The University of Sheffield
Department of Electronic and Electrical Engineering

EEE117 Problem Sheet

Thevenin and Norton Equivalent Circuits

Q1 For the circuit of figure 1, replace the source potential divider by its Thevenin equivalent circuit and evaluuate the Thevenin equivalent source and the thevenin equivalent series resistance. Hence work out I_L. [3 V, 750 Ω, 2 mA]

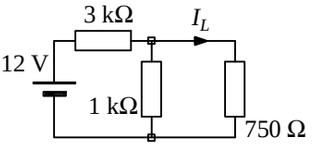


Figure 1

Q2 For the circuit of figure 2 replace the combinations V_1, R_1 and V_2, R_3 by Norton equivalent circuits and hence find I. [– 0.25 A]

Q3 For the circuit of figure 3 replace the combinations R_1, I_1 and R_2, I_2 by Thevenin equivalent circuits and hence work out V. [16.89 V]

Q4 For the circuit of figure 4, replace V_S and R_1 by a Norton equivalent circuit and find the value of I needed to make $V_R = 0$ V. [– 1.67 A]

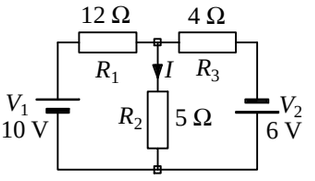


Figure 2

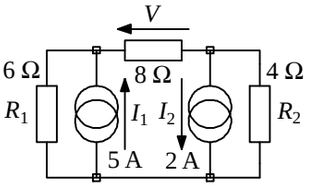


Figure 3

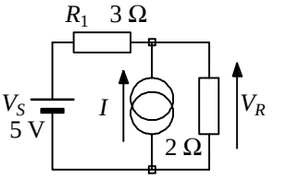
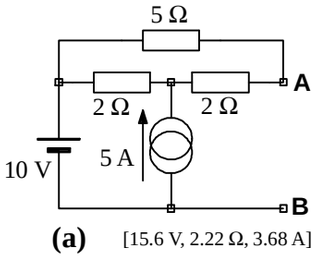
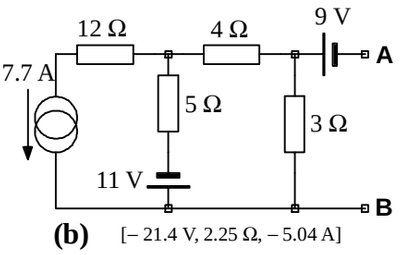


Figure 4

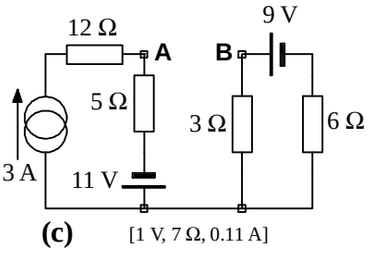
Q5 For figures 5 **(a)**, **(b)** and **(c)** find the Thevenin equivalent of the circuit shown looking into terminals **A** and **B** in each case. Assume that a positive Thevenin voltage will make $V_{\mathbf{A}}$ positive w.r.t $V_{\mathbf{B}}$. Hence for each circuit find the current that would flow through a 2 Ω resistor connected between **A** and **B** in a direction **A** to **B**.



(a) [15.6 V, 2.22 Ω, 3.68 A]



(b) [– 21.4 V, 2.25 Ω, – 5.04 A]



(c) [1 V, 7 Ω, 0.11 A]

Figure 5

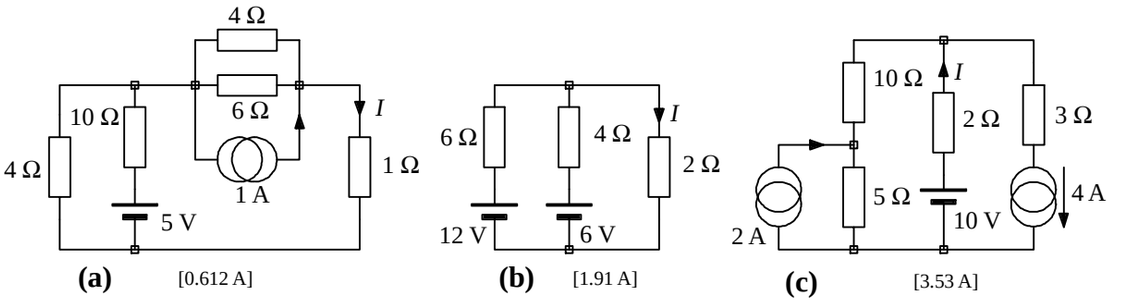


Figure 6

Q6 Use Thevenin to Norton and Norton to Thevenin transformations, as appropriate, to simplify the networks in figures 6 **(a)**, **(b)** and **(c)**. In each case the objective is to find the current *I*.

Q7 A particular power tool battery is loaded by a number of different resistors. The open circuit battery voltage is measured and for each load resistor the battery terminal voltage is measured. The table below gives the measurements

R_L (Ω)	∞	6	3	2	1.5	1.0	0.8	0.6	0.5
Measured *V* (volts)	14.4	13.9	13.5	13.1	12.7	10.2	11.5	10.8	10.3

You want to find the Thevenin equivalent circuit that represents the battery. Deduce what needs to plotted against what in order to get a straight line graph and then sketch the graph (do it in your lab notebook if necessary) and hence identify the Thevenin parameters of the battery. One of the points is a bad measurement - can you spot which one it is?

(*Hint: It will probably help to calculate I_L, the current through R_L, and get an equation by summing the voltages around the loaded Thevenin equivalent circuit of the battery.*)

[14.4 V, 0.2 Ω, the R_L = 1 Ω measurement]