Name: _____ (please print)

Signature: _____

ECE 2300 – Quiz #4
July 7, 2016

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

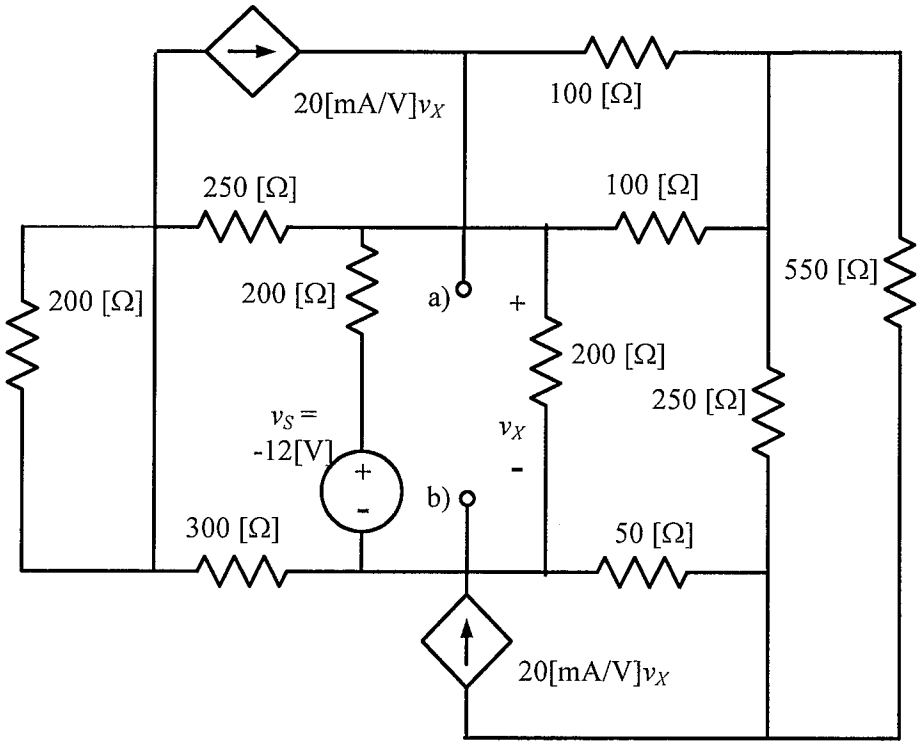
1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

_____/40

Room for extra work

The Trombettamax T-QX20 has been completely redesigned. The new device will be called the T-QX21 and has the circuit diagram shown below. Your company has a potential customer for the device who wants to know the Thevenin Equivalent with respect to terminals a), b).

Find the Thevenin Equivalent of the T-QX21 at terminals a), b). Draw the Thevenin Equivalent circuit and label the parameters.



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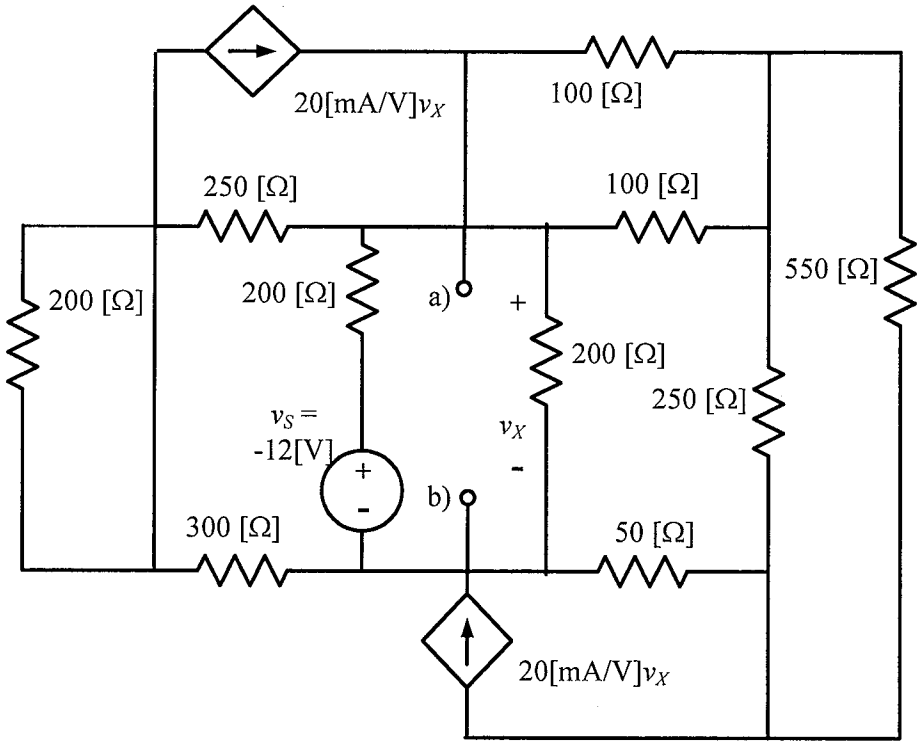


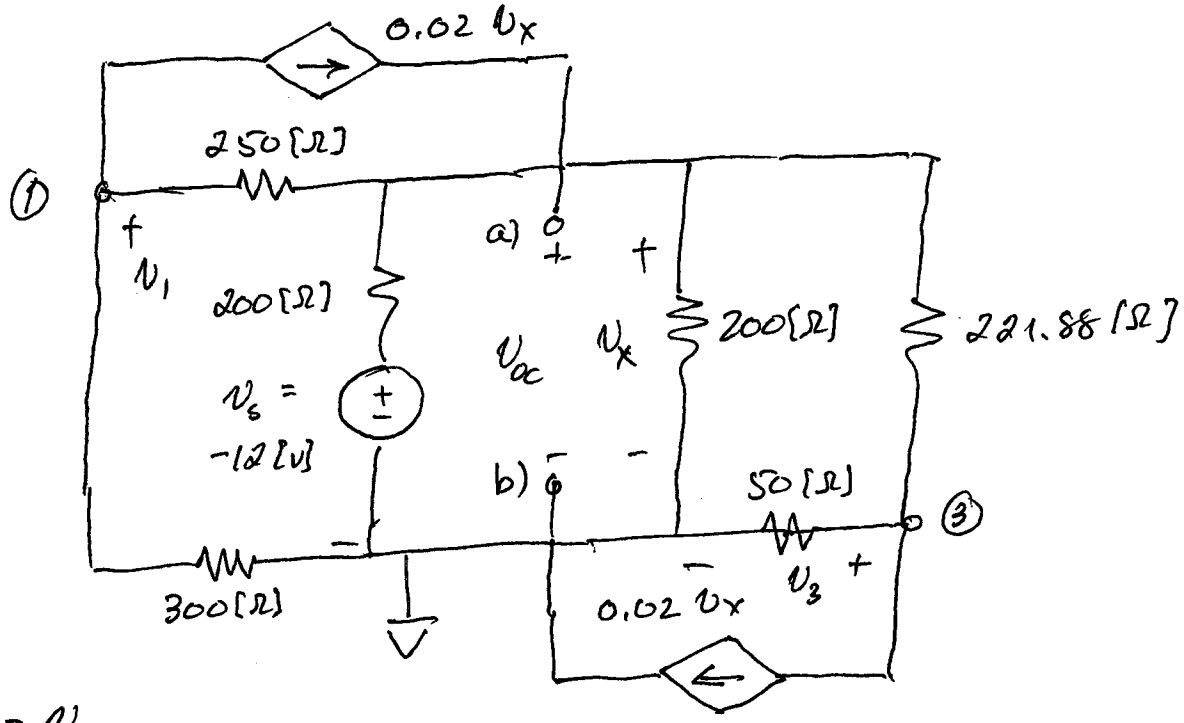
To find the Thevenin Equivalent, we need two of i) V_{oc}, ii) i'_{sc}, and iii) R_{Th} from a test source. We will do all three just because...

But first, note that we can simplify a bit:

- $550 \| 250\ [\Omega] = 171.88\ [\Omega]$
- the 200 [Ω] resistor on the left is shorted
- $100 \| 100\ [\Omega] = 50\ [\Omega]$, which is in series with 171.88 [Ω].

Room for extra work

We'll start with V_{oc}:



$V_x = V_{oc}$

$$\frac{V_{oc}+12}{200} + \frac{V_{oc}}{200} - 0.02\,V_{oc} + \frac{V_{oc}-V_1}{250} + \frac{V_{oc}-V_3}{221.88} = 0$$

$$\frac{V_1}{300} + \frac{V_1 - V_{oc}}{250} + 0.02\,V_{oc} = 0$$

$$\frac{V_3}{50} + 0.02\,V_{oc} + \frac{V_3 - V_{oc}}{221.88} = 0$$

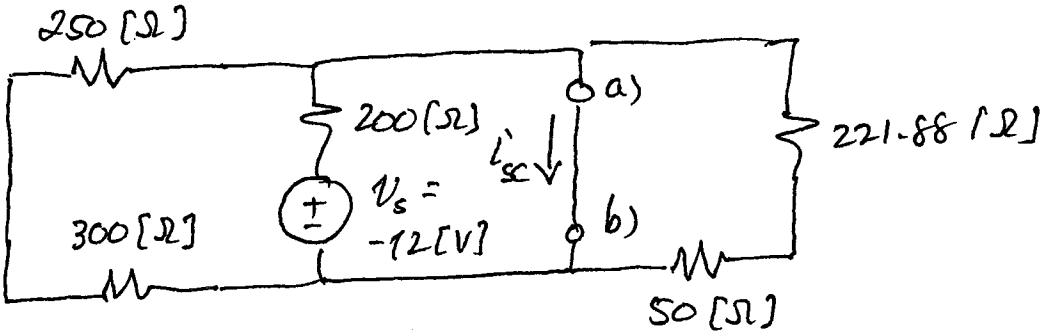
$$V_1 = 12.98\ [V]$$

$$V_3 = 3.762\ [V]$$

$$\boxed{V_{oc} = -5.950\ [V]}$$

Room for extra work

i_{sc} : With a short at a), b), $v_x \to 0$ so current sources open.



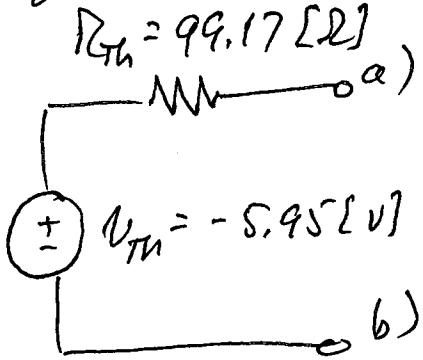
(221.88 + 50) [Ω] and (250 + 300) [Ω] are in parallel with a short, so...

$$-v_s + 200 i_{sc} = 0$$

$$i_{sc} = \frac{-12}{200} = -0.06 \text{ [A]}$$

We can find R_{Th} now: $R_{Th} = \frac{v_{oc}}{i_{sc}} = \frac{-5.95}{-0.06} = 99.17 \text{ [Ω]}$

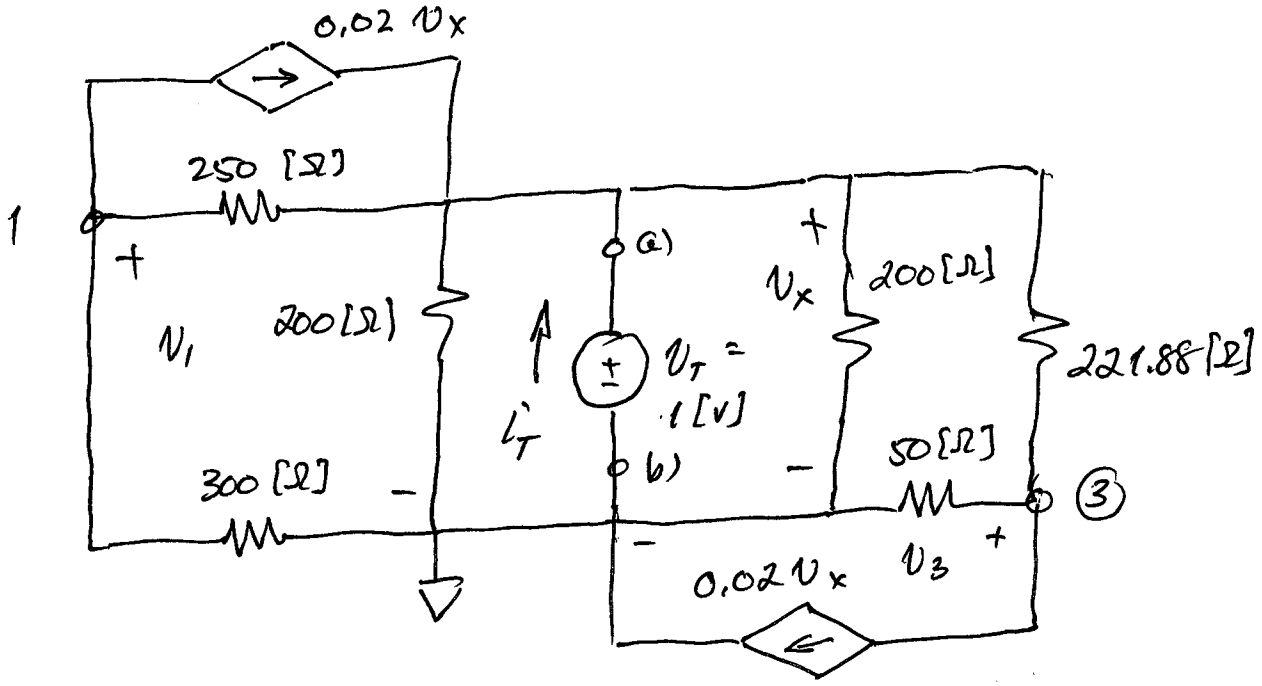
So... Thevenin Equivalent is



Let's do test source to check: →

Room for extra work

Test source: $V_s \rightarrow 0$



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

$$\frac{V_1 - V_T}{250} + 0.02\,V_T + \frac{V_1}{300} = 0 \quad \Rightarrow \quad V_1 = -2.182\,[V]$$

$$\frac{V_3}{50} + 0.02\,V_T + \frac{V_3 - V_T}{221.88} = 0 \quad \Rightarrow \quad V_3 = -0.632\,[V]$$

$$I_T' = -0.02\,V_T + 2\,\frac{V_T}{200} + \frac{V_T + 0.632}{221.88} + \frac{V_T + 2.182}{250}$$

$$= 0.01008\,[A]$$

$$\therefore R_{Th} = \frac{V_T}{I_T'} = \frac{1}{0.01008} = 99.21\,[\Omega]$$