**ECE 203**
**Exam 2**

Name Ethan Rashap Please also put your name on the back of the last page of the exam.

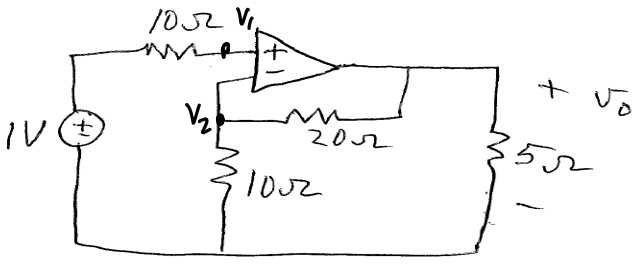
Open notes. No computers or other internet-connected devices. You must show your work on each problem in order to get credit for your answer, even if you can do the work in your head. You must show sufficient work to demonstrate that you know how to solve the problem- guesses will not get credit.

**ANSWERS (fill in your answers here)**

| | |
|---|---|
| 1. A | 6. D |
| 2. C | 7. C |
| 3. D | 8. B |
| 4. B | 9. A |
| 5. C | 10. D |

1. For the Op-amp circuit shown, find $v_o$.

(A) 3 V B) -2 V C) 1 V D) -3 V




$\frac{V_2 - V_o}{20} + \frac{V_2}{10} = 0$

$30V_2 - 10V_o = 0$

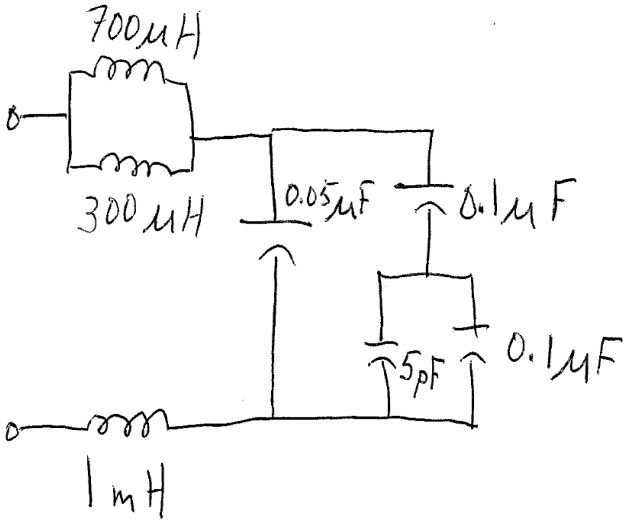
① $\rightarrow V_o = 3V_2$

$V_2 = V_1 = 1V$ ②

$\therefore V_o = 3V_2 = 3(1V)$

$V_o = 3V$

2. Which of the following is the equivalent of the capacitor network shown below.

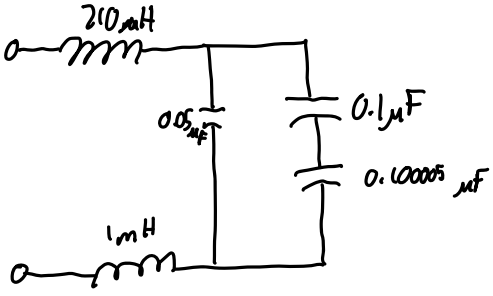



$5pF \| 0.1\mu F = (5\times10^{-12}) + (0.1\times10^{-6})$

$= 1.00005\times10^{-7}$

$700\mu H \| 300\mu H \Rightarrow \frac{1}{L_{eq}} = \frac{1}{700\mu H} + \frac{1}{300\mu H}$

$\frac{1}{L_{eq}} = \frac{1}{4761.9} \Rightarrow L_{eq} = 210\mu H$

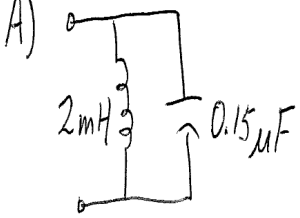



$\frac{1}{C_{eq}} = \frac{1}{0.1\mu F} + \frac{1}{0.1\mu F}$

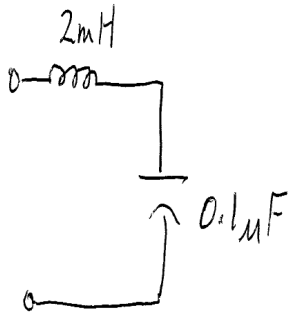
$C_{eq} = 5\times10^{-8}F$

$5\times10^{-8}F \| 0.05\mu F = 0.1\mu F$

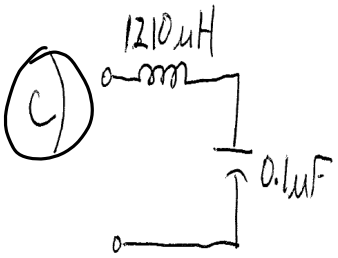
A)



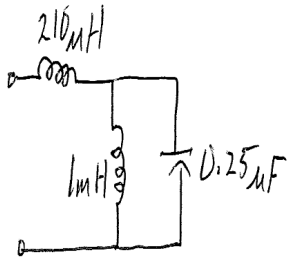

B)

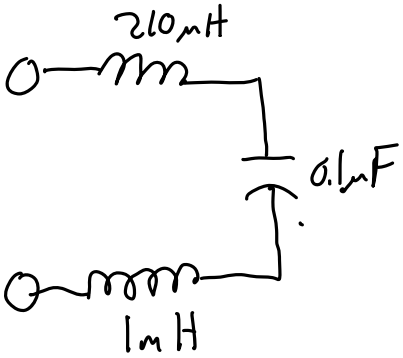



C)



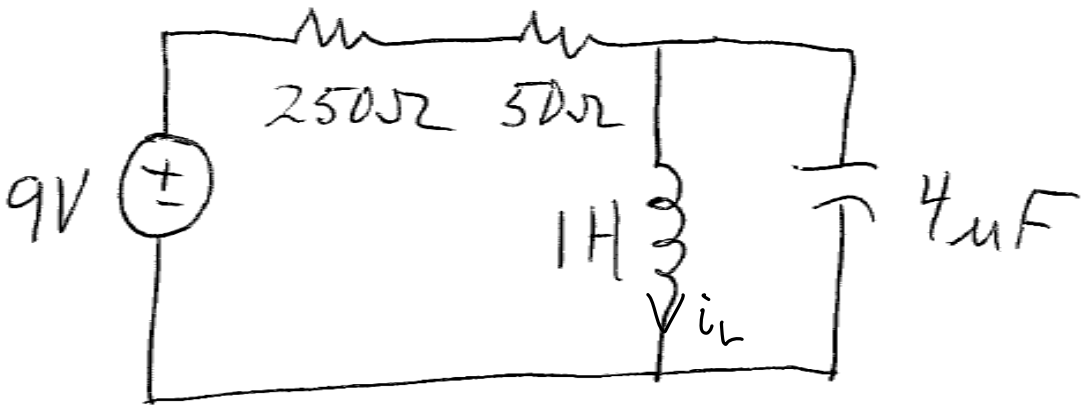

D)



3. Find the energy stored in the inductor.

A) 0.65 mJ B) 40.5 J C) 0.16 mJ D) 0.45 mJ




$$i_L = \frac{9V}{(250+50\Omega)} = 0.03A$$

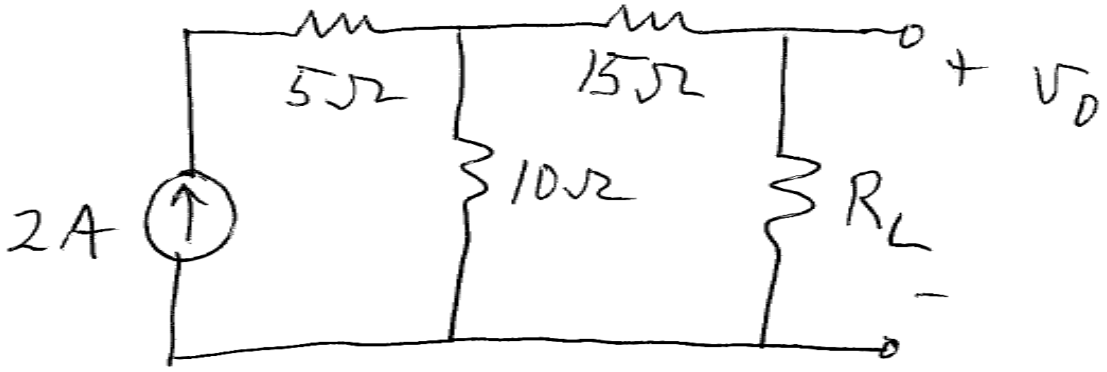
$$Energy = \frac{1}{2} L i^2$$

$$E = \frac{1}{2}(1H)(0.03)^2$$

$$E = \frac{0.9\times10^{-3}}{2} = 0.00045J$$

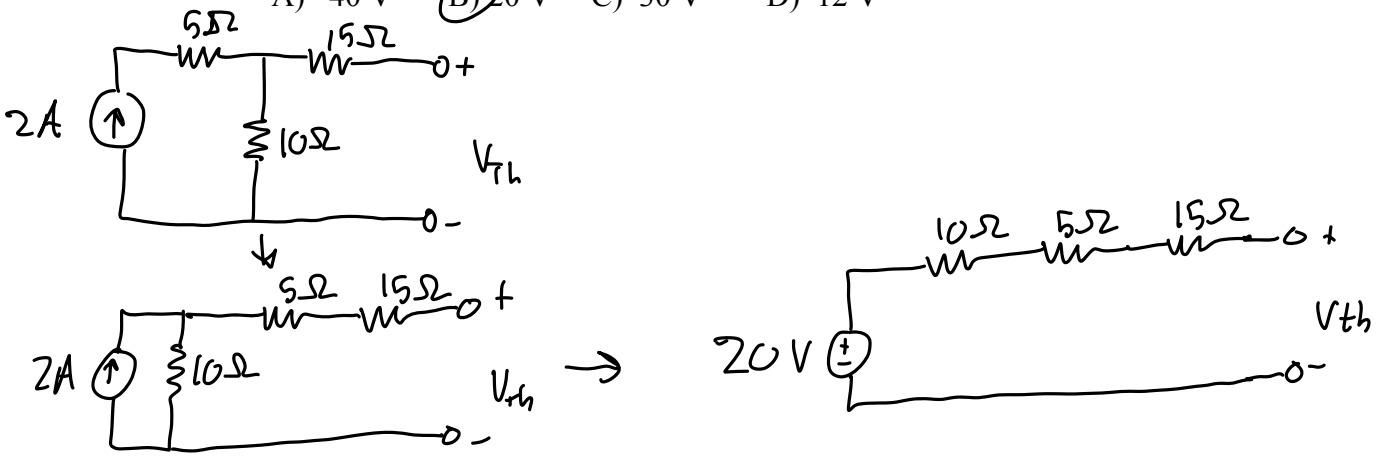
$$E = 0.45mJ$$

Problems 4 and 5 refer to the following circuit. You would like to use Thévenin's theorem to find the voltage $V_o$ (the voltage across the load resistor, $R_L$) in this circuit.




4. Find the Thévenin voltage (also known as the open-circuit voltage). Do this by removing the load resistor.

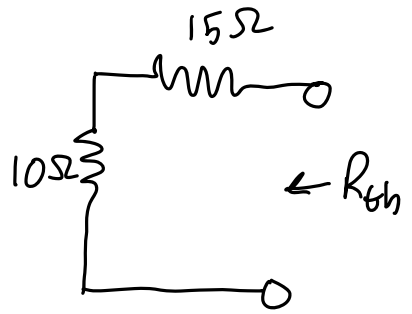
   A) 40 V  B) 20 V  C) 30 V  D) 12 V




5. Find the Thévenin resistance. You will also need to remove the load resistor.

   A) 3.33 Ω  B) 6 Ω  C) 25 Ω  D) 10 Ω

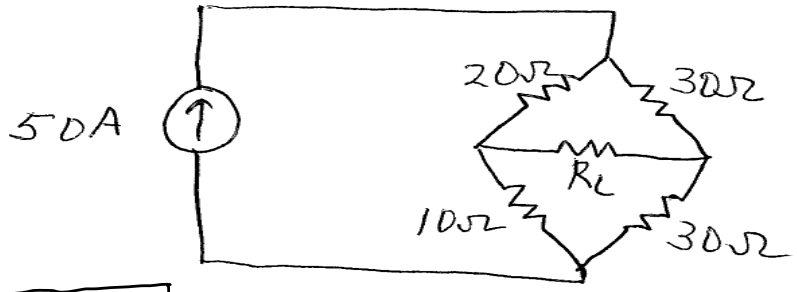
Short circuit source

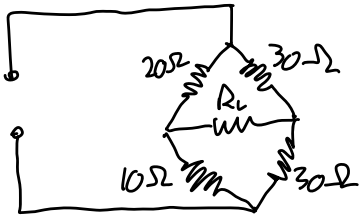



$R_{th} = 15\Omega + 10\Omega = 25\Omega$

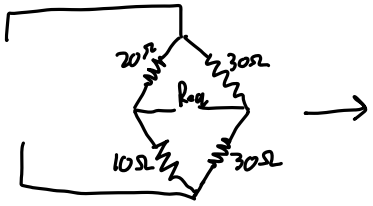
6. Find the value of $R_L$ for maximum power transfer to the load.

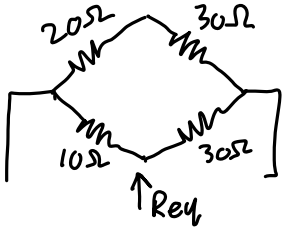
A) 20||10 + 15 Ω  B) 30||60 Ω  C) 20||30 + 40 Ω  D) 50||40 Ω




$P_{max}$ when $R_L = R_{eq}$



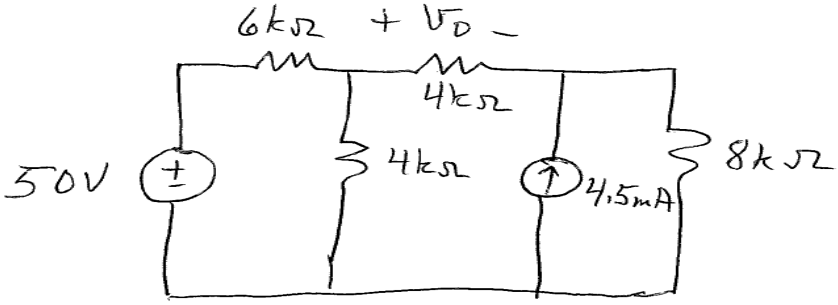



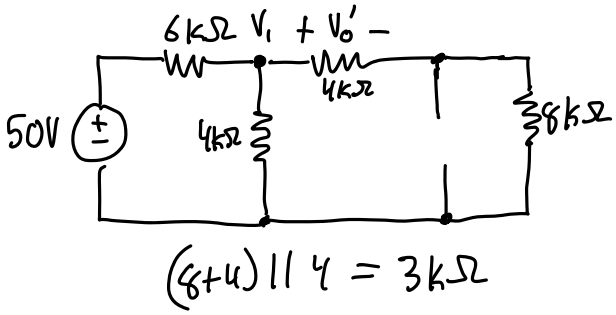

$(20+30) \,||\, (10+30)$

$50 \,||\, 40$

7. You would like to use superposition to find the value for $v_o$. For the first step in the process, you are going to calculate $v_o$' for the voltage source only. $v_o$' is:

A) 12.5 V  B) 2.22 V  C) 5.56 V  D) 7.78 V



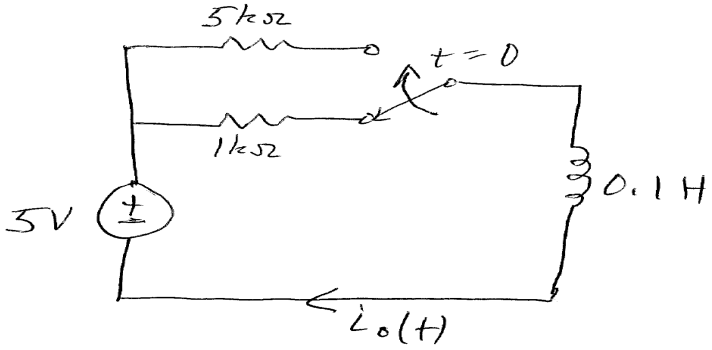

$(4+4) \,||\, 4 = 3k\Omega$

$$V_1 = 50V\left(\frac{3k\Omega}{3k\Omega+6k\Omega}\right) = 16.67V$$

$$V_o' = V_1\left(\frac{4k\Omega}{(4+8)k\Omega}\right) = \frac{16.67}{3}$$

$$V_o' = 5.56V$$

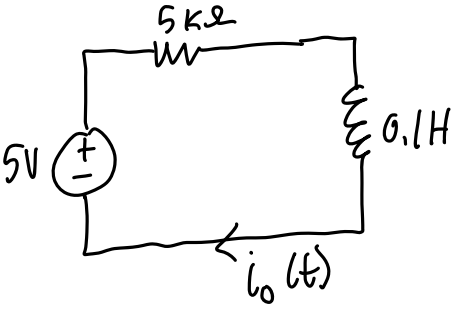
Problems 8, 9, and 10 refer to the following first order circuit.




8. Find the current thru the inductor at $t = 0^+$.

A) 1 mA (B) 5 mA C) 6 mA D) 0 mA

@ $t=0^+$

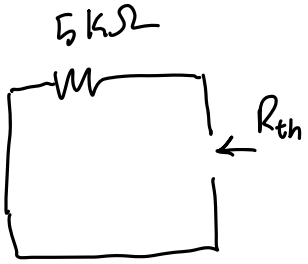



$$i_L(0^-) = \frac{5V}{1k\Omega} = 5mA$$

$$i_L(0^-) = i_L(0^+) = 5mA$$

9. What is the time constant for the circuit after the switch is thrown?

(A) 20 μs B) 120 μs C) 17 μs D) 100 μs



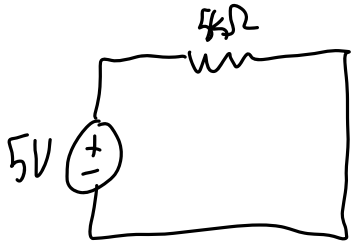

$$\tau = \frac{L}{R}$$

$$R = R_{th} = 5k\Omega, \; L = 0.1H$$

$$\tau = \frac{0.1H}{5 \times 10^3 \Omega}$$

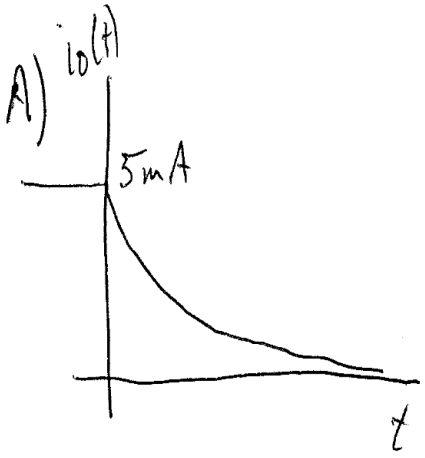
$$\tau = 2 \times 10^{-5} = 20\mu s$$

10. Which of the following waveforms for $i_o(t)$ is correct?

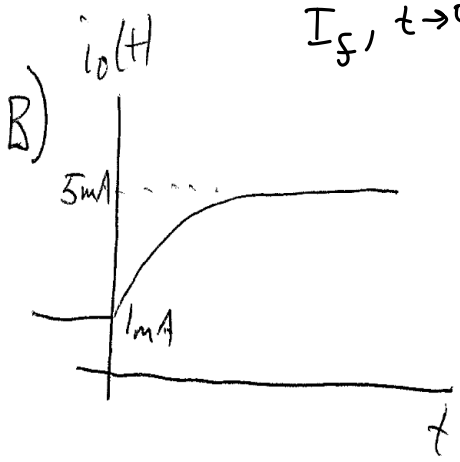



$I_f,\ t \to \infty$ $\quad i(\infty) = \frac{V}{R} = 1$

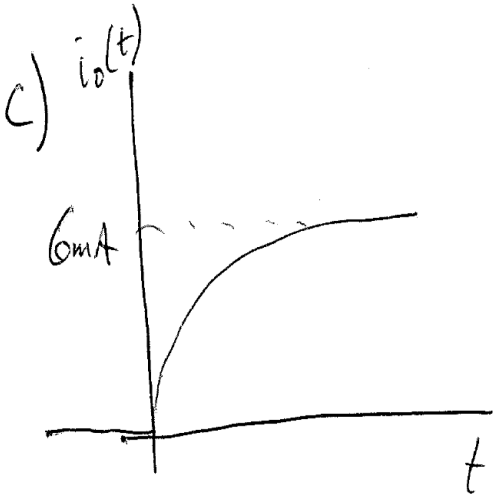
A)




B)




C)




D)