Name: SOLUTIONS (please print)

Signature: _____

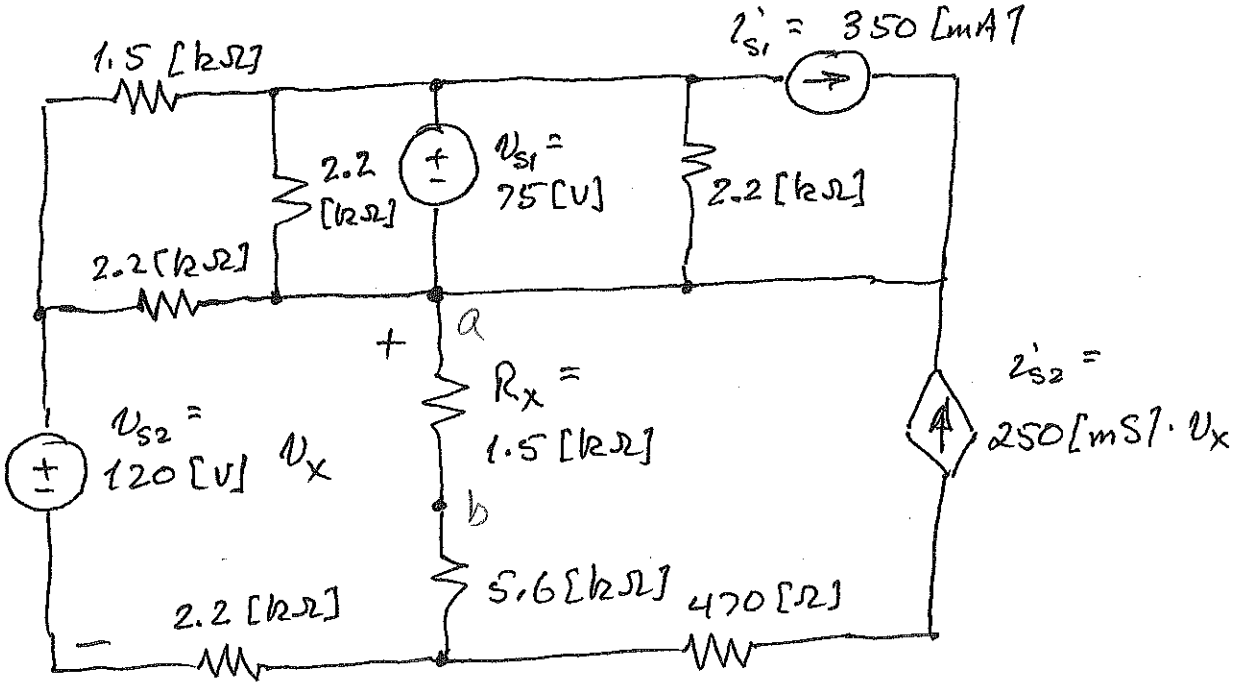
ECE 2300 – Quiz #5
October 25, 2012

Keep this quiz closed and face up until you are told to begin.

1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. Do not use red ink. Do not use red pencil.
5. You will have 30 minutes to work on this quiz.

_____/20

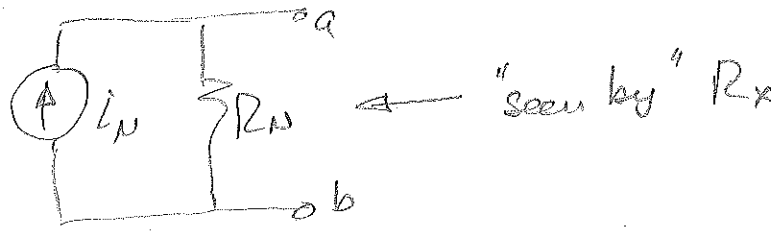
For the circuit below, find the Norton Equivalent seen by the resistor R_x.



We need two of open-circuit voltage, short-circuit current, and test source. Here we will do all three, but any two will do to find Thevenin or Norton.

** The 470 [Ω] resistor is in series with a current source and hence cannot be "seen by" R_x. The same goes for i_{s1} and the 2.2 [kΩ] resistors in parallel with v_{s1}.

Finally, note that we want the Norton Equivalent seen by R_x, so R_x is to be removed, we have labelled terminals a, b, so we are looking for i_N and R_N:

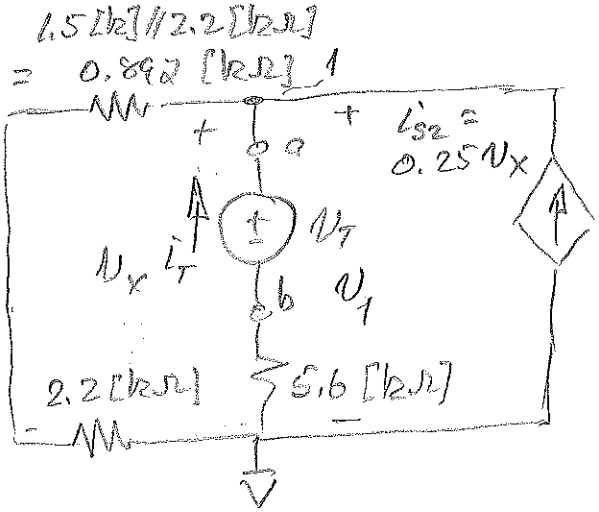


i_N = −33.57 [mA] R_N = 5586 [Ω]

Room for extra work

TEST VOLTAGE: V_{s1}, V_{s2} → short, i_{s1} → open

$V_T = 1\,[V] \Rightarrow$



$$\frac{V_1 - 1}{5600} + \frac{V_1}{892 + 2200} - 0.25 V_x = 0$$

$$V_x = V_1 \frac{0.892}{0.892 + 2.2}$$

$$= 0.2855\, V_1$$

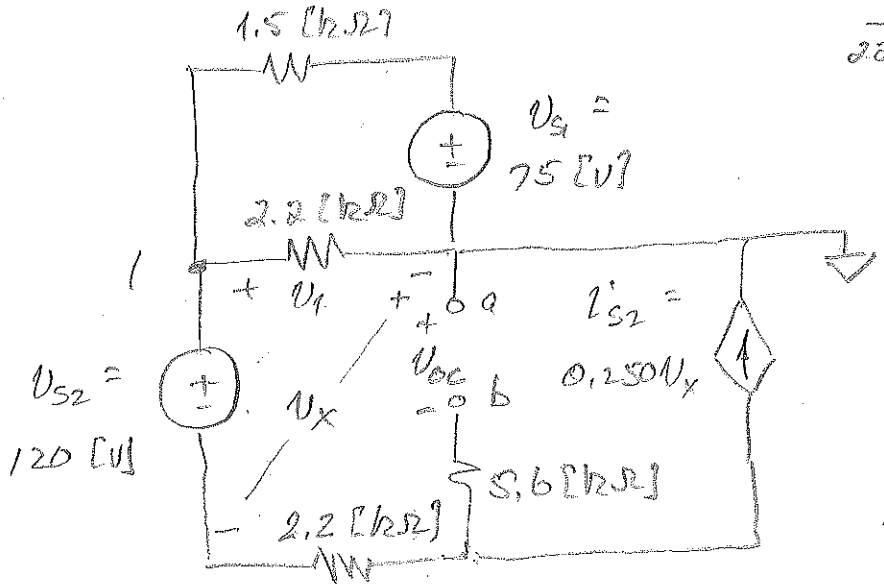
$$V_1 = -2.493\,[mV]$$

$$\Rightarrow i_T = -\frac{V_1 - 1}{5600} = 0.1790\,[mA]$$

+9

$$R_N = \frac{1}{0.1790 \times 10^{-3}} = 5586\,[\Omega]$$

OPEN-CIRCUIT VOLTAGE



$$\frac{V_1}{2200} + \frac{V_1 - 75}{1500} + 0.25 V_x = 0$$

$$V_1 + V_x - 120 = 0$$

$$\Rightarrow$$

$$V_1 = 120.34\,[V]$$

$$V_x = -0.3397\,[V]$$

$$V_{oc} - 2200(0.250 V_x) - V_x = 0$$

$$\Rightarrow V_{oc} = -187.17\,[V].$$

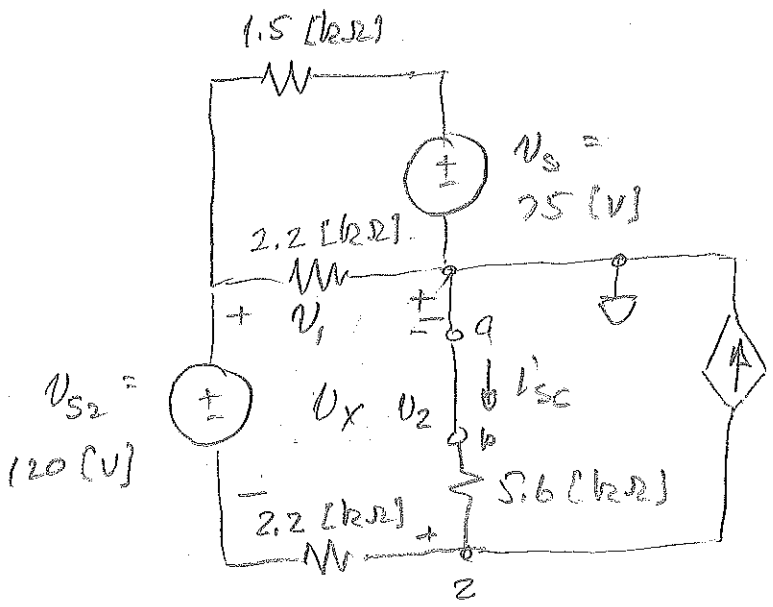
+9

+2

Room for extra work

This is enough to find i'_N : $i'_N = \frac{v_{oc}}{R_N} = -33.51$ [mA]

We will find $i'_{sc} = i'_N$ as well...



$$\frac{v_1}{2200} + \frac{v_1 - 120 - v_2}{2200} + \frac{v_1 - 75}{1500} = 0$$

$$\frac{v_2}{5600} + 0.25 v_x + \frac{v_2 - v_1 + 120}{2200} = 0$$

$$-v_1 + 120 - v_x = 0$$

$v_1 = 120.47$ [V] $\quad v_2 = 187.64$ [V] $\quad v_x = -0.4718$ [V]

$i'_{sc} = i'_N = -\frac{v_2}{5600} = -33.51$ [mA] (same as above!)

+9