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

ECE110S – Electrical Fundamentals
Term Test 1 – February 11, 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: _____

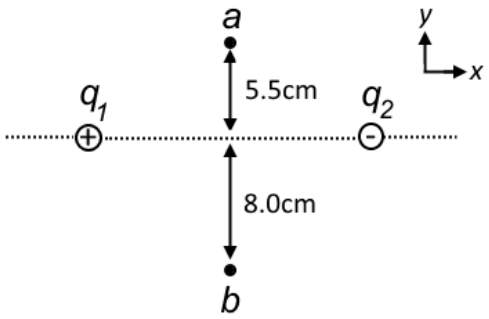
Student Number: _____

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 charges, $q_1 = +11\ nC$ and $q_2 = -11\ nC$, shown in the diagram below are separated by a distance of 11.0 cm.



i) Determine the electric field at location '*a*'. (4 marks)

ii) Find the electric potential at location '*a*'. (3 mark)

iii) How much external work is required to move a charge, $q = \frac{5}{11}\ nC$, from location '*a*' to location '*b*'? (3 marks)

Q2 [10 marks] A parallel plate capacitor is formed by two identical metal plates, each with an area $A = 12\ cm^2$. The plates are separated by a distance $d = 3.25\ mm$. The top plate has a charge of $q = 4.3 \times 10^{-8}\ C$ while the bottom plate has a charge of $q = -4.3 \times 10^{-8}\ C$.

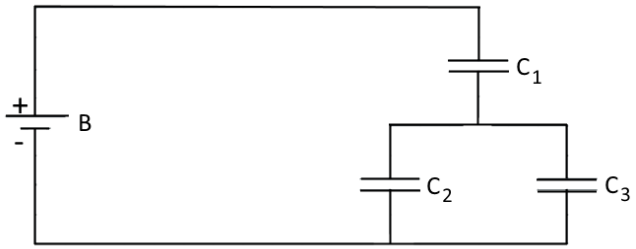
i) What is the capacitance of the capacitor? (1 mark)

ii) What is the voltage across the capacitor? (1 mark)

iii) What is the electric field strength between the plates of the capacitor? (1 mark)

Q2 continued

iv) The parallel plate capacitor above (labeled as C_1) is then fully discharged so that $q = 0$, and placed in the following circuit.



The circuit is then connected to the battery *B*, which has a voltage of *6 V*. If $C_2 = 10\ pF$ and $C_3 = 15\ pF$, calculate the new charge on C_1. (4 marks)

v) Calculate the energy stored in C_2. (3 marks)

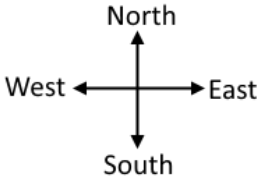
Q3 [10 marks]

i) Circle the correct statement(s) below: (1 mark)

A magnetic field obeys the principle of superposition.
B magnetic field lines of a moving charge form closed loops.
C magnetic flux through a closed surface is proportional to the total number of magnetic poles enclosed in the surface.

ii) A long straight copper wire lies in the north-south direction and carries a current pointing to north. The wire is immersed in a uniform magnetic field pointing out of the page. Circle the correct direction of the force exerted on the wire. (1 mark)

North East South West into the page out of the page



iii) Two long insulated wires are located along the positive x and y axes, each carrying a 10 A current, as shown below. Determine the magnetic field (strength and direction) at location (1 cm, 1 cm, 1 cm). (8 marks)