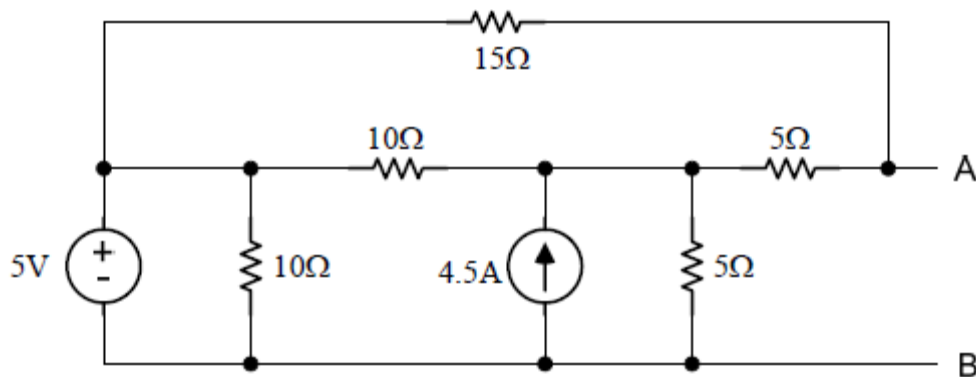


Homework Set #14
DUE Tuesday, April 18, 2017

1. Complete the following analysis for the circuit shown below:



- a. Find the Thevenin equivalent circuit looking into terminals A-B using the “open-circuit voltage, short-circuit current” technique.
 b. Repeat part “a” using the “open circuit voltage, equivalent resistance” technique.

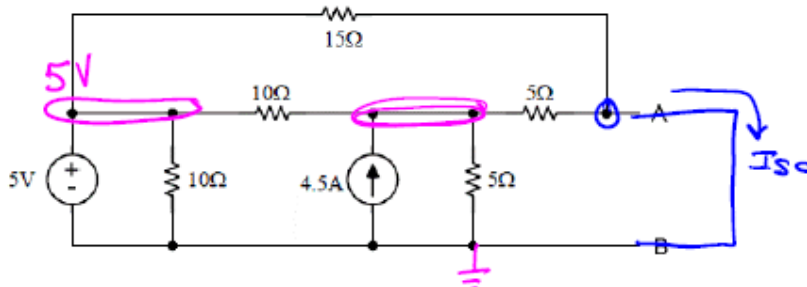
$$\text{KCL)} \quad \frac{V_1 - 5}{10} - 4.5 + \frac{V_1}{5} + \frac{V_1 - V_{oc}}{5} = 0$$

$$\text{KCL)} \quad \frac{V_{oc} - V_1}{5} + \frac{V_{oc} - 5}{15} = 0$$

$$V_1 = 15V$$

$$V_{oc} = 12.5V$$

Find I_{sc}



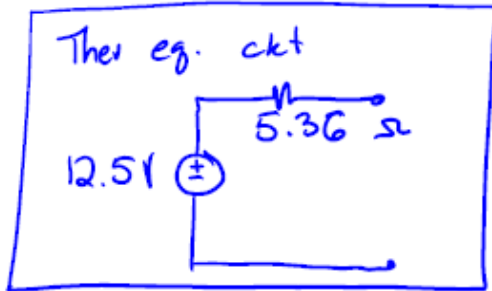
$$\text{KCL)} \quad \frac{V_1 - 5}{10} - 4.5 + \frac{V_1}{5} + \frac{V_1}{5} = 0$$

$$V_1 = 10V$$

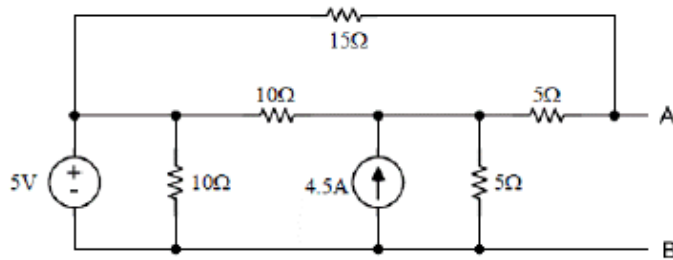
KCL ref $\frac{0 - V_1}{5} + \frac{0 - 5}{15} + I_{sc} = 0$

$I_{sc} = 2.33A$

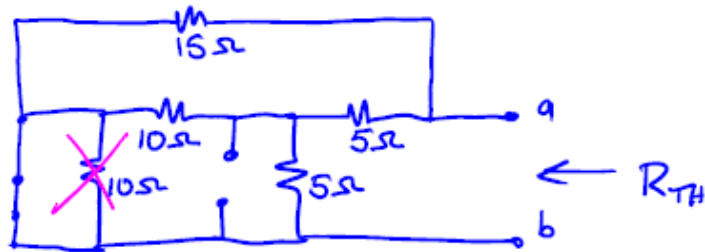
$R_{Th} = \frac{V_{oc}}{I_{sc}} = \frac{12.5V}{2.33A} = 5.36 \Omega$



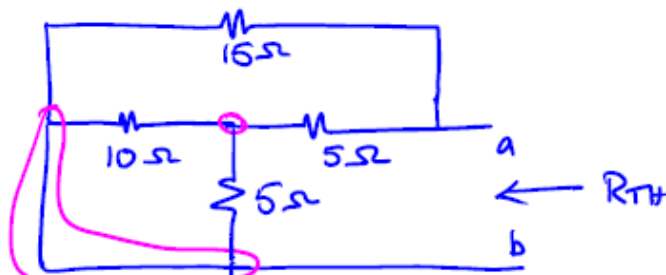
b) equivalent resistance



zero sources & find Req



shorted out 10 Ω



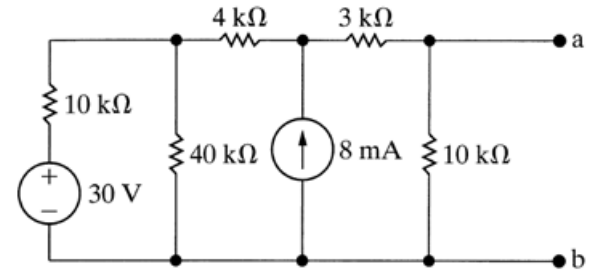
$10 // 5 = 10/3$

$R_{Th} = 5.36 \Omega$

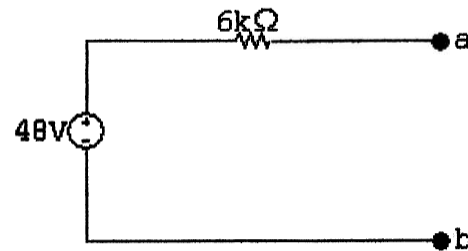
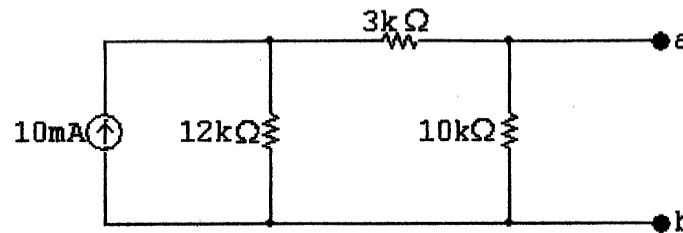
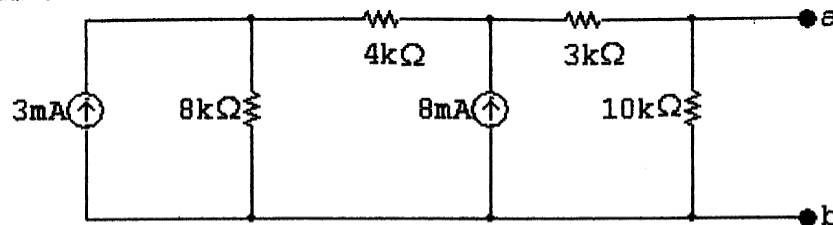
2. A voltmeter with a resistance of $100\text{ k}\Omega$ is used to measure the voltage v_{ab} in the circuit in Fig. P4.67.
- What is the voltmeter reading?
 - What is the percentage of error in the voltmeter reading if the percentage of error is defined as $[(\text{measured} - \text{actual})/\text{actual}] \times 100$?

Do this by finding the Thevenin Equivalent at $a - b$ and attaching the voltmeter to make a voltage divider.

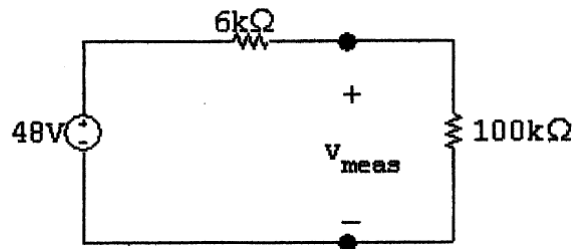
Figure P4.67



First, find the Thévenin equivalent with respect to a, b using a succession of source transformations.



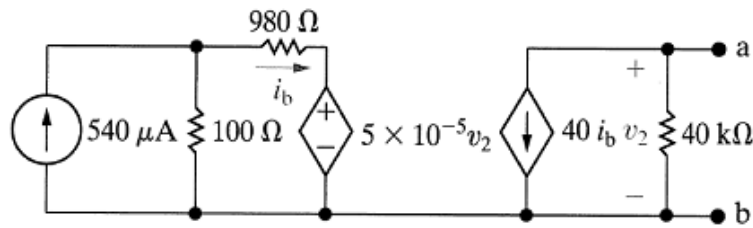
$$\therefore v_{Th} = 48\text{ V} \quad R_{Th} = 6\text{ k}\Omega$$



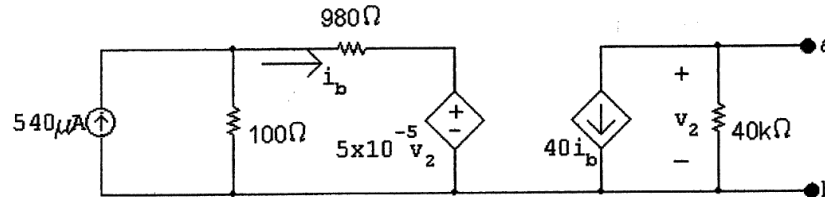
$$v_{\text{meas}} = \frac{100}{106}(48) = 45.28\text{ V}$$

$$\text{[b] \%error} = \left(\frac{45.28 - 48}{48} \right) \times 100 = -5.67\%$$

3. Determine the Thevenin Equivalent at a – b for the following circuit.



Do this by finding the open-circuit voltage and short-circuit current and use them to get the Thevenin Resistance.



OPEN CIRCUIT

$$v_2 = -40i_b \quad 40 \times 10^3 = -16 \times 10^5 i_b$$

$$5 \times 10^{-5} v_2 = -80i_b$$

$$980i_b + 5 \times 10^{-5} v_2 = 980i_b - 80i_b = 900i_b$$

So $900i_b$ is the voltage across the 100Ω resistor.

$$\text{From KCL at the top left node, } 540 \mu\text{A} = \frac{900i_b}{100} + i_b = 10i_b$$

$$\therefore i_b = \frac{540 \times 10^{-6}}{10} = 54 \mu\text{A}$$

$$v_{\text{Th}} = -16 \times 10^5 (54 \times 10^{-6}) = -86.40 \text{ V}$$

SHORT CIRCUIT

$$v_2 = 0; \quad i_{\text{sc}} = -40i_b$$

$$i_b = \frac{54 \times 10^{-3}}{1080} = \frac{54}{1.08} \times 10^{-6} = 50 \mu\text{A}$$

$$i_{\text{sc}} = -40(50) = -2000 \mu\text{A} = -2 \text{ mA}$$

$$R_{\text{Th}} = \frac{-86.4}{-2} \times 10^3 = 43.2 \text{ k}\Omega$$

