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

ECE110S – Electrical Fundamentals
Term Test 1 – February 13, 2013, 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 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: _____

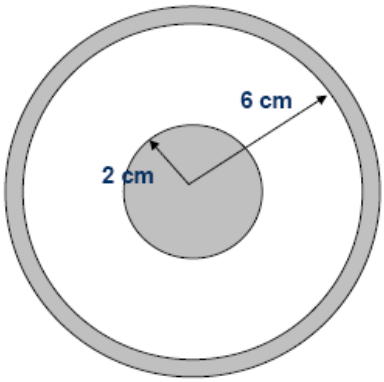
Student Number: _____

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

- ☐ 01 WB342 Mon. 3-5 p.m.
- ☐ 02 GB304 Mon. 3-5 p.m.
- ☐ 03 WB342 Tue. 4-6 p.m.
- ☐ 04 GB304 Tue. 4-6 p.m.
- ☐ 05 GB404 Wed. 4-6 p.m.
- ☐ 06 BA2185 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 SF3202 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 two concentric conductors, an inner sphere of radius 2 cm and an outer spherical shell of radius 6 cm as shown in the figure.
- The inner sphere has a positive charge and the outer spherical shell has a negative charge equal in magnitude to that of the inner sphere.
- The magnitude of the electric field is 9.94×10^6 N/C at r = 4 cm in the space halfway between the two concentric conductors.

(a) Compute the total flux through the surface of the inner sphere. (3 marks)

2×10^5 (Nm^2/C)

(b) What is the charge on the inner sphere? (2 marks)

1.8×10^{-6} (C)

(c) Compute the total flux through the outer surface of the spherical shell. (1 marks)

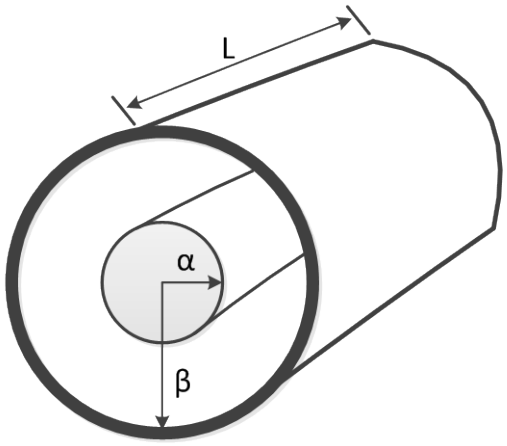
0

(d) What is the potential difference between the two concentric conductors? (4 marks)

5.3×10^5 (V)

Q2 [10 marks] For a capacitor consisting of two concentric conductors: an inner cylinder of radius α and an outer cylindrical shell of inner radius β as shown below.

a) Derive the expression for the capacitance. (7 marks)



$$\frac{2\pi\varepsilon_0 L}{\ln(\frac{\beta}{\alpha})}$$

b) What is the capacitance if the space in between the two conductors is filled with a dielectric material having a dielectric constant κ. (1 mark)

$$\frac{2\pi\kappa\varepsilon_0 L}{\ln(\frac{\beta}{\alpha})}$$

c) Determine the ratio of the energy stored in the two capacitors in (a) and (b), if both are charged to the same potential. (2 marks)

$$\frac{1}{\kappa}$$

Q3 [10 marks] An electron travels at a velocity $|\vec{v}| = 1\times10^{7}$ m/s horizontally between two large horizontal parallel plates. The plates are separated by 1.0 cm and have a potential difference of 200 V, as shown in the figure. What *magnetic field strength* and *direction* will allow the electron to pass between the plates un-deflected?

2 x 10^{-3} **-k** (T)