UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING

ECE 110H1 S -- ELECTRICAL FUNDAMENTALSFINAL EXAMINATION, APRIL 18, 2018, 2:00 p.m.

First Year -- Computer, Electrical, Industrial, Mechanical, Materials, and Track One Engineering Programs.
Examiners – B. Bardakjian, M. Mojahedi, B. Wang and P. Yoo

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

NAME : _____
(PLEASE PRINT) Family (Last) Name Given (First) Name

STUDENT NUMBER : _____

EXAMINATION TYPE : D (Students may use a single double sided 8.5" x 11" aid sheet)
CALCULATORS : Casio FX-991 (EX, EX Plus, or MS), Sharp EL-520 (X or W)
DURATION : 2.5 hours
INSTRUCTIONS :
- Answer all five questions. Put the final answers in the boxes provided.
- All work is to be done on these pages. Show steps, compute numerical results and state units. Write down any assumption made.
- Please note that the exam papers are double-sided
- **The last 2 blank pages may be removed for rough work.**

Question	Mark
1	
2	
3	
4	
5	
Total	

Q1 continued

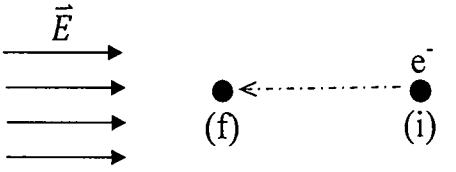
1.4 **(1 mark)** An electron (e^-) in the presence of a uniform electric field $\vec{E}$ moves from the initial position (i) to the final position (f). Let ΔU represent the change in potential energy and ΔV the change in electrostatic potential.

a. $\Delta U > 0$ *and* $\Delta V < 0$

b. $\Delta U < 0$ *and* $\Delta V < 0$

c. $\Delta U > 0$ *and* $\Delta V > 0$

d. $\Delta U < 0$ *and* $\Delta V > 0$



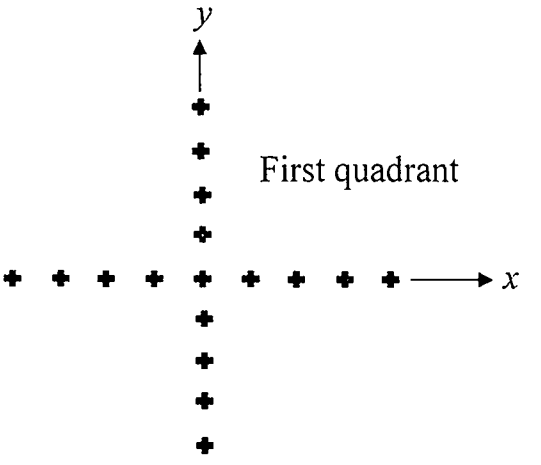
1.5 **(2 marks)** Figure shows the cross section of two uniform sheets of positive charges placed at the right angle to each other. What angle do the equipotential surfaces make with the positive x-axis in the first quadrant (see figure)?

a. 90°

b. 0°

c. 60°

d. 135°



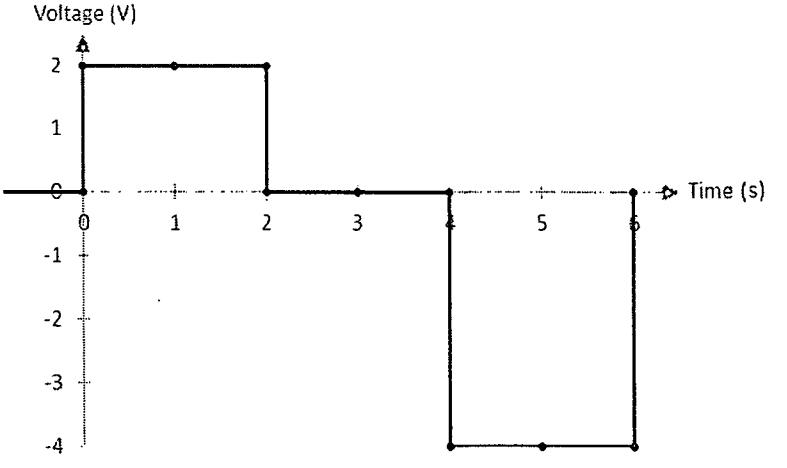
1.6 **(1 mark)** The voltage across a 2 [H] inductor is shown. What is the value of the current through the inductor at $t = 6$ [s]?

a. 2 [A]

b. -4 [A]

c. 4 [A]

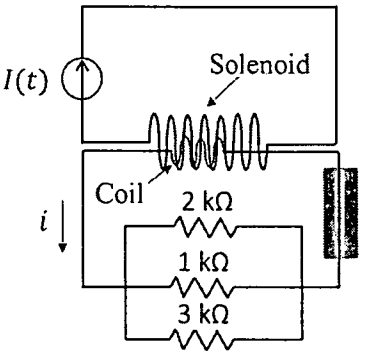
d. -2 [A]



Q2 [10 marks]

Consider the following diagram where the two parts of the circuit are electromagnetically coupled by placing a coil inside a solenoid. The dimensions of the solenoid and coil are provided in the table below:

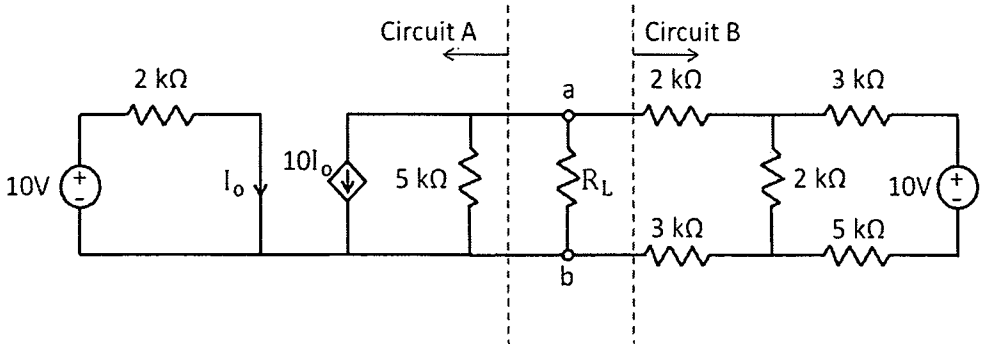
	Solenoid	Coil
Length (cm)	7	3
Diameter (mm)	5	2
Number of Turns	10,000	5,000



(a) **(2 marks)** For a current $I(t)$ applied by the independent current source, determine the magnitude of the electromotive force ($|\varepsilon|$) induced in the coil.

$|\varepsilon| =$

Q3 [10 marks]
Consider the following circuit:



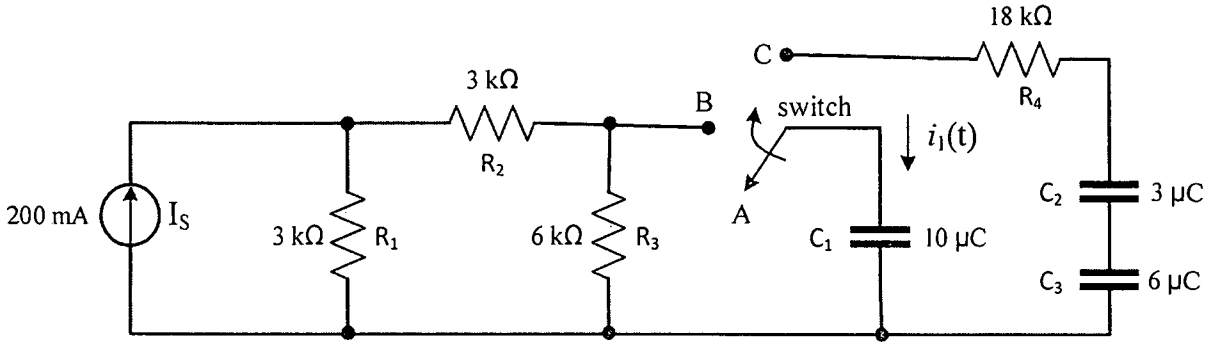
(a) **(4 marks)** Find the Thévenin equivalent of Circuit A between terminals a-b.

$V_{th} =$

$R_{th} =$

Q4 [10 marks]

In the circuit shown below, the switch is initially at position A. At t = 0 s, the switch moves to position B. At t = 5 s, the switch moves to position C. Assume that all of the capacitors have zero stored energy at t = 0 s. Answer the following questions.



(a) **(1 mark)** Calculate the time constant of the circuit when the switch is in position B.

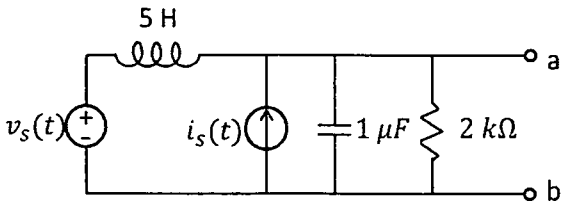
$\tau =$

(b) **(2 marks)** Calculate the voltage across the capacitor C_1 at t = 1 s.

$V_{C_1}(1) =$

Q5 [10 marks]

Consider the circuit shown:



$$i_s(t) = 5\cos(\omega t)\ \text{mA}.$$
$$v_s(t) = 10\cos(\omega t - 90^\circ)\ \text{V}$$

(a) **(7 marks)** Compute the Thévenin equivalent circuit between terminals a & b for $\omega = 200\ rad/s$ in the frequency domain.

$V_{th} =$

$Z_{th} =$

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