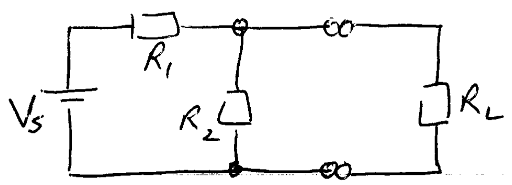
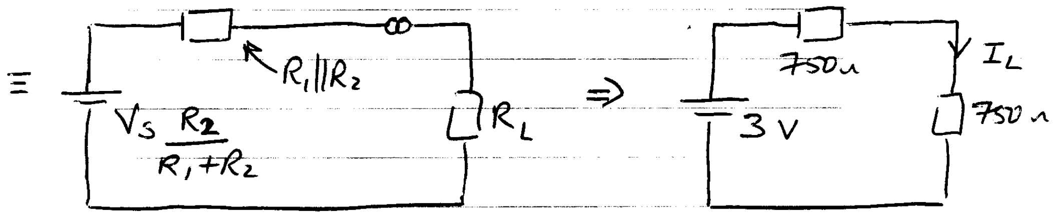
Q1

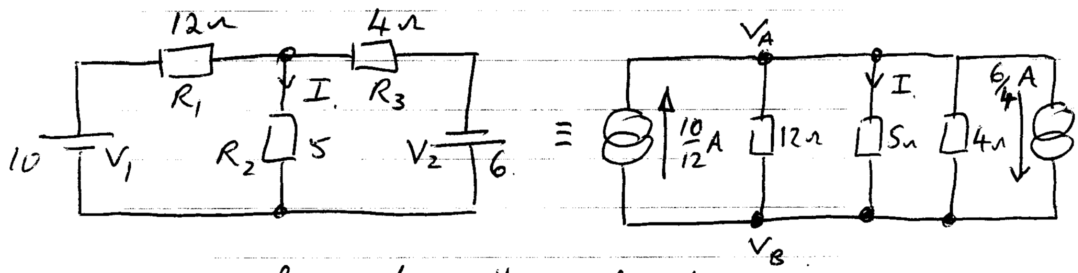


$V_S = 12$
$R_1 = 3k\Omega$
$R_2 = 1k\Omega$
$R_L = 750\ \Omega$

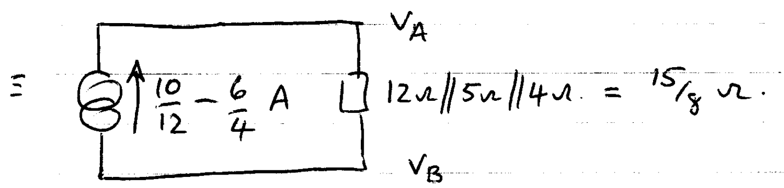


$V_{Th} = 3V$, $R_{TH} = 750\Omega$, $I_L = 2mA$.

Q2 Convert $V_1 + R_1$ and $V_2 + R_3$ from a Thevenin form to a Norton form ....



need to find the voltage $V_A - V_B$ .....



$$V_A - V_B = \left(\frac{10}{12} - \frac{6}{4}\right) \cdot \frac{15}{8} = -\frac{8}{12} \cdot \frac{15}{8} = -5/4\ V$$

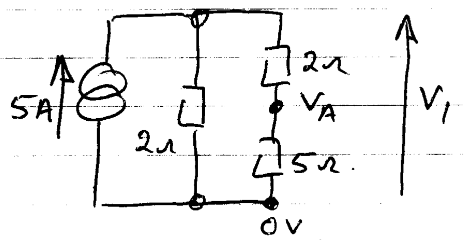
$$\therefore\ I = -5/4 / 5 = -1/4\ A = \underline{\underline{-0.25A}}$$

Q3. Try replacing the Norton circuits $R_1 + I_1$ and R_2 and I_2 by Thevenin equivalents and see where you end up.

Q4 The question tells you how to proceed. What is $I_{2\Omega}$ if $V_R = 0$?

Q5 (a) Work out $V_A - V_B$ (or simply V_A if you have remembered to make V_B your zero reference). Probably easiest to use superposition for this – the 10V is easy but I is a bit tricky.

V_A due to I



$V_1 = 5A \times 2\Omega // (2\Omega + 5\Omega)$

and $V_A = V_1 \times \dfrac{5\Omega}{2\Omega + 5\Omega}$.

$V_{TH} = 15.6V$

$R_{TH} = 2.22\Omega$

$I_{AB} = 3.68A$

(b) Nothing tricky in this one. The 9V source is easily dealt with once the voltage across the 3Ω resistor due to 7.7A and 11V is found. Again, superposition is probably the best method....

Remembering that V_B is the zero reference,

$V_{3\Omega}$ due to 7.7A $= -9.63V$

$V_{3\Omega}$ due to 11V $= -2.75V$

$\therefore V_{3\Omega}$ tot $= -12.4$.

$\therefore V_A = -12.4 - 9 = \underline{-21.4}$

$R_{TH} = 3\Omega // (4\Omega + 5\Omega) = 2.25\Omega$ by inspection (remember R_{TH} is the resistance looking into AB with all current sources replaced by open circuits and all voltage sources replaced by short circuits.)

So I_{AB} through 2Ω resistor $= \dfrac{-21.4}{2\Omega + 2.25\Omega}$

$= \underline{\underline{-5.04A}}$

(c) This one is easy but you need to be careful in your choice of reference. I would choose the common bottom line and work out V_A & V_B with respect to this before working out $V_A - V_B$, which equals V_{TH}.

Q6(a) 5V, 10Ω and 4Ω form a potential divider that can be represented as a Thevenin equivalent. The Norton circuit consisting of 1A, 6Ω and 4Ω can be converted into a Thevenin equivalent. This leaves a simple series circuit

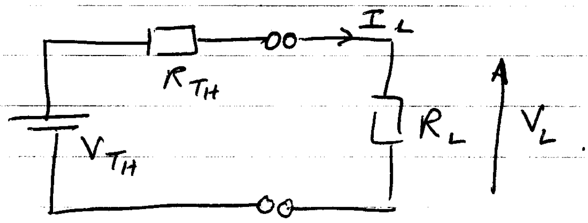
(b) convert 12V + 6Ω into a Norton equivalent and do the same with 6V + 4Ω. This gives you a parallel circuit. You can either work from the parallel circuit or you can combine the Nortons into one and convert to a Thevenin.

(c) convert the 2A and 5Ω into a Thevenin and then the Thevenin consisting of this and the 10Ω back into a Norton. The current of this Norton can be added to the 4A (using the correct signs, of course) and the resulting Norton converted to a Thevenin. You now have a simple series circuit.

The only tricky bit here is that you

need to recognise that the 3Ω in series with the 4A has no effect at all on I – the current through the 3Ω – 4A combination is always 4A and the voltage across it is set by the rest of the circuit.

Q7 This is a fairly standard way of measuring internal resistance – there are others. The model you are trying to find values for is



so $V_L = -I_L R_{TH} + V_{TH}$

which is equivalent to

$$y = mx + c.$$

$m = -R_{TH}$ = slope of straight line
V_{TH} = value of V at which extension of line cuts the y (voltage) axis.

The incorrectly measured point will not lie on the line.