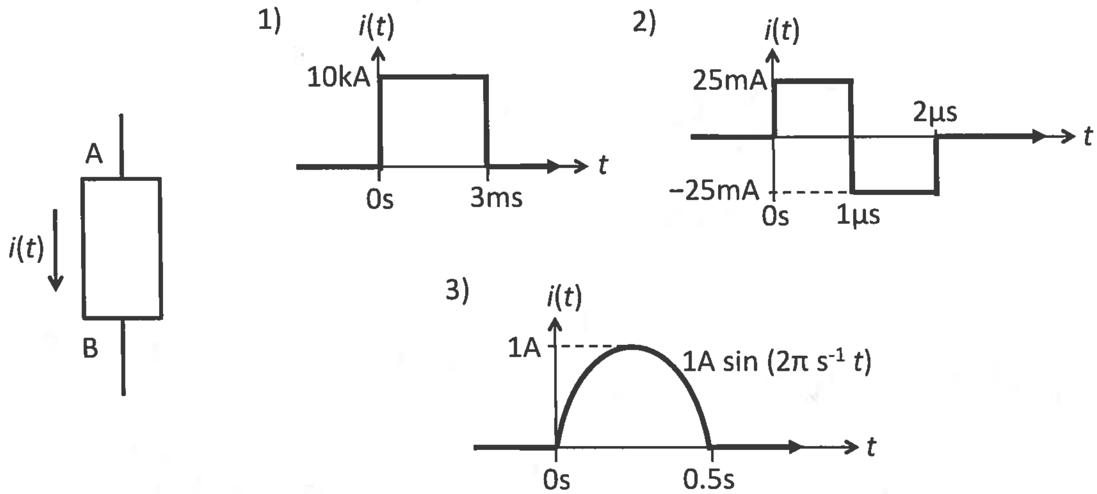
ECSE-200 Quiz # 1 (4344563120409/482729235601 Sept 2016)

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 below. The charge variable $q(t)$ is defined as the charge entering terminal "A" and exiting terminal "B" of the element. Time is denoted by the variable t. It is known that $q(0)$ = 0C. The current variable $i(t)$ is defined as the current entering terminal "A" and exiting terminal "B" of the element, as indicated in the figure. Answer the questions.



1) For the current $i(t)$ versus t shown in 1), what is the value of q(3ms)?

2) For the current $i(t)$ versus t shown in 2), what is the value of q(2μs)?

3) For the current $i(t)$ versus t shown in 3), what is the value of q(0.5s)?

4) For the current $i(t)$ versus t shown in 3), determine $q(t)$ for $0 < t < 0.5$s.

1) $q(3ms) = q(0) + \int_{0s}^{3ms} i(t)\,dt$ [+1]

$= 0C + 10kA \cdot 3ms$

$= 30\ C$ [+1]

2) $q(2\mu s) = q(0) + \int_{0s}^{2\mu s} i(t)\,dt = 0C$ [+1]

3) $$q(0.5s) = q(0) + \int_{0s}^{0.5s} i(t)\,dt$$

$$= 0C + \int_{0s}^{0.5s} 1A \cdot \sin(2\pi s^{-1} t)\,dt$$

$$= 0C + \left[1A \cdot \frac{-1}{2\pi s^{-1}} \cos(2\pi s^{-1} t) \right]_{0s}^{0.5s}$$

$$= \left[-\frac{1}{2\pi} C \cos(\pi) \right] - \left[-\frac{1}{2\pi} C \cos(0) \right]$$

$$= \frac{1}{\pi} C \qquad [+1]$$

$$= 0.318\ C$$

4) $$q(t) = q(0) + \int_{0s}^{t} i(t')\,dt' \qquad 0 < t < 0.5s$$

$$= 0C + \left[1A \cdot \frac{-1}{2\pi s^{-1}} \cos(2\pi s^{-1} t') \right]_0^t$$

$$= 0C + \left[-\frac{1}{2\pi} C \cos(2\pi s^{-1} t) \right] - \left[-\frac{1}{2\pi} C \cos(0) \right]$$

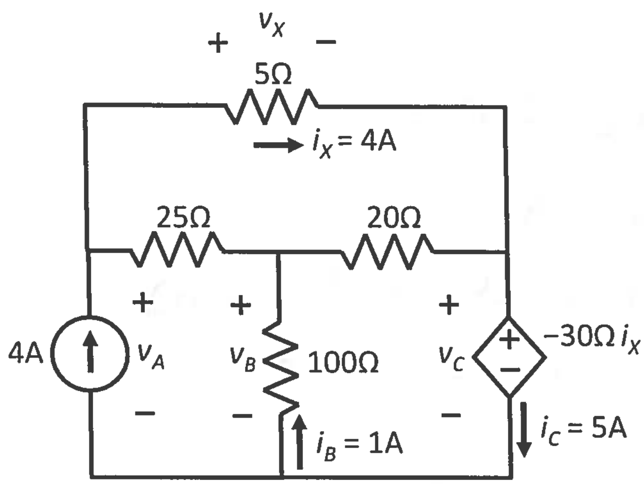
$$= \frac{1}{2\pi} C \left[1 - \cos(2\pi s^{-1} t) \right] \qquad [+1]$$

ECSE-200 Quiz # 2 ($4294967296^{1/8}$ Sept 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 below. Answer the questions.



a) Do the variables v_X and i_X satisfy passive sign convention? [1pt]

b) What is the value of v_X? [2pts]

c) The independent current source is absorbing 400W from the circuit. What is the value of v_A? [2pts]

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

e) Do the variables v_C and i_C satisfy passive sign convention? [1pt]

f) How much power is the dependent voltage source delivering or absorbing? [2pts]

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

a) yes [+1]

b) $v_x = 5\Omega \cdot i_x = 5\Omega \cdot 4A = 20V$ [+1]
[+1]

c) $P_{delivered} = 4A \cdot v_A = -400W$ [+1]

$v_A = -100V$ [+1]

d) $v_c = -30\Omega\, i_x$ [+1]

$= -30\Omega \cdot 4A$

$= -120V$ [+1]

e) yes [+1]

f) $P_{absorb} = v_c \cdot i_c$ [+1]

$= -120V \cdot 5A$

$= -600W$ absorbed [+1]

or $+600W$ delivered

g) $v_b = -i_b \cdot 100\Omega$ [+1]

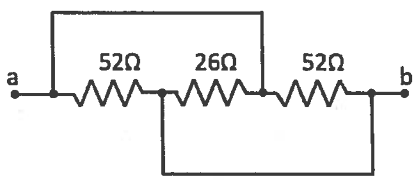
$= -1A \cdot 100\Omega$

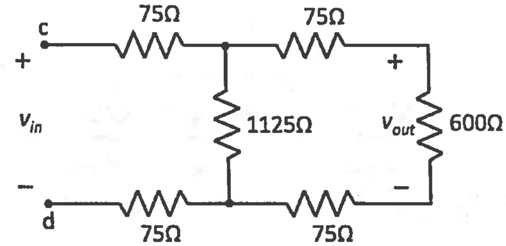
$= -100V$ [+1]

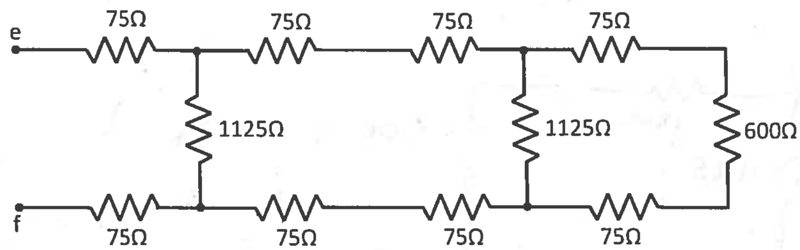
NAME____ McGill ID#____________________

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.





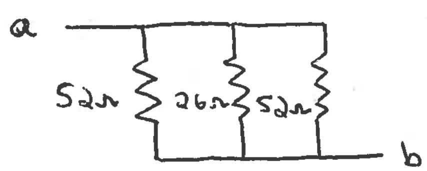


1) What is the equivalent resistance between nodes a and b ? [2pts]

2) What is the equivalent resistance between nodes c and d ? [2pt]

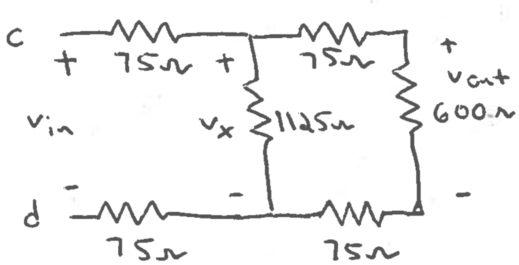
3) What is the voltage ratio, v_{out} / v_{in} ? [2pts]

4) What is the equivalent resistance between nodes e and f ? [2pts]



$R_{ab} = 52\Omega \,//\, 26\Omega \,//\, 52\Omega$ [+1]

$= 13\Omega$ [+1]



$R_{cd} = 75\Omega + 75\Omega + 1125\Omega \,//\, (75\Omega + 75\Omega + 600\Omega)$ [+1]

$= 150\Omega + 1125\Omega \,//\, 750\Omega$

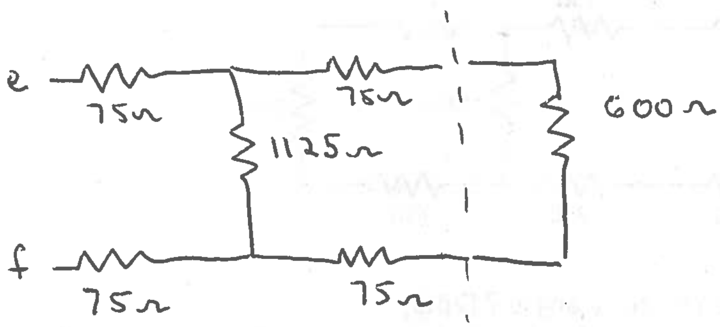
$= 150\Omega + 450\Omega$

$= 600\Omega$ [+1]

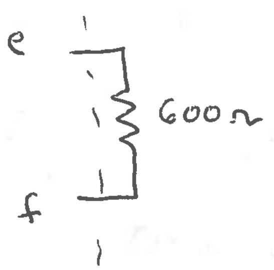
$$\frac{V_{out}}{V_x} = \frac{600\Omega}{600\Omega + 75\Omega + 75\Omega} = 0.8$$

$$\frac{V_x}{V_{in}} = \frac{1125\Omega \,//\, (75\Omega + 75\Omega + 600\Omega)}{1125\Omega \,//\, (75\Omega + 75\Omega + 600\Omega) + 75\Omega + 75\Omega} = 0.75$$

$$\frac{V_{out}}{V_{in}} = \frac{V_{out}}{V_x} \cdot \frac{V_x}{V_{in}} = 0.6 \quad [+2]$$



by 2)



by 2)

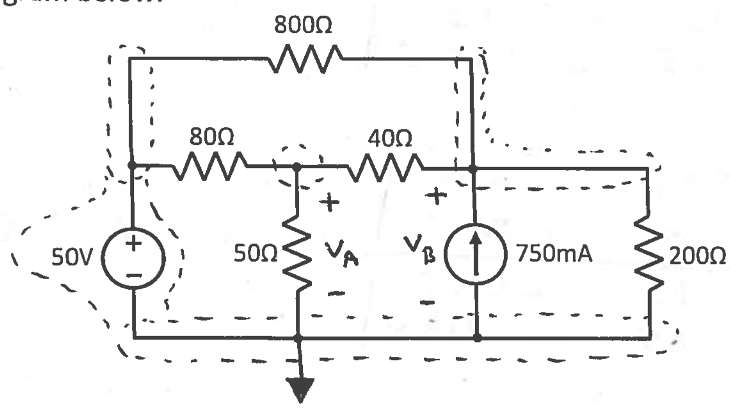
$R_{ef} = 600\Omega \quad [+2]$

ECSE-200 Quiz # 4 ($2(1+i)^8$ - 2 Sept 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 below.



1) How many node voltage variables are required to solve the circuit? [1pt]

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]

4) How much power does the independent current source deliver? [1pt]

5) How much power does the independent voltage source deliver? [2pts]

1) 2 [+1]

2) A: $0 = \frac{V_A - 50V}{80\Omega} + \frac{V_A}{50\Omega} + \frac{V_A - V_B}{40\Omega}$ [+2]

B: $0 = -0.75A + \frac{V_B}{200\Omega} + \frac{V_B - V_A}{40\Omega} + \frac{V_B - 50V}{800\Omega}$ [+2]

3) $\frac{5}{8} = \left(\frac{1}{80} + \frac{1}{50} + \frac{1}{40}\right) V_A + \left(-\frac{1}{40}\right) V_B$

$0.75 + \frac{5}{80} = \left(-\frac{1}{40}\right) V_A + \left(\frac{1}{200} + \frac{1}{40} + \frac{1}{800}\right) V_B$

$$0.625 = 0.0575\, v_A - 0.025\, v_B$$

$$0.8125 = -0.025\, v_A + 0.03125\, v_B$$

$$V_A = \frac{\begin{vmatrix} 0.625 & -0.025 \\ 0.8125 & 0.03125 \end{vmatrix}}{\begin{vmatrix} 0.0575 & -0.025 \\ -0.025 & 0.03125 \end{vmatrix}} = 34\text{ V} \qquad [+1/2]$$

$$V_B = \frac{\begin{vmatrix} 0.0575 & 0.625 \\ -0.025 & 0.8125 \end{vmatrix}}{\begin{vmatrix} 0.0575 & -0.025 \\ -0.025 & 0.03125 \end{vmatrix}} = 53.2\text{V} \qquad [+1/2]$$

c) $P_{del} = 750\text{mA} \cdot V_B = 39.9\text{ W}$ delivered [+1]

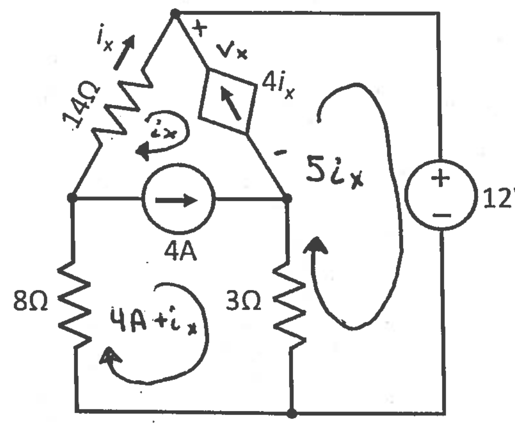
d) $P_{del} = 50\text{V} \cdot \left[\dfrac{50\text{V} - V_A}{80\Omega} + \dfrac{50\text{V} - V_B}{800\Omega} \right]$

$= 9.8\text{W}$ delivered [+2]

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) Nodal analysis is the most efficient method for solving every circuit. True or False? [1pt]

2) Mesh analysis is the most efficient method for solving every circuit. True or False? [1pt]

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

4) What is the power absorbed by the 3Ω resistor? [1pt]

5) What is the power delivered by the dependent source? [1pt]

3) KCL: $0 = (4A + i_x)\cdot 8\Omega + i_x \cdot 14\Omega + 12V$

$$i_x = \frac{-4A\cdot 8\Omega - 12V}{8\Omega + 14\Omega} = -2A \quad [+1]$$

4) $P_{abs} = [4A + i_x - 5i_x]^2 \cdot 3\Omega = (12A)^2 \cdot 3\Omega$

$= 432W$ absorbed [+1]

5) KVL: $0 = (5i_x - (4A + i_x))\cdot 3\Omega - v_x + 12V$

$v_x = -12A\cdot 3\Omega + 12V = -24V$

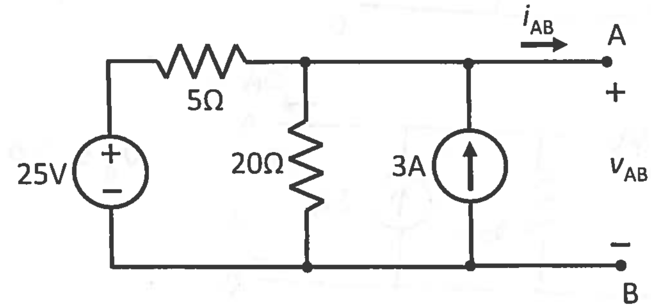
$P_{del} = v_x \cdot 4i_x = -24V \cdot (-8A) = 192W$ delivered [+1]

ECSE-200 Quiz # 6 (number of protons in a silicon atom Oct 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.



1) Find the Thévenin equivalent circuit with respect to the terminals A and B. [2pts]

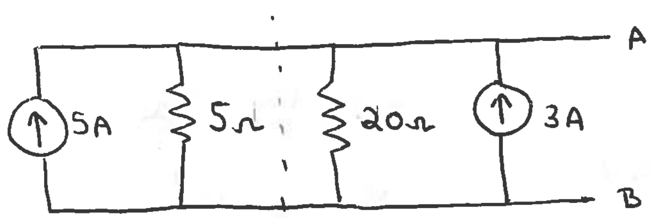
2) Find the Norton equivalent circuit with respect to the terminals A and B. [2pts]

3) Draw the diagram of i_{AB} versus v_{AB}. Label your axis intercepts. [1pt]

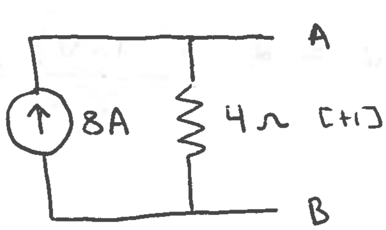
4) It is desired that v_{AB} = 0V with an open circuit at the terminals A and B. Keeping the voltage source unchanged, what should be the value (including the sign) of the current source? [1pt]

5) It is desired that v_{AB} = 0V with an open circuit at the terminals A and B. Keeping the current source unchanged, what should be the value (including the sign) of the voltage source? [1pt]

1)2)3)

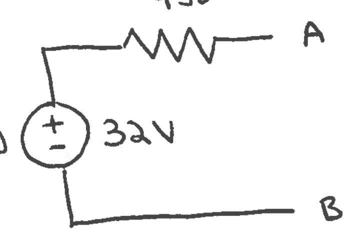


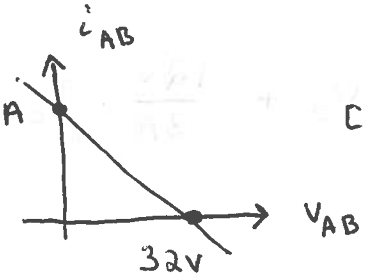
[+1]



4Ω [+1]

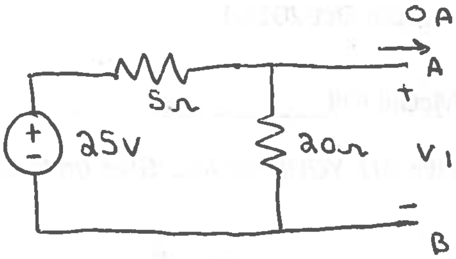
[+1]



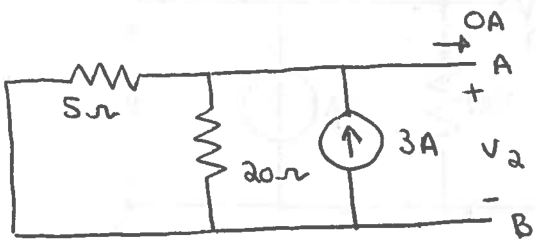


[+1]

Superposition:



$$V_1 = 25V \cdot \frac{20\Omega}{20\Omega + 5\Omega} = 20V$$



$$V_2 = 3A \cdot (20\Omega \parallel 5\Omega) = 12V$$

4) $V_{AB} = 20V + V_2' = 0V$

$V_2' = -20V$

by linearity

$$\frac{V_2}{3A} = \frac{V_2'}{I_o}$$

$$I_o = 3A \cdot \frac{(-20V)}{12V} = -5A$$

[+1]

5) $V_{AB} = V_1' + 12V = 0V$

$V_1' = -12V$

by linearity

$$\frac{V_1}{25V} = \frac{V_1'}{V_o}$$

$$V_o = 25V \cdot \frac{(-12V)}{20V} = -15V$$

[+1]

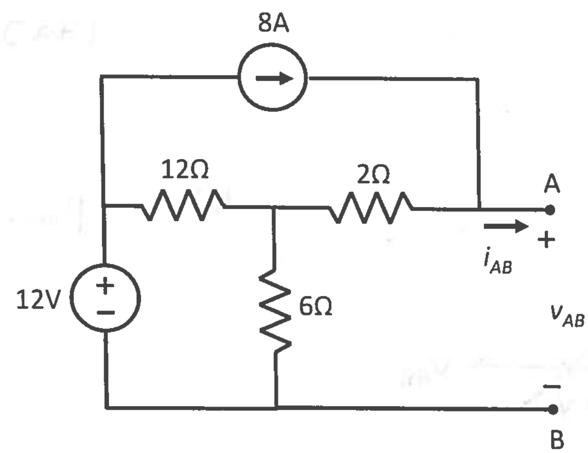
or $V_{AB} = \frac{20V}{25V} \cdot V_o + \frac{12V}{3A} \cdot I_o$

ECSE-200 Quiz # 7 (111_4 Oct 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.



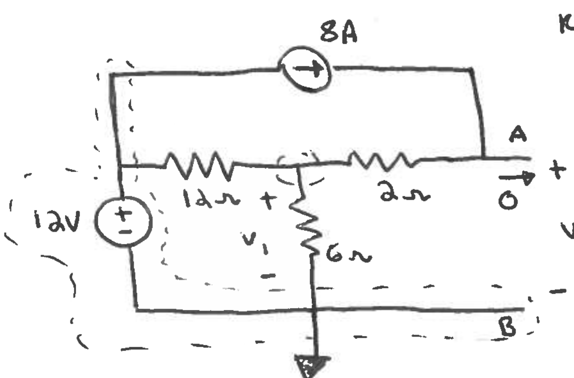
1) Find the Thévenin equivalent circuit with respect to the terminals A and B. [2pts]

2) Find the Norton equivalent circuit with respect to the terminals A and B. [2pts]

3) Draw the diagram of i_{AB} versus v_{AB}. Label your axis intercepts. [1pt]

4) What is the maximum power that this circuit can deliver to an optimally chosen load resistor attached to the terminals A and B? [2pts]

Find V_{oc}.



KCL:

$$0 = \frac{v_1 - 12V}{12\Omega} + \frac{v_1}{6\Omega} - 8A$$

$$v_1 = \frac{8A + 12V/12\Omega}{\frac{1}{12\Omega} + \frac{1}{6\Omega}}$$

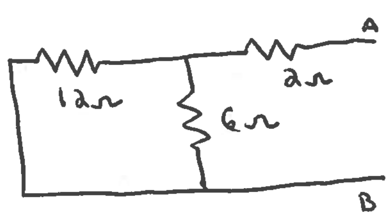
$$= 36V$$

KVL:

$$V_{oc} = v_1 + 8A \cdot 2\Omega$$

$$= 52V$$

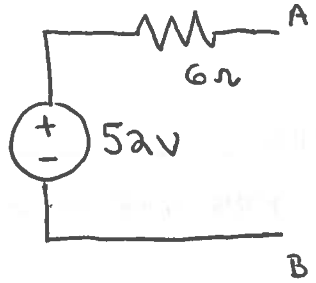
Find R_T. Turn off sources.



$$R_T = 2\Omega + 6\Omega // 12\Omega$$

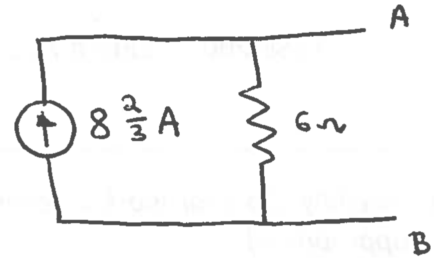
$$= 6\Omega$$

1)



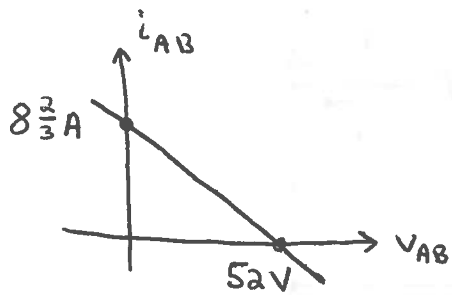
[+2]

2)



[+2]

3)



[+1]

4)

$$p_{max} = \frac{V_{oc}}{2} \cdot \frac{i_{sc}}{2} \quad [+1]$$

$$= \frac{52V \cdot 8\frac{2}{3}A}{4}$$

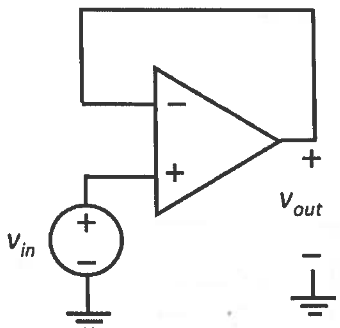
$$= 112\tfrac{2}{3}\ W \quad [+1]$$

NAME____ McGill ID#____________________

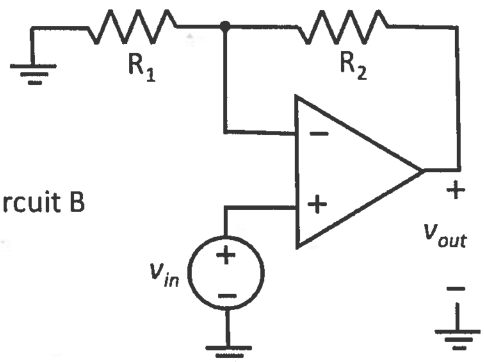
READ each question carefully. Do your work independently. SHOW ALL YOUR WORK. Give units on your answers (where appropriate).

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

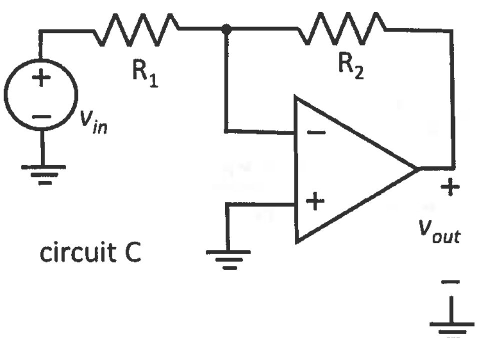
circuit A



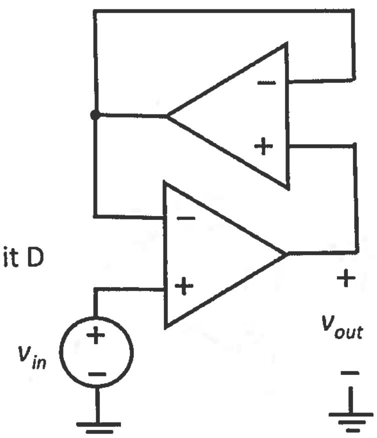
circuit B



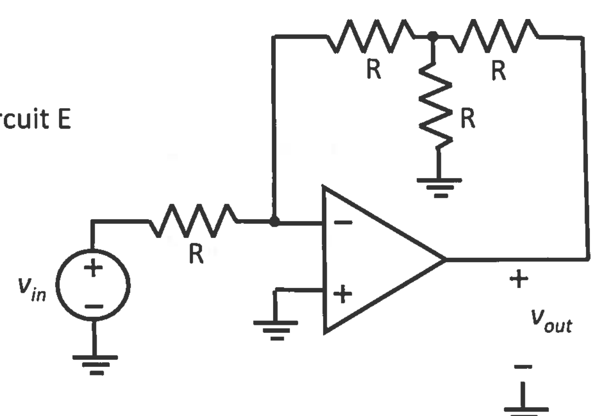
circuit C



circuit D



circuit E



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

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? [1pt]

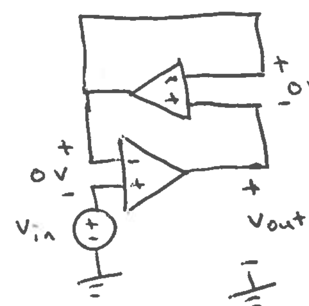
5) What is v_{out} / v_{in} for circuit E? [1pt]

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

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

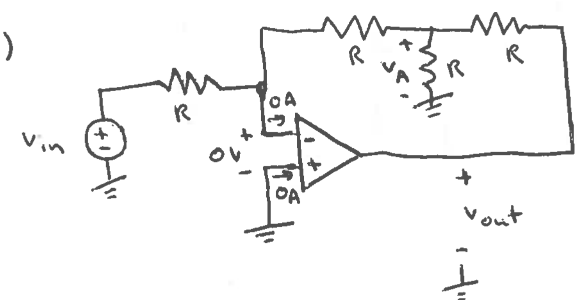
3) $\frac{v_{out}}{v_{in}} = -\frac{R_2}{R_1}$

4)



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

5)



node voltage (KCL):

$0 = \frac{0 - v_{in}}{R} + \frac{0 - v_A}{R}$

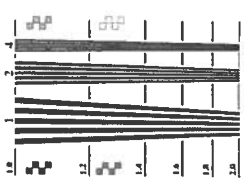
$v_A = -v_{in}$

node voltage (KCL):

$0 = \frac{v_A - 0}{R} + \frac{v_A}{R} + \frac{v_A - v_{out}}{R}$

$v_{out} = 3v_A = -3v_{in}$

$\frac{v_{out}}{v_{in}} = -3$ [+1]



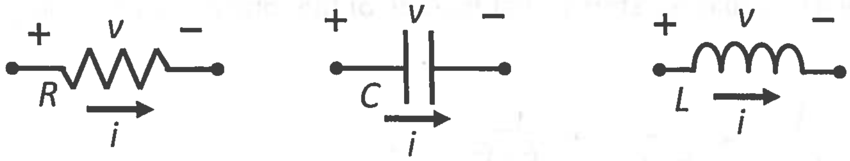
ECSE-200 Quiz #9 ($i^2(1+i)^4$ Nov 2016)

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*, *capacitor* and *resistor* as appropriate. [3pts]

2) For each of the three elements below, write an equation that gives the relationship between terminal voltage *v* and terminal current *i*. Algebraic, differential or integral equations are all acceptable. [3pts]



RESISTOR [+1]

CAPACITOR [+1]

INDUCTOR [+1]

$v = iR$ [+1]

$i = C\frac{dv}{dt}$ [+1]

$v = L\frac{di}{dt}$ [+1]

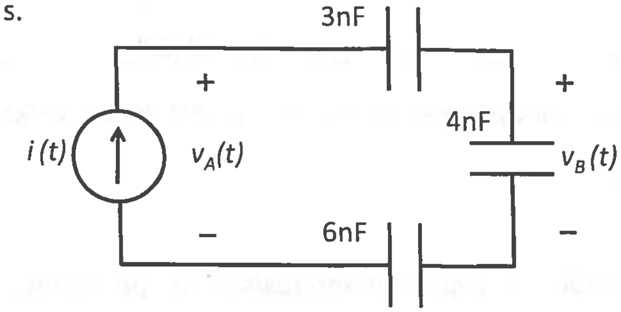
or

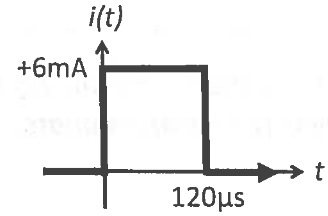
$v(t_2) - v(t_1) = \frac{1}{C}\int_{t_1}^{t_2} i(t)\,dt$

or

$i(t_2) - i(t_1) = \frac{1}{L}\int_{t_1}^{t_2} v(t)\,dt$

For the remainder of this quiz, consider the circuit and the diagram below. The capacitors store zero energy for $t < 0$ s.





3) Plot a diagram of $v_A(t)$ versus t. Label your axes. [2pts]

4) Plot a diagram of $v_B(t)$ versus t. Label your axes. [2pts]

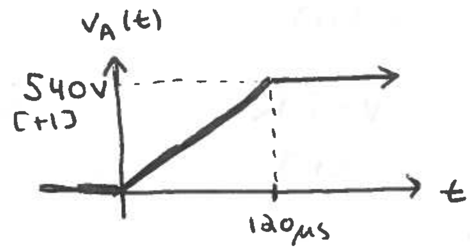
5) At t = 120 μs, the 4 nF capacitor stores what fraction of the total energy stored? [2pts]

3)
$$\frac{1}{C_{eq}} = \frac{1}{3nF} + \frac{1}{4nF} + \frac{1}{6nF}$$

$$C_{eq} = \frac{4}{3} nF$$

$$v_A(t) - v_A(0) = \int_0^t \frac{i(t')dt'}{C_{eq}}$$

$$v_A(120\mu s) = \frac{6mA \cdot 120\mu s}{4/3\ nF} = 540V$$

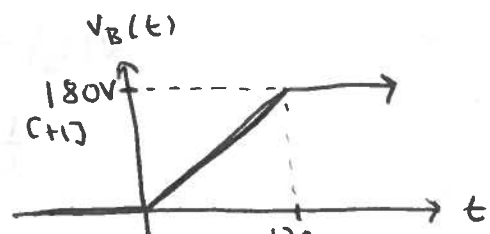


[+1] for shape

4)
$$v_B(t) - v_B(0) = \int_0^t \frac{i(t')dt'}{4nF}$$

$$v_B(120\mu s) = \frac{6mA \cdot 120\mu s}{4nF}$$

$$= 180V$$



[+1] for shape

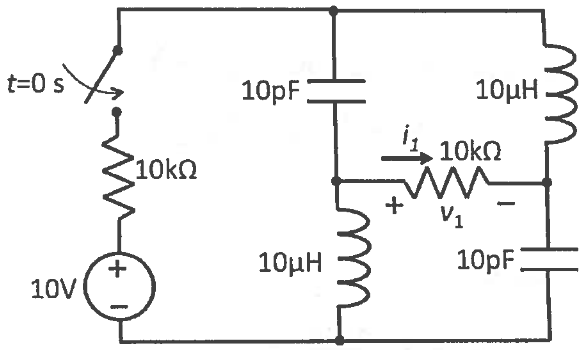
5)
$$f = \frac{\frac{1}{2} \cdot 4nF \cdot (180V)^2}{\frac{1}{2} \cdot \frac{4}{3} nF \cdot (540V)^2} = \frac{1}{3} \quad [+2]$$

ECSE-200 Quiz #10 ([tan(3π/11)+4sin(2π/11)]^2 Nov 2016)

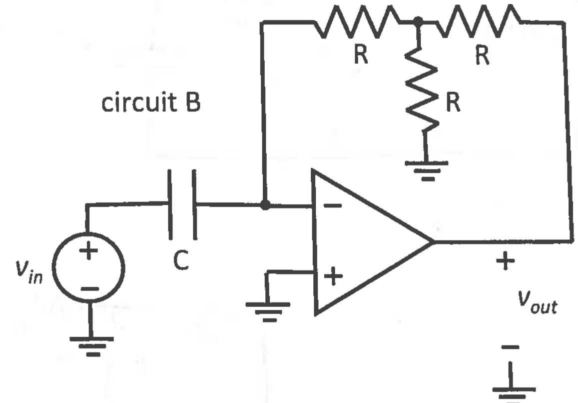
NAME________________________________ McGill ID#__________________

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

circuit A



circuit B

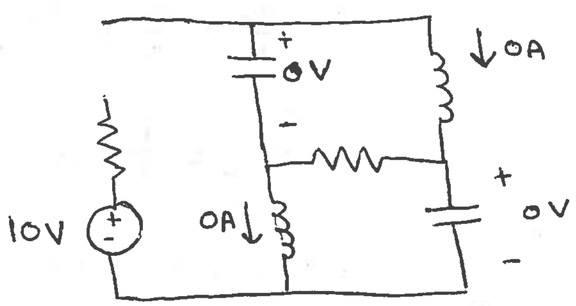


Consider circuit A. The circuit is in dc steady state for $t < 0$. The switch closes instantly at t = 0s.

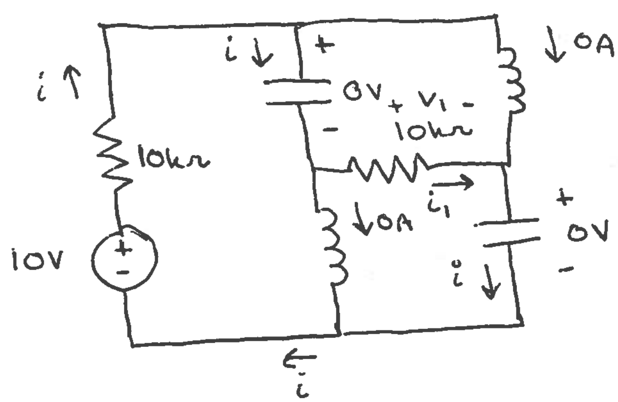
1) What is $v_1(0+)$? [1pt] 2) What is $v_1(\infty)$? 3) What is $i_1(0+)$? 4) What is $i_1(\infty)$?

Consider circuit B. Assume ideal op-amp behaviour. 5) Find v_{out} in terms of v_{in}.

A $t = 0-$



$t = 0+$



KCL: $i_1 = i$

KVL + Ohm:

$-10V + 10k\Omega \cdot i + 10k\Omega\, i_1 = 0$

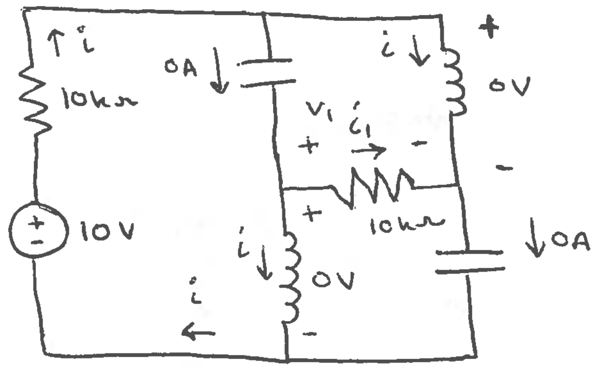
$i_1(0+) = 10V / 20k\Omega$

$= 0.5mA$ [+1]

$v_1(0+) = 10k\Omega \cdot i_1(0+)$

$= 5V$ [+1]

$t \to \infty$



KCL: $i_1 = -i$

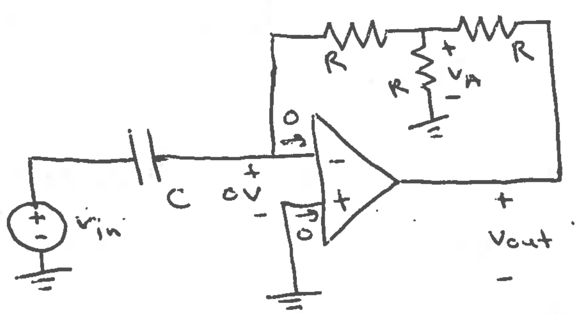
KVL + Ohm:

$$-10V + 10k\Omega \cdot i - 10k\Omega \, i_1 = 0$$

$$i_1(\infty) = \frac{-10V}{20k\Omega} = -0.5\,mA \quad [+1]$$

$$v_1(\infty) = 10k\Omega \cdot i_1(\infty)$$
$$= -5V \quad [+1]$$

B



KCL:

$$0 = -C\frac{dv_{in}}{dt} - \frac{V_A}{R}$$

$$\hookrightarrow V_A = -RC\frac{dv_{in}}{dt}$$

KCL:

$$0 = \frac{V_A}{R} + \frac{V_A}{R} + \frac{V_A - V_{out}}{R}$$

$$\hookrightarrow V_A = \frac{1}{3} V_{out}$$

$$\therefore \; V_{out} = -3RC\frac{dv_{in}}{dt} \quad [+1]$$

ECSE-200 Quiz #11 (2(x+y) = 10x + y; x,y ∈ {1,2,3,...} Nov 2016)

NAME____ McGill ID#__________________

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

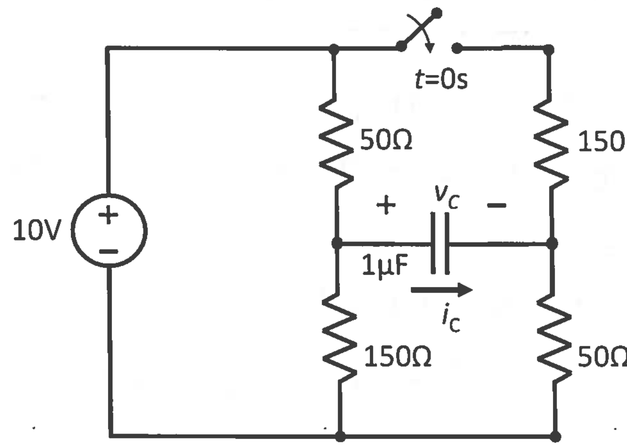
1) Express the time constant τ of an RC circuit in terms of *R* and *C*. [1pt] $\tau = RC$ [+1]

Consider the circuit diagram. The circuit is in dc steady-state for $t < 0$. The switch closes instantaneously at $t = 0$s.

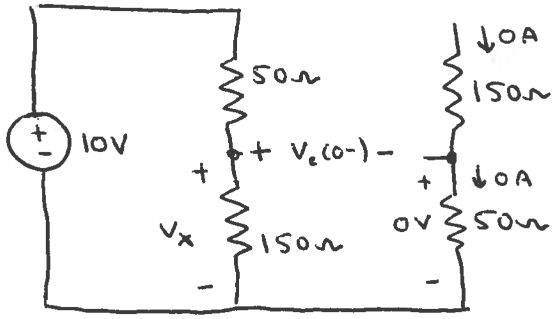
2) Find $v_c(t)$ for $t > 0$. [4pts]

3) Plot $v_c(t)$ versus t. Label your axes. [1pt]

4) Find $i_c(t)$ for $t > 0$. [1pt]



2) $t = 0-$

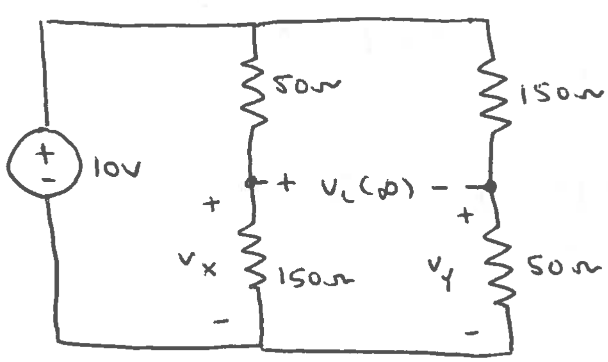


$$V_x = 10V \cdot \frac{150\Omega}{50\Omega + 150\Omega} = 7.5V$$

$$V_c(0-) = V_x = 7.5V$$

$$\therefore V_c(0+) = V_c(0-) = 7.5V \quad [+1]$$

$t \to \infty$

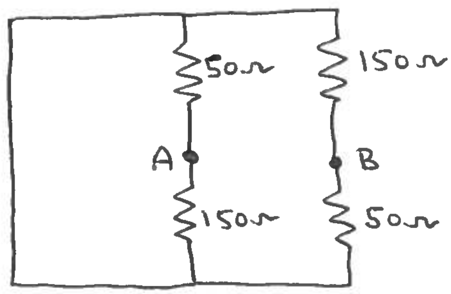


$$V_x = 10V \cdot \frac{150\Omega}{200\Omega} = 7.5V$$

$$V_y = 10V \cdot \frac{50\Omega}{200\Omega} = 2.5V$$

$$V_c(\infty) = V_x - V_y = 5V \quad [+1]$$

Find τ. Turn off voltage sources and find R_T at A and B.



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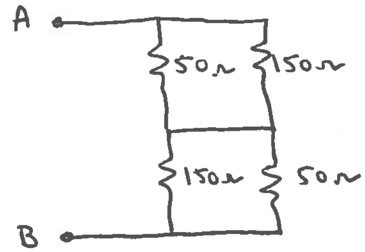


$R_T = 50\Omega \,||\, 150\Omega + 50\Omega \,||\, 150\Omega = 75\Omega$

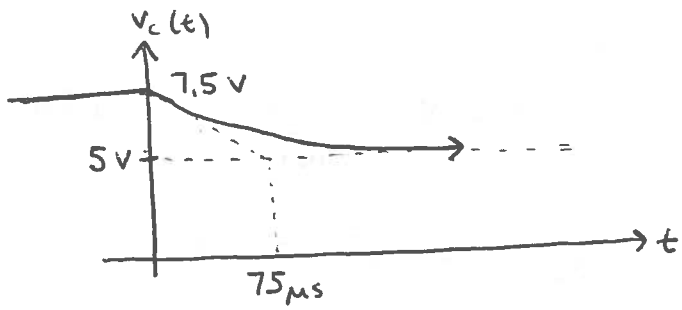
$\tau = R_T C = 75\Omega \cdot 1\mu F = 75\,\mu s$ [+1]

for $t > 0$:

$V_c(t) = v_c(\infty) + [v_c(0^+) - v_c(\infty)]\exp(-t/\tau)$

$= 5V + 2.5V\exp(-t/75\mu s)$ [+1]

3)



[+1]

4)

$i_c(t) = C\,\dfrac{dv_c}{dt}$

$= 1\mu F \cdot 2.5V \cdot \left(\dfrac{-1}{75\mu s}\right)\exp(-t/75\mu s)$

$= -33.33\,mA\,\exp(-t/75\mu s)$ [+1]

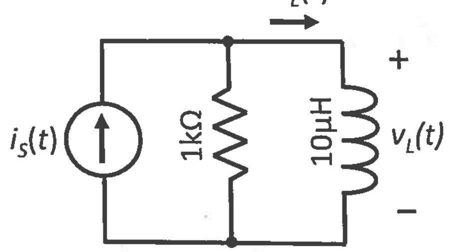
$t > 0$.

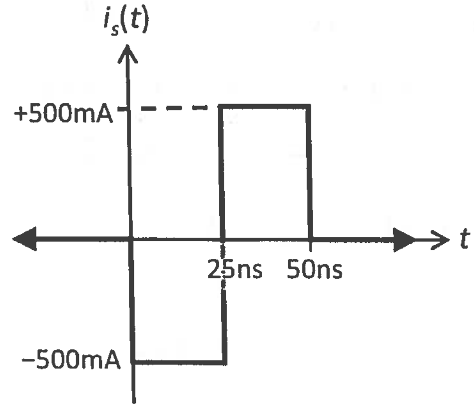
ECSE-200 Quiz #12 (3^2+4^2 Nov 2016)

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 $i_L(50\text{ns})$? [1pt]

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

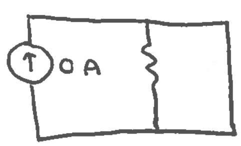
1) $i_s(t) = -500\,\text{mA}\,u(t)$ [+1]

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

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

2) Find step response.

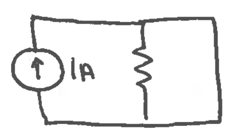
$t = 0-$



$\downarrow i_L(0-) = 0\text{ A}$

$i_L(0+) = i_L(0-) = 0\text{ A}$

$t \to \infty$



$\downarrow i_L(\infty) = 1\text{A}$

$\tau = \dfrac{L}{R_{th}} = \dfrac{10\mu\text{H}}{1\text{k}\Omega} = 10\text{ns}$

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

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

$$+\,1000\,\text{mA}\,[1 - \exp(-(t-25\text{ns})/10\text{ns})]\,u(t-25\text{ns}) \qquad [+1]$$

$$-\,500\,\text{mA}\,[1 - \exp(-(t-50\text{ns})/10\text{ns})]\,u(t-50\text{ns}) \qquad [+1]$$

3) $$i_L(50\text{ns}) = -500\,\text{mA}\,[1 - \exp(-5)]$$

$$+\,1000\,\text{mA}\,[1 - \exp(-2.5)]$$

$$-\,500\,\text{mA} \cdot 0$$

$$= 421\,\text{mA} \qquad [+1]$$

4) $$V_L = L\,\frac{di_L}{dt}$$

unit step response for inductor voltage

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

$$= \frac{10\,\mu\text{H}}{10\text{ns}} \cdot 1\text{A}\,\exp(-t/10\text{ns})\,u(t)$$

$$= 1\,\text{kV}\,\exp(-t/10\text{ns})\,u(t)$$

$$V_L(t) = -500\text{V}\,\exp(-t/10\text{ns})\,u(t)$$

$$+\,1000\text{V}\,\exp(-(t-25\text{ns})/10\text{ns})\,u(t-25\text{ns})$$

$$-\,500\text{V}\,\exp(-(t-50\text{ns})/10\text{ns})\,u(t-50\text{ns}) \qquad [+1]$$

alternatively, one may solve for each time interval individually.