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

ECE110S – Electrical Fundamentals
Term Test 2 – March 17, 2016, 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: _____

First Name: _____

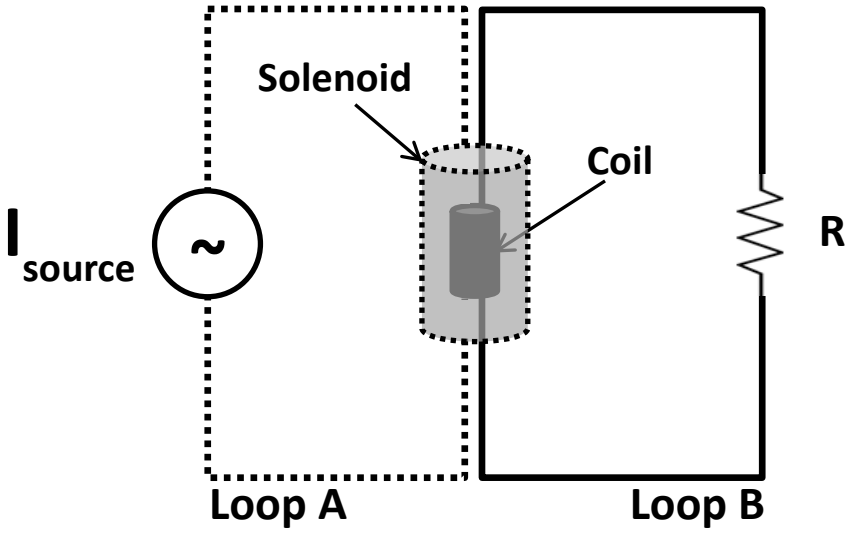
Student Number: _____

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

- ☐ 01 SF2202 Fri. 4-6 p.m.
- ☐ 02 HA403 Fri. 4-6 p.m.
- ☐ 03 SF2202 Tue. 4-6 p.m.
- ☐ 04 SF2202 Wed. 3-5 p.m.
- ☐ 05 SF2202 Mon. 1-3 p.m.
- ☐ 06 GB404 Wed. 12-2 p.m.
- ☐ 07 RS310 Fri. 4-6 p.m.
- ☐ 08 SF2202 Wed. 9-11 a.m.
- ☐ 09 GB304 Tue. 10-12 p.m.
- ☐ 10 GB248 Fri. 3-5 p.m.
- ☐ 11 GB303 Tue. 3-5 p.m.
- ☐ 12 RS310 Tue. 3-5 p.m.

Question	Mark
1	
2	
3	
TOTAL	

Q1 [10 marks] The following circuit consists of two loops that are coupled magnetically by a coil placed within a solenoid. The solenoid (10,000 turns, radius of 4.5 cm, and length of 20 cm) in Loop A is connected in series with a time-varying current source ($\mathbf{I_{source}}$ = 10 sin(t) A). Loop B consists of a coil (40 turns, cross sectional area of 2 cm^2) placed within the center of the solenoid, and connected in series to a resistor (R = 100 Ω). Assume all circuit elements are ideal.



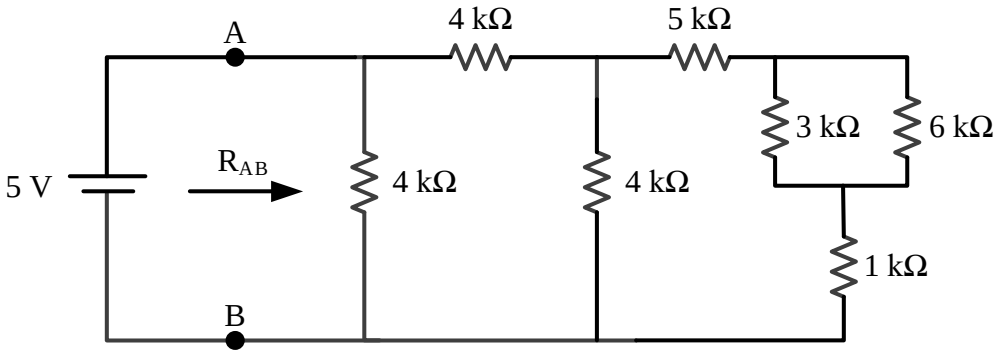
a) Use Ampere's law to derive the relationship between the magnetic field (B) induced within a solenoid and the electrical current provided by the current source ($\mathbf{I_{source}}$). (3 marks)

Q1 continue

b) For the given sinusoidal current waveform, $\mathbf{I_{source}}$ = 10 sin(t) A, calculate the power consumed by the resistor in **Loop B** at t = (π/4) radians. (4 marks)

c) Let us suppose that a second set of solenoid (10,000 turns, radius of 4.5 cm, and length of 20 cm) & coil (cross sectional area of 2 cm^2) has been connected in series to the existing set. If the power consumption by the resistor in **Loop B** is measured to be half of the value obtained in part **b)**, how many turns should the coil have? (3 marks)

Q2 [10 marks] Consider the following resistive circuit and do the required computations in fractional rather than decimal form



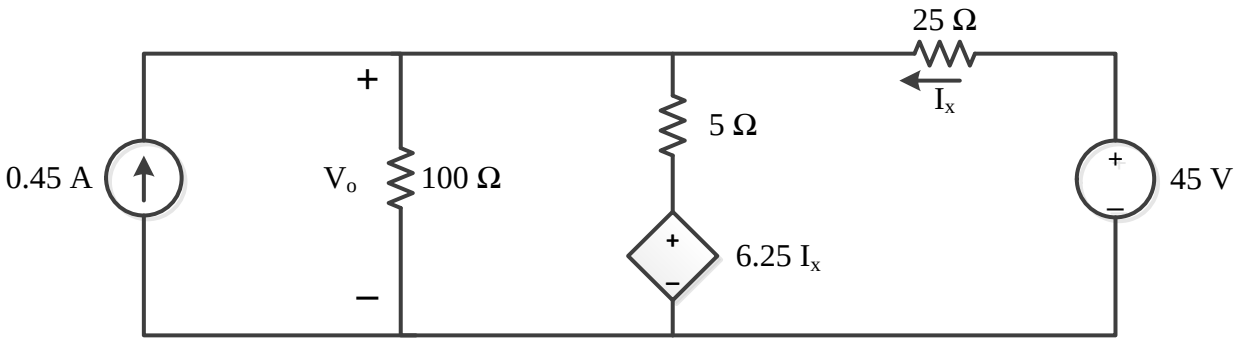
a) Find the equivalent resistance R_{AB} as seen by the 5V battery. (4 marks)

b) Compute the total power dissipated in the resistive network. (2 marks)

Q2 continue

c) What is the current in the 6 kΩ resistor? (4 marks)

Q3 [10 marks]



a) Use either nodal or mesh method to find V_o and I_x in the circuit. (5 marks)

Q3 continue

b) Find the power absorbed by the dependent source. (2 marks)

c) Find the total power supplied by the independent sources. (3 marks)