UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

ECE110 – Electrical Fundamentals

FINAL EXAMINATION, June 25, 2015

DURATION: 2½ hrs

Calculator Type: 2 (non-programmable calculators)

Examiner: Hamid S. Timorabadi

**FAMILY NAME:** _____

**GIVEN NAME:** _____

**STUDENT NUMBER:** _____

**INSTRUCTIONS:**

- Answer all FIVE questions.
- All questions are of equal value.
- All work is to be done on these sheets.
- Use the back of the pages if you need more space.
- Show details of your solutions for all questions.

**MARKS**

| | |
|---|---|
| **Q1** | **/10** |
| **Q2** | **/10** |
| **Q3** | **/10** |
| **Q4** | **/10** |
| **Q5** | **/10** |
| **Total** | **/50** |

**[10 *Marks*] 1.**

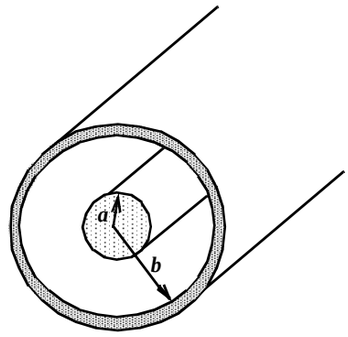
A cylindrical capacitor consisting of two coaxial cylinders of radius ***a*** and ***b*** (***b***>***a***) and length (***L***) where ***L***>>***b*** is shown in the Figure below. The inner shell has a total charge of **+*q*** and the outer shell has a total charge of **-*q***. Fringing is neglected.

Develop the following relationships in terms of ***a***, ***b***, and ***L*** for:

***a)*** Electric Field between two plates.

***b)*** Electric Potential (Voltage) between two plates.

***c)*** Capacitance of this device.



**[10 *Marks*] 2.**

A square wire loop with ***4 m*** sides is perpendicular to a uniform magnetic field with half the area of the loop in the field as shown below. The resistance of the loop is ***R = 4 Ω*** and the loop contains a ***20 V*** battery. The magnitude of the filed varies with time according to:

$$\boldsymbol{B = (0.042 - 0.87t)} \qquad \textit{(Tesla)}$$

*a)* Draw an electric circuit showing the loop resistance, induced emf, and the emf (voltage) from the battery.

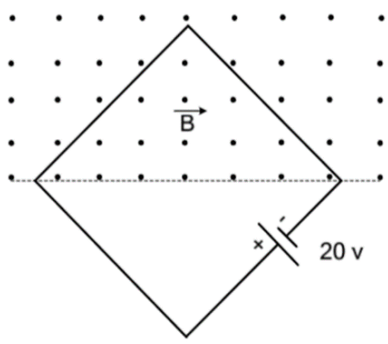
***Determine:***

*b)* The magnitude of the induced emf in the circuit.

*c)* The magnitude of the total (net) emf in the circuit.

*d)* The magnitude of the induced current.

*e)* The amount and direction of the total (net) current in the loop for the given ***R = 4 Ω***.



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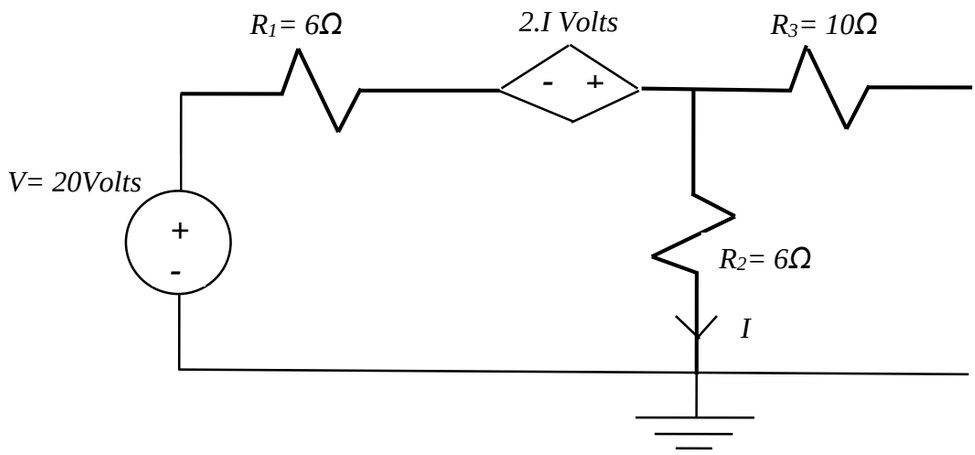
**[*10 Marks*] 3.**

Determine and draw the Thevenin's equivalent for the following circuit.



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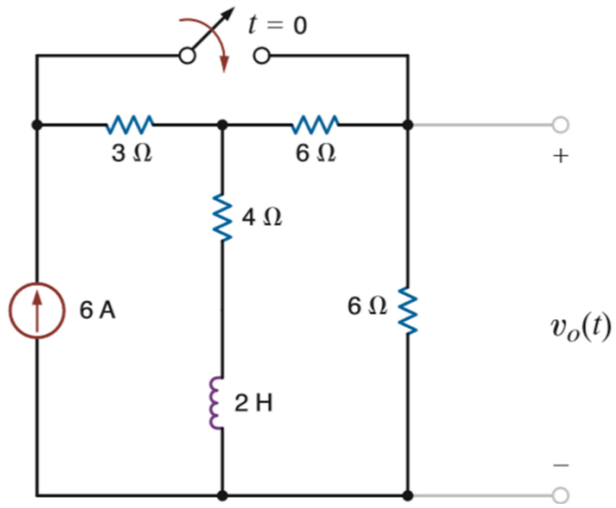
**[10 *Marks*] 4.**

Determine output voltage ($v_o(t)$) for **t > 0** in the circuit shown below.
Note that the switch is closed at time **t = 0**.



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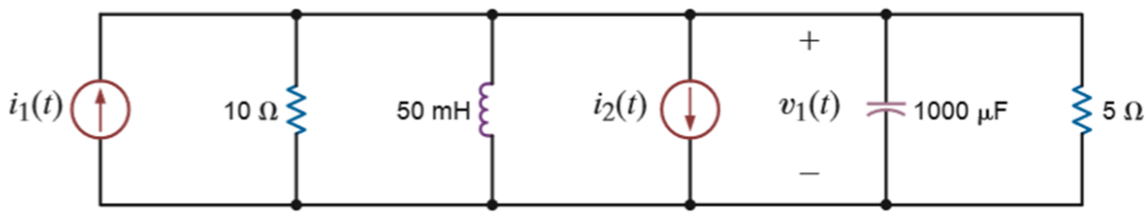
**[10 *Marks*] 5.**

Consider the following circuit where

$$\boldsymbol{i_1(t) = 7\cos(100t)} \quad \textbf{(A)}$$

$$\boldsymbol{i_2(t) = 3\cos(100t + 45^\circ)} \quad \textbf{(A)}$$

a) Draw a phasor circuit and show the phasor values on the phasor circuit.
b) Determine the $\boldsymbol{v_1(t)}$
c) Draw a phasor diagram for source currents ($\boldsymbol{i_1}$, $\boldsymbol{i_2}$), capacitor and inductor currents, and the voltage ($\boldsymbol{v_1}$).



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