ 07 SF2202 Wed. 2-4 p.m.
- ☐ 08 GB304 Wed. 2-4 p.m.
- ☐ 09 GB120 Fri. 4-6 p.m.
- ☐ 10 WB130 Fri. 4-6 p.m.
- ☐ 11 SF2202 Fri. 2-4 p.m.
- ☐ 12 WB130 Fri. 2-4 p.m.

Question	Mark
1	
2	
3	
TOTAL	

Q1 [10 marks] Consider the co-axial cable shown in the figure below. The currents in the central region and the outer shell are equal in magnitude and flowing in opposite directions. Assume that the current is *uniformly* distributed across each region.



$a = 1\ cm$
$b = 3\ cm$
$c = 4\ cm$
$i = 200\ mA$

(a) Calculate the magnitude of the magnetic field at the surface of the inner conductor. (2 marks)

$4 \times 10^{-6}\ T$

(b) Calculate the magnetic field in the region where **r > c**. (2 marks)

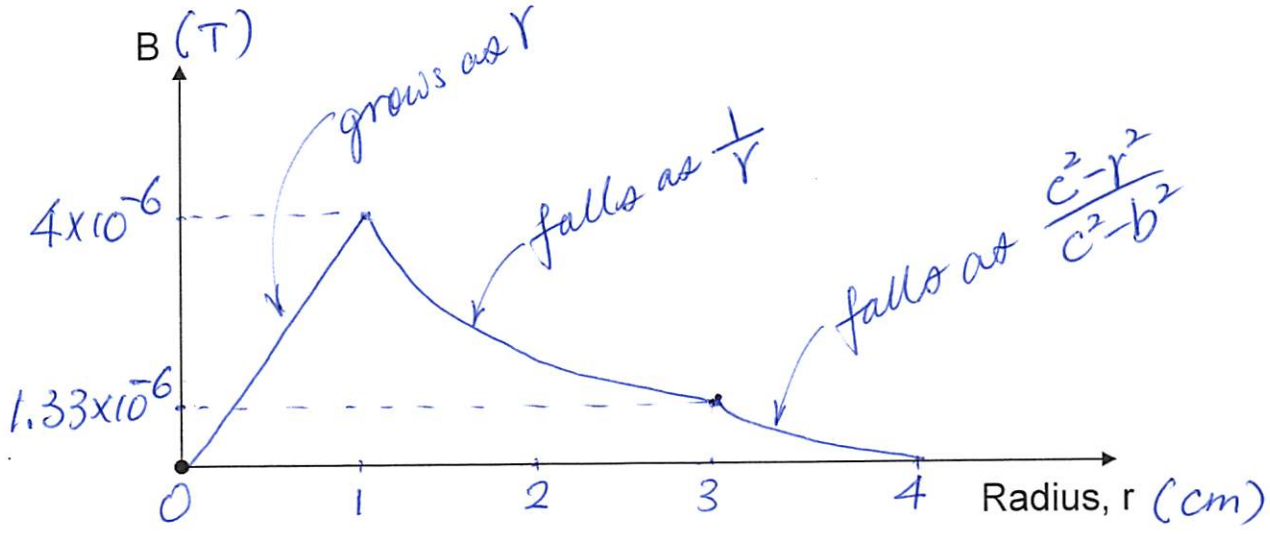
$\vec{B} = 0$

(c) Use Ampere's law to calculate the magnitude of B-field at a distance of **3.5 cm** from the center of the cable. (4 marks)

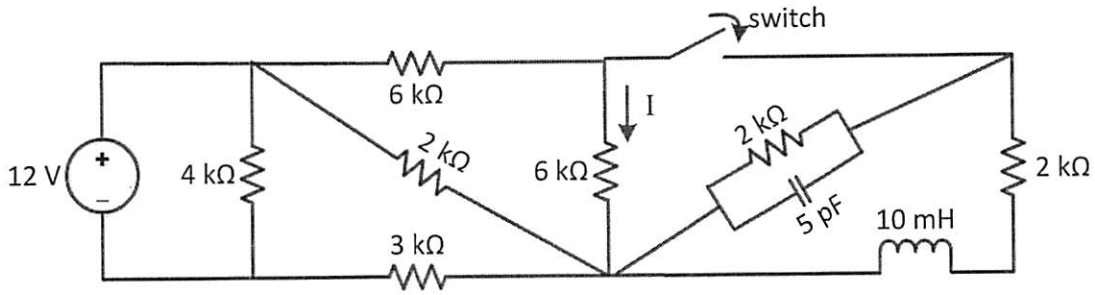
$6.11 \times 10^{-7}\ T$

(c) cond.

(d) Graph the variation of the magnetic field as a function of the radius of the cable, from $r = 0$ to $r > c$. Clearly indicate the key points on the graph. (2 marks)



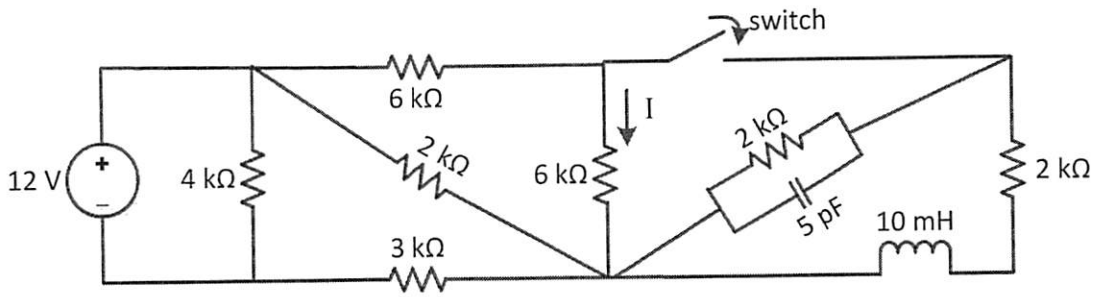
Q2 [10 marks] For the circuit diagram given below, assume ideal circuit elements.



(a) How would a capacitor and an inductor behave under DC conditions? (2 marks)

Capacitor: open circuit Inductor: short circuit

(b) Calculate the current (I), before the switch is closed. (4 marks) 0.4 mA



(c) Calculate the current (I), after the switch has been closed for a long time. (4 marks) 0.09 mA

Q3 [10 marks] For the circuit shown in the figure below, find the value of the dc voltage source ($\mathbf{V_x}$) such that the current in the 20 Ω resistor ($\mathbf{I_o}$) is zero.

-45 V