ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 3: verification of Thevenin's and Norton's theorems in DC circuits.

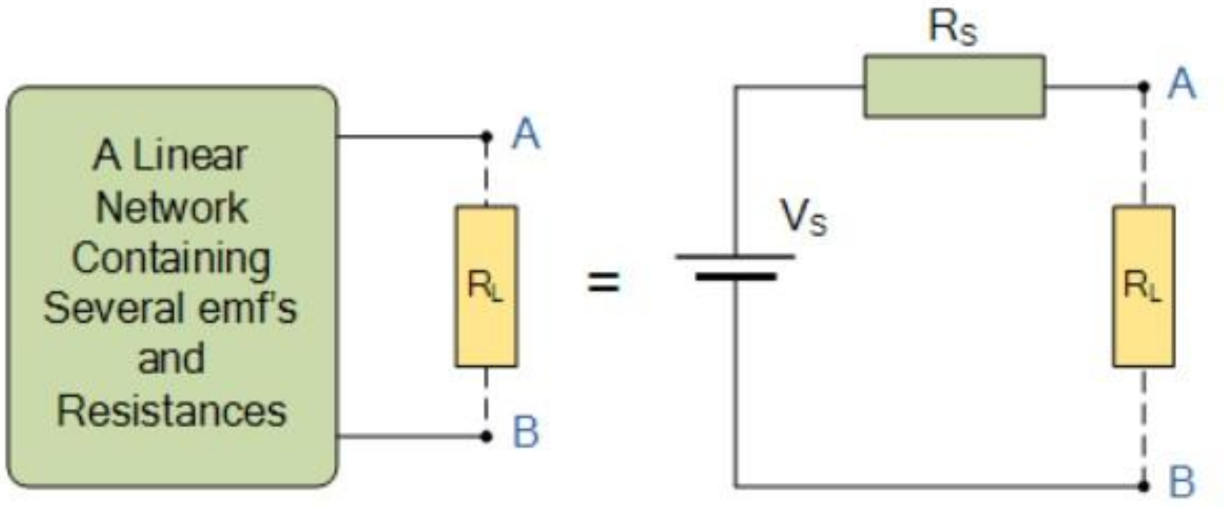
Introduction

Thevenin’s Theorem

It states that “*Any linear circuit containing several voltages and resistances can be replaced by just one single voltage in series with a single resistance connected across the load*”. In other words, it is possible to simplify any electrical circuit, no matter how complex, to an equivalent two-terminal circuit with just a single constant voltage source in series with a resistance (or impedance) connected to a load as shown below.

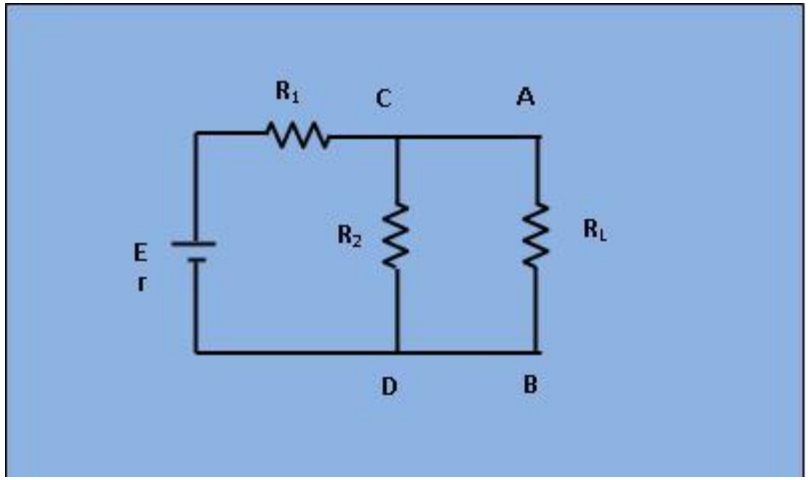
Introduction

Thevenin's Equivalent Circuit



An Example

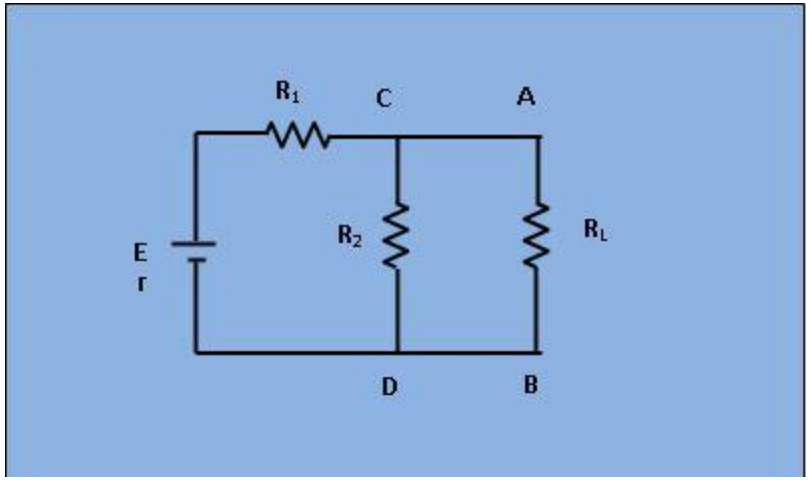
Find the current across the load resistor by applying the Thevenin’s theorem.



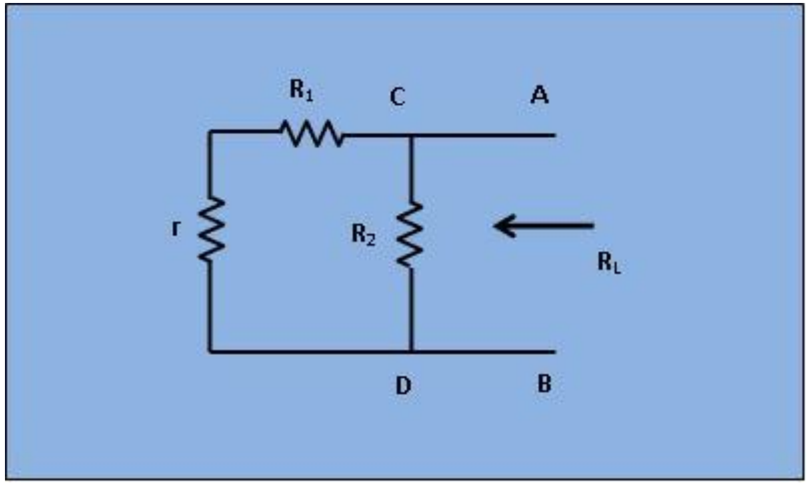
An Example

Find Equivalent Resistance, Rs

Step 1: Firstly, we have to remove the RL load resistor connected across the terminals A-B



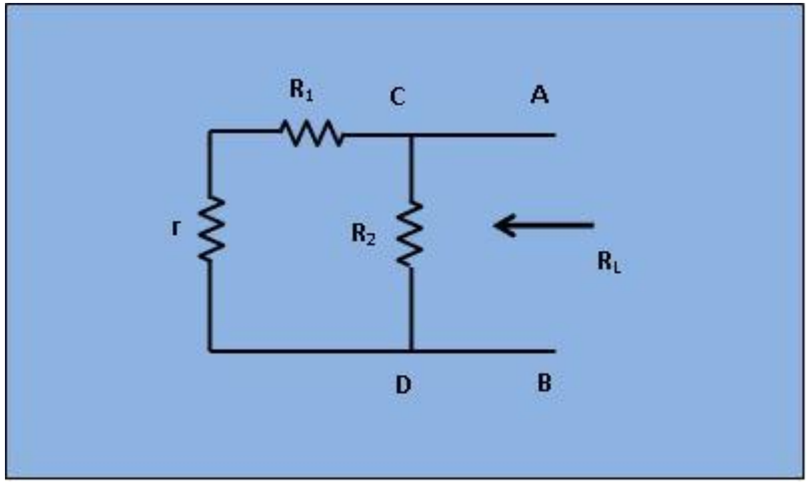
Step 2: Remove any internal resistance associated with the voltage source(s). This is done by shorting out all the voltage sources connected to the circuit with their internal resistance r.



An Example

Find Equivalent Resistance, Rth

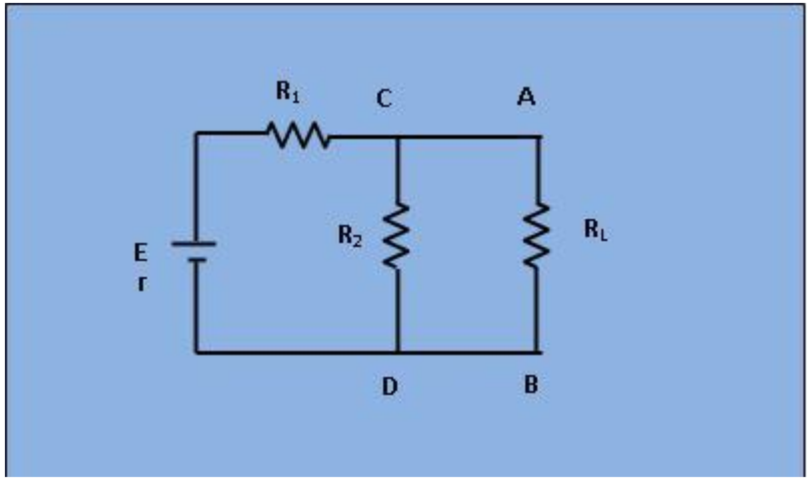
Step 3: The value of the equivalent resistance, Rth is found by calculating the total resistance looking back from the terminals A and B with all the voltage sources shorted.

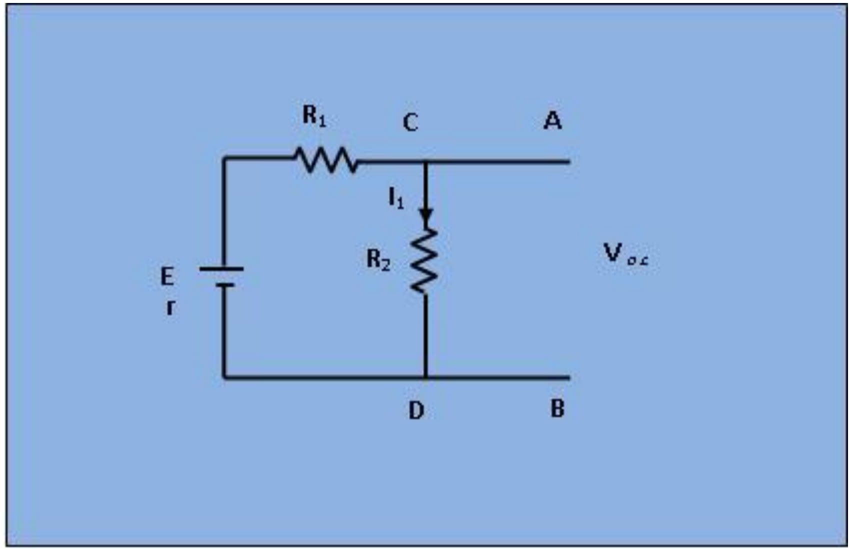


An Example

Find Equivalent Voltage, Vs

Step 4: We now need to reconnect the two voltages back into the circuit, and find the $V_{th} = V_{oc}$ by applying the KVL law

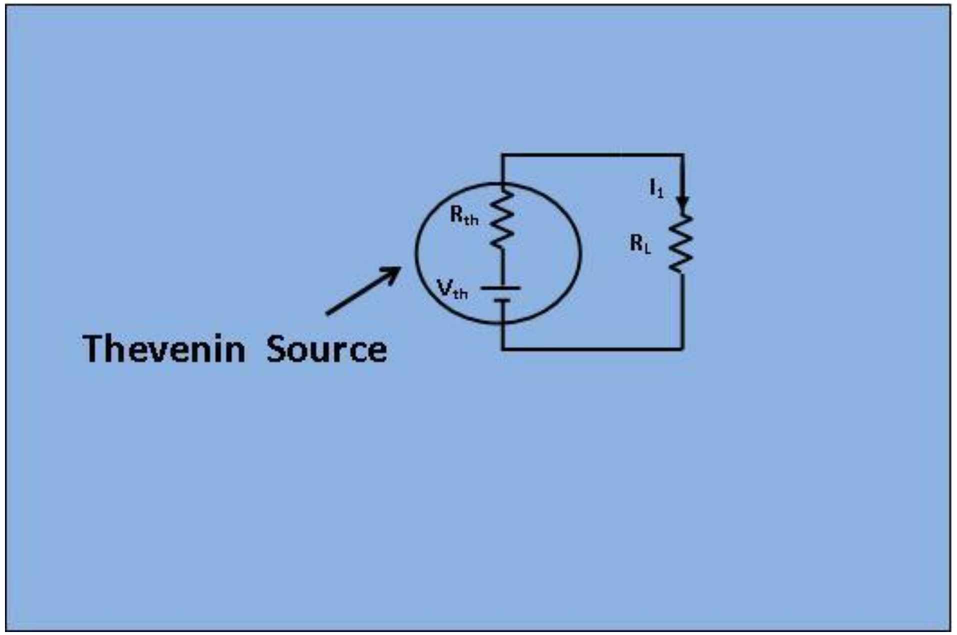




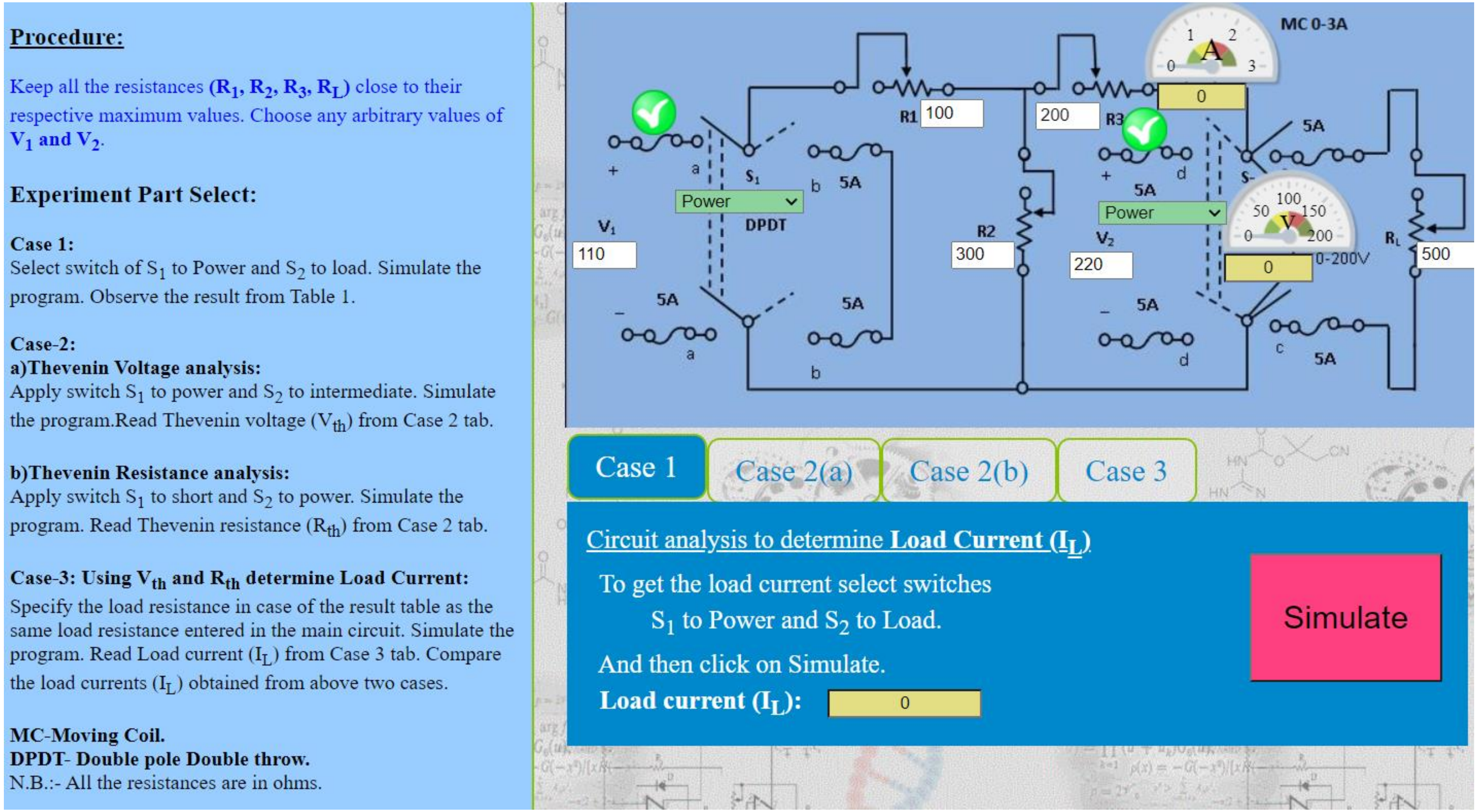
An Example

Step 5:. Consequently, as viewed from terminals A and B, the whole network (excluding RL) can be reduced to single source (called thevenin's source) whose e.m.f equal to VO.C. and whose internal reistance equal to Rth as shown in figure.

RL is now connected back across terminals A and B from where it was temporaily removed earlier. Current flowing through RL is given by,



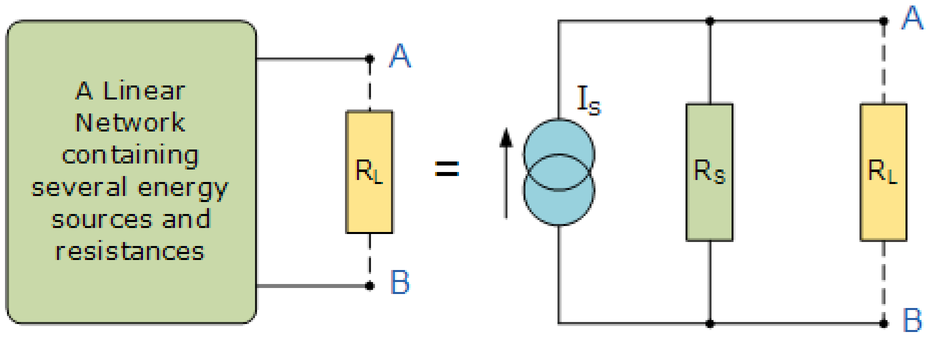
Let Verify using Virtual Lab



Introduction

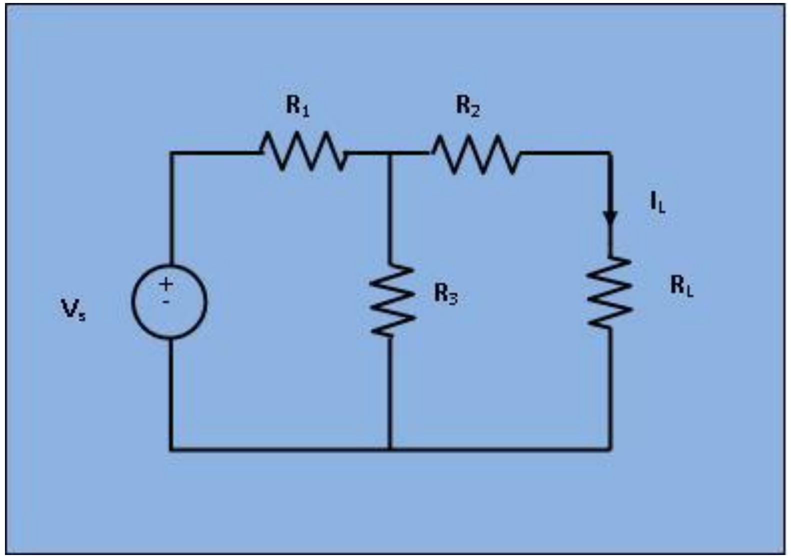
Norton’s Theorem

It states that *“Any linear circuit containing several energy sources and resistances can be replaced by a single Constant Current generator in parallel with a Single Resistor”*.



An Example

Find the current across the 40Ω load resistor by applying the Norton’s theorem.



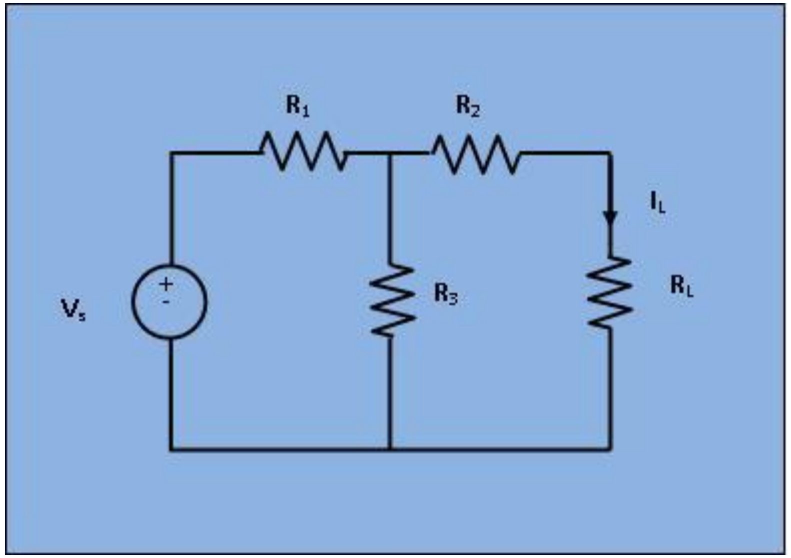
Find Equivalent Resistance, Rth

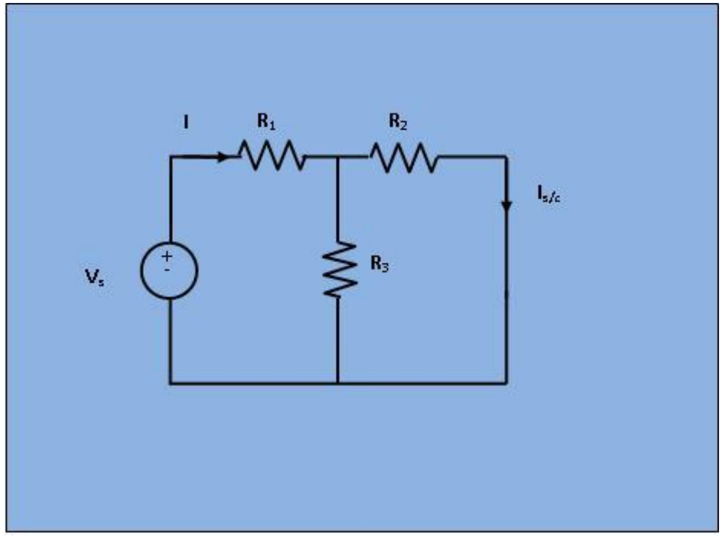
Step 1-3

An Example

Find Short circuit Current, Is

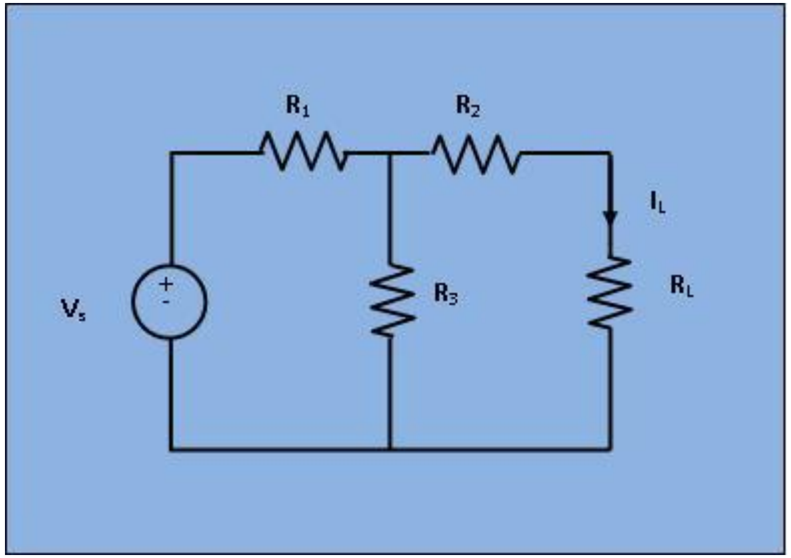
Step 4: To find the Norton’s equivalent of the above circuit we firstly have to remove the centre oad resistor and short out the terminals A and B to give us the following circuit and find the short circuit current by applying the KCL.

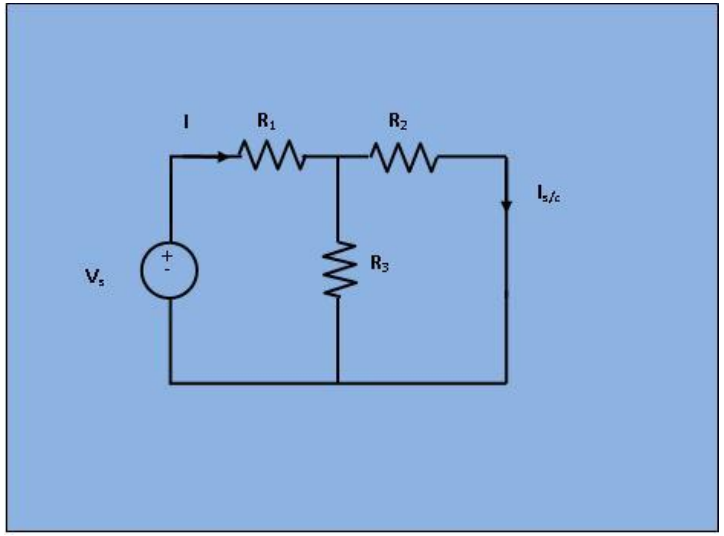




An Example

Step 5: As per Norton's theorem , the equivalent circuit as shown in figure, would contain a current source in parallel to the internal resistance, the current source being the short circuited current across the shorted terminals of the load resistor.





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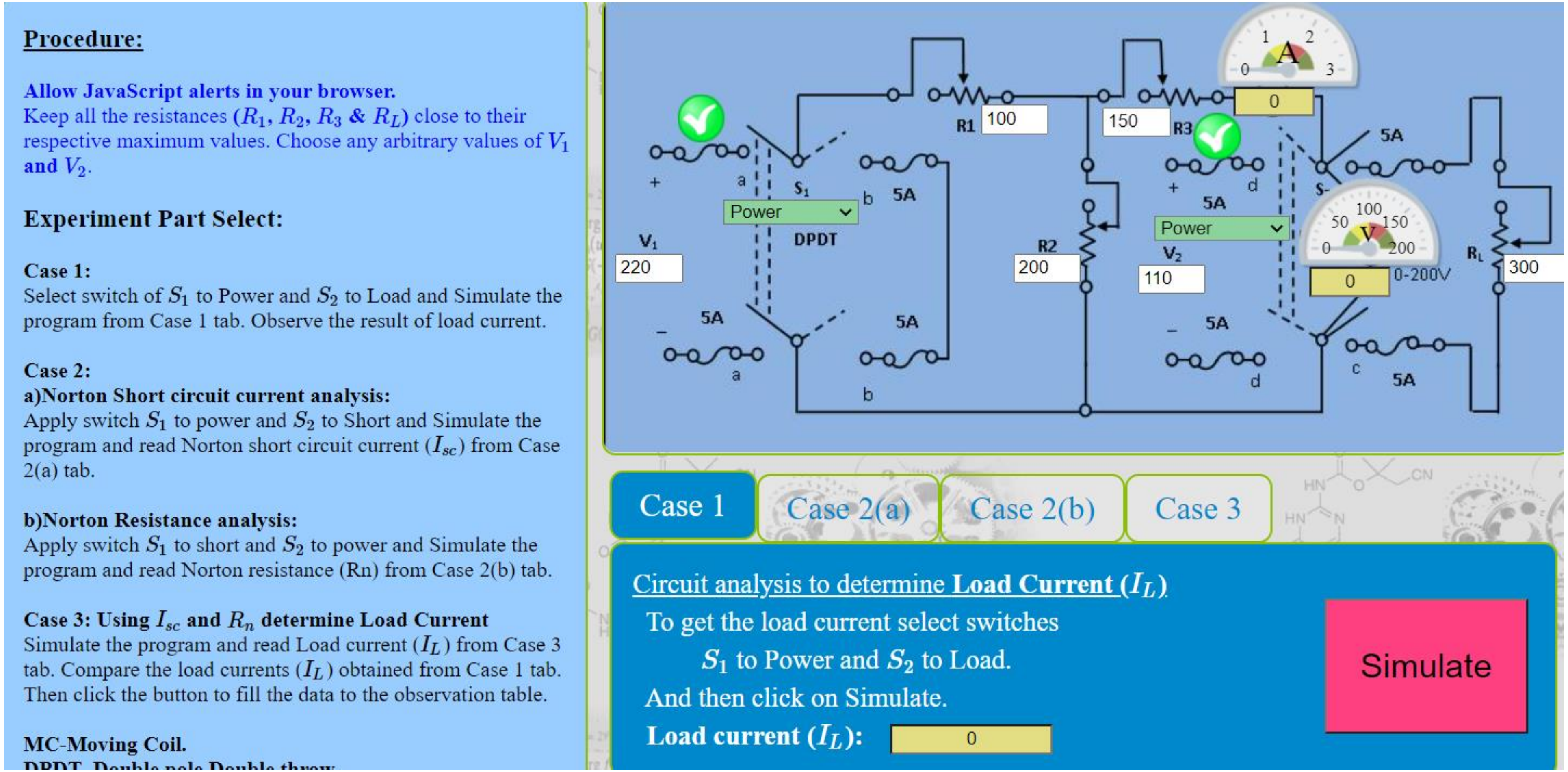

Thanks You