Signature

Name (print, please)

Student No.

ECE 2300 Circuit Analysis
Summer 2009

Quiz 8

DO NOT OPEN THIS QUIZ BOOKLET UNTIL INSTRUCTED TO DO SO

This quiz has 4 pages including this cover page. If you are missing any pages, raise your hand. You have 30 minutes to complete the quiz.

Notes

1. Be sure your name and signature appear above.
2. The quiz is closed-book. You may have a calculator and one 8 ½ " x 11" crib sheet.
3. To receive full credit for a problem, you must:

- Show all work necessary to solve the problem;
- Define all variables and parameters and label them on circuit diagrams;
- Use the proper notation for all variables.
- Show all units explicitly in intermediate and final results;
- Indicate clearly whether power being calculated is absorbed or delivered;

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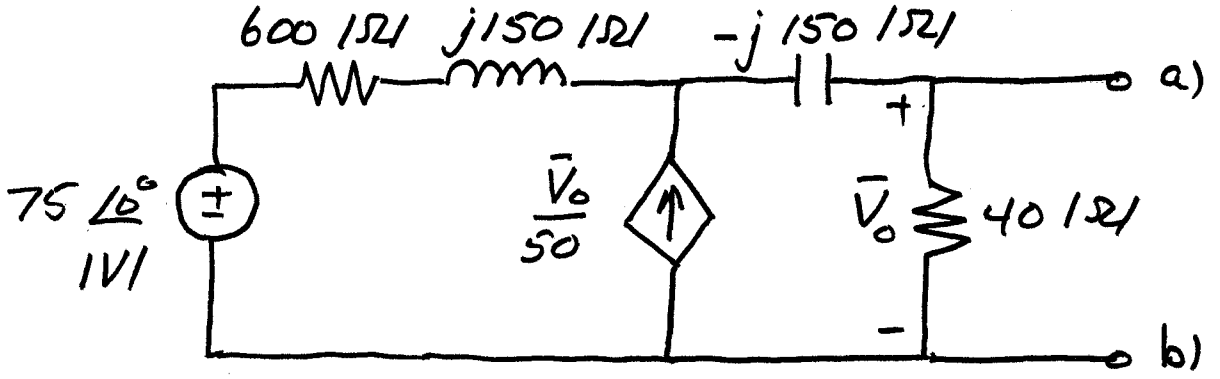
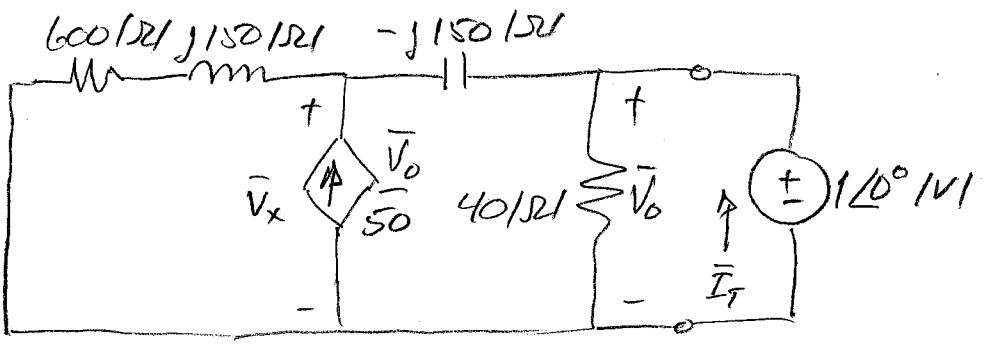
For the circuit below, find phasor domain representation of either the Thevenin or the Norton equivalent circuit (your choice) at the terminals a), b).



We will find the Thevenin Equivalent. For illustration we will use a test source, open-circuit voltage, and short-circuit current even though we need only two of these.

Test Source



$$\frac{\bar{V}_x}{600+j150} - \frac{1\angle 0^\circ}{50} + \frac{\bar{V}_x - 1\angle 0^\circ}{-j150} = 0 \quad \Rightarrow \bar{V}_x = 3.260\angle -52.53^\circ \text{ V}$$

$$\therefore \bar{I}_T = \frac{1\angle 0^\circ}{40} + \frac{1\angle 0^\circ - \bar{V}_x}{-j150} = 8.332\times10^{-3}\angle -36.89^\circ \text{ A}$$

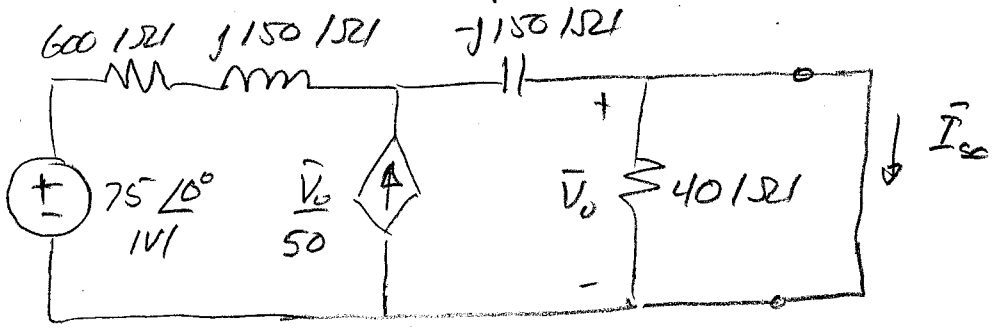
$$= 6.664\times10^{-3} - j\,5.001\times10^{-3} \text{ A}$$

$$\therefore Z_{Th} = \frac{1\angle 0^\circ}{\bar{I}_T} = 120\angle 36.89^\circ \ \Omega$$

$$= 96.0 + j\,72.04 \ \Omega$$

Room for Extra Work

Short-circuit current



$\bar{V}_o = 0 \Rightarrow$ current source is open-circuit and 40 Ω has no current in it.

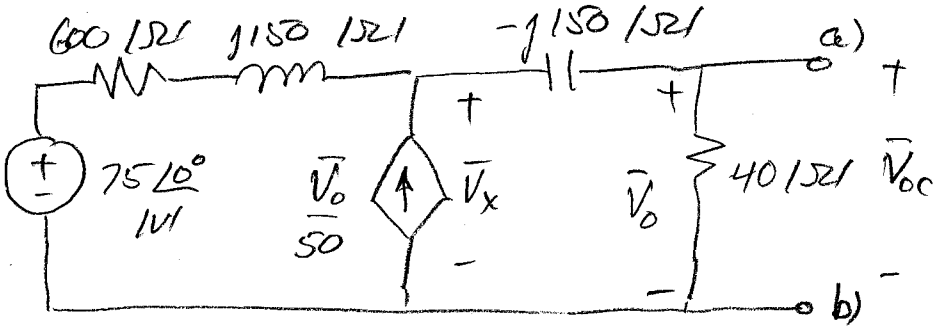
$$\therefore \quad \bar{I}_{sc} = \frac{75\angle 0^\circ}{600 + j150 - j150} = 0.125\angle 0^\circ \ |A|$$

This implies a Thevenin voltage of

$$\bar{V}_{Th} = \bar{I}_{sc} \cdot Z_{Th} = 15.00\angle 36.87^\circ \ |V|$$
$$= 12.00 + j\,9.005 \ |V|$$

We will check this by finding ... (not required)

open-circuit voltage



Room for Extra Work

$$-\frac{\bar{V}_o}{50} + \frac{\bar{V}_x}{40-j150} + \frac{\bar{V}_x - 75\angle 0^\circ}{600+j150} = 0$$

$$\bar{V}_o = \bar{V}_x \cdot \frac{40}{40-j150} = \bar{V}_x \cdot 0.2577 \angle 75.07^\circ$$

$$\therefore \bar{V}_x \left(-\frac{0.2577\angle 75.07^\circ}{50} + \frac{1}{40-j150} + \frac{1}{600+j150} \right)$$

$$= \frac{75\angle 0^\circ}{600+j150}$$

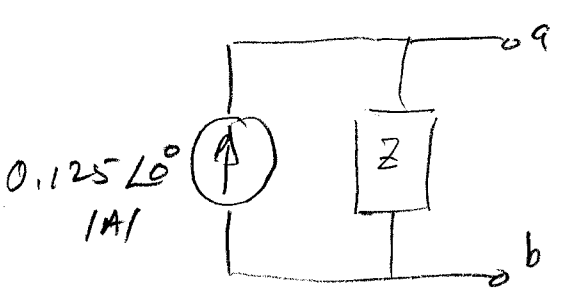
$$\bar{V}_x \left(2.083\times 10^{-3} \angle 24.14^\circ \right) = 0.121 \angle -14.04^\circ$$

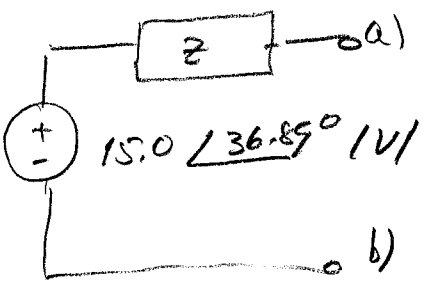
$$\bar{V}_x = 58.22 \angle -38.18^\circ \ |V|$$

$$\Rightarrow \bar{V}_o = \bar{V}_{oc} = 15.0 \angle 36.89^\circ \ |V| \ \checkmark$$

So we are confident of our result...

The Norton and Thevenin equivalents are shown





$$Z = 120 \angle 36.89^\circ \ |\Omega|$$