LEHIGH UNIVERSITY

DEPT. OF ELECTRICAL & COMPUTER ENGINEERING

ECE 083 – INTRODUCTION TO ELECTRICAL ENGINEERING

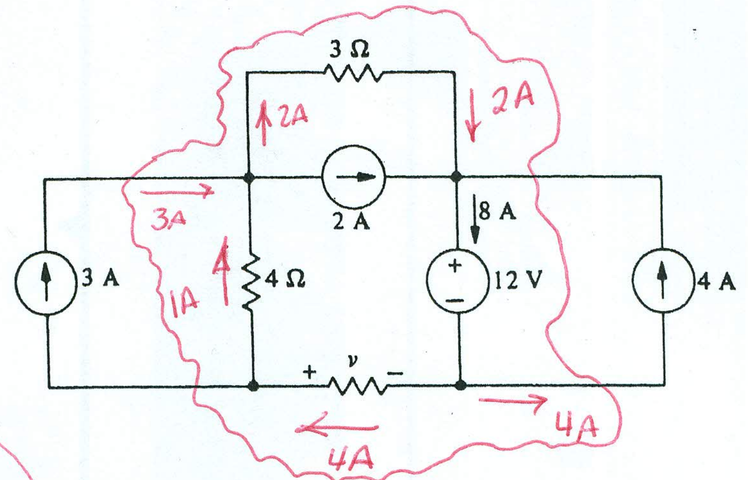
SPRING 2010

EXAM #1

SOLUTIONS

(#1) FOR THE CIRCUIT SHOWN FIND V

(10)



NOTE: Observing and Analyzing Nodes We See

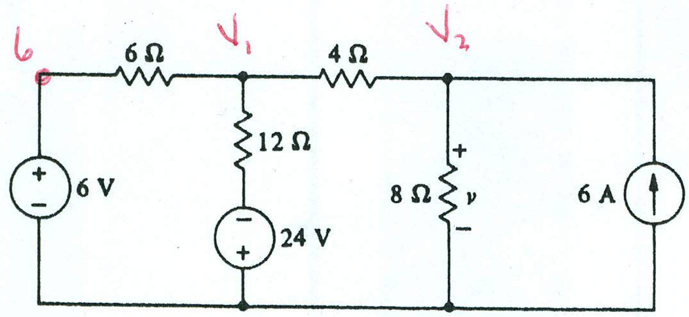
NOTE: KVL OF { } Loop Yields

$$6 + 12 - V + 4 = 0$$

$$\boxed{V = 22V}$$

(#2) For the Given Circuit Find V

(10)



Using Node Voltages: $\frac{V_1 - 6}{6} + \frac{V_1 - V_2}{4} + \frac{V_1 + 24}{12} = 0$

$$\frac{V_2 - V_1}{4} + \frac{V_2}{8} - 6 = 0$$

Solving Yields:

$V_1 = 9V$

$V_2 = 22V$

Hence: $v = V_2$

$$\boxed{v = 22V}$$

#3 For the Given Circuit Find $i_{3\Omega}$

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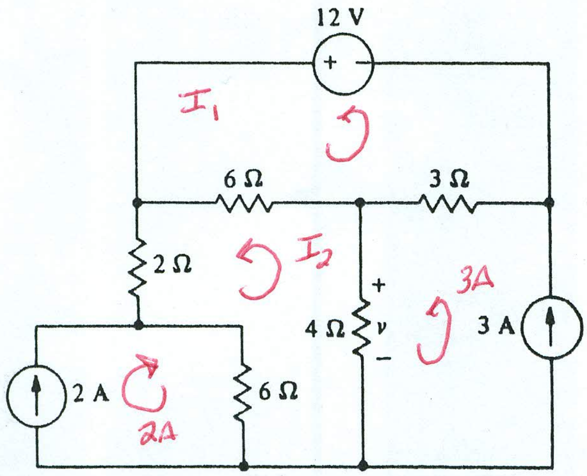


I_1 mesh : $-12 + 6(I_1 - I_2) + 3(I_1 - 3) = 0$

I_2 mesh : $6(I_2 - I_1) + 2(I_2) + 6(I_2 + 2) + 4(I_2 - 3) = 0$

These Become : $9I_1 - 6I_2 = 21$

$-6I_1 + 18I_2 = 0$

Solving $I_1 = 3A$

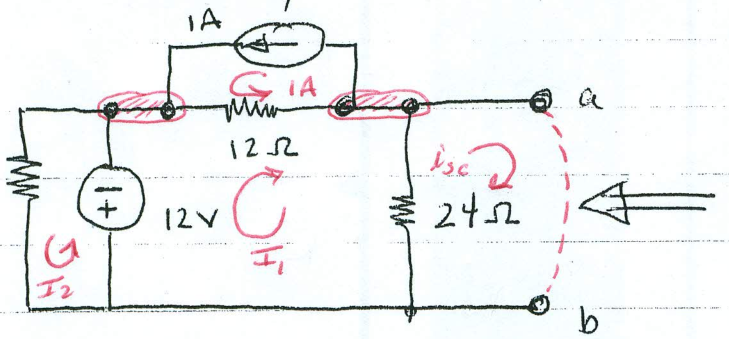
$I_2 = 1A$

Hence : $i_{3\Omega} = I_1 - 3$

$i_{3\Omega} = 0$

(#4) Find the Norton & Thevenin Equivalent Subcircuits For the Following Circuit.

(25)



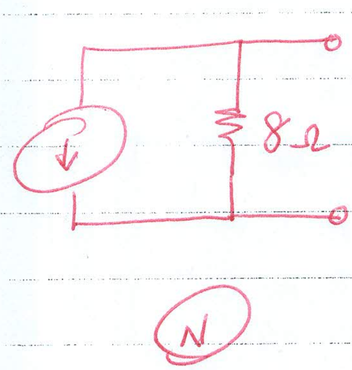
No Dependent Sources: Zero Sources (Ⓘ oc, Ⓥ sc) and Solve Directly.

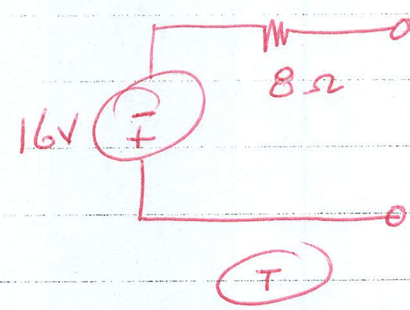
$R_{TH} = 24 // 12 = 8\Omega$ (Note: Short Circuit Ⓥ Cancel Out 10Ω)

i_{sc} : $24(i_{sc} - I_1) = 0$

I_1 : $24(I_1 - i_{sc}) + 12 + 12(I_1 + 1) = 0$

Solving: $\{i_{sc} = -2A\}$ $\Longrightarrow$ $I_N = i_{sc}$ $\quad V_T = i_{sc} R_{TH}$





#5 Find $i(t)$ for $t>0$ if the circuit is in steady state prior to the switch moving from 1 to 2

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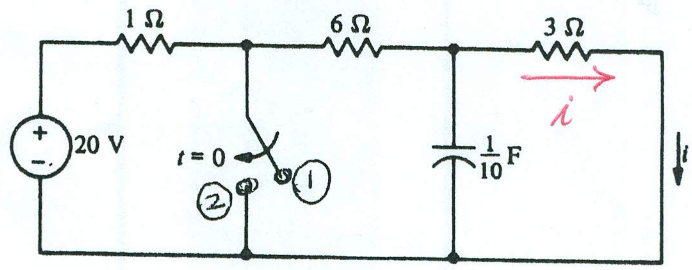

In steady state: capacitors act as open circuits

$i(0) = \frac{20}{10} = 2A$ (With capacitor OC $R_{eq} = 1S.6S.3 = 10$)

After switch closes no current or voltage will reach $i_{3\Omega}$.
Hence

$i(\infty) = 0A$

From our definition: $i(t) = i(\infty) + [i(0) - i(\infty)]e^{-t/\tau}$

But $\tau = R_{TH} C$

As seen through the capacitor

$i(t) = 0 + [2 - 0]e^{-t/.2}$

$R_{TH} = 6 \| 3$
$= 2$

$\boxed{i(t) = 2e^{-5t}}$

$\tau = 2(\frac{1}{10}) = 0.2$

#6

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You Have A Collection of Only 50Ω and 10Ω resistors. You Need A Circuit whose $R_{eq} = 87.5\,\Omega$. Design A Circuit that Accomplishes this With the <u>Minimum</u> Number of resistors.

$87.5\,\Omega = 50 + 25 + 12.5$