

ID:

Name:

**Brac University**

Semester: Summer 2023

Course Code: CSE250

Circuits And Electronics

Set

A

Assessment: *Final*

Duration: 2 hours

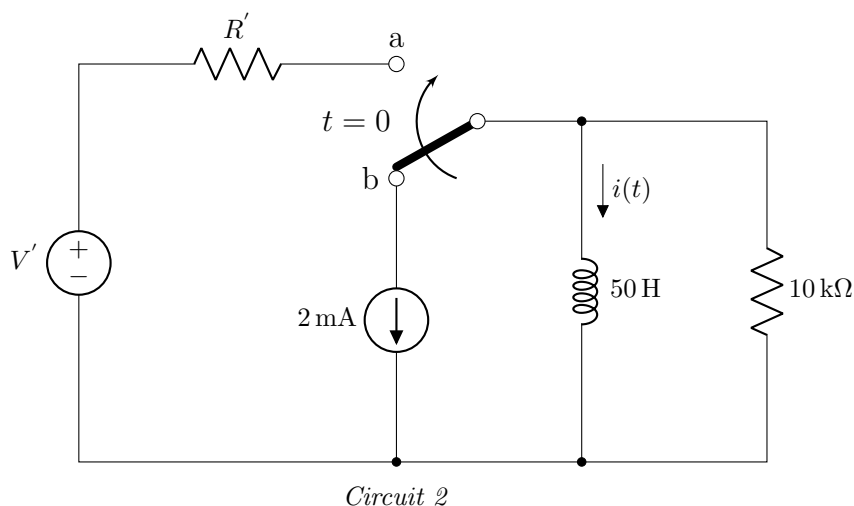
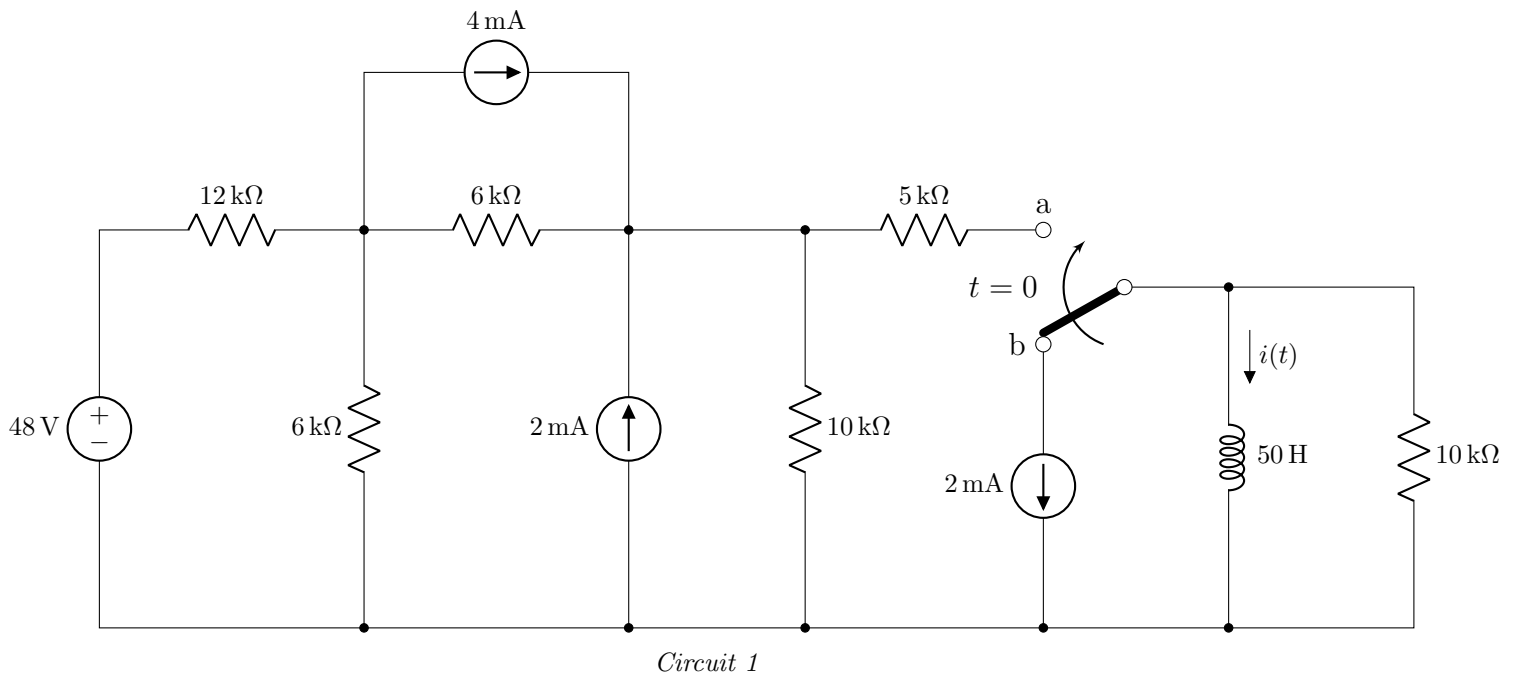
Date: September 8, 2023

Full Marks (incl. bonus 5): 55

- ✓ No washroom breaks. Phones must be turned off. Using/carrying any notes during the exam is not allowed.
- ✓ At the end of the exam, both the **answer script** and the **question paper** must be returned to invigilator.
- ✓ All **3 questions** are compulsory. Marks allotted for each question are mentioned beside each question.
- ✓ Answer the question 1(c) on the **question paper** using the provided grid.
- ✓ Symbols have their usual meanings.

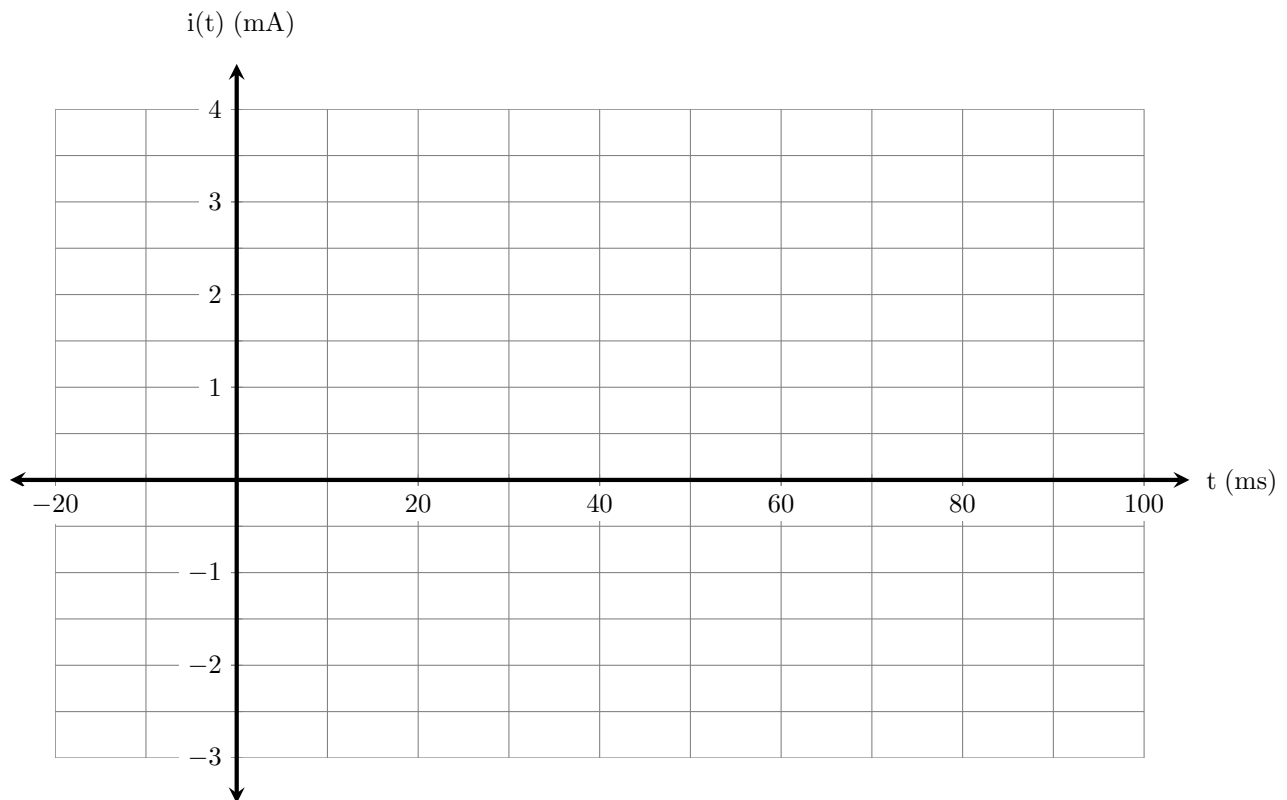
■ Question 1 of 3 [*CO2, CO3*] [20 marks]

Consider the the following circuits which are equivalent to each other.



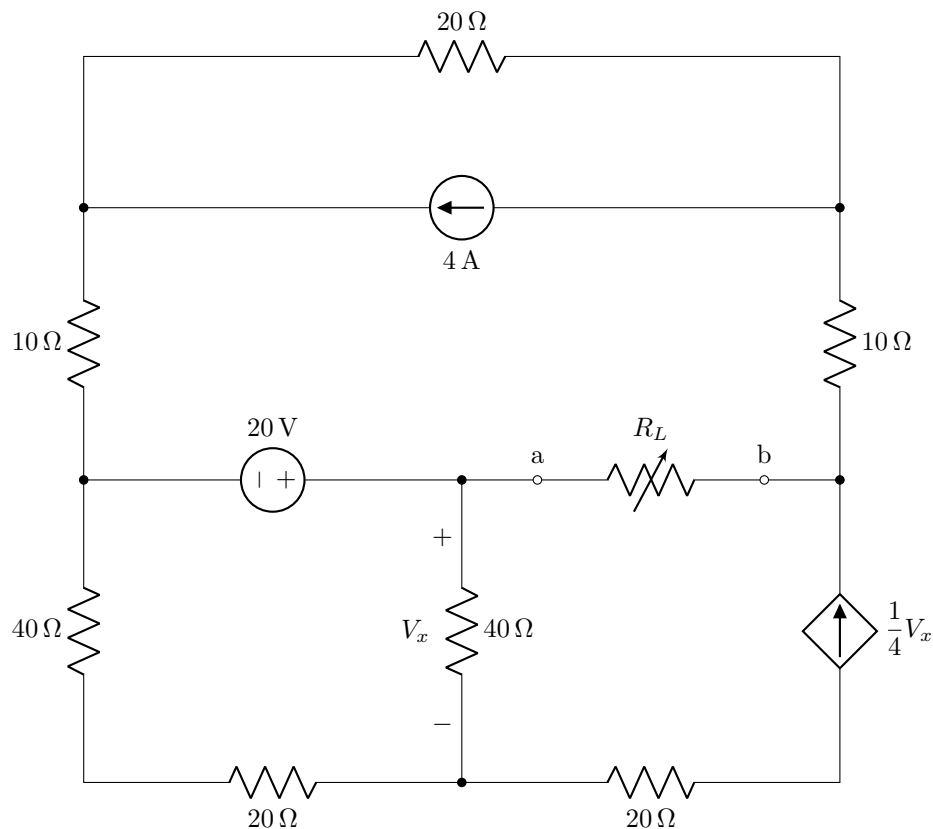
- (a) [7 marks] **Derive** *Circuit 2* from *Circuit 1*. What are the values of V' and R' ?
- (b) [9 marks] Now, **analyze** the transient behavior of the circuit assuming that the switch moves from position b to position a at $t = 0$. Determine $i(t)$ for $t > 0$.

- (c) [4 marks] Based on your answer in (b), does the inductor get charged or discharged? In the following grid, draw the current $i(t)$ found in (b) as a function of time. Mark the time where the inductor is fully charged or discharged.



■ Question 2 of 3 [CO2] [15 marks]

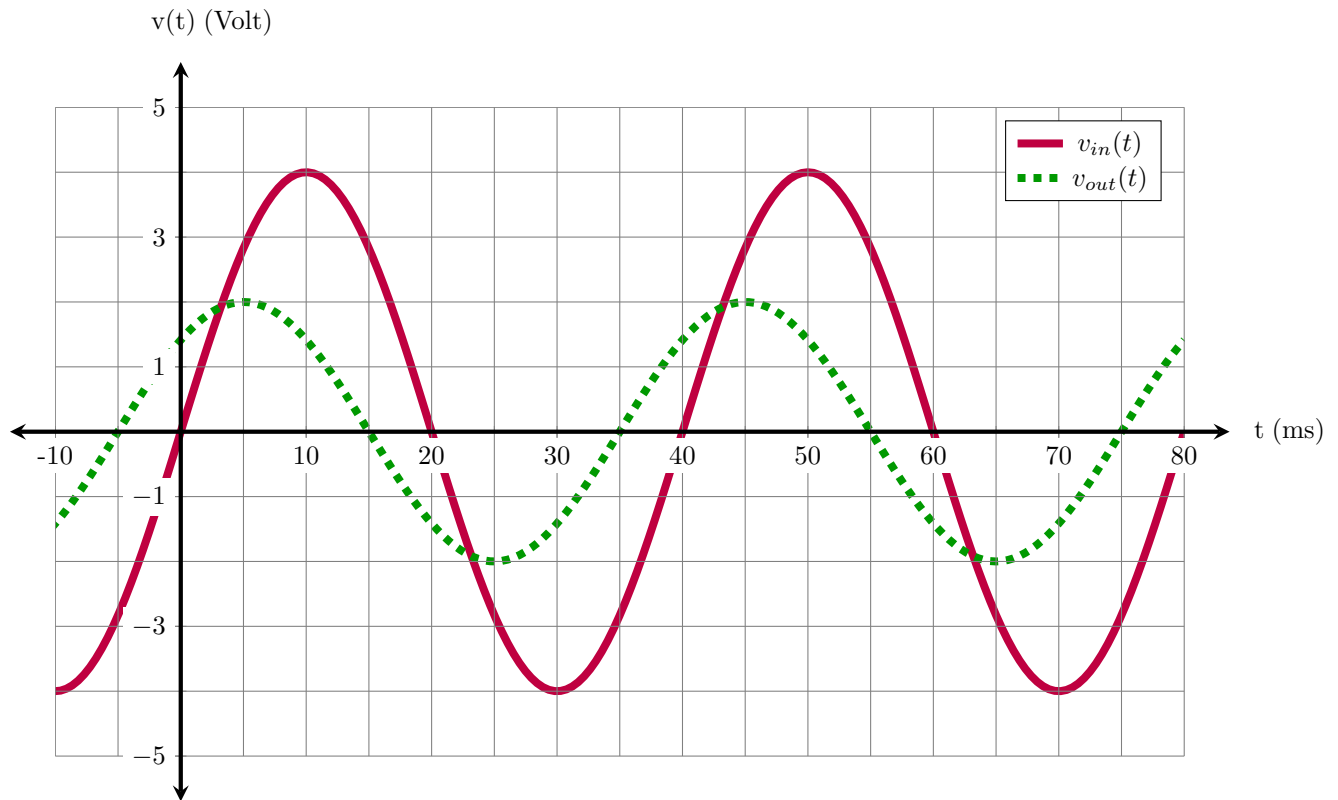
Consider the following circuit with a load R_L connected between terminals a and b.



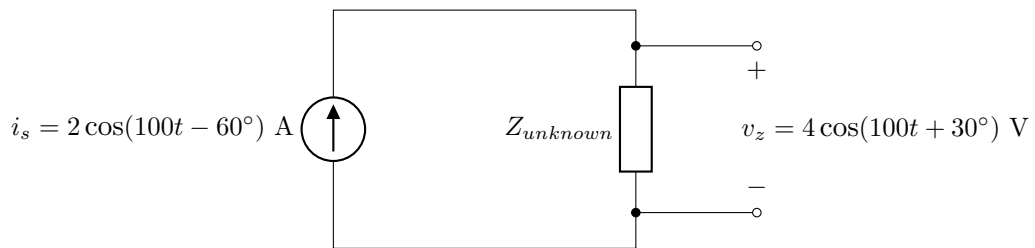
- (a) [8 marks] **Determine** the value of R_L that will draw the maximum power from the circuit.
- (b) [7 marks] **Determine** the value of the maximum power.

■ Question 3 of 3 [CO3] [20 marks]

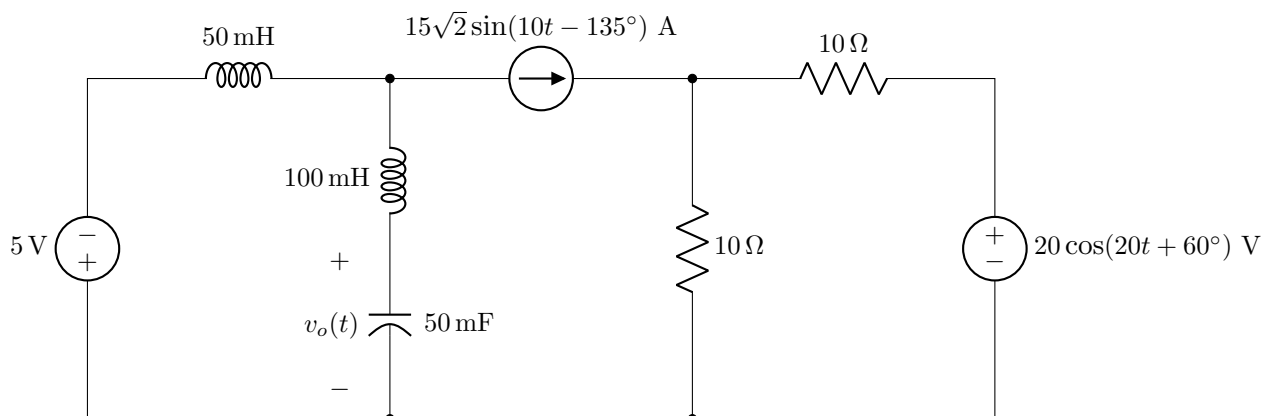
- (a) [4 marks] The input $v_{in}(t)$ and output $v_{out}(t)$ voltage waveforms of a two terminal ac circuit are plotted as a function of time below. **Determine** mathematically the phase difference between the two and specify which one is leading.



- (b) When a current of $i_s = 2 \cos(100t - 60^\circ)$ A passes through an unknown circuit element with an impedance of $Z_{unknown}$, it causes a voltage drop of $v_z = 4 \cos(100t + 30^\circ)$ V across it as shown below.



- (i) [1 mark] Does the voltage (v_z) lead or lag the current (i_s)?
(ii) [1 mark] Determine the value of the impedance $Z_{unknown}$.
(iii) [2 marks] Based on your answer in (ii), guess the circuit element and **determine** the value of it with appropriate units.
- (c) [12 marks] For the circuit shown below, **determine** $v_o(t)$, the voltage across the capacitor.



Brac University

Semester: Summer 2023

Course Code: CSE250

Circuits And Electronics

Set

A

Assessment: *Makeup Final*

Duration: 1 hour 50 minutes

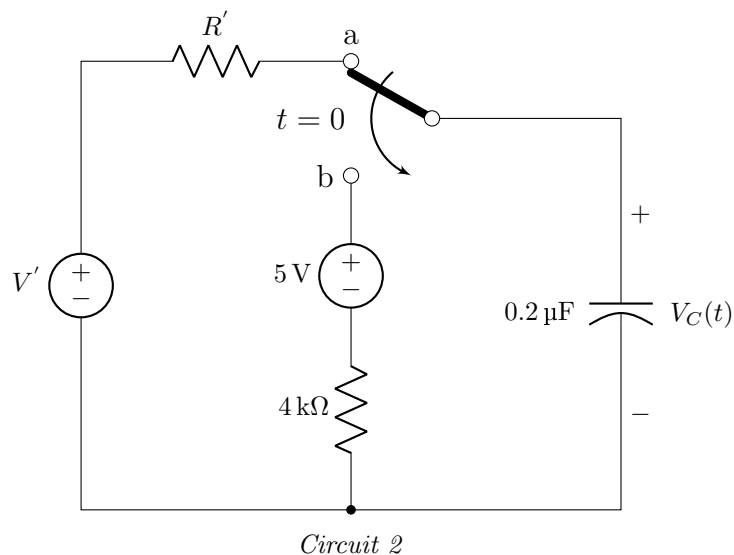
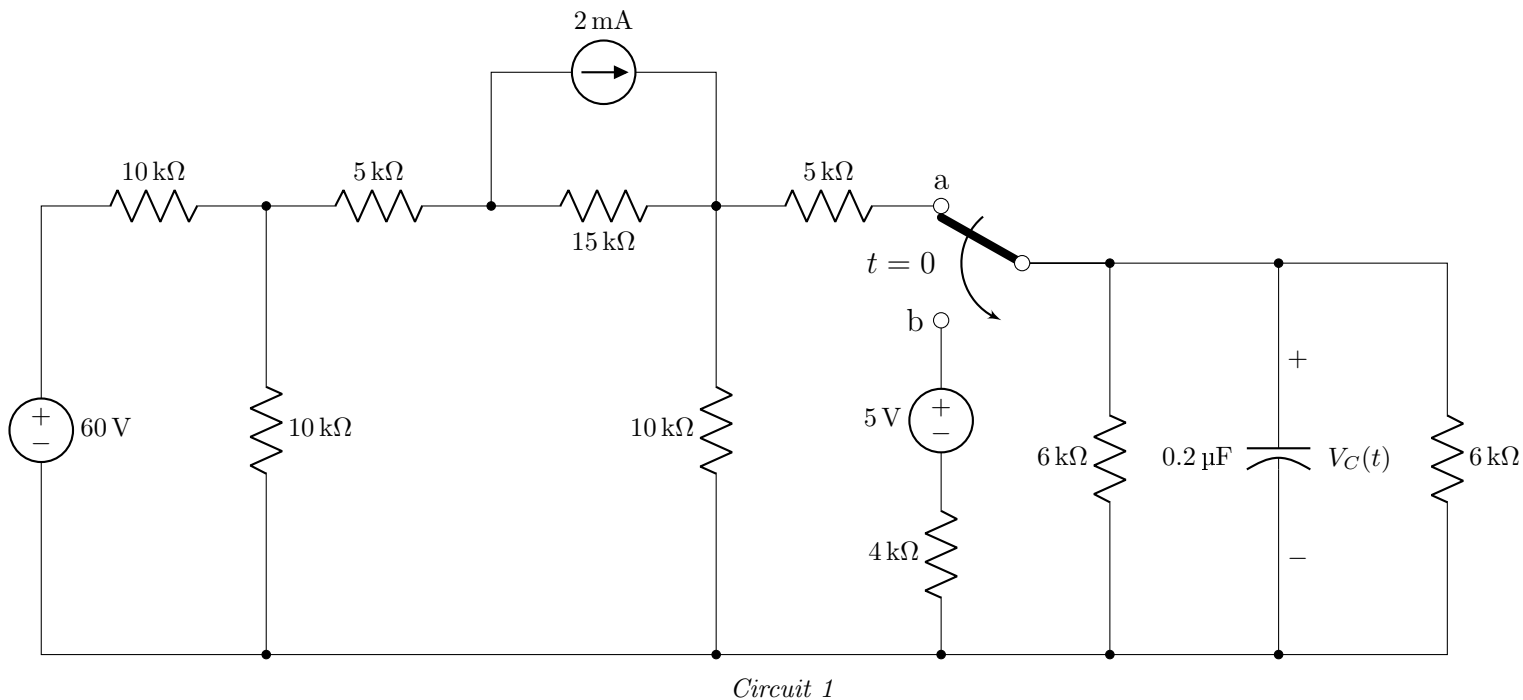
Date: October 14, 2023

Full Marks: 55

- ✓ No washroom breaks. Phones must be turned off. Using/carrying any notes during the exam is not allowed.
- ✓ At the end of the exam, both the **answer script** and the **question paper** must be returned to invigilator.
- ✓ All **3 questions** are compulsory. Marks allotted for each question are mentioned beside each question.
- ✓ Symbols have their usual meanings.

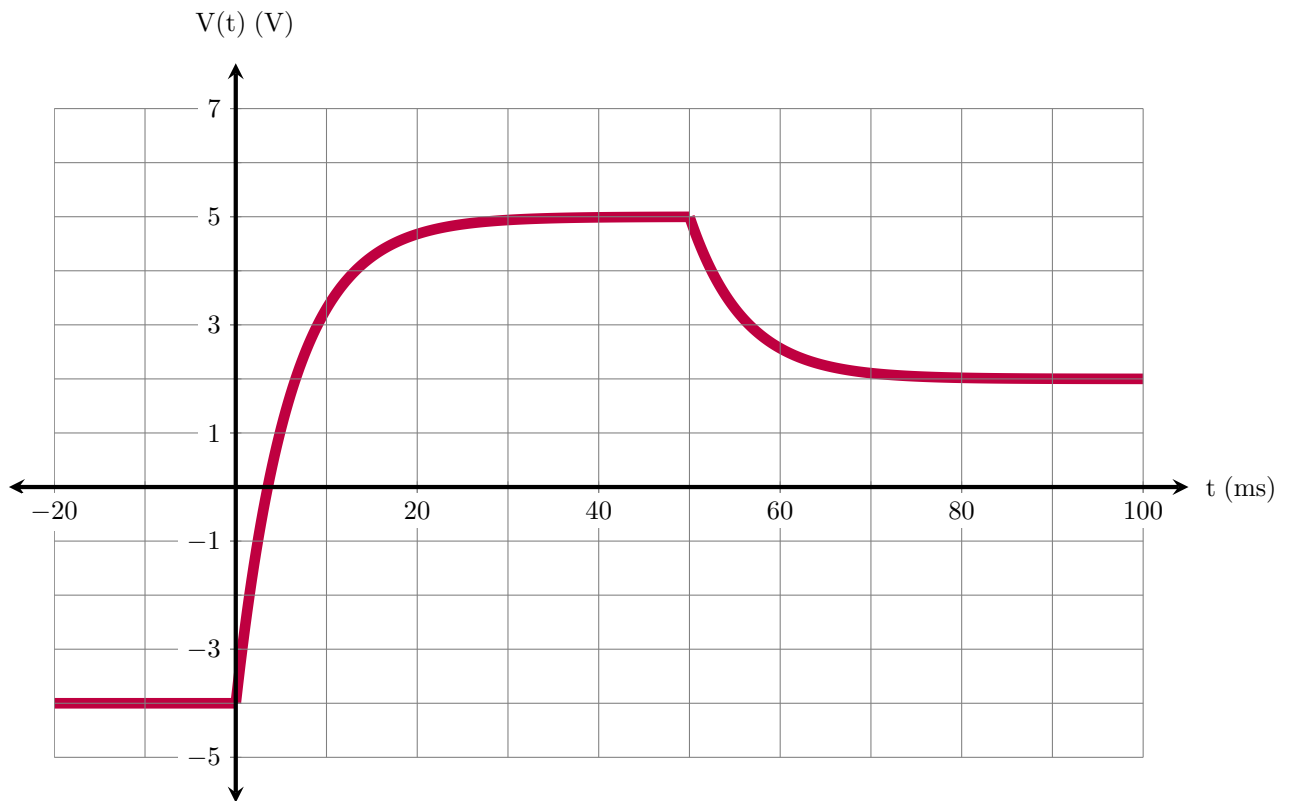
■ Question 1 of 3 [CO2, CO3] [20 marks]

Consider the the following circuits which are equivalent to each other.



- (a) [8 marks] **Derive** Circuit 2 from Circuit 1. What are the values of V' and R' ?
- (b) [7 marks] Now, **analyze** the transient behavior of the circuit assuming that the switch moves from position a to position b at $t = 0$. Determine $V_C(t)$ for $t > 0$.

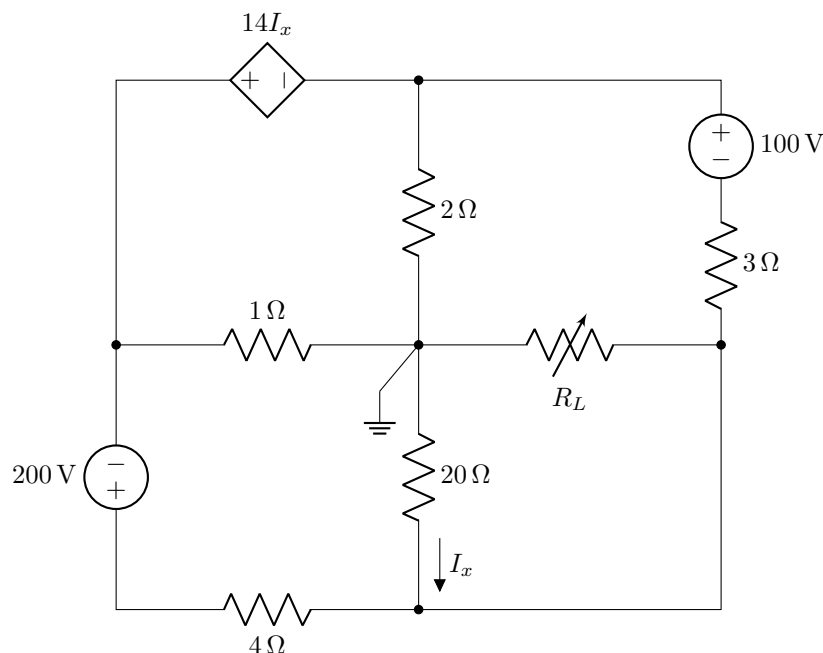
- (c) The following $V(t)$ vs. t plot shows the response of a capacitor in a series RC circuit to sudden changes in the DC voltage applied through resistors.



- (i) [3 marks] Write the mathematical expression of $V(t)$ for $t > 0$. Use appropriate values from the plot. [Hint: consider the plot in segments.]
- (ii) [2 marks] Predict and draw a circuit with appropriate switching mechanism that can generate the voltage response as shown only for up to 30 ms. The value of the capacitance is $100\ \mu\text{F}$. Mention the values of the resistances and sources used.

■ Question 2 of 3 [CO2] [15 marks]

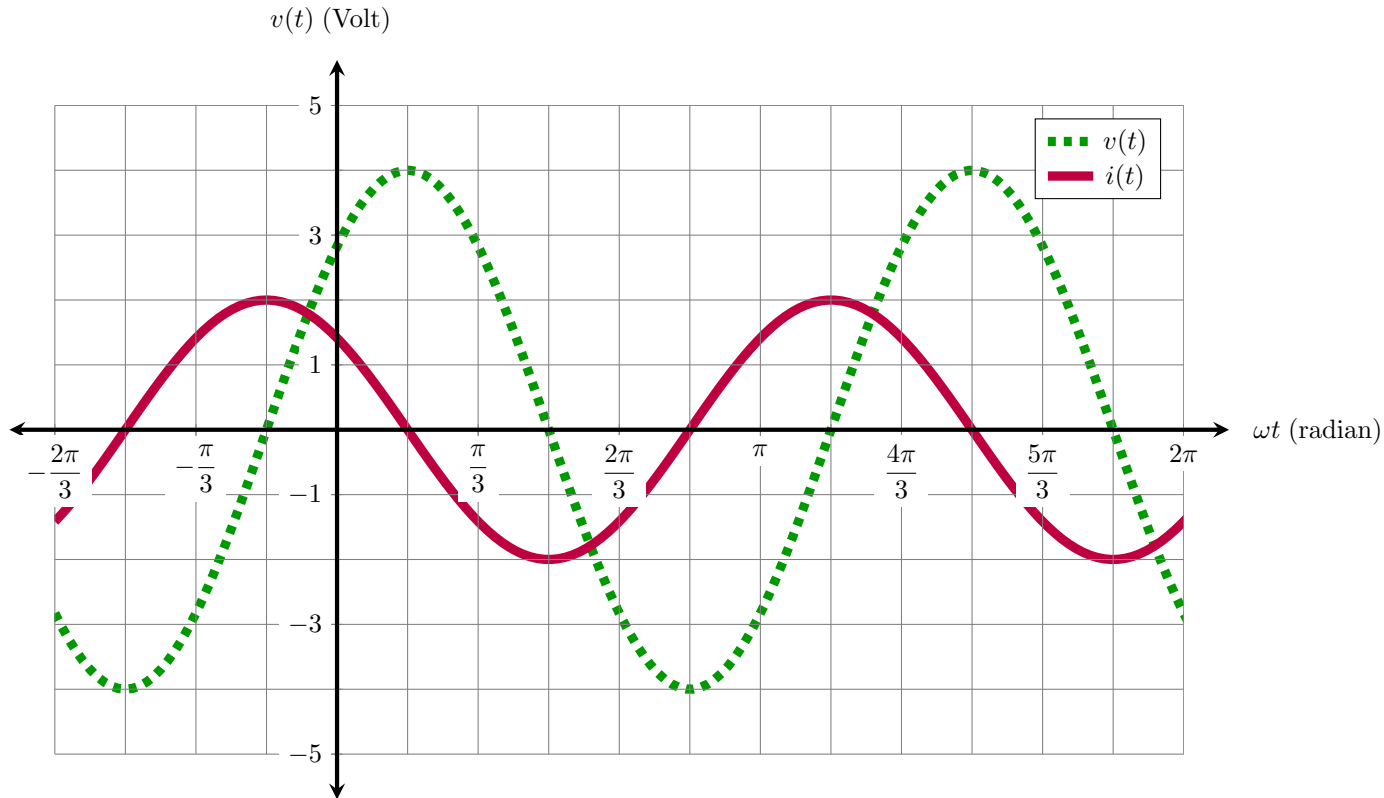
Consider the following circuit with a load R_L connected between terminals a and b.



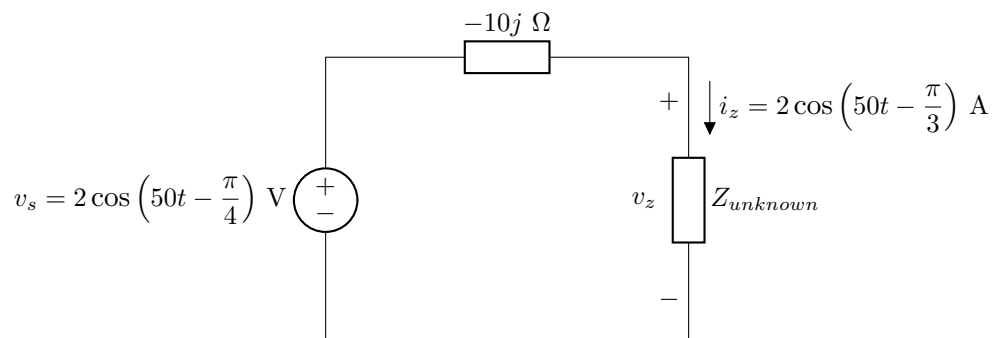
- (a) [8 marks] Determine the value of R_L that will draw the maximum power from the circuit.
- (b) [7 marks] Determine the value of the maximum power.

■ Question 3 of 3 [CO3] [20 marks]

- (a) Voltage $v(t)$ and current $i(t)$ of a two terminal circuit element connected in an ac circuit are plotted as a function of angle (ωt) below.
- [1½ marks] **Determine** the phase difference between $v(t)$ and $i(t)$ and specify which one is leading.
 - [½ mark] Is the element capacitive or inductive?
 - [2 marks] Determine the minimum difference in time between the waveforms.



- (b) When a current of $i_s = 2 \cos(100t - 60^\circ)$ A passes through an unknown circuit element with an impedance of $Z_{unknown}$, it causes a voltage drop of $v_z = 4 \cos(100t + 30^\circ)$ V across it as shown below.



- [1 mark] Does the voltage (v_z) lead or lag the current (i_s)?
- [1 mark] Determine the value of the impedance $Z_{unknown}$.
- [2 marks] Based on your answer in (ii), guess the circuit element and **determine** the value of it with appropriate units.

(c) [12 marks] For the circuit shown below, **determine** $i_o(t)$, the current through the inductor.

