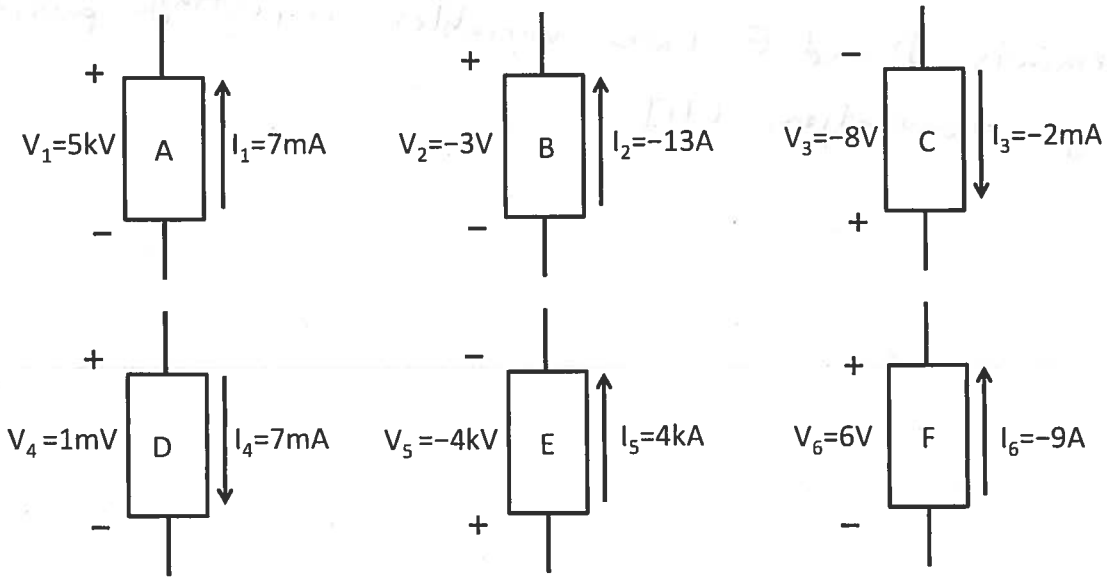
ECSE-200 Quiz # 1 (33_4 Jan 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagrams below. Answer the questions.



1) What is the power delivered (or absorbed) by the circuit element A ?

2) What is the power delivered (or absorbed) by the circuit element B ?

3) What is the power delivered (or absorbed) by the circuit element C ?

4) What is the power delivered (or absorbed) by the circuit element D ?

5) What is the power delivered (or absorbed) by the circuit element E ?

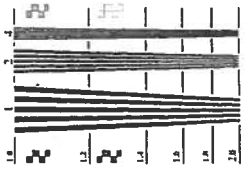
6) What is the power delivered (or absorbed) by the circuit element F ?

7) List the circuit elements above for which the voltage and current variables respect passive sign convention.

1) $P_{del} = v_1 \cdot i_1 = 5\,kV \cdot 7\,mA = +35\,W$ delivered by A [+1]

2) $P_{del} = v_2 \cdot i_2 = -3V \cdot -13A = +39\,W$ delivered by B [+1]

3) $P_{del} = v_3 \cdot i_3 = -8V \cdot -2mA = +16\,mW$ delivered by C [+1]

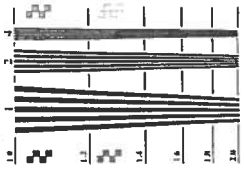


4) $p_{abs} = v_4 \cdot i_4 = 1mV \cdot 7mA = +7\mu W$ absorbed by D [+1]

5) $p_{abs} = v_5 \cdot i_5 = -4kV \cdot 4kA = -16MW$ absorbed by E [+1]

6) $p_{del} = v_6 \cdot i_6 = 6V \cdot -9A = -54W$ delivered by F [+1]

7) elements D and E have variables respecting passive sign convention. [+1]



ECSE-200 Quiz # 2 (In 31381059609 / In 3 Jan 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram below. Answer the questions.

a) KVL is satisfied for every loop in a circuit. (TRUE) / FALSE [1pt]

b) KCL is satisfied for every node in a circuit. (TRUE) / FALSE [1pt]

c) What is the value of v_2 ? [2pts]

d) What is the value of i_2 ? [2pts]

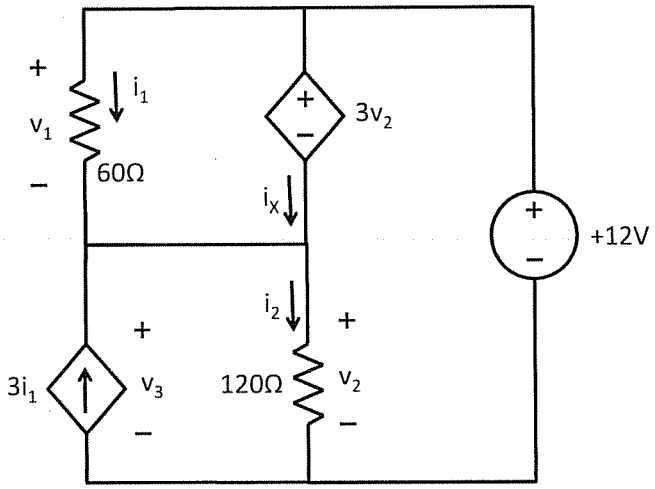
e) What is the value of v_3 ? [2pts]

f) What is the value of v_1 ? [2pts]

g) What is the value of i_1 ? [2pts]

h) What is the value of i_X ? [2pts]

i) How much power is the dependent current source delivering (or absorbing)? [2pts]



c) $0 = -v_2 - 3v_2 + 12V$ [+1]

$v_2 = 3V$ [+1]

d) $v_2 = 120\Omega \cdot i_2$ [+1]

$i_2 = \frac{3V}{120\Omega} = 25mA$ [+1]

e) $0 = -v_3 + v_2$ [+1]

$v_3 = 3V$ [+1]

f) $0 = -v_3 - v_1 + 12V$ [+1]

$v_1 = 12V - 3V = 9V$ [+1]

g) $v_1 = 60\Omega \cdot i_1$ [+1]

$i_1 = \frac{9V}{60\Omega} = 150mA$ [+1]

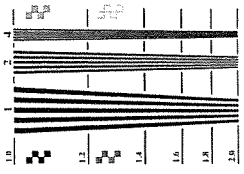
h) $0 = -i_1 - 3i_1 + i_2 - i_X$ [+1]

$i_X = i_2 - 4i_1$

$= -575mA$ [+1]

i) $P_{del} = 3i_1 \cdot v_3$ [+1]

$= 1.35W$ [+1]



ECSE-200 Quiz # 3 ($2^2+3^2+4^2$ Jan 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagrams below. Answer the questions.

What is the equivalent resistance between the following nodes:

1) a and b ? [1pt]

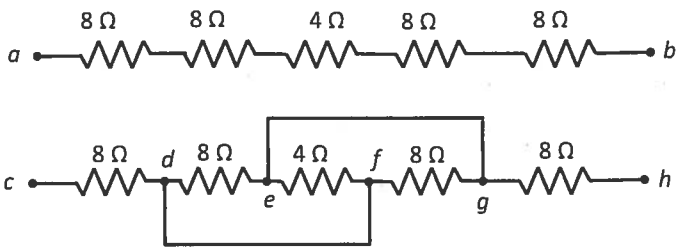
2) c and h ? [1pt]

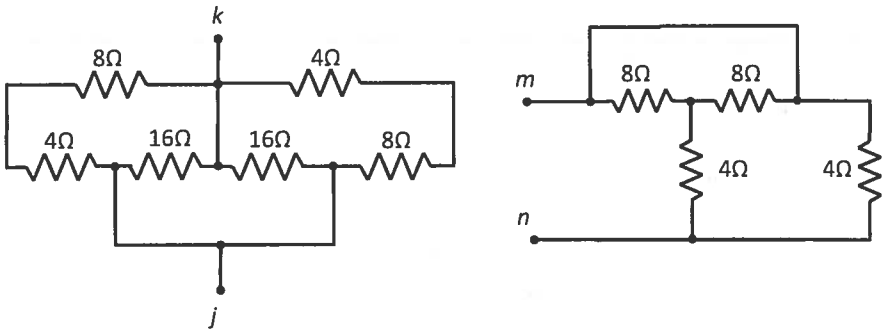
3) d and g ? [1pt]

4) e and f ? [1pt]

5) j and k ? [1pt]

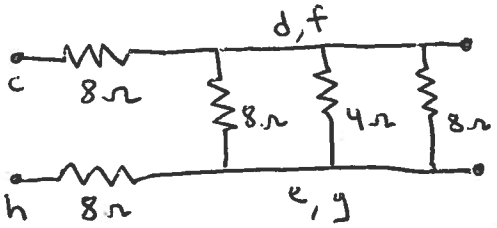
6) n and m? [1pt]





1) $R_{ab} = 8\Omega + 8\Omega + 4\Omega + 8\Omega + 8\Omega = 36\Omega$ [+1]

2)



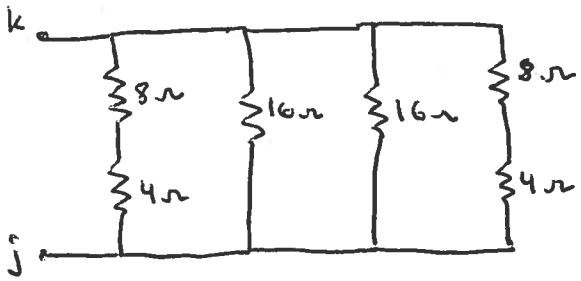
$R_{ch} = 8\Omega + (8\Omega \,//\, 4\Omega \,//\, 8\Omega) + 8\Omega$

$= 18\Omega$ [+1]

3) $R_{dg} = 8\Omega \,//\, 4\Omega \,//\, 8\Omega = 2\Omega$ [+1]

4) $R_{ef} = R_{dg} = 2\Omega$ [+1]

5)



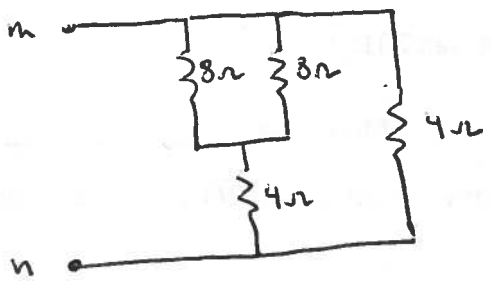
$R_{jk} = 16\Omega \,//\, 16\Omega \,//\, 12\Omega \,//\, 12\Omega$

$= 8\Omega \,//\, 16\Omega$

$= \frac{48}{14}\Omega = \frac{24}{7}\Omega$ [+1]

$= 3\frac{3}{7}\Omega$

6)



$R_{mn} = 4\Omega \,//\, (4\Omega + 8\Omega \,//\, 8\Omega)$

$= \frac{32}{12}\Omega = \frac{8}{3}\Omega$

$= 2\frac{2}{3}\Omega$

ECSE-200 Quiz # 4 ((3-10(⅛+(⅛+(⅛+(...)^2)^2)^2)^2)^2 Feb 2018)

NAME_____ McGill ID#_____

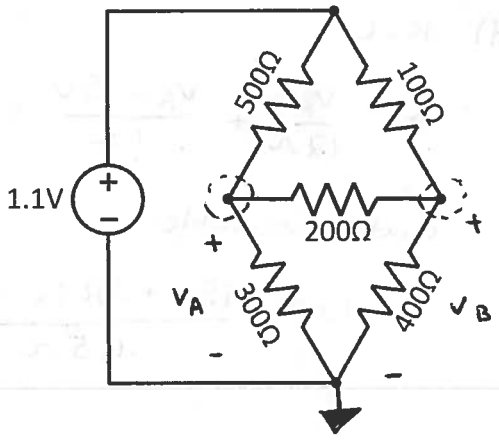
READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram. Answer the questions.

1) How many node voltage variables are required to solve this circuit? [2pts]

2) Write the node voltage equations for the circuit. Be sure to *clearly define your variables* on the circuit diagram. [4pts]

3) Solve for the node voltages. [1pt]



1) two variables [+2]

2) $$0 = \frac{V_A}{300} + \frac{V_A - V_B}{200} + \frac{V_A - 1.1V}{500}$$ [+2]

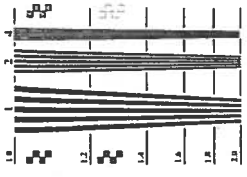
$$0 = \frac{V_B}{400} + \frac{V_B - V_A}{200} + \frac{V_B - 1.1V}{100}$$ [+2]

3) $0.220 = 1.0333\, V_A - 0.5000\, V_B$

$1.10 = -0.5000\, V_A + 1.7500\, V_B$

$$V_A = \frac{\begin{vmatrix} 0.220 & -0.500 \\ 1.100 & +1.750 \end{vmatrix}}{\begin{vmatrix} 1.0333 & -0.5000 \\ -0.5000 & +1.7500 \end{vmatrix}} = 0.6000 \text{ V}$$ [+1/2]

$$V_B = \frac{\begin{vmatrix} 1.0333 & 0.22 \\ -0.500 & 1.10 \end{vmatrix}}{\begin{vmatrix} 1.0333 & -0.5000 \\ -0.5000 & +1.7500 \end{vmatrix}} = 0.8000 \text{ V}$$ [+1/2]

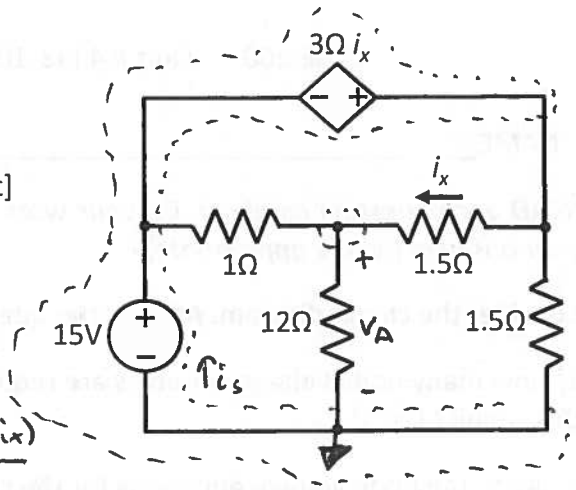


Consider the circuit diagram. Answer the questions.

4) What is the value of i_x? [1pt]

5) How much power does the 24Ω resistor absorb? [1pt]

6) How much power does the 15V source deliver? [1pt]



4) KCL:

$$0 = \frac{v_A}{12\Omega} + \frac{v_A - 15V}{1\Omega} + \frac{v_A - (15V + 3\Omega i_x)}{1.5\Omega}$$

control variable:

$$i_x = \frac{15V + 3\Omega i_x - v_A}{1.5\Omega}$$

$$25 = 1.750\, v_A - 2 i_x$$
$$-10 = -0.6667\, v_A + i_x$$

$$i_x = \frac{\begin{vmatrix} 1.750 & 25 \\ -0.6667 & -10 \end{vmatrix}}{\begin{vmatrix} 1.750 & -2 \\ -0.6667 & +1 \end{vmatrix}} = -2A \quad [+1]$$

5)

$$v_A = \frac{\begin{vmatrix} 25 & -2 \\ -10 & +1 \end{vmatrix}}{\begin{vmatrix} 1.750 & -2 \\ -0.6667 & +1 \end{vmatrix}} = 12V \qquad P_{abs} = \frac{v_A^2}{12\Omega} = 12W \quad [+1]$$

6)

$$i_s = \frac{v_A}{12\Omega} + \frac{15V + 3\Omega i_x}{1.5\Omega} = \frac{12V}{12\Omega} + \frac{15V + (-6V)}{1.5\Omega} = 7A$$

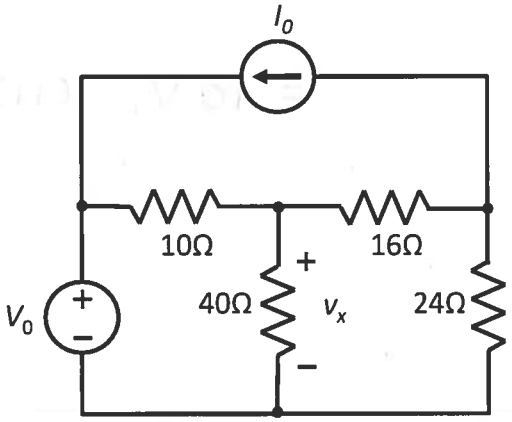
$$P_{del} = 15V \cdot 7A = 105W \quad [+1]$$

ECSE-200 Quiz # 5 (1100_2 Feb 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram.



1) How many node voltage equations would be required to solve the circuit? Assume V_0 and I_0 are known. [1pt]

2) How many mesh current equations would be required to solve the circuit? Assume V_0 and I_0 are known. [1pt]

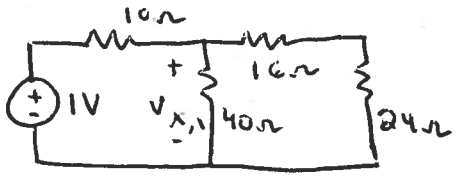
3) The voltage source V_0 = 15 V. What should the value be of the current I_0 to achieve v_x = 0 V? [3pts]

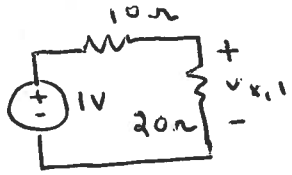
4) The voltage V_0 = 75 V and the current I_0 = 10 A. What is the value of v_x? [2pts]

1) 2 equations [+1] 2) 2 equations [+1]

3) Apply the principle of superposition.

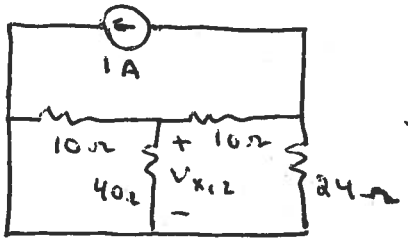
(I)

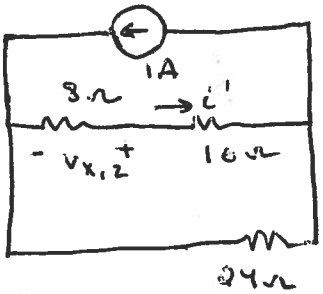




$$v_{x,1} = 1V \cdot \frac{20\Omega}{10\Omega + 20\Omega} = \frac{2}{3} V$$

(II)





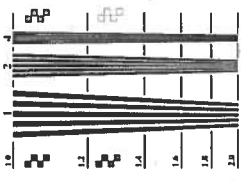
$$i' = \frac{1A \cdot 24\Omega}{24\Omega + 24\Omega} = \frac{1}{2} A$$

$$v_{x,2} = -\frac{1}{2} A \cdot 8\Omega = -4V$$

$$\therefore v_x = \frac{2}{3} \cdot V_0 + \left(-4 \frac{V}{A}\right) \cdot I_0$$

$$0V = \frac{2}{3} \cdot 15V + \left(-4 \frac{V}{A}\right) \cdot I_0 = \underbrace{10V}_{[+2]} - 4 \frac{V}{A} I_0$$

$I_0 = 2.5A$ [+1]

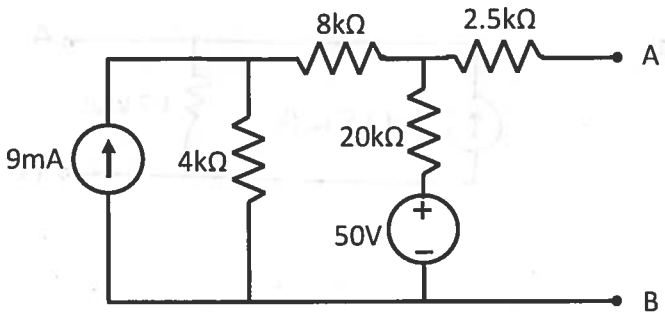


4) $V_x = \frac{2}{3} V_o + \left(-4\frac{V}{A}\right) I_o$ [+1] for any valid method of solution

$= \frac{2}{3} \cdot 7.5V + \left(-4\frac{V}{A}\right) \cdot 1.0A$

$= 10\ V$ [+1]

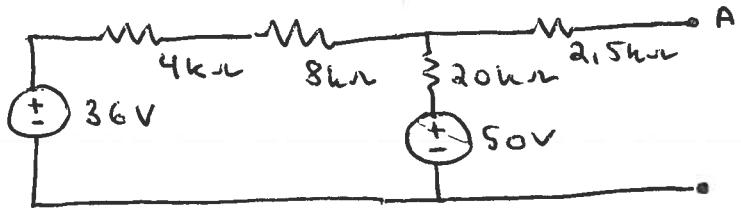
Consider the circuit diagram.

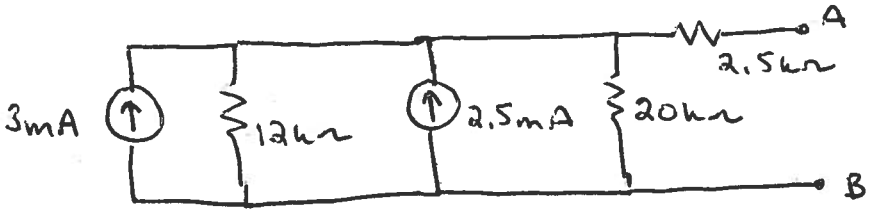


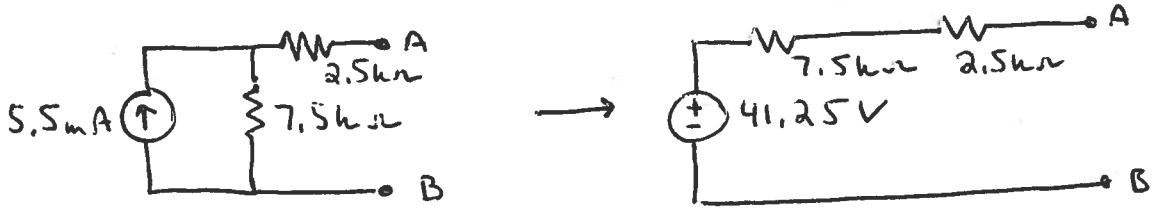
5) What is the Thévenin equivalent circuit (voltage source in series with a resistor) with respect to terminals A and B? [4pts]

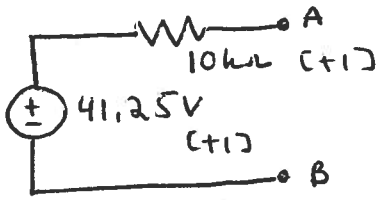
6) What is the Norton equivalent circuit (current source in parallel with a resistor) with respect to terminals A and B? [1pt]

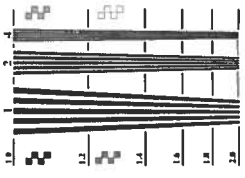
5) Use source transformations. [+2]





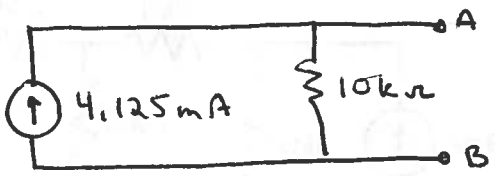






work space

6)



[+1]

ECSE-200 Quiz # 6 (8th prime Feb 2018)

NAME_____ McGill ID#_____

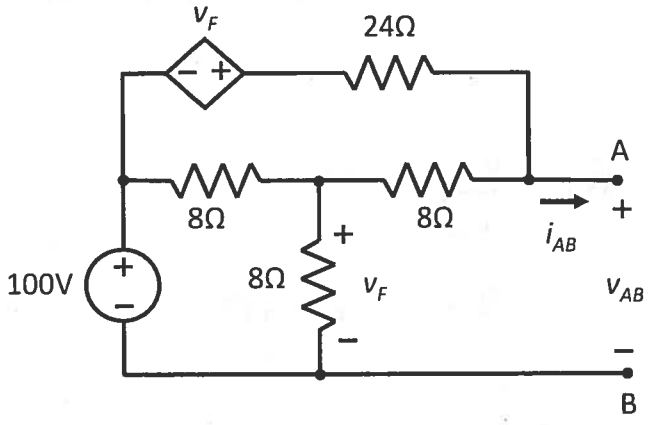
READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram.

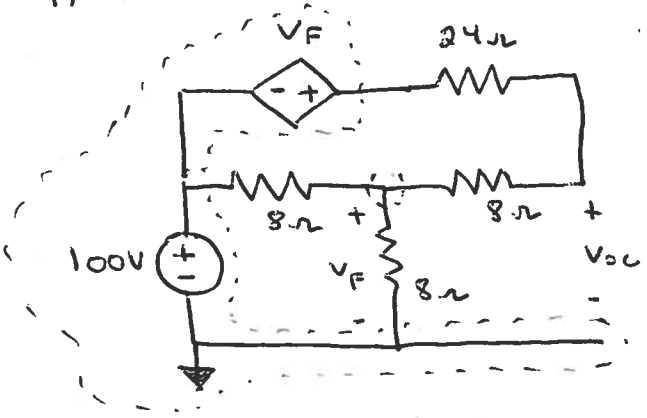
1) What is the open circuit voltage of the circuit with respect to the terminals A and B ? [2pts]

2) What is the short circuit current of the circuit with respect to the terminals A and B ? [2pts]

3) What is the Thévenin resistance of the circuit with respect to the terminals A and B? [2pts]



1) Find V_{oc}



[+1] for applying open circuit conditions.

KCL:

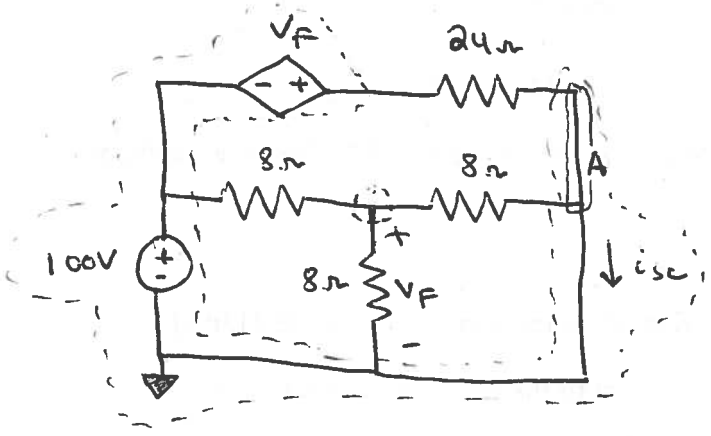
$$0 = \frac{V_F}{8\Omega} + \frac{V_F - 100V}{8\Omega} + \frac{V_F - (100V + V_F)}{32\Omega}$$

$$V_F = \frac{100V/8\Omega + 100V/32\Omega}{1/8\Omega + 1/8\Omega} = 62.5V$$

$$V_{oc} = V_F + \left[\frac{(100V + V_F) - V_F}{32\Omega}\right] \cdot 8\Omega$$

$$= 87.5V \quad [+1]$$

2) Find i_{sc}.



KCL:

$$0 = \frac{V_F}{8\Omega} + \frac{V_F - 100V}{8\Omega} + \frac{V_F}{8\Omega}$$

$$V_F = 33.33V$$

KCL at A:

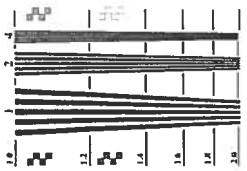
$$0 = i_{sc} + \frac{0 - V_F}{8\Omega} + \frac{0 - (100V + V_F)}{24\Omega}$$

$i_{sc} = 9.722\ A$ [+1]

[+1] for short circuit conditions.

3) $V_{oc} = i_{sc} \cdot R_T$ $\quad R_T = \frac{V_{oc}}{i_{sc}}$ [+1]

$= 9.000\ \Omega$ [+1]

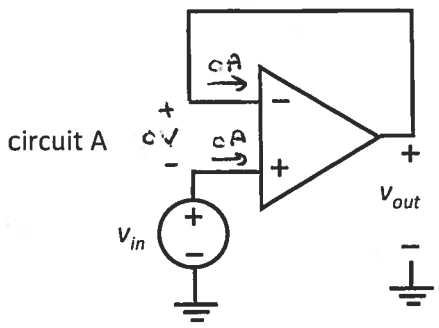


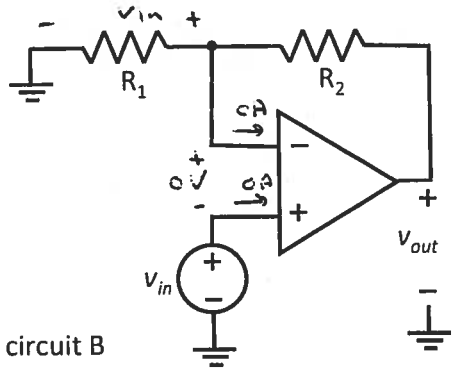
ECSE-200 Quiz # 7 ($1A_{16}$ Feb 2018)

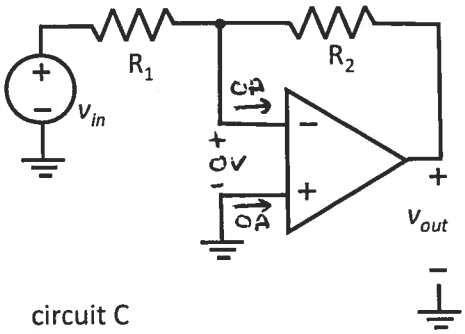
NAME_____ McGill ID#_____

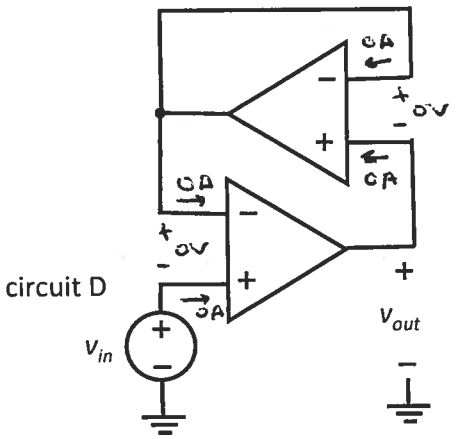
READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagrams. Assume ideal op-amp behaviour.









1) What is v_{out}/v_{in} for circuit A? [2pts]

2) What is v_{out}/v_{in} for circuit B? [2pts]

3) What is v_{out}/v_{in} for circuit C? [2pts]

4) What is v_{out}/v_{in} for circuit D? [2pts]

1) $\frac{v_{out}}{v_{in}} = 1$ [+2]

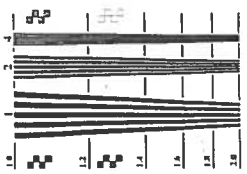
2) $0 = \frac{v_{in}}{R_1} + \frac{v_{in} - v_{out}}{R_2}$

$\frac{v_{out}}{v_{in}} = 1 + \frac{R_2}{R_1}$ [+2]

3) $0 = \frac{0 - v_{in}}{R_1} + \frac{0 - v_{out}}{R_2}$

$\frac{v_{out}}{v_{in}} = -\frac{R_2}{R_1}$ [+2]

4) $\frac{v_{out}}{v_{in}} = 1$ [+2]

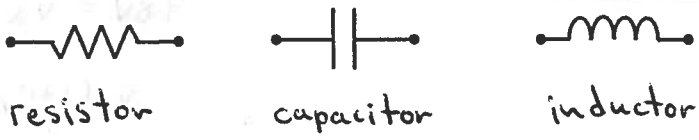


ECSE-200 Quiz # 8 (π/arctan(2-$3^{1/2}$) Mar 2018)

NAME_____ McGill ID#_____

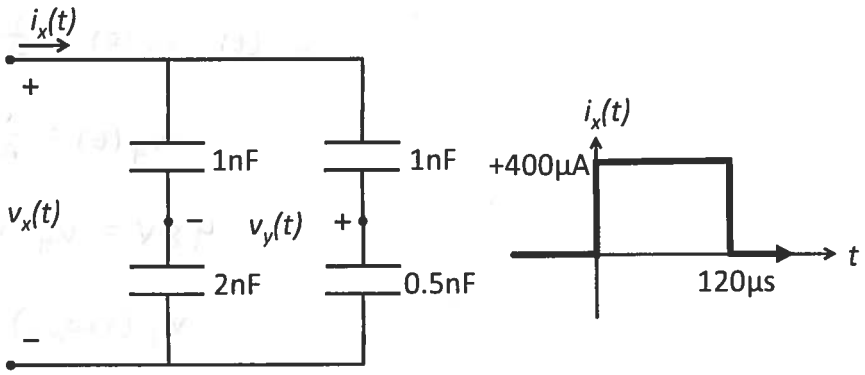
READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

1) Label the three elements below as *inductor*, *resistor* and *capacitor* as appropriate. [1pt]



[+1]

Consider the circuit diagram below. The capacitors store zero energy for $t < 0$s. The current $i_x(t)$ is a square pulse versus time t as shown below.



2) What is the voltage $v_x(t)$ at t = 0 μs ? [1pt]

3) What is the voltage $v_x(t)$ at t = 60 μs ? [1pt]

4) What is the voltage $v_x(t)$ at t = 120 μs ? [1pt]

5) What is the voltage $v_y(t)$ at t = 120 μs ? [1pt]

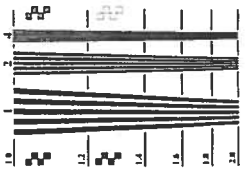
6) What is the total energy stored in the capacitors at t = 120 μs ? [2pts]

2) zero energy stored for $t<0 \rightarrow v_x(0) = 0V$ [+1]

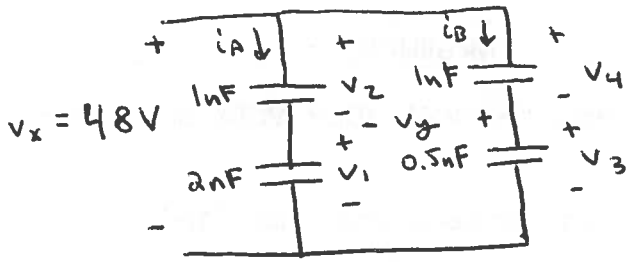
3) $C_{eq} = \frac{1}{\frac{1}{1nF}+\frac{1}{2nF}} + \frac{1}{\frac{1}{1nF}+\frac{1}{0.5nF}} = 1nF$

$v_x(60\mu s) = v_x(0) + \frac{1}{1nF}\int_0^{60\mu s} 400\mu A\, dt = 24V$ [+1]

4) $v_x(120\mu s) = v_x(0) + \frac{1}{1nF}\int_0^{120\mu s} 400\mu A\, dt = 48V$ [+1]



$t = 120\,\mu s$



$$i_A = 1nF \frac{dv_2}{dt} = 2nF \frac{dv_1}{dt}$$

$$v_2(t) - v_2(0) = 2\,(v_1(t) - v_1(0))$$

$$v_2(t) = 2\,v_1(t)$$

$$48V = v_2(120\mu s) + v_1(120\mu s)$$

$$v_1(120\mu s) = \frac{48V}{3} = 16V$$

$$i_B = 1nF \frac{dv_4}{dt} = 0.5nF \frac{dv_3}{dt}$$

$$v_4(t) - v_4(0) = \frac{1}{2}\,(v_3(t) - v_3(0))$$

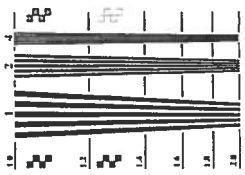
$$v_4(t) = \frac{1}{2}\,v_3(t)$$

$$48V = v_4(120\mu s) + v_3(120\mu s)$$

$$v_3(120\mu s) = \frac{48V}{3/2} = 32V$$

$$v_y = v_3 - v_1 = 16V \quad [+1]$$

6) $$U = \frac{1}{2}\,C_{eq} \cdot v_x^2 = \frac{1}{2} \cdot 1nF \cdot (48V)^2 = 1.152\,\mu J \quad [+1]$$

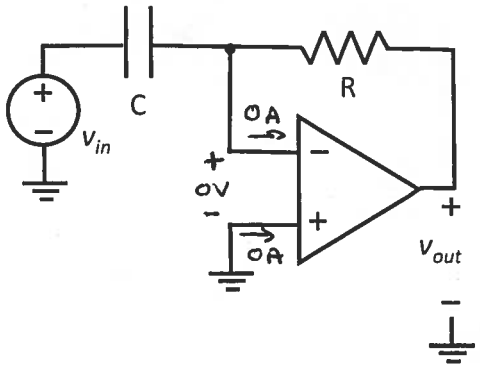


ECSE-200 Quiz #9 (XIX March 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

1) Consider the circuit to the right. Assume ideal op-amp behavior. Give an expression for $v_{out}(t)$ in terms of $v_{in}(t)$. [2pts]



$$0 = C\frac{d}{dt}(0 - v_{in}) + \frac{0 - v_{out}}{R}$$

$$v_{out} = -RC\frac{dv_{in}}{dt} \quad [+2]$$

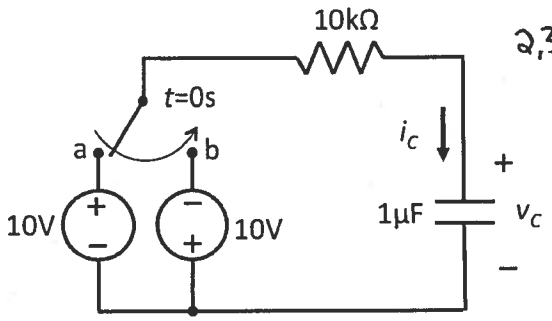
Consider the circuit below. The circuit is in dc steady state for $t < 0$ with the switch in position a. The switch moves instantaneously to the position b at $t = 0$.

2) What is $v_c(t)$ at $t = 0-$? [1pt]

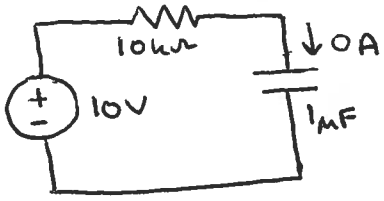
3) What is $i_c(t)$ at $t = 0-$? [1pt]

4) What is $v_c(t)$ at $t = 0+$? [1pt]

5) What is $i_c(t)$ at $t = 0+$? [1pt]



2,3) $t = 0^-$, steady state

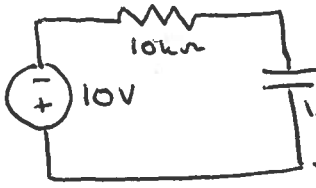


KVL: $-10V + 0 \cdot 10k\Omega + v_c(0-) = 0$

$v_c(0-) = +10V$ [+1]

$i_c(0-) = 0A$ [+1]

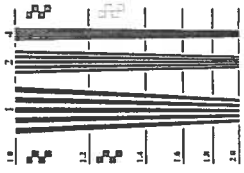
4,5) $t = 0+$



KVL: $+10V + i_c(0+) \cdot 10k\Omega + v_c(0+) = 0$

$i_c(0+) = -2mA$ [+1]

[+1]



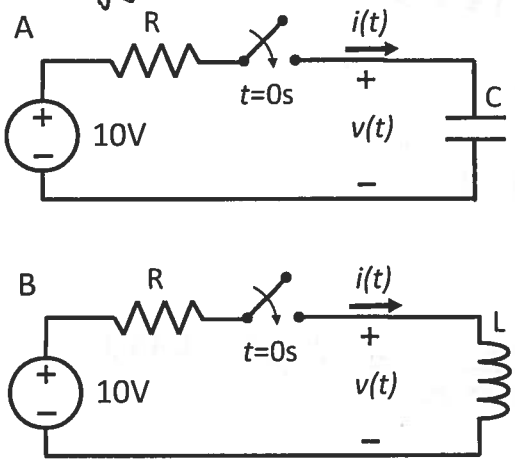
ECSE-200 Quiz #10 ($1A_{16}$ Mar 2018)

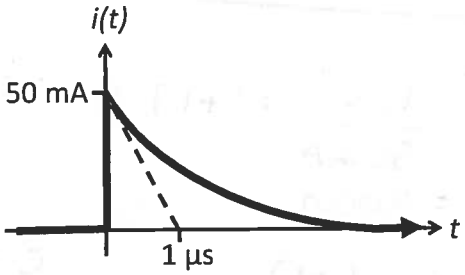
NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuits A and B below. The circuits are in dc steady state for $t < 0$, and the switches close instantaneously at $t = 0$ s. A plot of current $i(t)$ versus time t is also shown below.

Zero energy stored for $t<0$.





1) Which circuit, A or B, will give a current $i(t)$ versus t as shown in the plot? [2pts]
(Note that ***only one*** of the two circuits, A ***or*** B, can give the current as shown in the plot.)

Use your answer to part 1), and the plot of current $i(t)$ versus time t, to answer the remaining questions.

2) What is the resistance R ? [2pts]

3) What is the capacitance C or the inductance L ? [2pts]

4) What is the voltage $v(t)$ versus t, for $t > 0$? [3pts]

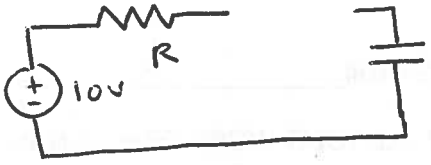
1) As $t \to \infty$, inductor → short and $i(\infty) = 10V/R$.

capacitor → open and $i(\infty) = 0A$.

∴ circuit A gives $i(t)$ [+2]

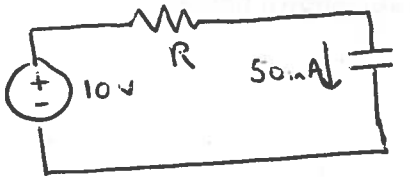
Note also that inductor current must be continuous.

2) $t = 0^-$



$v_c(0^-) = 0V$ [+1]

$t = 0^+$

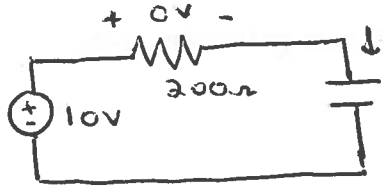


$v_c(0^+) = v_c(0^-) = 0V$

$$R = \frac{10V}{50mA} = 200\Omega \quad [+1]$$

3) $\tau = RC$ [+1] $\qquad C = \frac{1\mu s}{200\Omega} = 5nF$ [+1]

4) $t \to \infty$

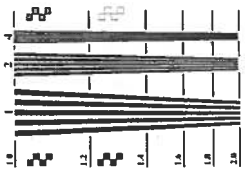


$v_c(\infty) = 10V$ [+1]

$\tau = 1\mu s$ [+1]

$\therefore$ for $t > 0$ $\quad v_c(t) = v_c(\infty) + [v_c(0^+) - v_c(\infty)] \exp(-t/\tau)$

$= 10V - 10V \exp(-t/1\mu s)$ [+1]

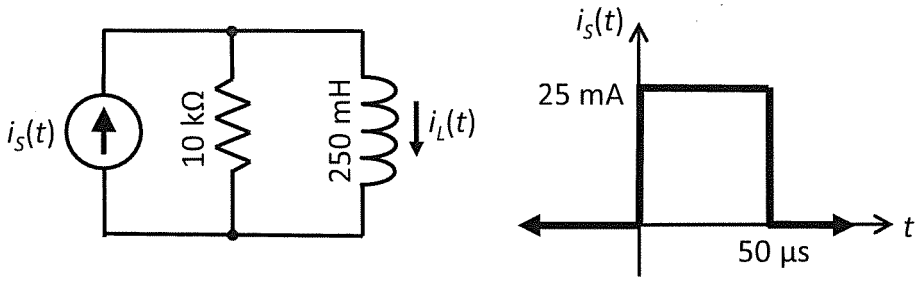


ECSE-200 Quiz #11 ((387420489)$^{(1/10 + 1/100 + 1/1000 + 1/10000 + \ldots)}$ April 2018)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram and the plot of current $i_S(t)$ versus time t. The circuit is in dc steady-state for $t < 0$. Answer the questions.



1) Express the input $i_S(t)$ shown in the figure above in terms of the unit step function $u(t)$. [2pts]

2) What is the current $i_L(t)$ in response to a ***unit step function*** input $i_S(t) = 1A\ u(t)$? [3pts]

3) What is the current $i_L(t)$ in response to the input $i_S(t)$ as shown in the figure above? [2pts]

1) $i_S(t) = 25\,mA \cdot u(t) + (-25\,mA) \cdot u(t - 50\,\mu s)$ [+2]

2) $i_L(0+) = i_L(0-) = 0\ A$ [+1/2]

$i_L(\infty) = 1\ A$ [+1/2]

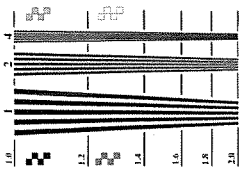
$\tau = \frac{250\,mH}{10k\Omega} = 25\,\mu s$ [+1/2]

$i_L(t) = 1A\,[1 - \exp(-t/25\,\mu s)] \cdot u(t)$ [+3/2]

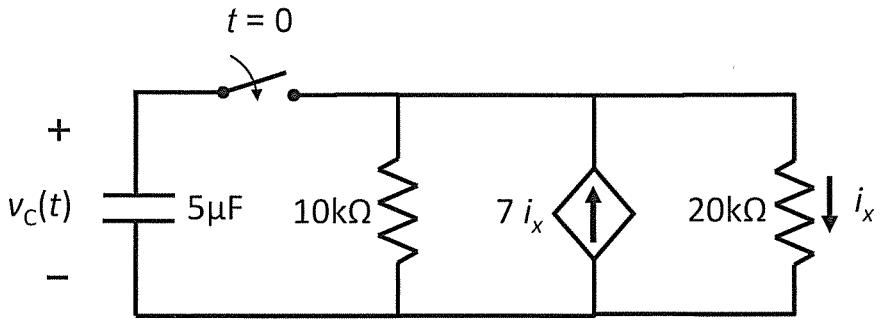
3) $i_L(t) = 25\,mA\,[1 - \exp(-t/25\,\mu s)]\,u(t)$

$+ (-25\,mA)\,[1 - \exp(-(t-50\,\mu s)/25\,\mu s)]\,u(t - 50\,\mu s)$

[+1 for each component]



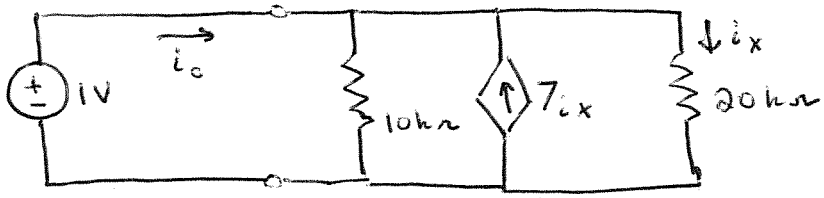
Consider the circuit diagram. The circuit is in dc steady-state and stores zero energy for $t < 0$. The switch closes instantaneously at $t = 0$. Answer the questions.



4) What is the Thévenin resistance connected to the capacitor for $t > 0$? [2pts]

5) Is the response of this RC circuit ***stable***, or ***unstable***? [1pt]

4)



[+1 for test circuit with voltage or current source]

KCL: $0 = -i_o + \frac{1V}{10k\Omega} + \frac{1V}{20k\Omega} - 7 \cdot \frac{1V}{20k\Omega}$

$i_o = 1mA\left(\frac{1}{10} + \frac{1}{20} - \frac{7}{20}\right) = -1mA \cdot \frac{1}{5}$

$R_{TH} = \frac{1V}{i_o} = -5k\Omega$ [+1]

5) unstable (because $\tau < 0$)

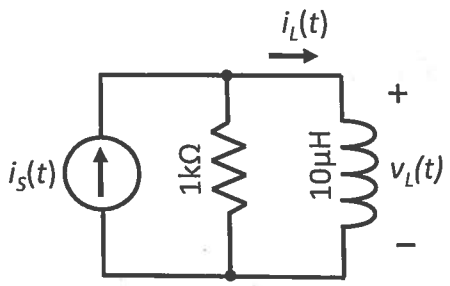
[+1]

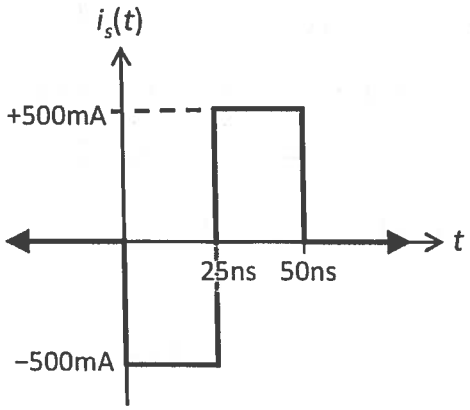
ECSE-200 Quiz #12 (3^2+4^2 Nov 2016)

NAME_____ McGill ID#_____

READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

Consider the circuit diagram. The circuit is in dc steady-state for $t < 0$.





1) Express $i_S(t)$ in terms of the unit step function. [3pts]

2) Find $i_L(t)$. [3pts]

3) What is the value of $i_L(50ns)$? [1pt]

4) Find $v_L(t)$. [1pt]

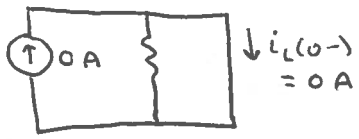
1) $i_s(t) = -500\,mA\,u(t)$ [+1]

$+1000\,mA\,u(t-25ns)$ [+1]

$-500\,mA\,u(t-50ns)$ [+1]

2) Find step response.

$t = 0-$



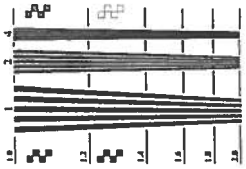
$i_L(0+) = i_L(0-) = 0A$

$t \to \infty$

$\tau = \frac{L}{R_{th}} = \frac{10\mu H}{1k\Omega}$

$= 10ns$

$i_L(t) = x(t) = 1A\,[1 - \exp(-t/10ns)]\,u(t)$



$$i_L(t) = -500\text{mA}\,[1 - \exp(-t/10\text{ns})]\,u(t) \quad [+1]$$
$$+ 1000\text{ mA}\,[1 - \exp(-(t-25\text{ns})/10\text{ns})]\,u(t-25\text{ns}) \quad [+1]$$
$$- 500\text{mA}\,[1 - \exp(-(t-50\text{ns})/10\text{ns})]\,u(t-50\text{ns}) \quad [+1]$$

3) $$i_L(50\text{ns}) = -500\text{mA}\,[1 - \exp(-5)]$$
$$+1000\text{mA}\,[1 - \exp(-2.5)]$$
$$-500\text{mA}\cdot 0$$
$$= 421\text{ mA} \quad [+1]$$

4) $v_L = L\frac{di_L}{dt}$ unit step response for inductor voltage

$$x(t) = 10\mu\text{H}\cdot\left\{\frac{d}{dt}\,1\text{A}\,[1 - \exp(-t/10\text{ns})]\right\}u(t)$$
$$= \frac{10\mu\text{H}}{10\text{ns}}\cdot 1\text{A}\,\exp(-t/10\text{ns})\,u(t)$$
$$= 1\text{kV}\,\exp(-t/10\text{ns})\,u(t)$$

$$v_L(t) = -500\text{V}\,\exp(-t/10\text{ns})\,u(t)$$
$$+1000\text{V}\,\exp(-(t-25\text{ns})/10\text{ns})\,u(t-25\text{ns})$$
$$-500\text{V}\,\exp(-(t-50\text{ns})/10\text{ns})\,u(t-50\text{ns}) \quad [+1]$$

alternatively, one may solve for each time interval individually.