THE UNIVERSITY OF MELBOURNE

Semester One Mid-semester Assessment
April 2018

Department of Electrical and Electronic Engineering
ELEN 20005 FOUNDATIONS OF ELECTRICAL NETWORKS

Time allowed: 60 minutes
This paper has 4 pages

Authorised materials:

Only the following calculators may be used:

- Casio FX82 (any suffix)
- Casio FX100 (any suffix)

Students may bring **ONE** sheet of A4 paper containing hand-written notes into the exam room.

Instructions to invigilators:
All examination material (script book and test paper) will be collected at the end of the Test.

Instruction to students:

Attempt **ALL** questions.

The questions carry weight in proportion to the marks in brackets after the question numbers. These marks total 50 marks. **You must show your work in order to receive credit!**

Answer all questions and show all working in the script book provided, except for **the circuit diagram in Question 4(b), which must be drawn on the breadboard diagram on page 4 of this Question paper**.

Question 1 (12 marks)

(a) **[3 marks]** Draw a closed circuit that contains a 6 Ω resistor, a 10 V voltage source and a current controlled voltage source (CCVS) with a gain of $K = 2\Omega$. Place all three elements in series and assume that the control current for the CCVS is the current through the resistor.

(b) **[3 marks]** For each device in your circuit, compute its power and state whether it is acting as a source or a sink.

(c) **[5 marks]** Draw another circuit meeting the same specifications as in part (a), but ensure that it operates differently from the one you drew in part (a). Show that your circuit is different by computing the power of each device and showing that they are different from the powers you obtained for your circuit in part (a).

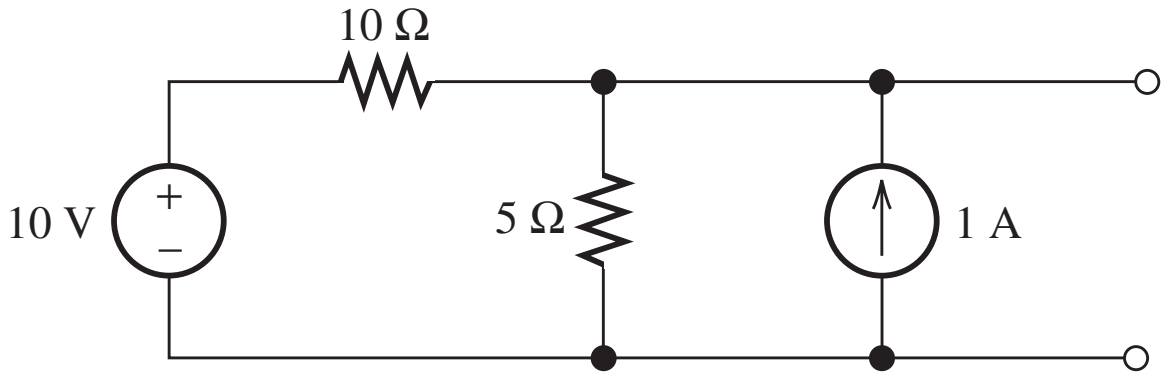
(d) **[1 mark]** A five-band resistor has colour code Green/Blue/Black/Brown/Gold. What is its resistance and tolerance? You may use the Colour code Table:

Silver $= 10^{-2}$	Gold $= 10^{-1}$	Black $= 0$	Brown $= 1$	Red $= 2$	Orange $= 3$
Yellow $= 4$	Green $= 5$	Blue $= 6$	Purple $= 7$	Grey $= 8$	White $= 9$

Tolerances	Silver $= 10\%$	Gold $= 5\ \%$	Red $= 2\%$	Brown $= 1\%$

Question 2 (7 marks)

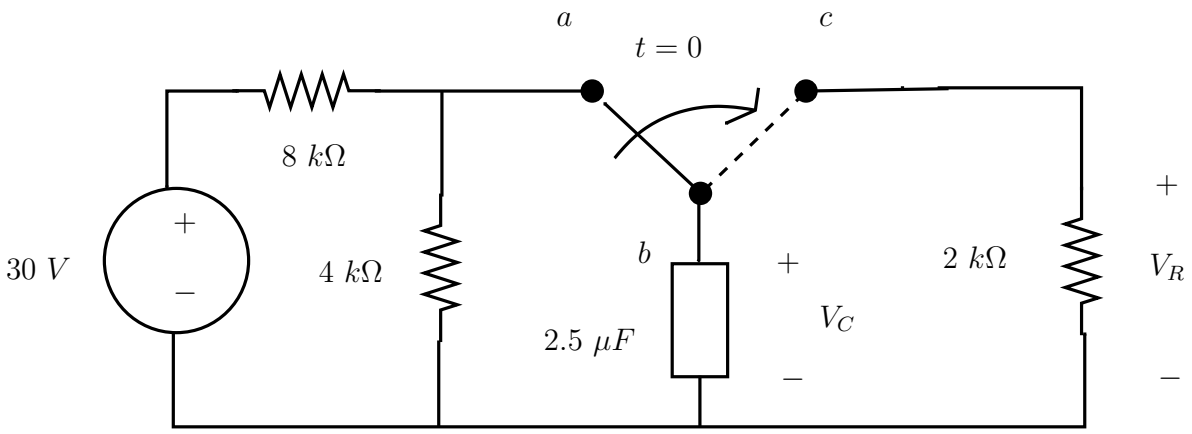
Draw the Norton equivalent circuit for the following circuit.



Question 3 (16 marks)

The single pole, double throw switch in the following circuit has been in position a for a long time, giving a short circuit between node a and node b, and an open circuit between nodes b and c. The rectangular box represents a capacitance of $C = 2.5\ \mu F$.

At time $t = 0\ s$ the switch is instantaneously moved to position c, causing an open circuit between terminals a and b of the circuit, and a short circuit between nodes b and c.



(a) **[2 marks]** What is $V_C(0^-)$, the voltage across the capacitor immediately **before** the switch is moved to node c? Explain your answer (use a maximum of 20 words).

(b) **[2 marks]** What is $V_C(0^+)$, the voltage across the capacitor immediately **after** the switch is moved to node c? Explain your answer (use a maximum of 20 words).

(c) **[2 marks]** What is $V_C(\infty)$, the steady-state voltage across the capacitor after the switch has been at node c for along time? Explain your answer (use a maximum of 20 words).

(d) **[6 marks]** Find $V_C(t)$ for $t \geq 0$ and sketch its graph.

(e) **[4 marks]** After what time does $V_R(t) = 2\ V$?

Question 4 (15 marks)

Assume that you have a supply voltage of 12 V. You have also have a single-pole single-throw (SPST) switch and a supply of 100 Ω resistors, with power ratings of 0.25 W.

(a) **[7 marks]** Design a two-terminal circuit that will produce 6 V at the outputs when the switch is OFF, and 4 V when the switch is ON. Show that each resistor does not exceed its power rating.

(b) **[8 marks]** Your laboratory kit contains the following equipment:

- GDM 8135 digital multimeter and a GPS 3303 DC Power Supply;
- A breadboard, connecting wires and power leads;
- One SPST (single-pole, single throw) switch and a supply of 100 Ω resistors.

Use the breadboard template below to show how you to build your circuit:

Then explain how you would test the circuit you have built to show that is does meet the desired output voltages. Use a maximum of 80 words, and write your explanation in your script book.