MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN APPLIED PHYSICS AND TECHNOLOGY

SPH 202: ELECTRICAL CIRCUITS

DATE: 9/12/2021 **TIME: 2:00 – 4:00 PM**

INSTRUCTION

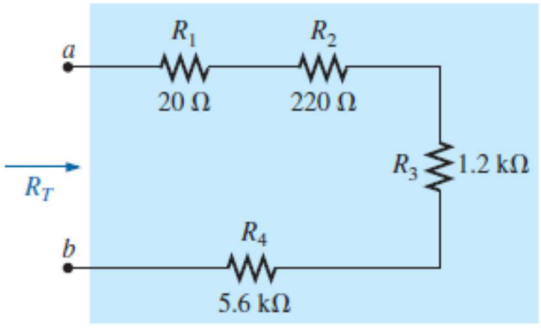
ANSWER QUESTIONS ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE (COMPULSORY) (30 MARKS)

(a) State Ohm's law and give the mathematical formulation for the same. (2 marks)

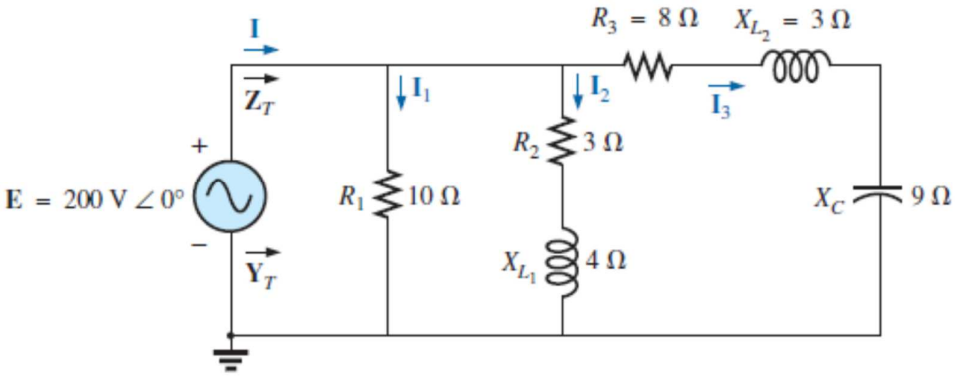
(b) Calculate the resistance of a 60 W bulb if a current of 500 mA results from an applied voltage of 120 V. (2 marks)

(c) Find the total resistance R_T shown the figure below. (2 marks)



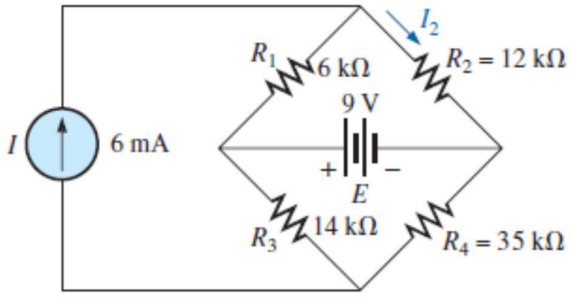
(d) State Kirchhoff's voltage law (KVL) and Kirchhoff's current law (KCL). Support your statements with necessary mathematical expressions. (4 marks)

(e) For the network below, determine the currents I, I_1, I_2, and I_3 and verify KCL for these currents. Also determine the total circuit impedance. (10 marks)

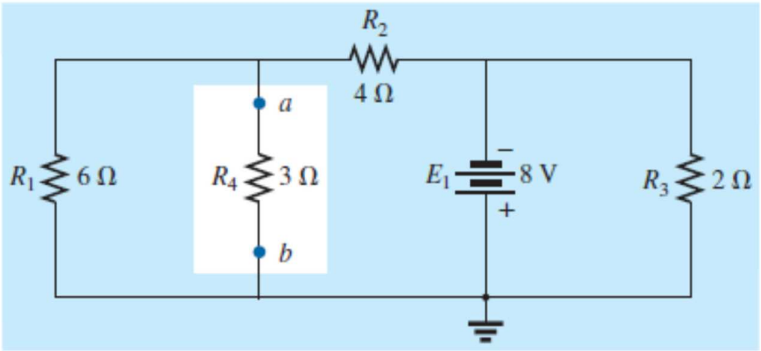


(f) Using superposition theorem, determine the current I_2 shown in the network below.

(6 marks)



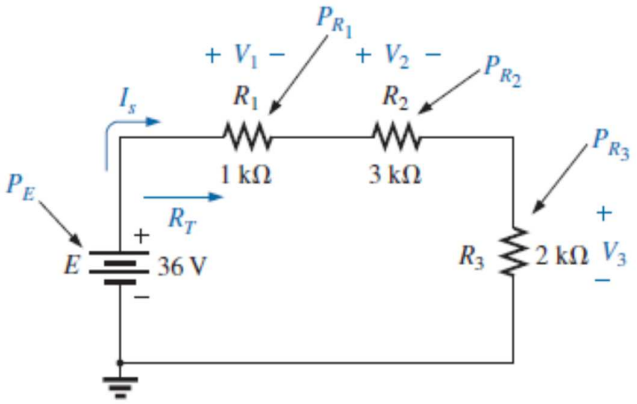
(g) Find the Thevenin's equivalent circuit as see across terminals a and b in the network below. (4 marks)



QUESTION TWO (20 MARKS)

(a) Determine the current through a 5 kΩ resistor when the power dissipated by the element is 20 mW. (3 marks)

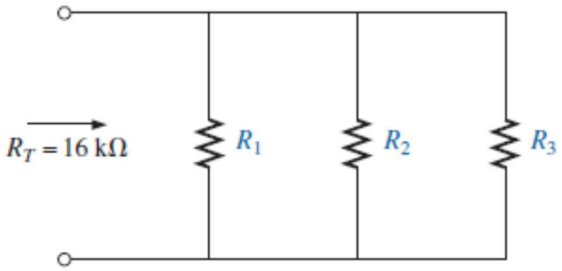
(b) For the network shown below



i) Determine the total resistance R_T.
ii) Calculate the current I_s.
iii) Determine the voltage across each resistor.
iv) Determine the power dissipated by each resistor.

(10 marks)

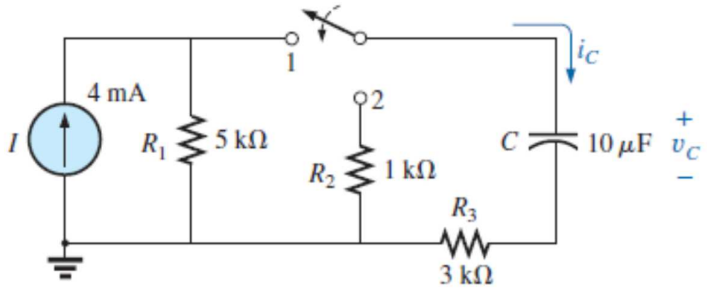
(c) Determine the values of R_1, R_2 and R_3 in the figure below if $R2 = 2R1$, $R3 = 2R2$, and the total resistance is RT= 16 kΩ. (4 marks)



(d) The current through a 0.1-H inductor is $i(t) = 10te^{-5t}$A. Find the voltage across the inductor and the energy stored in it. (3 marks)

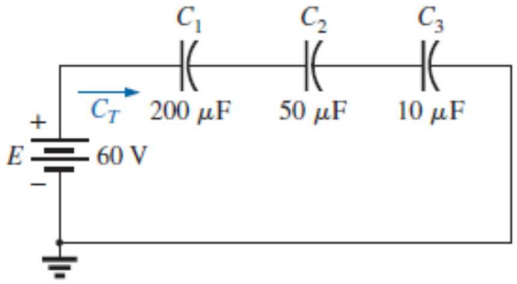
QUESTION THREE (20 MARKS)

(a) For the network shown below, find the mathematical expression for the transient behavior of the voltage across the capacitor if the switch is thrown into position 1 at t=0 s. (4 marks)

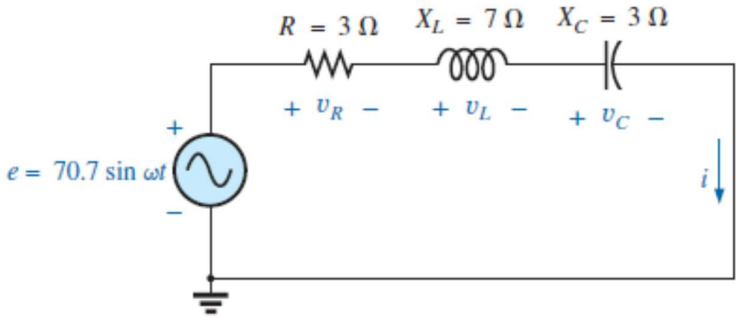


(b) For the network shown below,

i. Find the total capacitance.
ii. Determine the charge on each plate.
iii. Find the voltage across each capacitor. (6 marks)

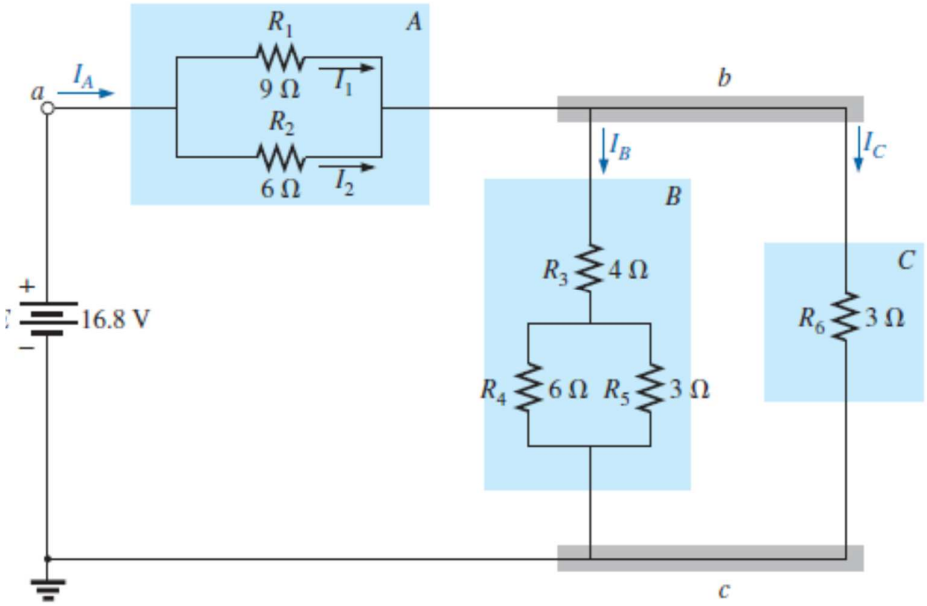


(c) For the series RLC ac circuit below, determine the total circuit impedance, the current flowing in the circuit I and the voltage drops across each of the circuit elements R, L, and C. (10 marks)

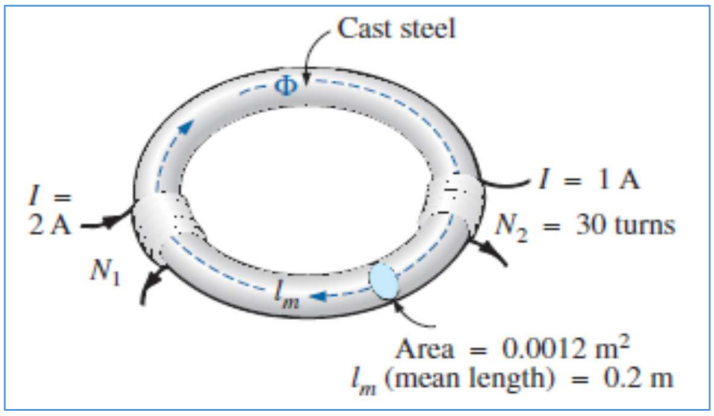


QUESTION FOUR (20 MARKS)

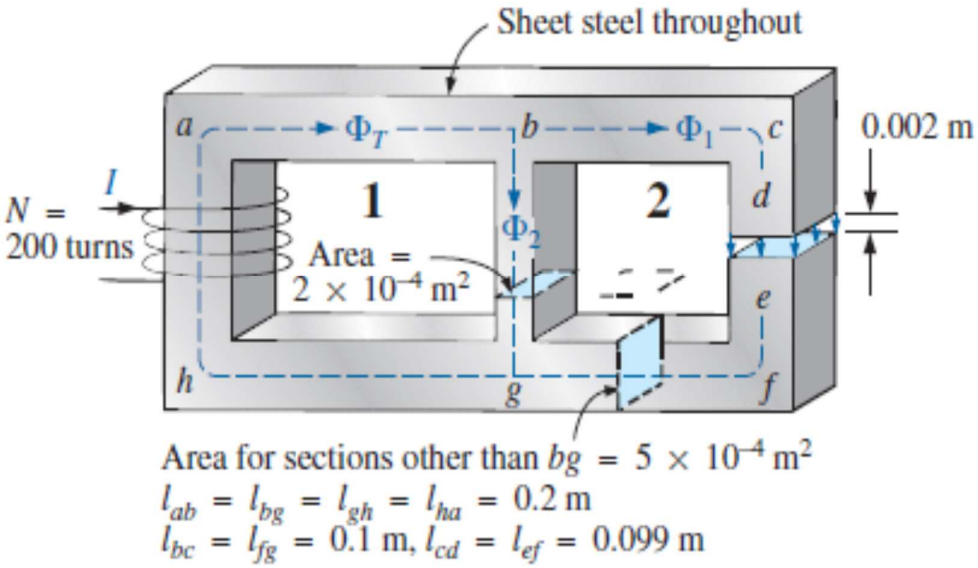
(a) Determine the currents I_A, I_B and I_C shown in the network diagram below. (6 marks)



(b) Find the number of turns N_1 required to establish a flux of 12×10^{-4} Wb in the magnetic circuit shown below and find the permeability μ of the material. (6 marks)



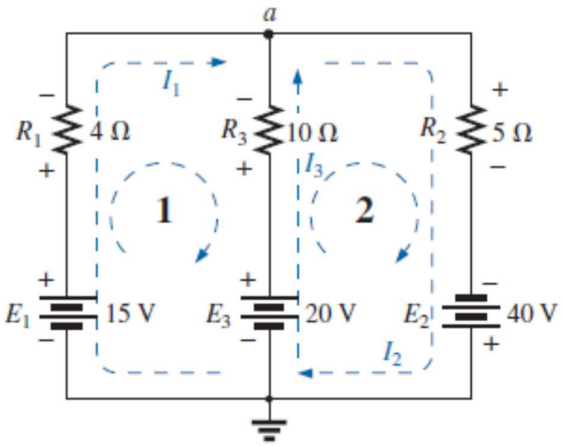
(c) For the series-parallel magnetic circuit shown below, find the value of I required to establish a flux in the gap of 2×10^{-4} Wb. (8 marks)



QUESTION FIVE (20 MARKS)

(a) Using mesh analysis, determine the currents I_1, I_2 and I_3 shown in the network below.

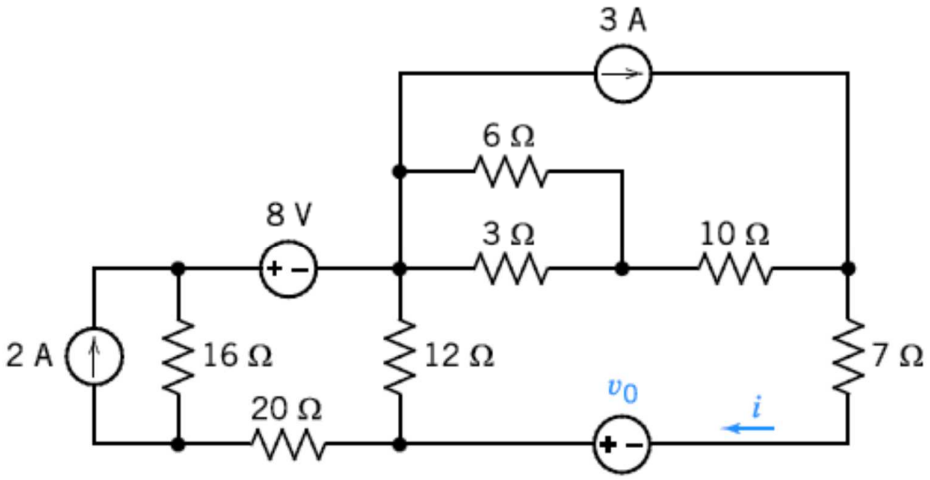
(6 marks)



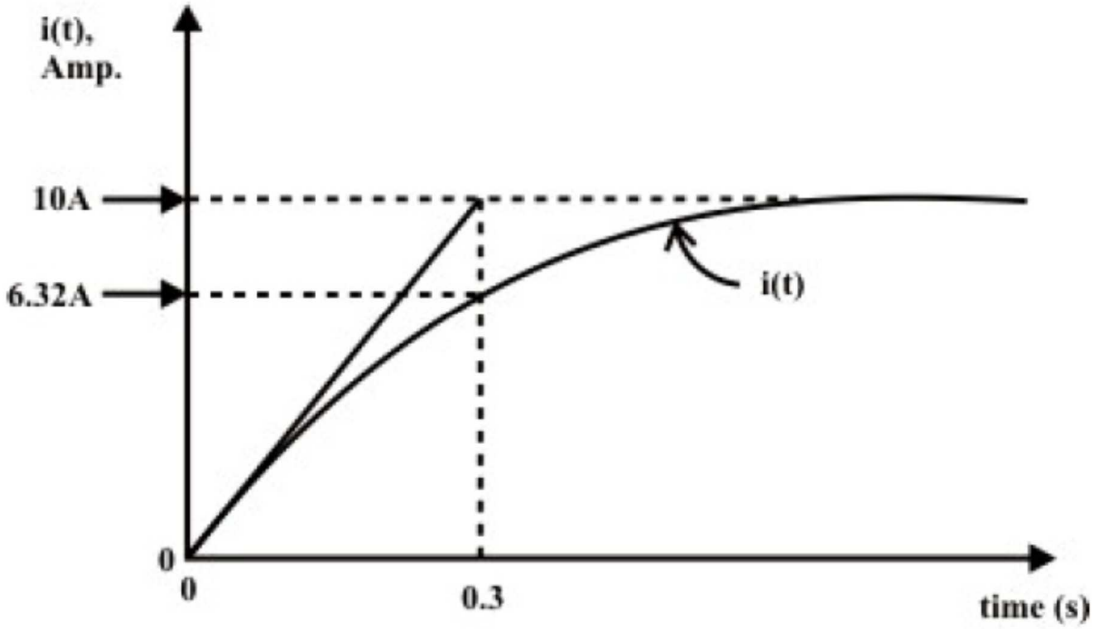
(b) Find v_o using source transformations if i = 5/2 A in the circuit shown in figure below.

Hint: Reduce the circuit to a single mesh that contains the voltage source labeled v_o.

(6 marks)



(c) The figure below shows the plot of current through a series *RL*– circuit when a constant forcing function of magnitude V_S=50V is applied to it. Calculate the values of resistance *R* and inductance *L*. (4 marks)



(d) From the circuit shown below determine the current through the 10Ω resistor using Norton's theorem. (4 marks)