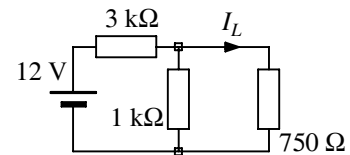


## EEE101 Problem Sheet

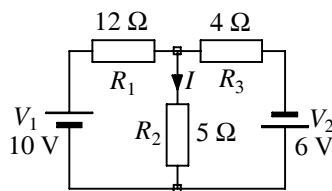
# Thevenin and Norton Equivalent Circuits

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

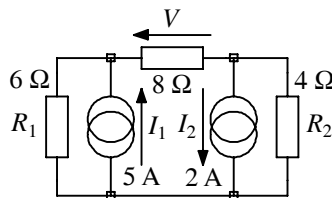


**Figure 1**

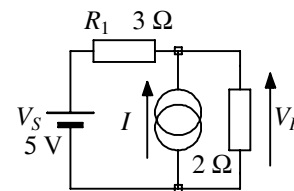
- Q2** For the circuit of figure 2 replace the combinations  $V_1$ ,  $R_1$  and  $V_2$ ,  $R_3$  by Norton equivalent circuits and hence find  $I$ . [−0.25 A]
- Q3** For the circuit of figure 3 replace the combinations  $R_1$ ,  $I_1$  and  $R_2$ ,  $I_2$  by Thevenin equivalent circuits and hence work 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**

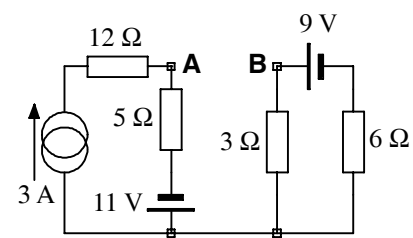
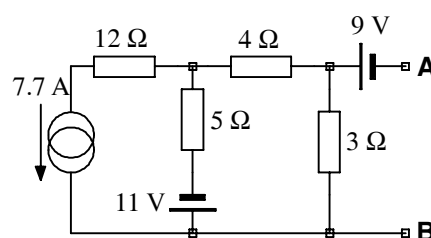
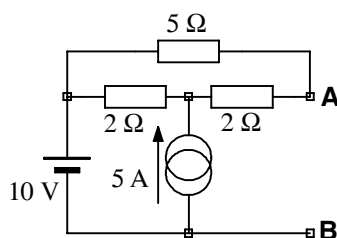


**Figure 3**

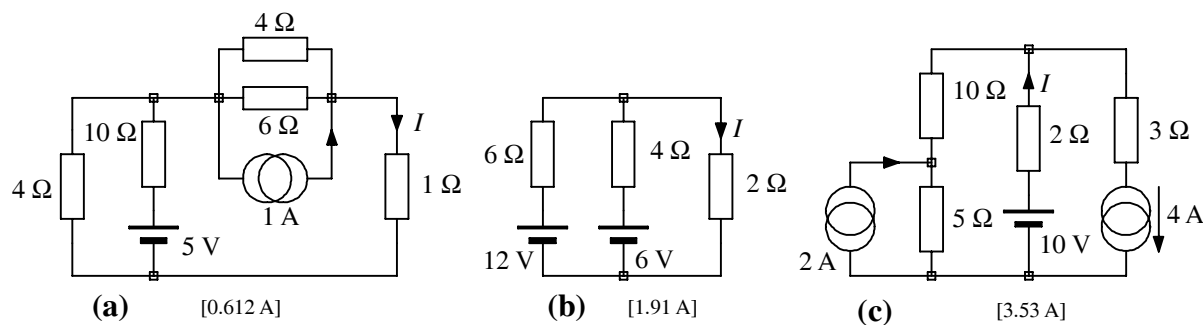


**Figure 4**

- 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  $V_A$  positive w.r.t  $V_B$ . Hence for each circuit find the current that would flow through a 2  $\Omega$  resistor connected between **A** and **B** in a direction **A** to **B**.



**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

$R_L$ ( $\Omega$ )	$\infty$	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 be 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  $\Omega$ , the  $R_L = 1 \Omega$  measurement]