LUMS
A Not-for-Profit University

Department of Electrical Engineering

School of Science and Engineering

EE240 Circuits I - Fall 2022

ASSIGNMENT 1

Due Date: 4:30pm, Monday. October 03, 2022
Format: 6 problems, for a total of 100 marks

(Assignment is to be submitted in class)

Instructions:

- You are allowed to collaborate with your peers but copying your colleague's solution is strictly prohibited. This is not a group assignment. Each student must submit his/her own assignment.
- Solve the assignment on blank A4 sheets and staple them before submitting.
- Submit in-class or in the drop box labelled EE-240 outside the instructor's office.
- Write your name and roll no. on the first page.
- Feel free to contact the instructor or the teaching assistants if you have any concerns.

Course Learning Outcomes Covered:

Derive and apply working principle of passive components R, L,C and independent and controlled energy sources for device and circuit modeling and analysis

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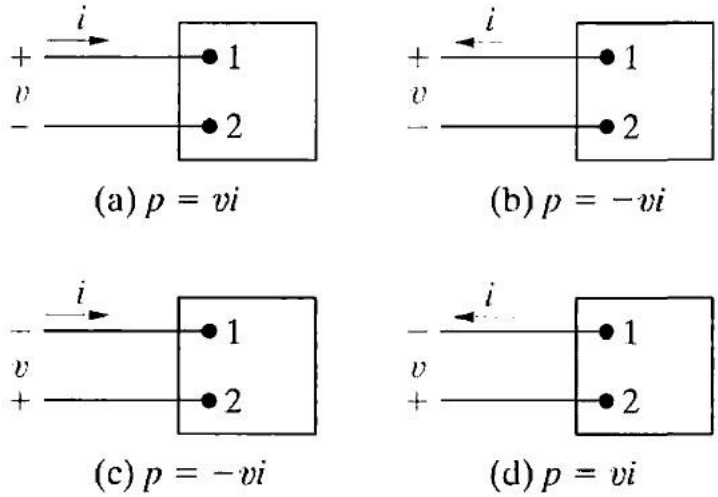
Problem 1 [12 marks]: Power and circuit variables



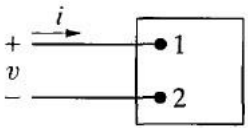
Consider a 20 V voltage drop occurs across an element from terminal 2 to terminal 1 and that a current of 4 A enters terminal 2.

a) **[8 marks]** Specify the values of V and I for the polarity references shown in figures (a)-(d) above.

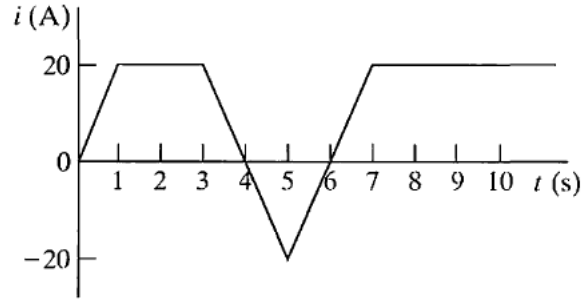
b) **[2 marks]** Describe whether the circuit inside the box is absorbing or delivering power.

c) **[2 marks]** How much power is the circuit absorbing, if its not absorbing then explain why?

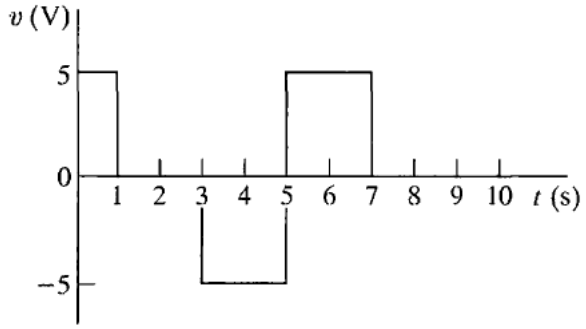
Problem 2 [12 marks]: Energy and Power



The voltage and current across the terminals of the circuit element above are shown in the plots (a) and (b) below:



(a)



(b)

a) **[6 marks]** Sketch the power versus time plot for 0 <= t <= 10s.

b) **[2+2+2 marks]** Calculate the energy delivered to the circuit element at t = 1, 6, and 10s respectively.

Problem 3 [20 marks]: Capacitors

A parallel plate capacitor can handle 46J for 200V.

(a) **[12 marks]**

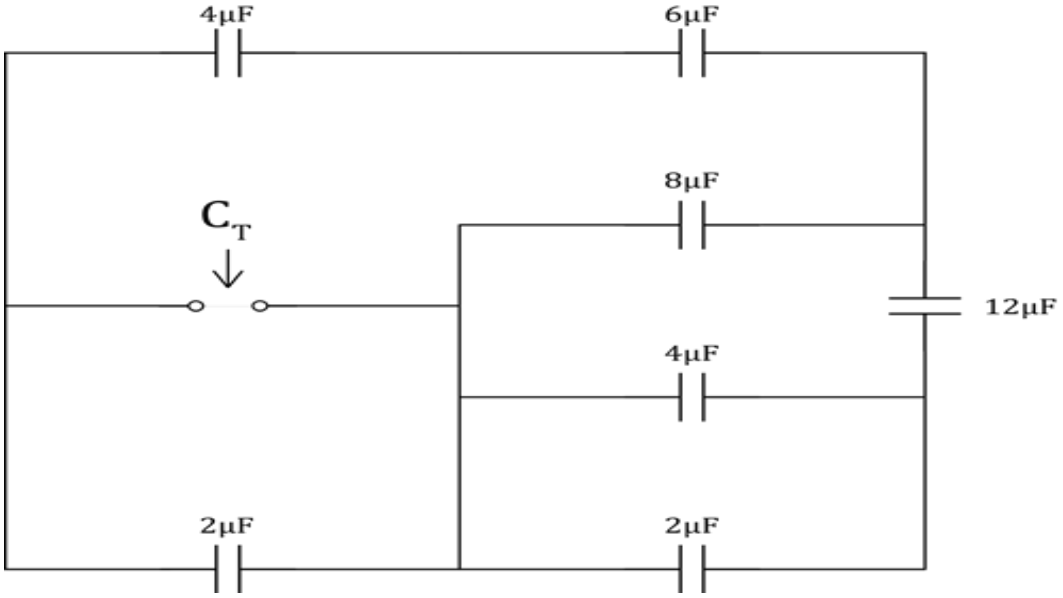
(i) **[3 marks]** What is its capacitance?

(ii) **[2 mark]** If the distance between the two capacitor plates is d = 1cm, what is the area of the plates?

(iii) **[4 marks]** The distance between the two plates is now decreased to quarter of d, keeping the plates at the same potential, what is the change in the capacitance? And how about when the area is halved keeping the distance and potential constant?

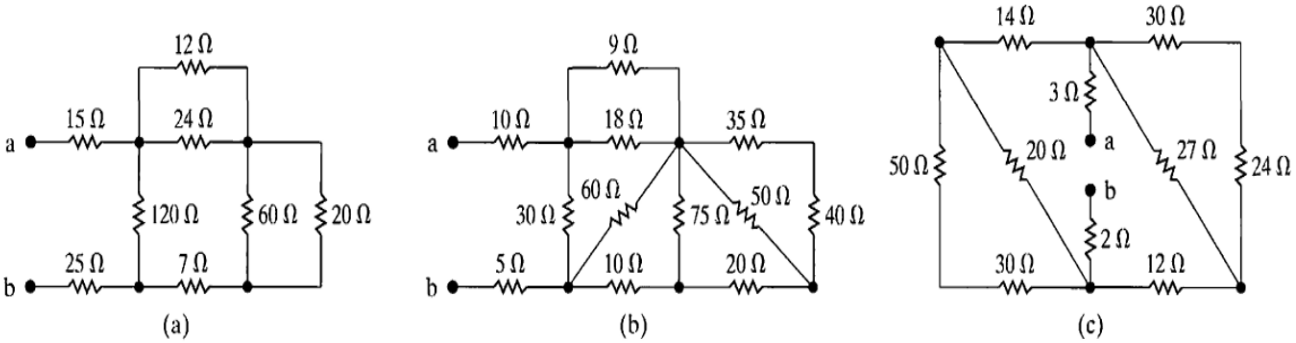
(iv) **[3 marks]** What is the amount of the current that needs to be discharged in both cases mentioned in (iii)?

(b) **[9 marks]** Find the capacitance C_T for the network below.



Problem 4 [15 marks]: Equivalent Resistance

Find the equivalent resistance at R_{ab}, for each of the circuits in figures (a), (b), and (c) below.



Problem 5 [20 marks]: Inductors

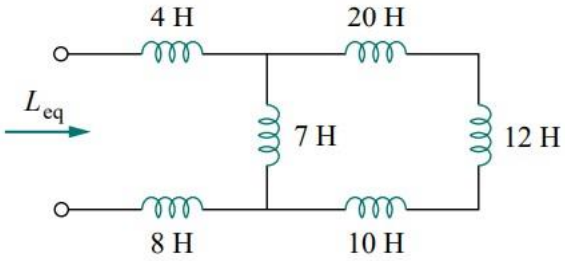
a) **[5 marks]** The current through a 0.1-H inductor is $i(t) = 10te^{-5t}$A. Find the voltage across the inductor and the energy stored in it.

b) **[5 marks]** Find the current through a 5-H inductor if the voltage across it is:

$$v(t) = \begin{cases} 30t^2, & t > 0 \\ 0, & t < 0 \end{cases}$$

Also find the energy stored within 0 <t< 5 s.

c) **[5marks]** Find the equivalent inductance of the circuit shown in figure below:



d) **[2 marks]** The current in an 80-mH inductor increases from 0 to 60 mA. How much energy is stored in the inductor?

e) **[3 marks]** The current through a 12-mH inductor is 4*sin*100t A. Find the voltage, and also the energy stored in the inductor for $0 < t < \pi/200$ s.

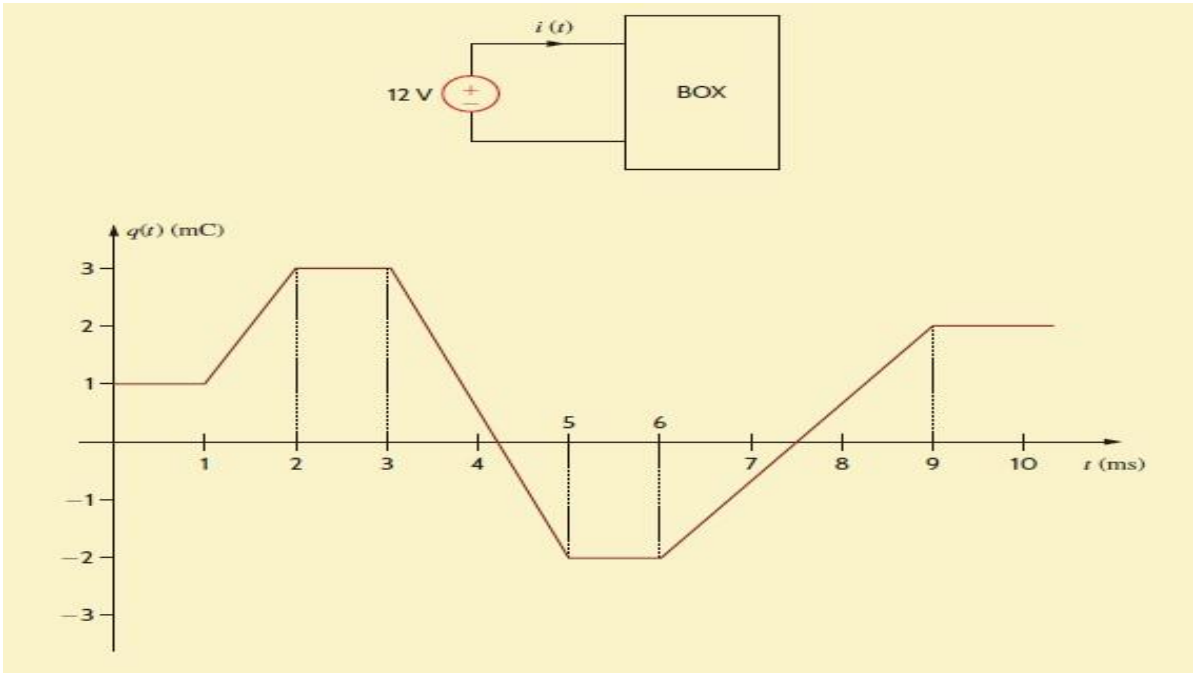
Problem 6 [20 marks]: Visualizing circuit parameters

The charge that enters the BOX is shown in figure below. Calculate and sketch the

a) Current flowing into the BOX.

b) and the power absorbed by the BOX.

between 0 and 10 milliseconds.



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