Solution Set

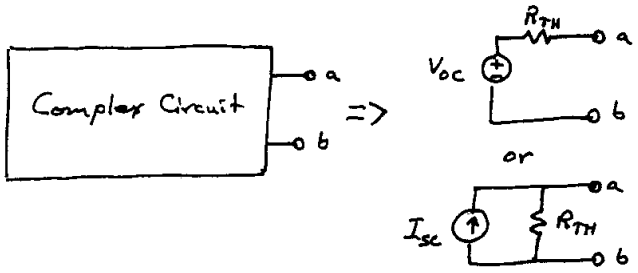
EECS 210 Sec 2 – W'01 Midterm 2 – 3/16/01

50 minutes, closed book, 2-sides 8.5x11 crib sheet, calculator, no scratch sheets

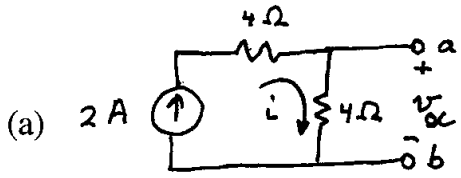
Honor Code Pledge: "I have neither given nor received aid on this exam, nor have I concealed any violation of the Honor Code."

Signature:_____ **Print Name:**_____

1 Find Thevenin and Norton components. Include units. Hint with (c), believe your math. Follow the sign conventions shown in this sketch.

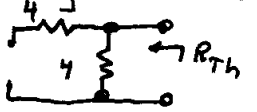


(a)



$v_{oc} = i \times 4 = 2 \times 4 = 8\ V$

killing source yields

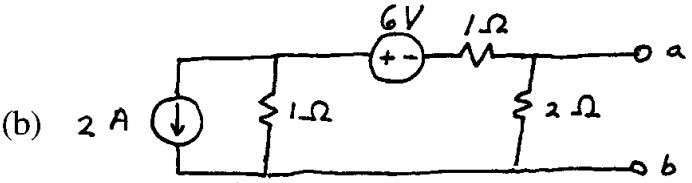


$\Rightarrow R_{TH} = 4\ \Omega$

$I_{sc} = \frac{v_{oc}}{R_{TH}} = \frac{8}{4} = 2\ A$

	V_{OC}	I_{SC}	R_{TH}
(a) (10%)	8 V	2 A	4 Ω

(b)



$v_{oc} = \frac{2}{2+1+1}(-8V)$ (voltage divider)

$= -4V$

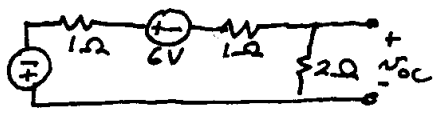
Kill sources

$R_{TH} = 2 \| 2 = 1\ \Omega$

$I_{sc} = \frac{v_{oc}}{R_{TH}} = \frac{-4}{1} = -4A$

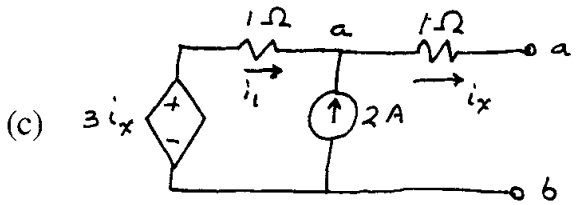
Thevenin form

=>



	V_{OC}	I_{SC}	R_{TH}
(b) (15%)	−4 V	−4 A	1 Ω

(c)



For I_{sc}

Nodal KCL at a

$i_1 + 2 - i_x = 0$

$\frac{3i_x - v_a}{1} + 2 - i_x = 0$ but $i_x = \frac{v_a}{1}$

$\therefore 3i_x - i_x + 2 - i_x = 0 \Rightarrow i_x = I_{sc} = -2$ A

For V_{oc}, $i_x = 0 \Rightarrow$ kill dependent source $\Rightarrow v_a = 1\Omega \times 2A = 2$ V

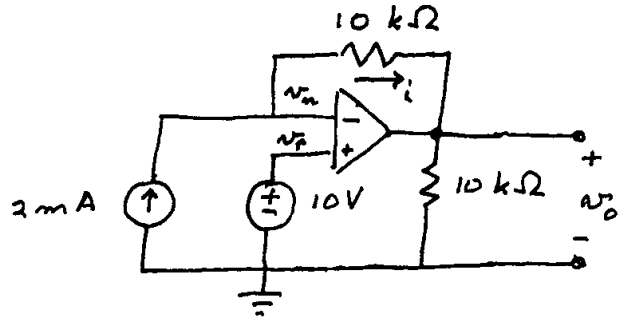
with $i_x = 0$, $V_{oc} = v_a = 2$ V

$R_{TH} = \frac{2}{-2} = -1\Omega$

	V_{OC}	I_{SC}	R_{TH}
(c) (15%)	2 V	−2 A	−1 Ω

2 Find the output voltages, v_o, for each of the following Op Amp circuits. Assume that you can use the "Golden Rules".

(a)



$v_m = 10$ V

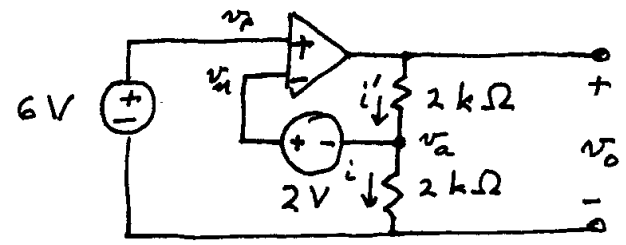
$i = \frac{v_m - v_o}{10k} = 2 \times 10^{-3}$

$10 - v_o = 20$

$v_o = -10$ V

(a) (15%) v_o = −10 V

(b)



$v_p = v_m = 6$ V

$v_a = v_m - 2 = 4$ V

$i = \frac{v_a}{2 \times 10^3} = i'$

$v_o = v_a + i' \times 2 \times 10^3$

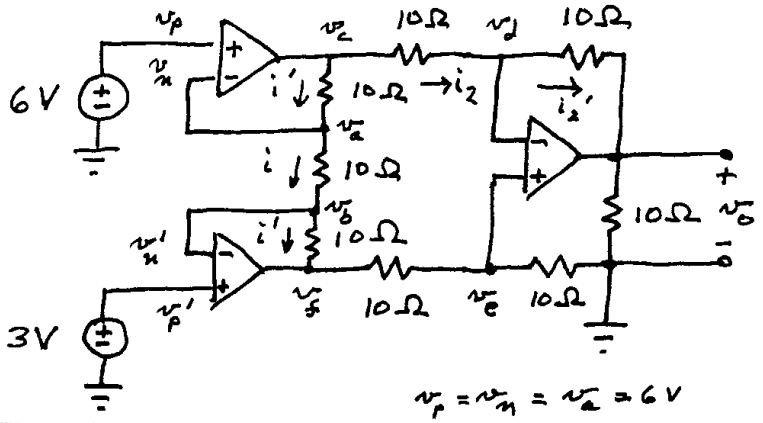
$= v_a + \frac{v_a}{2 \times 10^3} \times 2 \times 10^3$

$= 2 v_a = 2 \times 4$

$= 8$ V

(b) (15%) v_o = 8 V

(c)



$v_p = v_n = v_a = 6\,V$

$v_p' = v_n' = v_b = 3\,V$

$i = i' = \frac{v_a - v_b}{10} = \frac{3\,V}{10}$

$v_e = v_a + i' \times 10 = 6 + 3 = 9\,V$

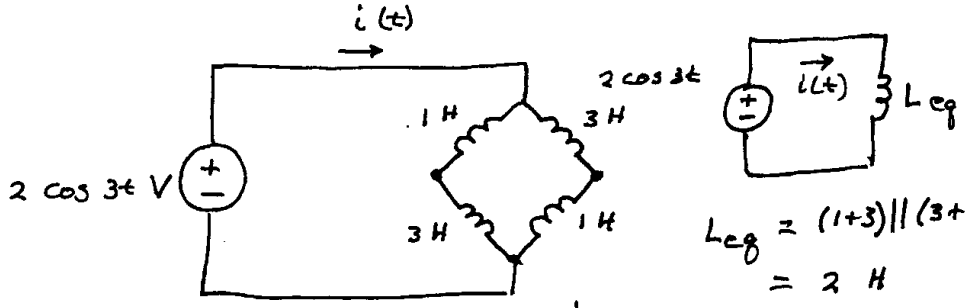
$v_f = v_b - i' \times 10 = 3 - 3 = 0\,V$

$\Rightarrow v_e = 0 \Rightarrow v_2 = 0 \Rightarrow i_2 = \frac{v_e - v_2}{10} = \frac{9}{10}$

$i_2 = i_2' \Rightarrow i_2' = \frac{v_2 - v_o}{10} = \frac{-v_o}{10} = \frac{9}{10} \Rightarrow v_o = -9\,V$

(c) (15%) v_o = − 9 V

In the following steady-state system, what is i(t) if its time average is zero?



$L_{eq} = (1+3) \| (3+1) = 4 \| 4$

$= 2\,H$

(15%) i(t) = $\frac{1}{3}$ sin 3t A

$$\int_{i(t_0)}^{i(t)} di' = \frac{1}{L_{eq}} \int_{t_0}^{t} v(t)\,dt$$

$$i(t) - i(t_0) = \frac{1}{2} \int_{t_0}^{t} 2\cos 3t\,dt$$

$$= \frac{1}{3} \sin 3t \Big|_{t_0}^{t}$$

$$= \frac{1}{3} \sin 3t - \frac{1}{3} \sin 3t_0$$

∴ $i(t) = \text{constant} + \frac{1}{3} \sin 3t$

Average over all time of sinusoid is zero, ∴ for average over all time of i(t) to be zero, constant = 0