TUTORIAL 3 RESISTANCE AND DC CIRCUITS

3.1 Write down an equation relating current and charge.

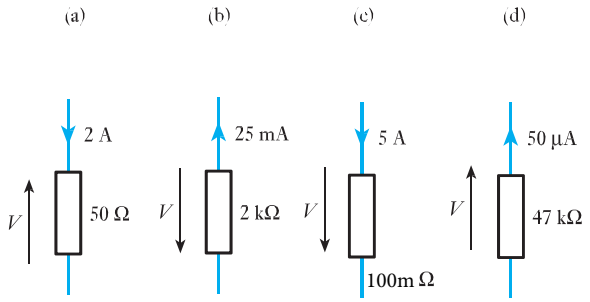
3.2 What quantity of charge is transferred if a current of 5 A flows for 10 seconds?

3.3 What is the internal resistance of an ideal voltage source?

3.4 What is meant by a *controlled* voltage source?

3.5 What is the internal resistance of an ideal current source?

3.6 Determine the voltage V in each of the following circuits, being careful to note its polarity in each case.



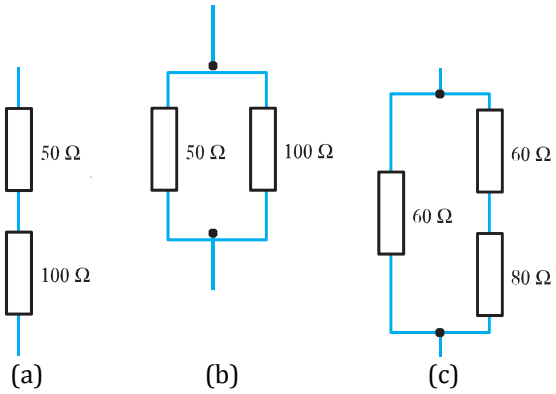
3.7 For each circuit in exercise 3.6, determine the power dissipated in the resistor.

3.8 Estimate the resistance of a copper wire with a cross-sectional area of 1 mm^2 and a length of 1 m at 20 °C.

(resistivity of copper at 20 degrees is 1.68 x 10^-8 ohm m)

3.9 What is the relationship between the *conductivity* of a material and its *resistivity*?

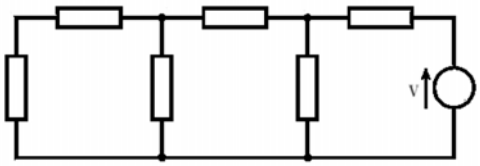
3.10 Determine the resistance of each of the following combinations.



3.11 What resistance corresponds to $10k\Omega // 10k\Omega$?

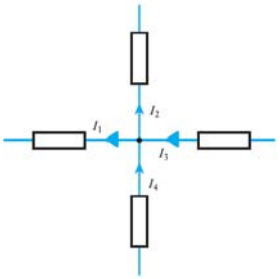
3.12 Define the terms 'node', 'loop' and 'mesh'.

3.13 Label each of the nodes in the following arrangement with the letters A, B, C etc

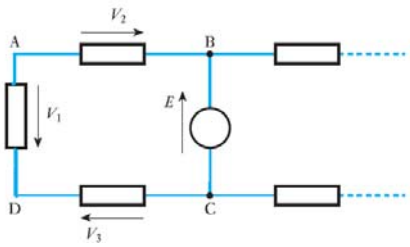


3.14 Having labelled each of the *nodes* in the previous exercise, use these labels to define each of the *loops* within the circuit and each of the *meshes*.

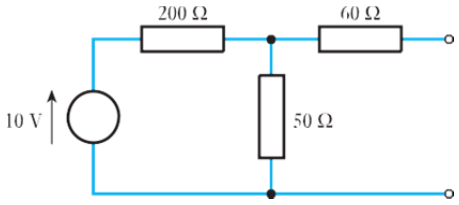
3.15 Given that $I_1 = 6$ A, $I_3 = 8$ A and $I_4 = 5$ A determine the magnitude of I_2 in the following circuit.



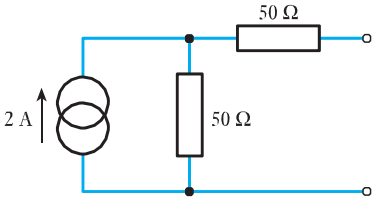
3.16 Given that $V_1 = 2$ V, $V_3 = 4$ V and E = 12 V, determine the magnitude of V_2 in the following circuit.



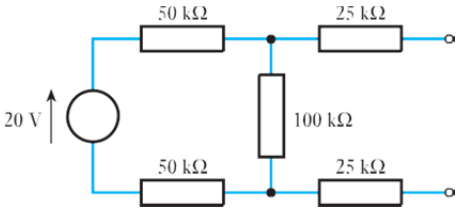
3.17 Derive Thévenin and Norton equivalent circuits for the following arrangements.



(a)



(b)



(c)

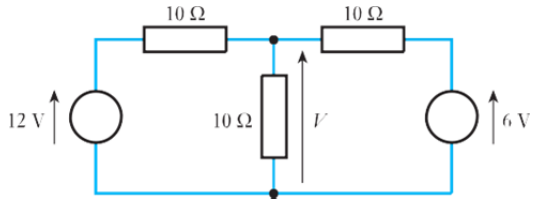
3.18 A two-terminal network is investigated by measuring the output voltage when connected to different loads. When a resistance of 12 Ω is connected across the output the output voltage is 16 V, and when a load of 48 Ω is connected the output voltage is 32 V. Use a graphical method to determine the Thévenin and Norton equivalent circuits of this arrangement.

3.19 Repeat Exercise 3.18 using a non-graphical approach.

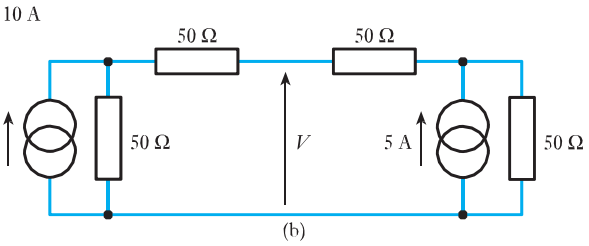
3.20 The Thévenin equivalent circuit of an arrangement consists of a voltage source of 10 V in series with a resistance of 100 Ω. What would be an appropriate Norton equivalent circuit?

3.21 The Norton equivalent circuit of an arrangement consists of a current source of 25 mA in parallel with a resistance of 2.5 kΩ. What would be an appropriate Thévenin equivalent circuit?

3.22 Use the principle of superposition to determine the voltage V in each of the following circuits.



(a)



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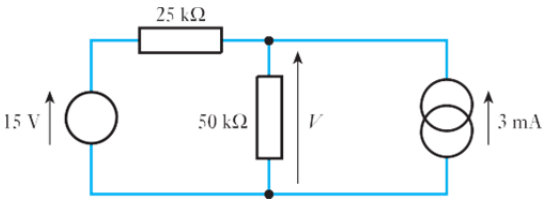
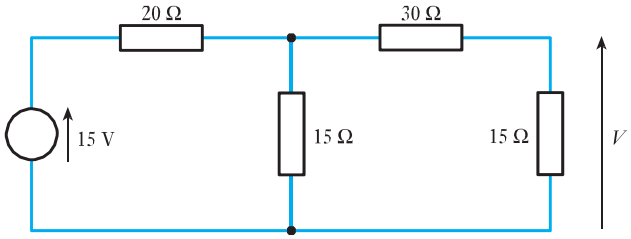
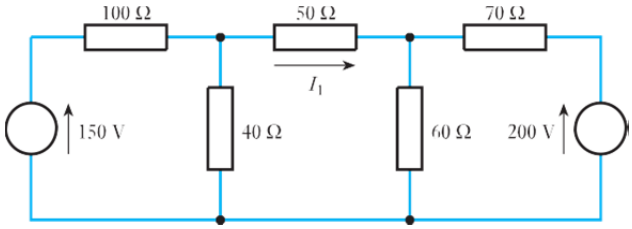


(c)

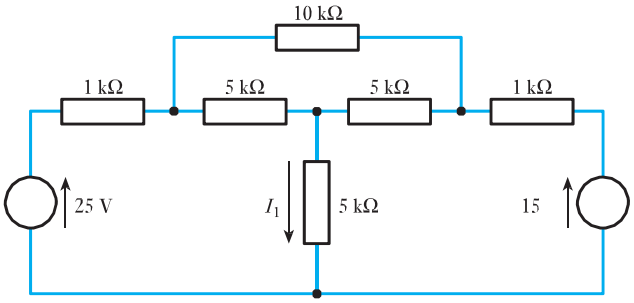
3.23 Use nodal analysis to determine the voltage V in the following circuit.



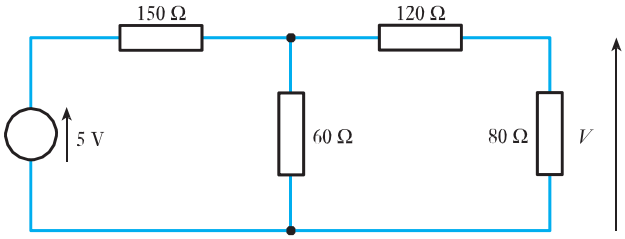
3.24 Use nodal analysis to determine the current I_1 in the following circuit.



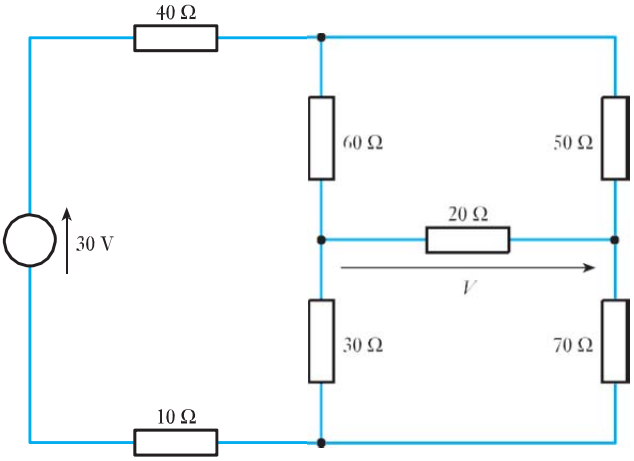
3.25 Use nodal analysis to determine the current I_1 in the following circuit



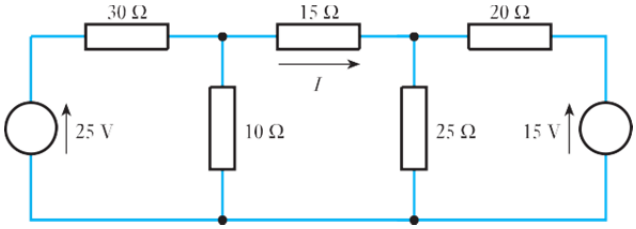
3.26 Use mesh analysis to determine the voltage V in the following circuit.



3.27 Use mesh analysis to determine the voltage V in the following circuit.



3.28 Use mesh analysis to determine the current I in the following circuit.



3.29 Use an appropriate form of analysis to determine the voltage V_O in the following circuit.