Circuits and Systems 1

Recap of Thevenin Theorem

In Thevenin analysis of circuit, we need to compute the following three terms

- Open-circuit voltage denoted by v_{oc} (computed by disconnecting the load)
- Thevenin resistance denoted by R_{th} or R_t (obtained by deactivating voltage source by replacing it with short circuit and deactivate a current source by replacing it with open circuit)
- Short-circuit current denoted by i_{sc} to verify the correctness of circuit (otherwise it is not needed)

Recap of Norton Theorem

In this theorem, we obtain an equivalent circuit having current source in parallel with Norton equivalent resistance.

Using source transformation, we can easily convert a Thevenin equivalent circuit to Norton equivalent circuit.

Norton Theorem - P5.5-4 on page 204

Determine the Norton equivalent circuit for this circuit

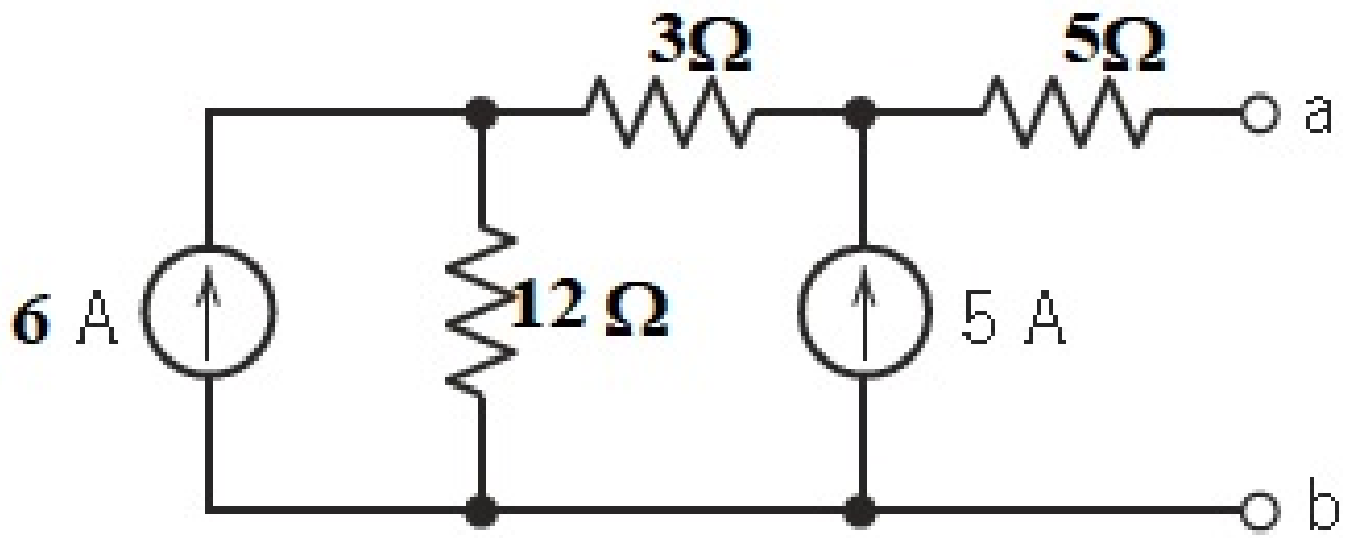

Figure: Norton equivalent circuit problem

P5.5-4 on page 204 - Solution - Part a

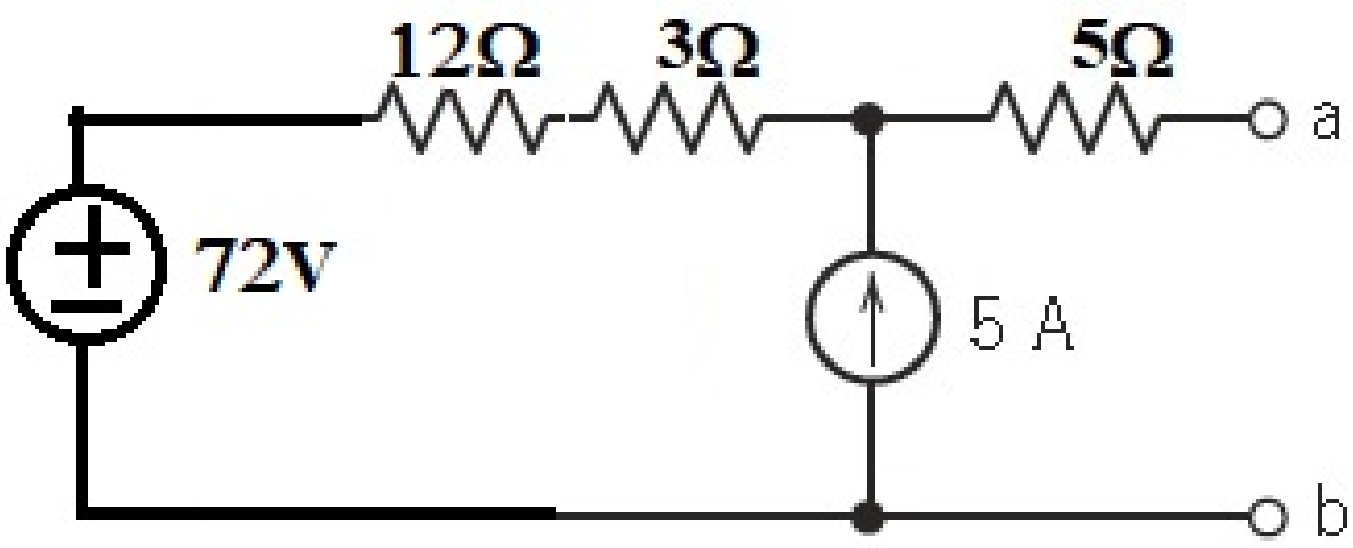

Figure: Computing the Norton equivalent circuit - Part a

P5.5-4 on page 204 - Solution - Part b

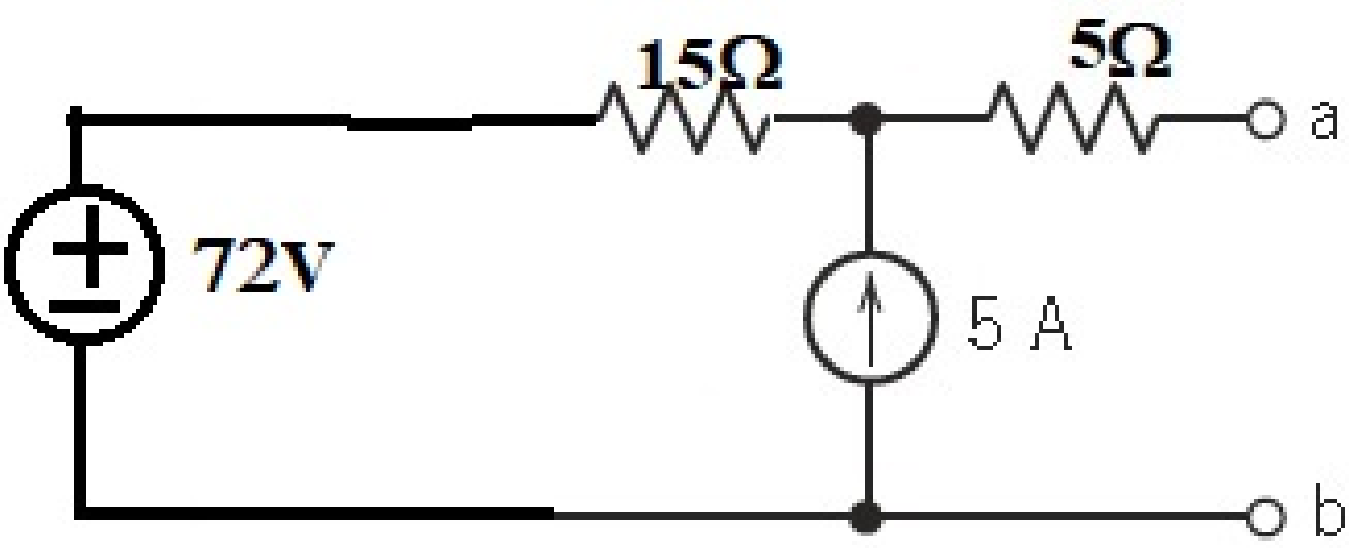

Figure: Computing the Norton equivalent circuit - Part b

P5.5-4 on page 204 - Solution - Part c

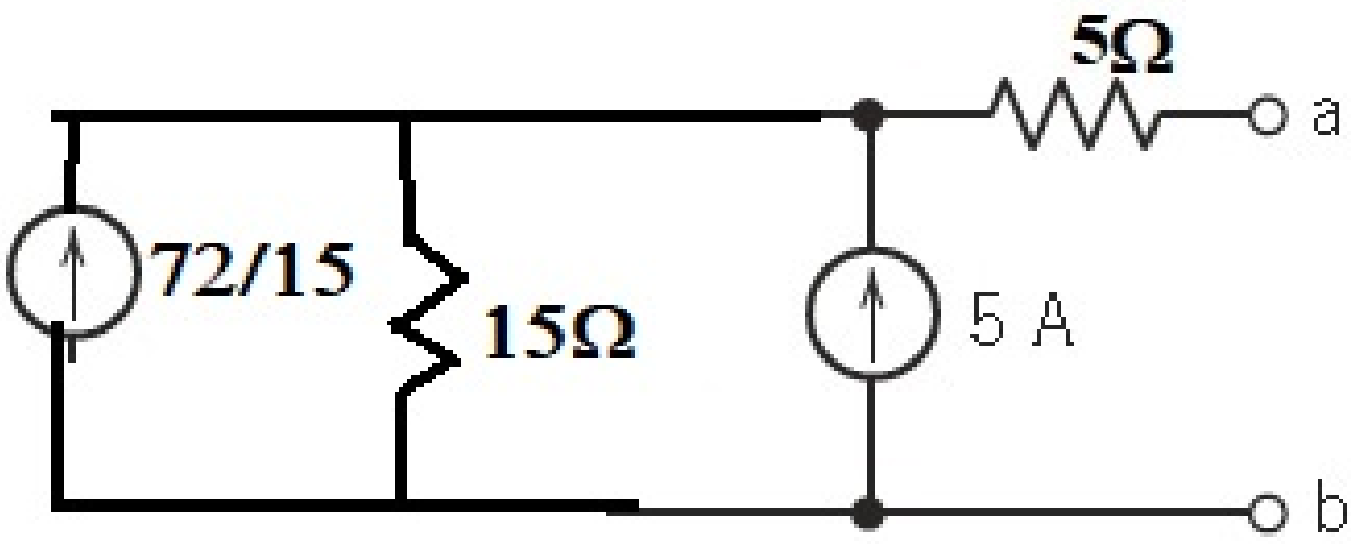

Figure: Computing the Norton equivalent circuit - Part c

P5.5-4 on page 204 - Solution - Part d

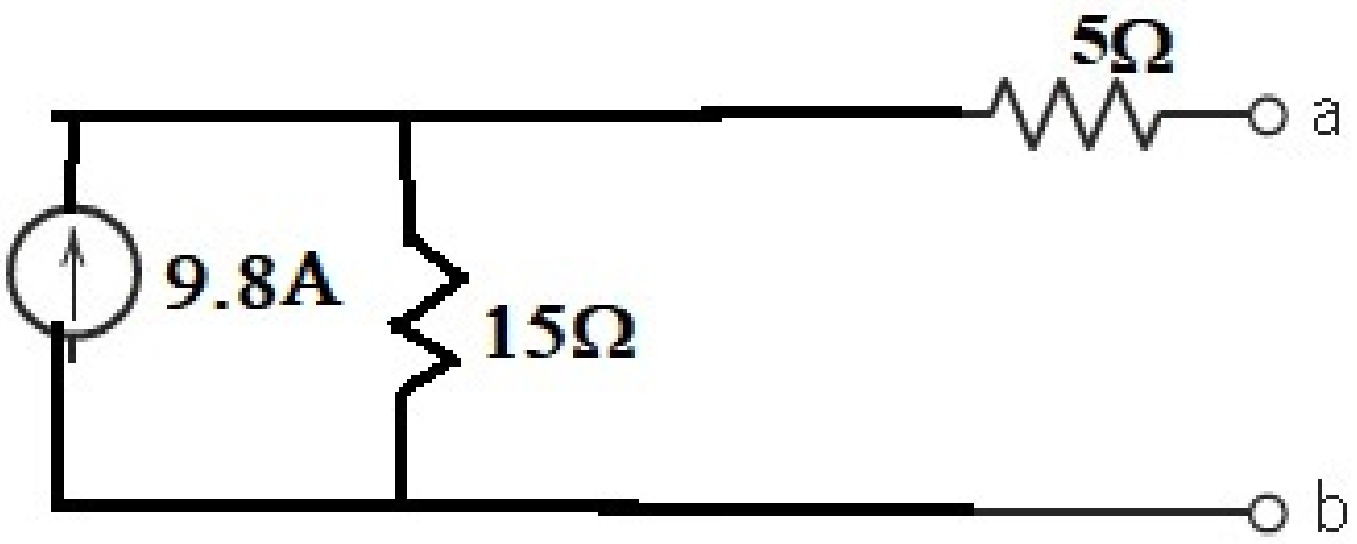

Figure: Computing the Norton equivalent circuit - Part d

P5.5-4 on page 204 - Solution - Part e

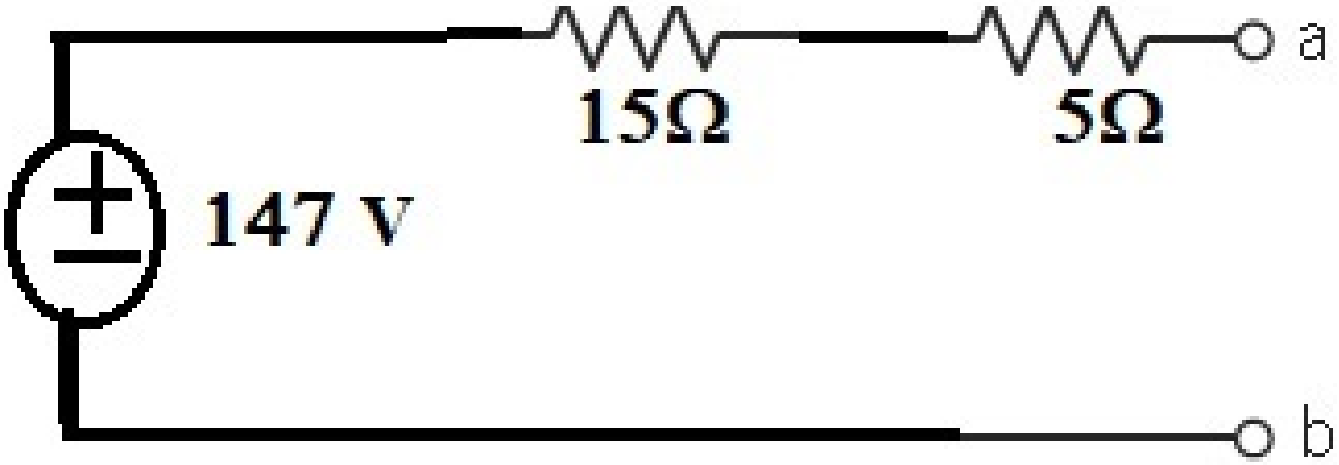

Figure: Computing the Norton equivalent circuit - Part e

P5.5-4 on page 204 - Solution - Part f

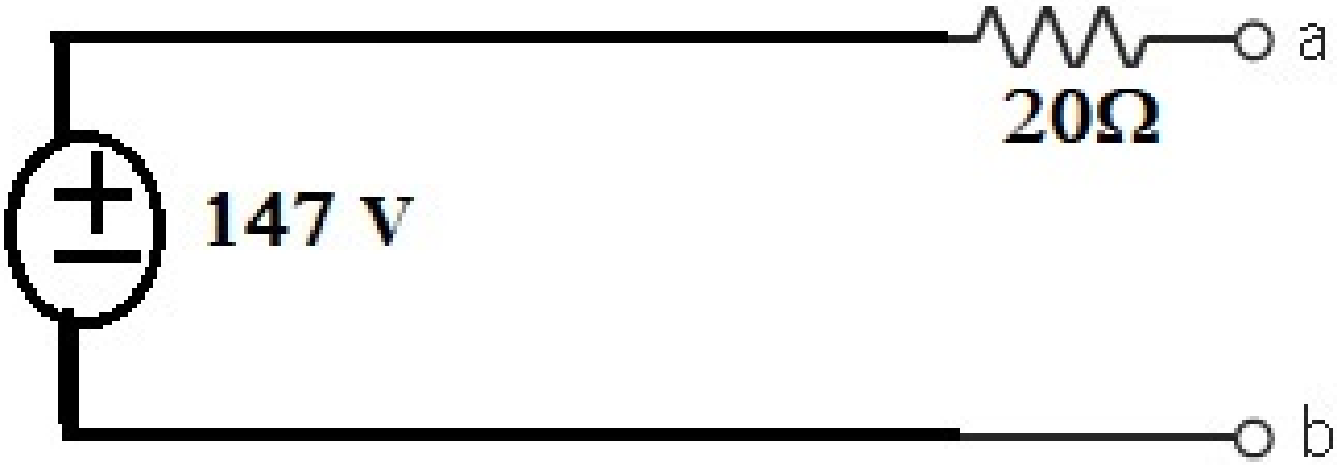

Figure: Computing the Norton equivalent circuit - Part f

P5.5-4 on page 204 - Solution

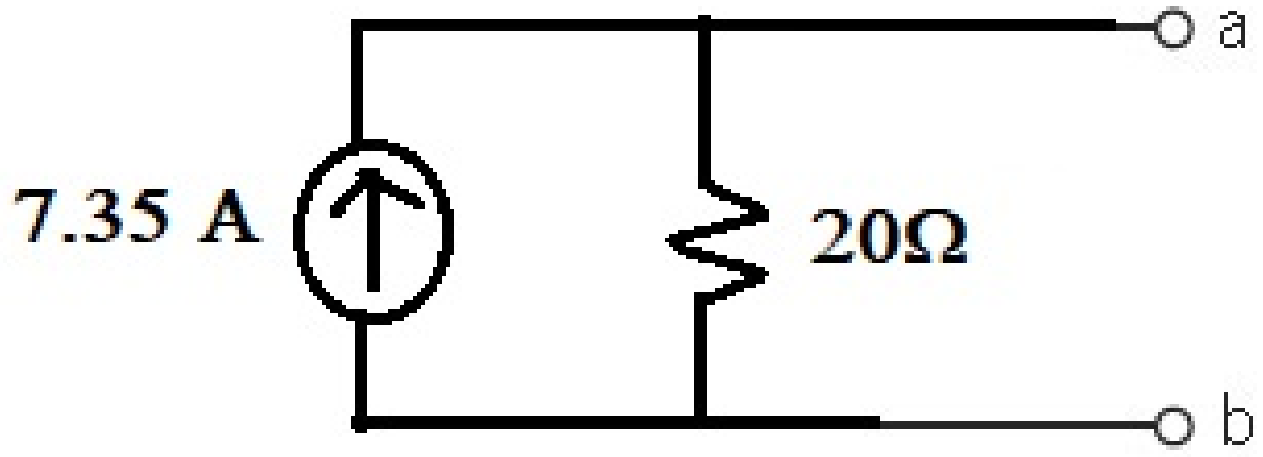

Figure: Norton equivalent circuit

Maximum Power Transfer - P5.6-2 on page 206

The circuit model for a photovoltaic cell is given in figure below. The current i_s is proportional to the solar isolation.

- Part a - Find the load resistance R_L for maximum power transfer to the load.
- Part b - Find the maximum power transferred when $i_s = 1A$.

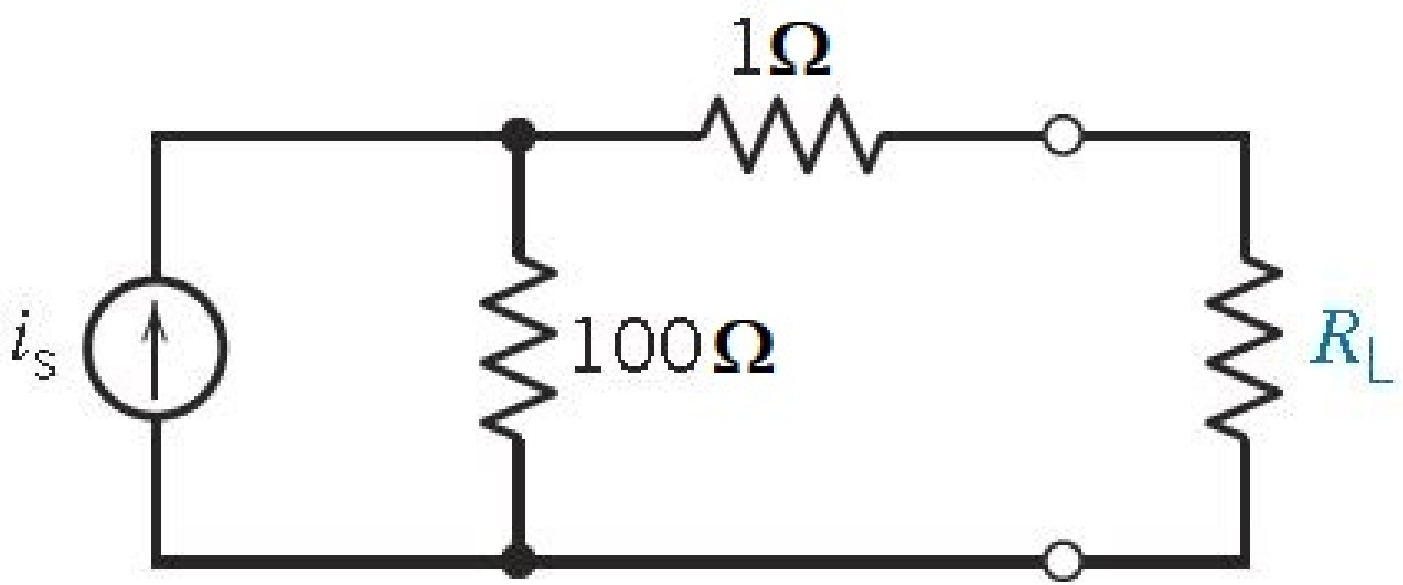

Figure: Circuit model of a photovoltaic cell

P5.6-2 on page 206 - Solution - Part a

For maximum power transfer, we need to replace the current source by open circuit and disconnect the load. Let us compute the Thevenin equivalent resistance

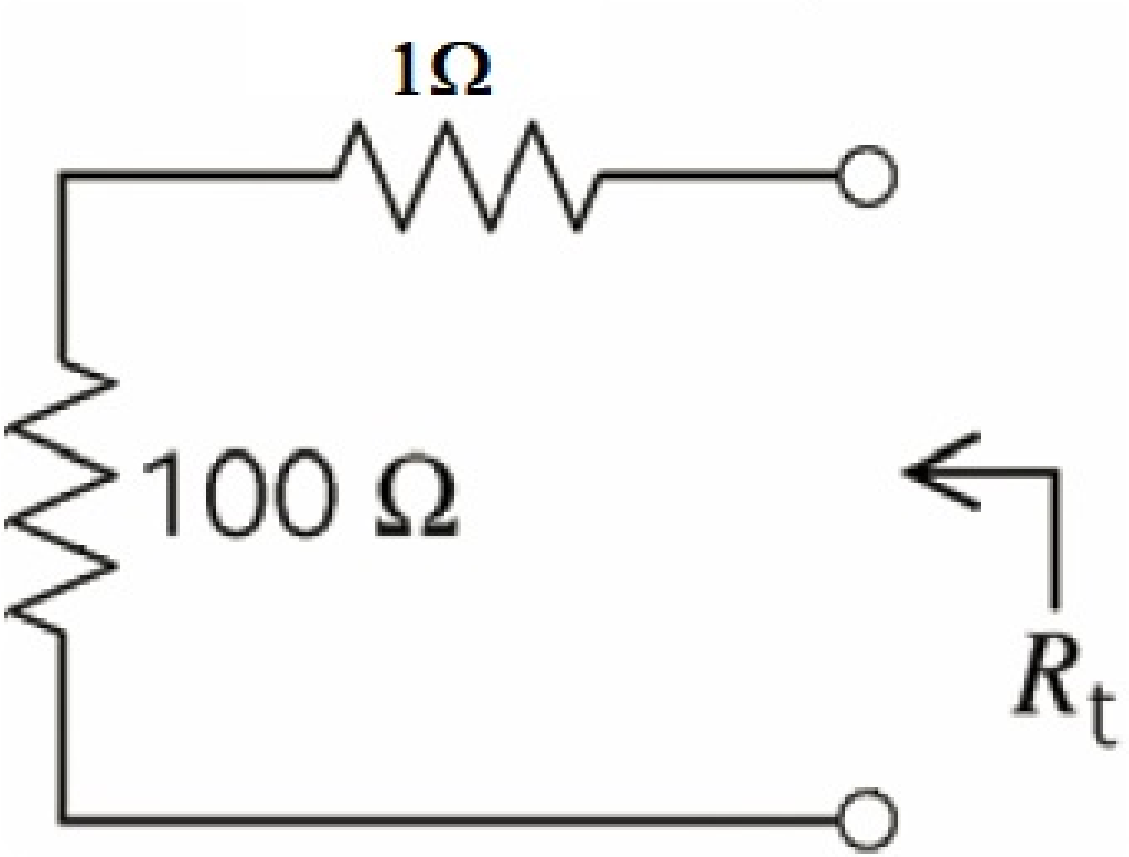

Figure: Computing the Thevenin equivalent circuit for part a

P5.6-2 on page 206 - Solution - Part a

We obtain the following:

$$\boldsymbol{R_T = 100 + 1 = 101\Omega}$$

So, for maximum power transfer, set $\boldsymbol{R_L = 101\Omega}$.

For solving part b, we substitute $\boldsymbol{i_s = 1A}$ and $\boldsymbol{R_L = 101\Omega}$, and then compute the Thevenin equivalent circuit

P5.6-2 on page 206 - Solution - Part b

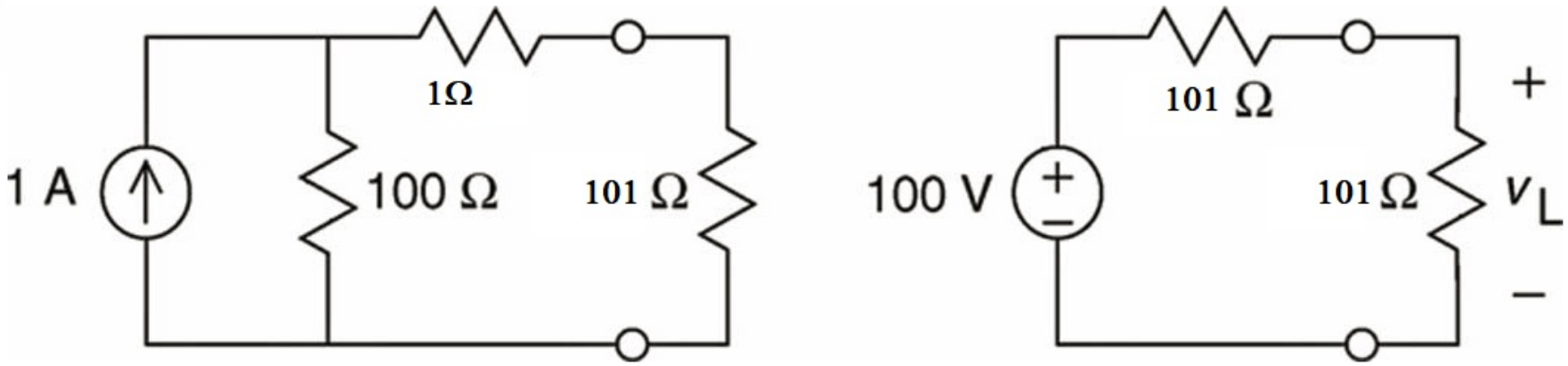

Figure: Computing the Thevenin equivalent circuit for part b

P5.6-2 on page 206 - Solution - Part b

$$V_L = \frac{105}{105+105}100 = 50V$$

The maximum power is computed as follows:

$$p_{max} = \frac{V_L^2}{R_L} = \frac{50 \times 50}{105} = 23.8W$$

Instructions for final exam

1. Write your name, registration number and page number on the top of every page in your copy (that you are submitting)
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3. Take pictures of all pages that you want to submit and copy them in MS-word file (including software code if you want)
4. Covert MS-word file to pdf file and submit it in Google Forms file management system
5. Email the pdf file to your own email address (not Dr. Salman email address) but your own email uetpeshawar domain email address
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