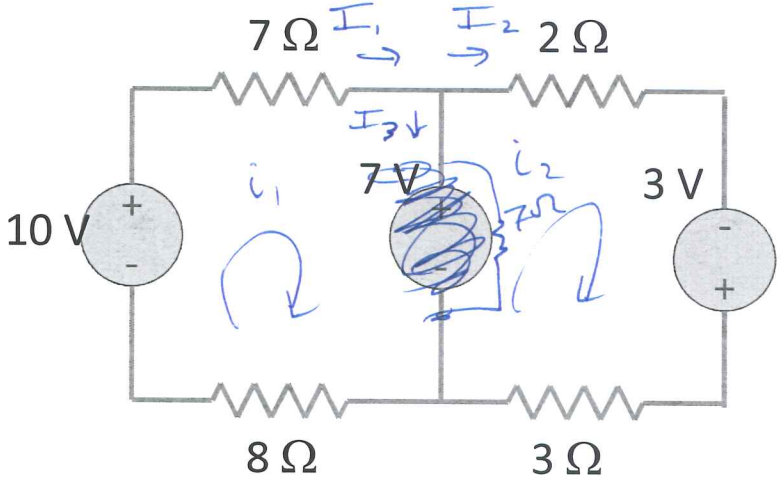
Mesh Analysis Example 1



Note: I changed example to be a 7Ω resistor in the center.

KVL

$-10V + i_1 7\Omega + (i_1 - i_2)7\Omega + i_1 8\Omega = 0$

$-(i_1 - i_2)7\Omega + i_2 2\Omega - 3V + i_2 3\Omega = 0$

Solve i_1, i_2

then I_1 I_2 I_3

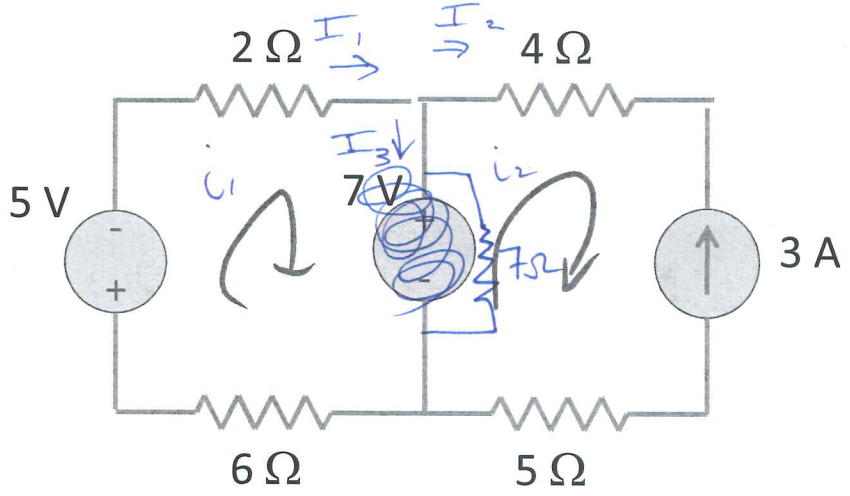
then voltages.

$I_1 = i_1$

$I_2 = i_2$

$I_3 = i_1 - i_2$

Mesh Analysis Example 2



$I_1 = i_1$

$I_2 = i_2$

$I_3 = i_1 - i_2$

Also change 7V to resistor.

NO 5A

$5V + i_1\,2\Omega + (i_1 - i_2)\,7\Omega = 0$

$i_2 = -3A$

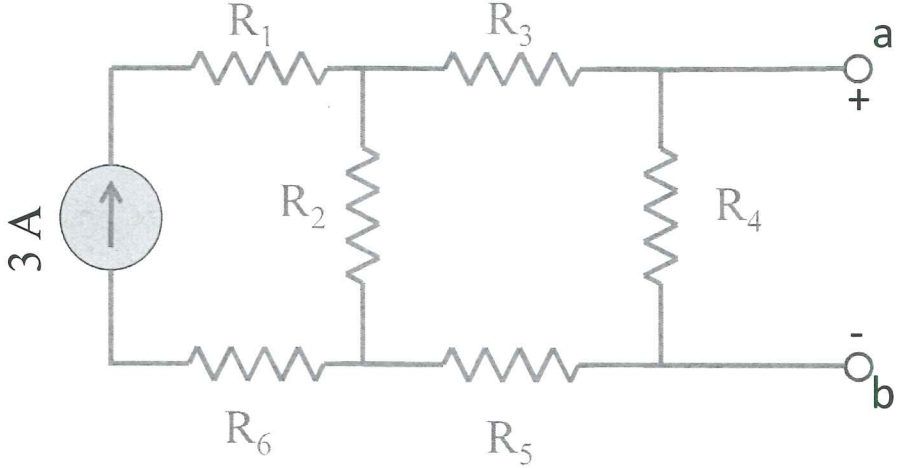
Solve i_1, i_2

then I_1 I_2 I_3

then Voltages

Thevenin/Norton example 1

Find the Thevenin & Norton equivalent circuit of the circuit below with respect to terminals a and b:

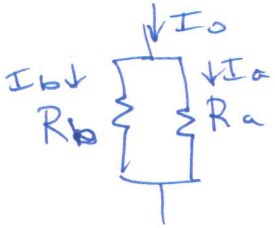


Step one Vth

Calc. Vab w/nothing connected.

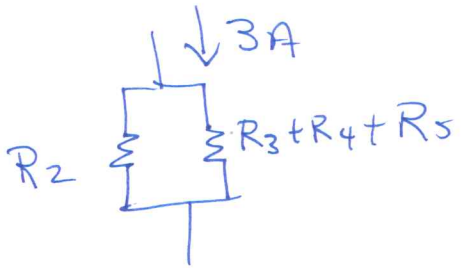
Hint: find current thru R_4 then $V_{ab} = R_4 \times$ current thru R_4

Use knowledge of current divider:



$$I_a = \left(\frac{R_b}{R_a + R_b}\right) I_o$$

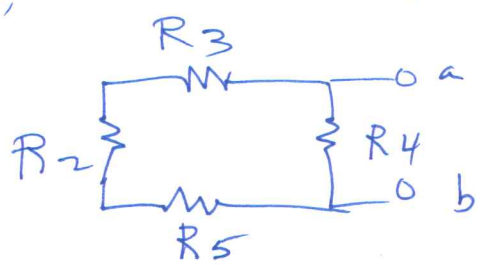
then



$$\text{Curr thru } R_4 = 3A \frac{R_2}{R_2+R_3+R_4+R_5}$$

$$\Rightarrow V_{th} = \frac{R_2 R_4}{R_2+R_3+R_4+R_5} 3A$$

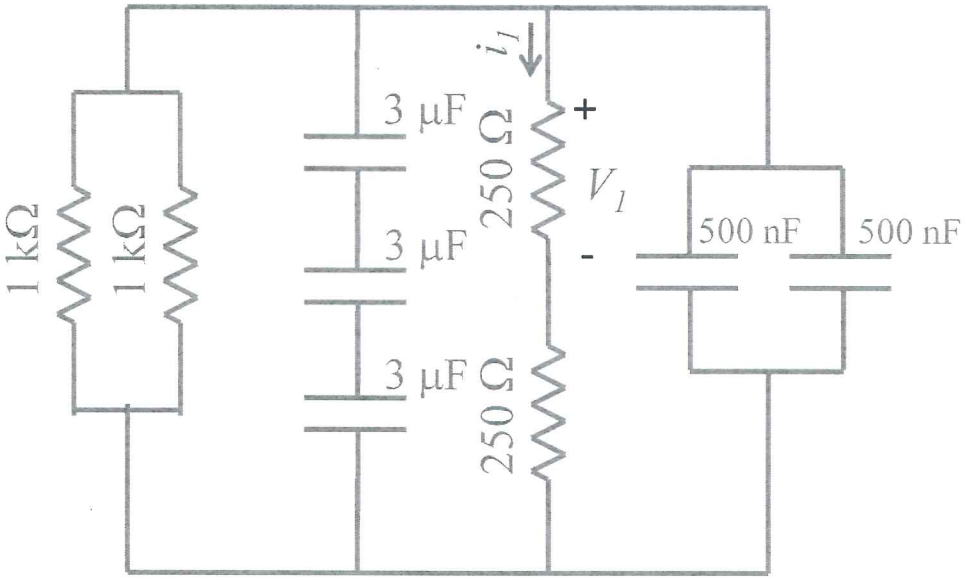
For R_{th}, Find R_{ab} when ind. sources off:



$$R_{th} = R_4 \| (R_2 + R_3 + R_5)$$

Example RC problem 1

Find $i_1(t)$, given that $V_1(t=0) = 3$ Volts



$v(t) = v(t=0)\, e^{-t/R_{eq}C_{eq}}$

$= R_{eq} \quad C_{eq}$

$R_{eq} = (1k\Omega \,||\, 1k\Omega) \,||\, (250\Omega + 250\Omega)$

$= 500\Omega \,||\, 500\Omega = 250\Omega$

$C_{eq} = (500nF \,||\, 500nF) \,||\, (1\mu F)$

~~series with~~

$= 1\mu F \,||\, 1\mu F$

$= 2\mu F$

= 3 μF in series with 3 μF in series with 3 μF

$R_{eq} C_{eq} = 500\mu s = 0.5ms$

$(= 2\mu F \times 250\Omega)$

$V_1(t) = \frac{1}{2} V(t) \Rightarrow V_1(t=0) = \frac{1}{2} V(t=0)$

$\Rightarrow V(t=0) = 6V$

$i_1(t) = \frac{V_1(t)}{250\Omega} = \frac{1}{500\Omega} V(t)$

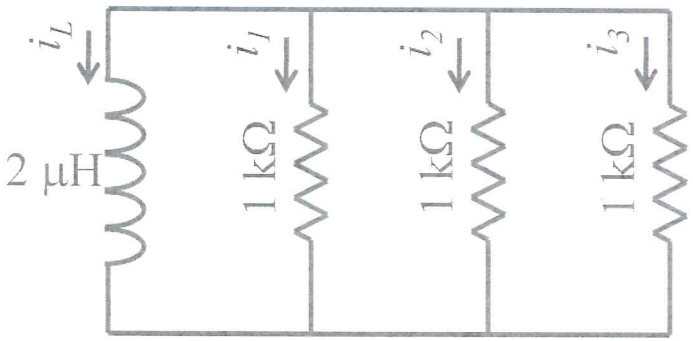
$= \frac{6V}{500\Omega} e^{-t/0.5ms}$

$= \frac{6}{500} A\, e^{-t/0.5ms} = i_1(t)$

Example LR problem #1

(Students) Find $i_1(t)$ given $i_L(t=0) = 5$ A.

Hint: $i_1+i_2+i_3 = -i_L$. How are i_1, i_2, i_3 related?

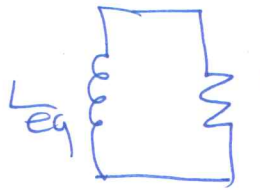


$i_1 = i_2 = i_3$

$i_1 = -\frac{1}{3} i_L$

$i_1(t) = -\frac{5}{3} A\, e^{-t/\frac{2}{3}ms}$

$i_L(t) = i_L(t=0)\, e^{-t/\tau}$



$\tau = \frac{L_{eq}}{R_{eq}}$

$L_{eq} = 2\mu H$

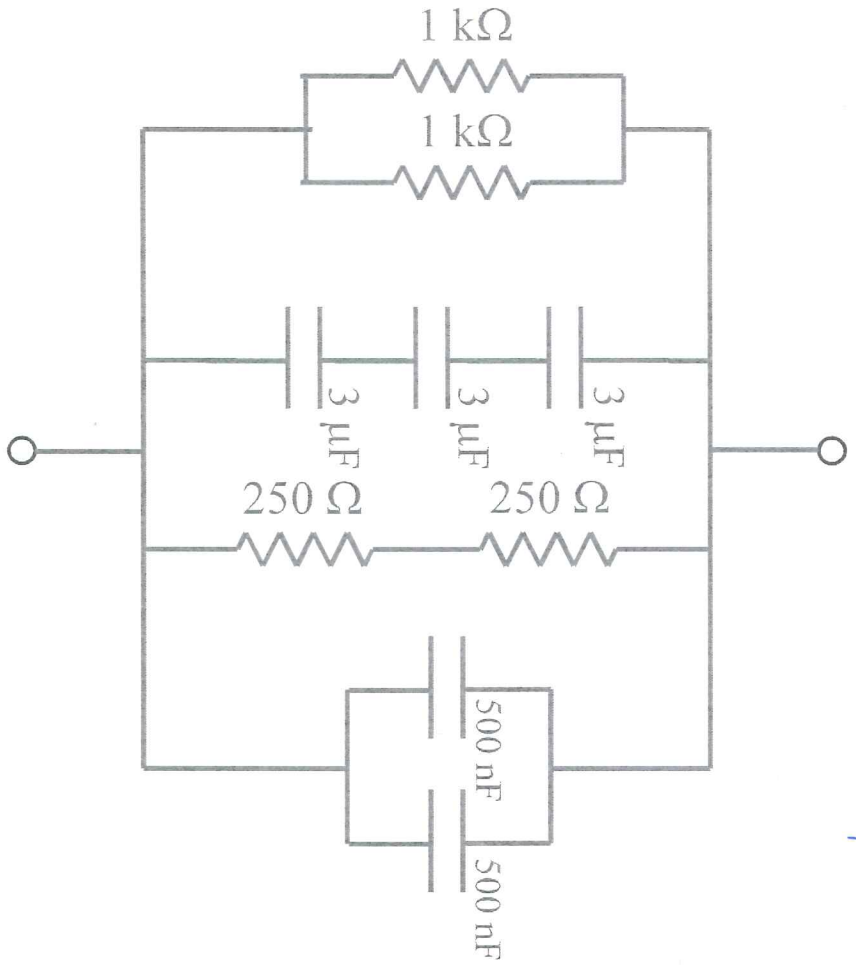
$R_{eq} = (1k\Omega) \| (1k\Omega) \| (1k\Omega)$

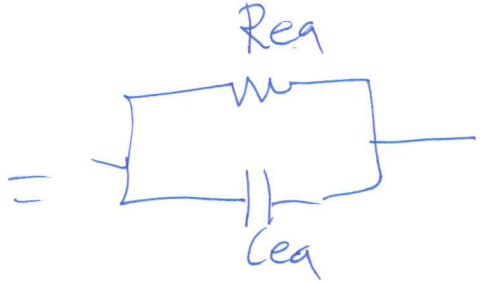
$= \frac{1}{3} k\Omega$

$\Rightarrow \tau = \frac{2}{3} ms$

Example Impedance Problem

Find Z_{eq} for this circuit: (students)





See Slide #30

$R_{eq} = 250\,\Omega$

$C_{eq} = 2\,nF$

$$\frac{1}{Z_{eq}} = \frac{1}{R_{eq}} + \frac{1}{1/j\omega C_{eq}}$$

$$\Rightarrow Z_{eq} = \frac{R_{eq}\,\frac{1}{j\omega C_{eq}}}{R_{eq} + \frac{1}{j\omega C_{eq}}} = \frac{R_{eq}}{1 + j\omega C_{eq} R_{eq}}$$