THE UNIVERSITY OF MELBOURNE

Semester One Mid-semester Assessment
April 2019

Department of Electrical and Electronic Engineering
ELEN20005 FOUNDATIONS OF ELECTRICAL NETWORKS

Time allowed: 60 minutes
This paper has 6 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 their own 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:

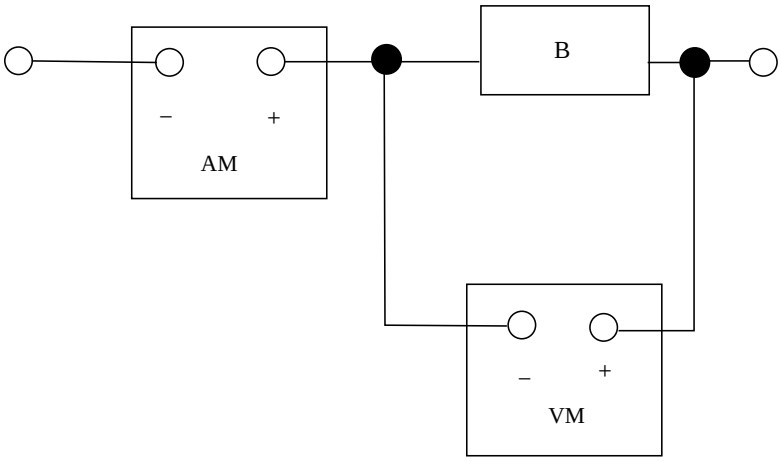
Attempt **ALL** questions.

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 5(c), which must be drawn on the breadboard diagram on page 6 of this Question paper**.

Question 1 (5 marks)

Consider the figure below. An ammeter (AM) and voltmeter (VM) are connected to measure the current through and the voltage across a device B. When positive current enters the AM meter at the + terminal the reading will be positive, otherwise a negative reading results. If the voltage potential at the + terminal is higher than the voltage potential at the − terminal of the VM meter, the reading will be positive, otherwise a negative reading results. For the purpose of this exercise, assume that the VM does not require any current through it to register a reading.

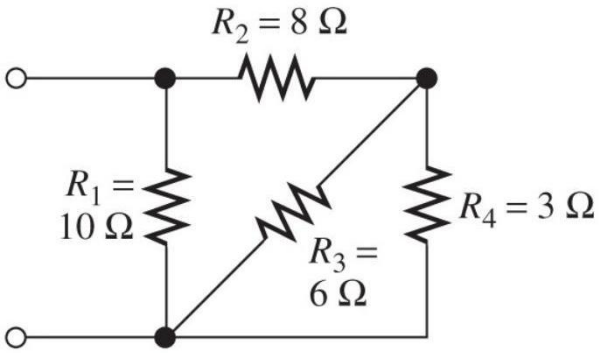


(a) Decide whether Passive or Active Sign Convention used in this figure. Give reasons for your answer.

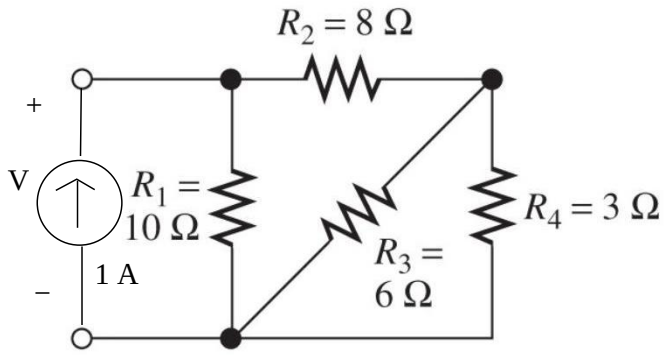
(b) The AM reading is 3 A and the VM reading is -10 V. Calculate the power for the device B, and indicate if it is absorbing or generating power.

Question 2 (12 marks)

(a) By combining resistors that are in series or in parallel, find the the equivalent resistance at the input terminals for the following circuit:



(b) A 1 A test current is applied at the input terminals as shown.



Use Node Voltage Analysis to compute the voltage V observed across the input terminals.

(c) Use your answer to part (b) to verify your answer from part (a) for the equivalent resistance.

Question 3 (6 marks)

(a) A 5-band resistor has colour bands Brown/Black/Black/Brown/Red. What are its resistance and tolerance?

(b) What are the colour bands of a 4-band 6.8 mH inductor with a 2% tolerance?

(c) A polyester capacitor has a capacitance 3.3 nF, and a tolerance of 5%. What is its alpha-numeric code?

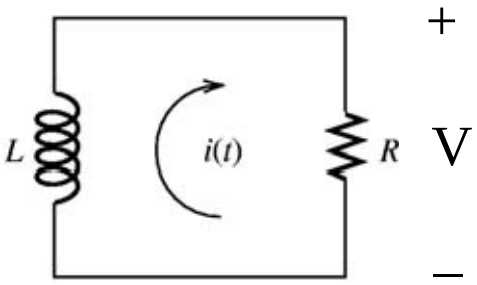
Use the following colour codes and tolerances.

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 (Resistors and Inductors)	Silver $= 10\%$	Gold $= 5\ \%$	Red $= 2\%$	Brown $= 1\%$
Tolerances (Capacitors)	M $= 20\%$	K $= 10\ \%$	J $= 5\%$	

Question 4 (13 marks)

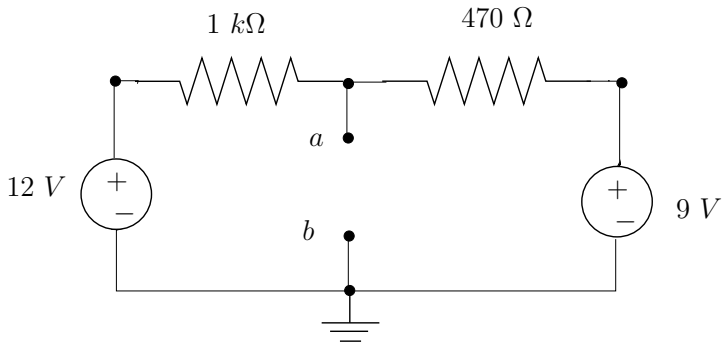
The circuit below has an initial current at time $t = 0$ of $i(0) = I_0$.



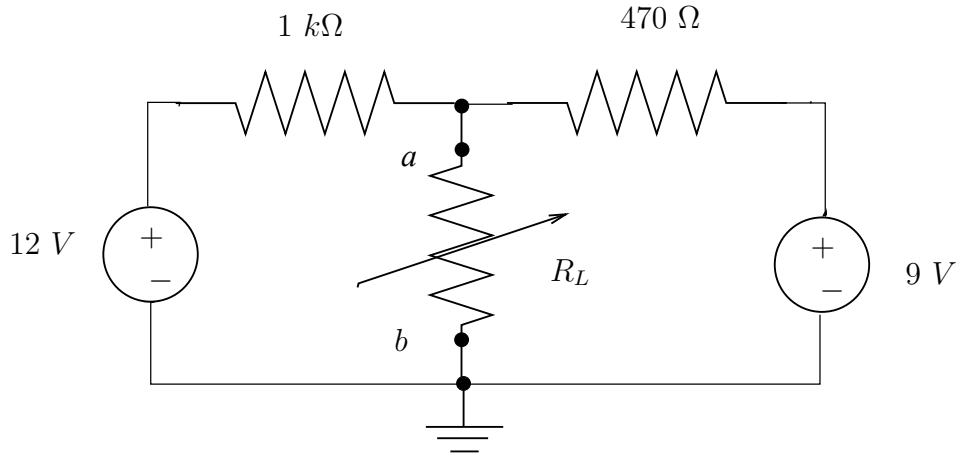
Find expressions for $i(t)$ and $V(t)$, the voltage across the resistor, in terms of L, R and I_0.

Question 5 (14 marks)

(a) For the following circuit, find and draw the equivalent Norton circuit at the output terminals a and b.



(b) Now assume that a variable load resistor R_L is placed between nodes a and b. Use your Norton circuit to find the value of R_L such that the current through the load from a to b will be 20 mA.



(c) Your laboratory kit contains the following equipment:

- GDM 8135 digital multimeter;
- GPS 3303 DC Power Supply;
- A breadboard and connecting wires;
- A 470 Ω and a 1 $k\Omega$ resistor, and a 1 $k\Omega$ variable resistor.
- Two pairs of red and black banana-banana leads, and one pair of multimeter probes.

Use the Breadboard diagram below to show how you would build the circuit in Part (b), and measure the current from a to b. Draw and label the input DC power supply, the multimeter, the voltage terminals, the resistors (these may be drawn as rectangular boxes) and the connecting wires. Also label nodes a and b and show where you would place the multimeter probes in order to measure the current through the variable resistor.