Name _____

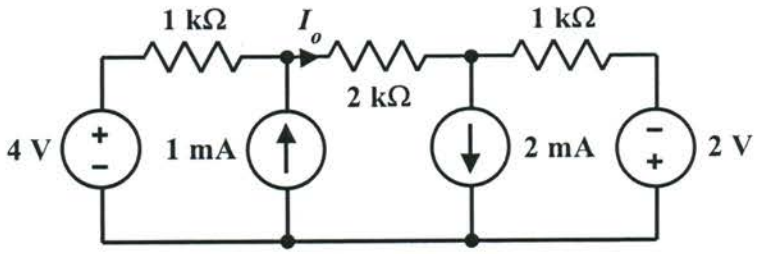
EE 2240

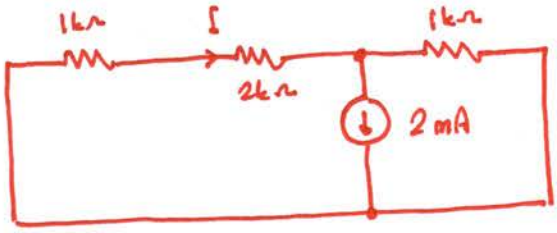
Exam #2

Thursday, March 31, 2016

2:30PM – 3:45PM

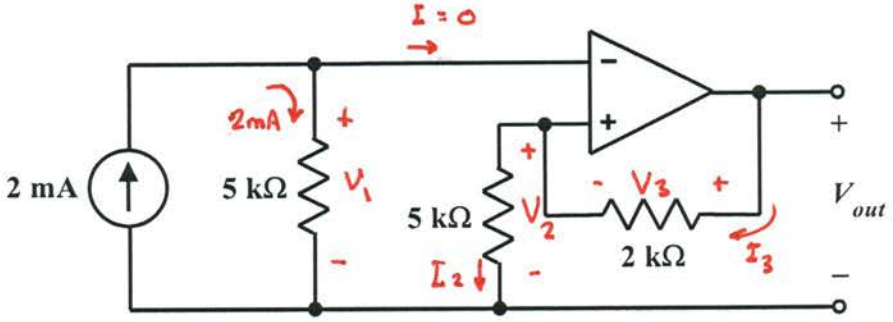
1. [Superposition] Suppose you have decided to use the superposition method to solve for the value of I_o in the circuit shown below. As a first step, you want to solve for the contribution due to the 2mA independent current source. Show your work and determine this contribution. ***You are not required to find the value of I_o, but just to determine the contribution due to the 2mA current source.***





$$I = \frac{1k\Omega}{3k\Omega + 1k\Omega}(2mA) = \frac{1}{2}\,mA$$

2. [Operational Amplifier Circuit] Find the output voltage, V_{out}, of the circuit shown below:



$V_1 = (5k\Omega)(2mA) = 10\,V$

$V_2 = V_1 = 10\,V$

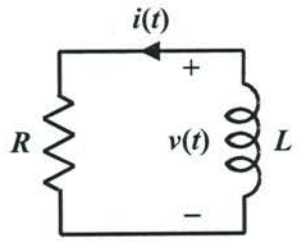
$I_2 = \frac{V_2}{5k\Omega} = 2\,mA$

$I_3 = I_2 = 2\,mA$

$V_3 = (2k\Omega)\,I_3 = 4\,V$

$V_{out} = V_3 + V_2 = 14\,V$

3. [RL Circuit] In the circuit shown below, $v(t) = 10e^{-2t}$ V and $i(t) = 2e^{-2t}$ A.



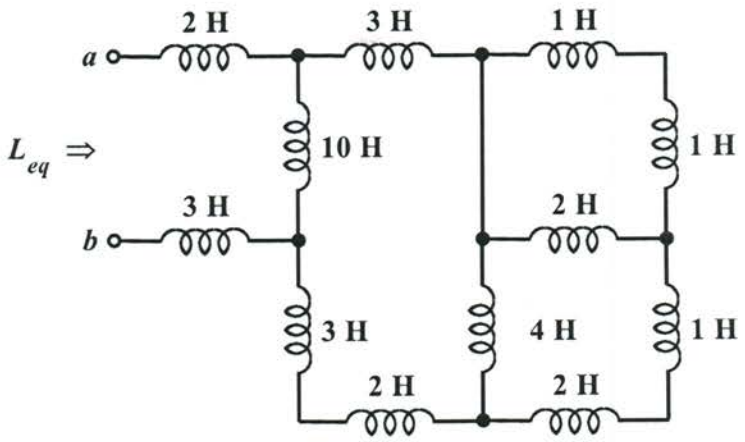
(a) Determine the value of R.

$$v(t) = R\,i(t) \Rightarrow R = \frac{v(t)}{i(t)} = \frac{10e^{-2t}\ \text{V}}{2e^{-2t}\ \text{A}} = 5\ \Omega$$

(b) Determine the value of L.

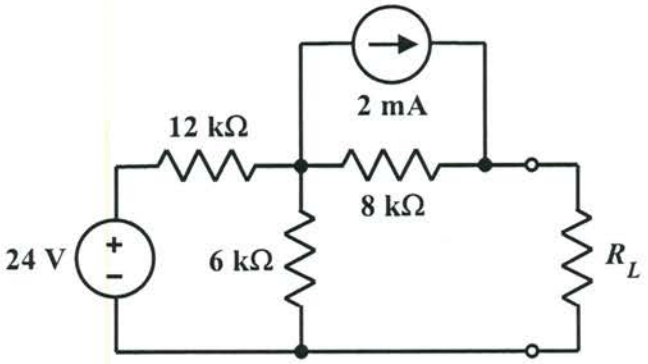
$$v(t) = -L\frac{di}{dt} \Rightarrow L = -\frac{v(t)}{\left(\frac{di}{dt}\right)} = -\frac{10e^{-2t}\ \text{V}}{-4e^{-2t}\ \text{A/s}} = 2.5\ \text{H}$$

4. [Capacitance/Inductance] Determine the equivalent inductance with respect to terminals *a*-*b*.



$L_{eq} = 10$ H

5. [Maximum Power Transfer Theorem] For the circuit shown below:



(a) Find the value of the load resistance R_L needed for maximum power transfer to the load.

$$R_L = 8k\Omega + (12k\Omega \| 6k\Omega)$$
$$= 8k\Omega + 4k\Omega$$
$$= 12k\Omega$$

(b) For R_L equal to the value determined in part (a), find the power delivered to the load.

$$V_T = (8k\Omega)(2mA) + \left(\frac{6k\Omega}{12k\Omega + 6k\Omega}\right)(24V)$$
$$= 16 + 8 = 24V$$

$$\therefore P_L = \frac{\left(\frac{24}{2}\right)^2}{12k\Omega} = 12\,mW$$