

UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION

DECEMBER 2018

TITLE OF PAPER: BASIC ELECTRICAL ENGINEERING

COURSE CODE: EEE251

DURATION: 3 HOURS

INSTRUCTIONS:

1. There are five (5) questions in this paper. Answer question 1 and any other three (3) questions.
2. Each question carries equal marks.
3. Start each question in a new page.

This paper should not be opened until permission has been given by the invigilator.

This paper contains eight (8) pages including this page.

Question 1 [25 Marks]

- a. What is the effect of temperature on the resistance of insulators and conductors? [3 Marks]
- b. What is breakdown voltage of an insulator? [1 Marks]
- c. What is the difference between voltage potential and potential difference? [1 Marks]
- d. Generally, in what way do resistors of the same color coding but different physical sizes differ? [2 Marks]
- e. An electric heater draws 4A when connected to a 240V supply.
 - i. What is the resistance of the heater? [2 Marks]
 - ii. How much energy does it convert in 30 minutes? [2 Marks]
- f. A wire of uniform cross section has a resistance of 0.8Ω . If the length of the wire is doubled and its cross sectional area increased 4 times, what is the resistance? (Ignore the effect of temperature). [4 Marks]
- g. Consider **Figure Q.1g**. Given that 72 joules is expended from each battery to supply a constant current of 2mA to R_L for a period. How long will the batteries be able to supply this current to the load resistor. [4 Marks]

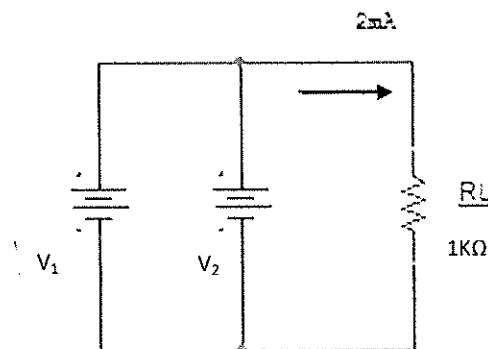


Figure Q.1g

- h. A $20k\Omega$ resistor has a power rating of 100W. What is the maximum current and voltage that can be applied to the resistor? [2 Marks]
- i. What is the total cost of using the following appliances at 1 Lilangeni 82 cents per kilowatt-hour?
 - i. 200W fan for 4 hrs. [1 Mark]
 - ii. 150 W LCD TV for 2hrs 20 minutes [1 Mark]
 - iii. 1500 W hair dryer for 30 minutes [1 Mark]
 - iv. 70 W radio for 36minutes [1 Mark]

Question 2 [25 Marks]

- a. Reduce the resistor network between terminals a and b of Figure Q.2a to a single resistor. [9 Marks]

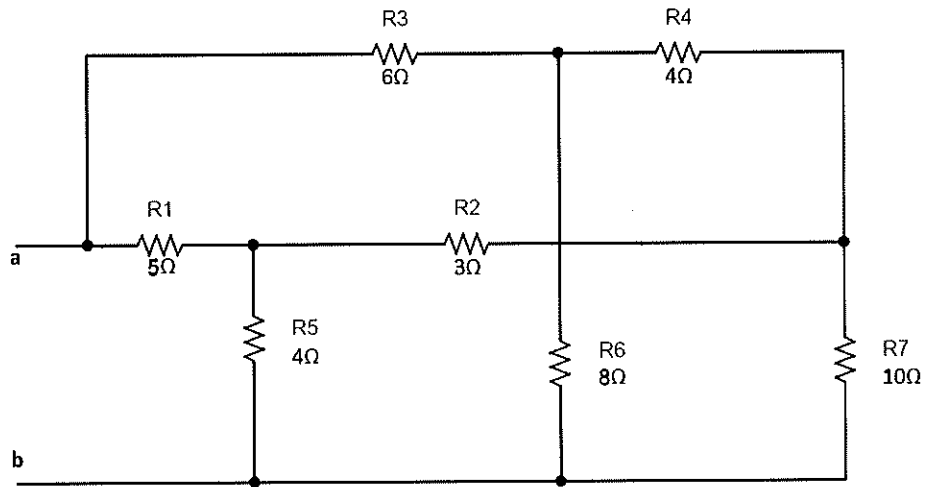


Figure Q.2a

- b. Using mainly source transformation find the current through the 6Ω resistor in Figure Q.2b. [5 Marks]

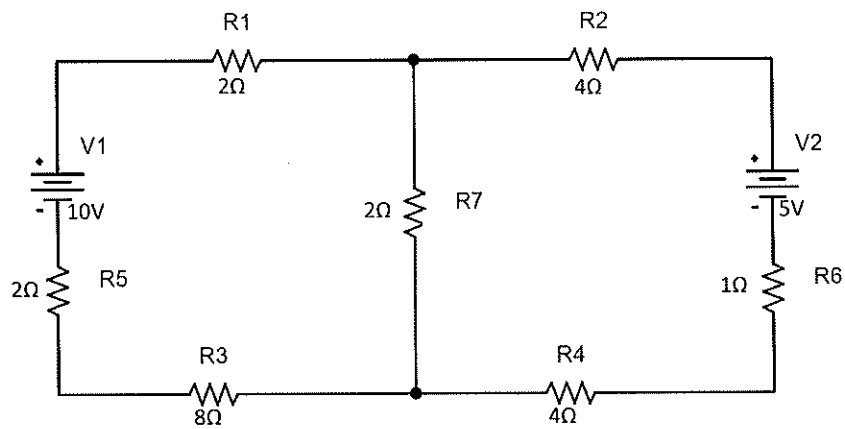


Figure Q.2b.

- c. Consider the circuit of Figure Q.2c, for the following; [8 Marks]
 i. Find all the branch currents in the circuit. [3 Marks]
 ii. Find the power supplied by the current source.

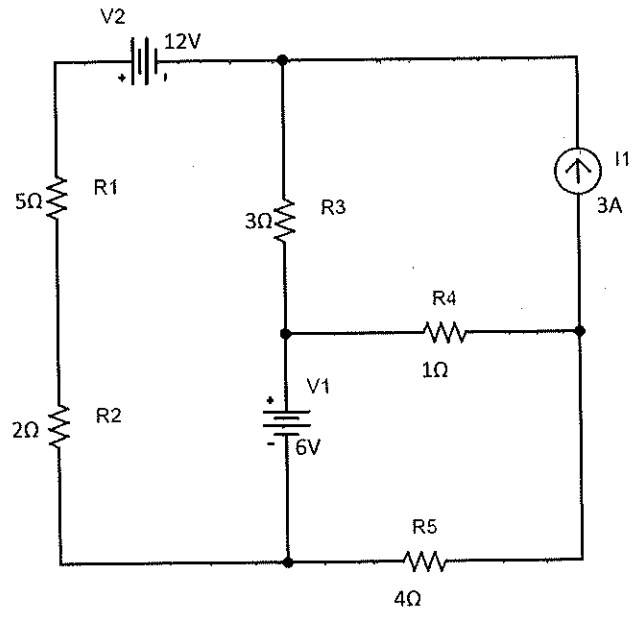


Figure Q.2c

Question 3 [25 Marks]

- a. Use nodal analysis to find current I_1 and I_2 in the circuit shown in Figure Q.3b. [10 Marks]

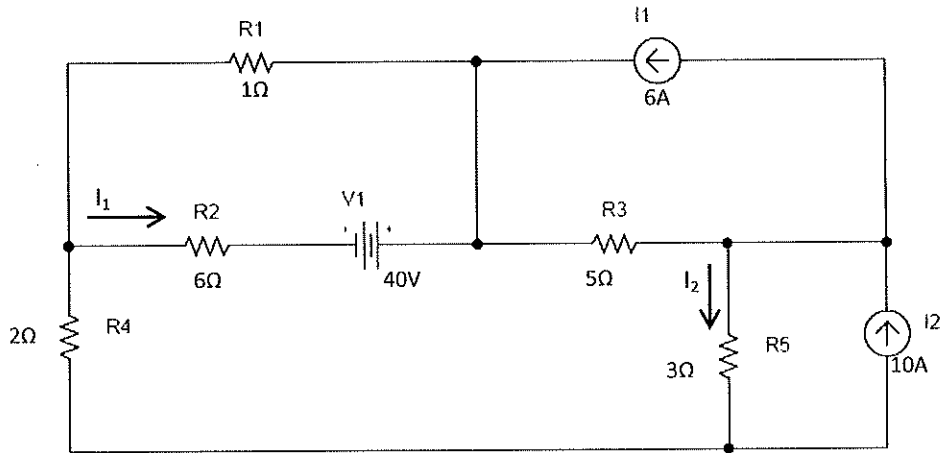


Figure Q.3b.

- b. Find the Thevenin equivalent circuit with respect to terminal a,b for the circuit shown in Figure Q.3b. [7 Marks]

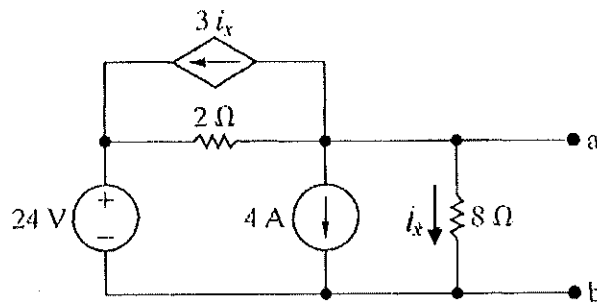


Figure Q.3b

- c. Using superposition find the node voltages V_1 and V_2 in the circuit shown in Figure Q.3c. [8 Marks]

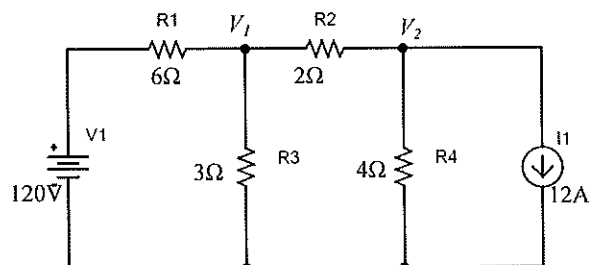


Figure Q.3c

Question 4 [25 Marks]

a. Given the circuit shown in Figure Q.4a, answer the following:

i. Use mesh analysis to determine current I_1 and I_2

[16 Marks]

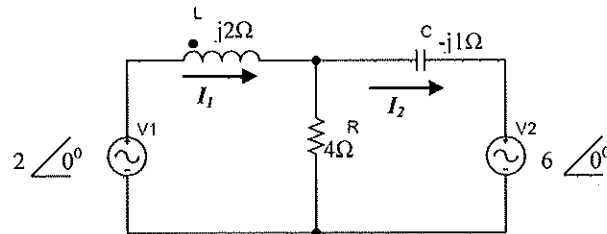


Figure Q.4a

ii. Find the power supplied (or absorbed) by each source of the circuit.

[4 Marks]

b. An impedance $Z_1 = (4 + j4)\Omega$ is connected in parallel with an impedance $Z_2 = (12 + j6)\Omega$. If the input reactive power is 2500VAR (lagging), what is the total active power?

[5 Marks]

Question 5 [25 Marks]

- a. Consider the circuit shown to answer the following. Assume the capacitor has already been fully charged.

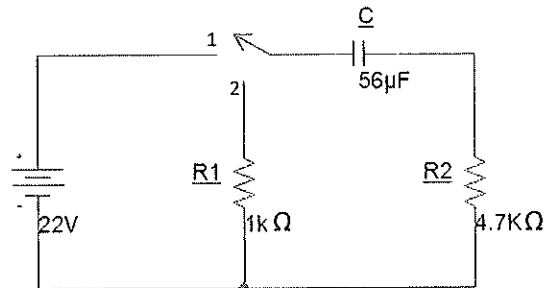


Figure Q.5a

- i. Determine the time it takes for the capacitor to discharge i.e. when the switch is placed at position 2. [2 Marks]
 - ii. Give the mathematical expression for v_c and i_c when capacitor is discharging. [4 Marks]
 - iii. Sketch the transients of v_c and i_c . [4 Marks]
- b. A coil of inductance 0.1 H is connected across a 50 V, 60 Hz supply, in parallel with it is a 100 µF capacitor which is also in parallel with a 30 Ω resistor as shown in Figure Q.5b. Determine:
- i. The total impedance of the circuit. [4 Marks]
 - ii. The branch currents [3 Marks]
 - iii. The total Active Power taken from the supply. [2 Marks]
 - iv. The total reactive power supplied. [2 Marks]
 - v. The apparent power supplied. [2 Marks]
 - vi. The power factor of the circuit stating whether it is leading or lagging. [2 Marks]

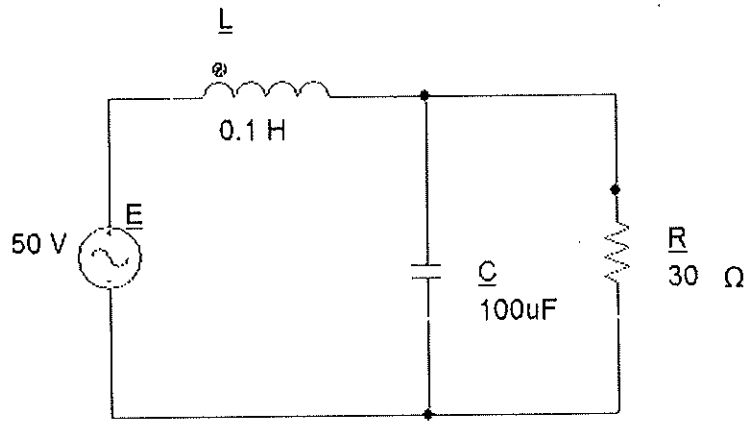


Figure Q.5b.

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