ID:	Name:

Set **B**

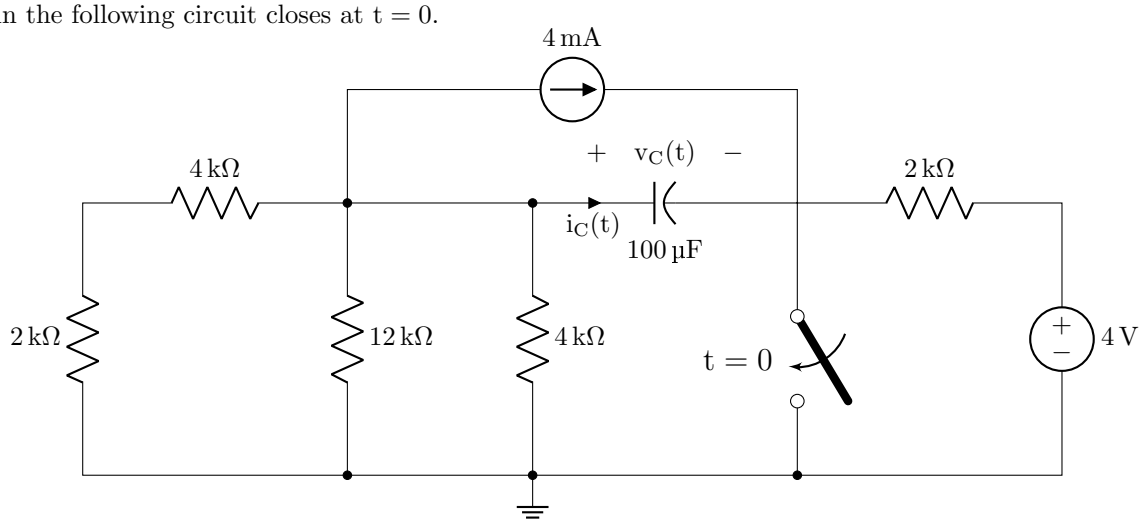
Brac University
Semester: Spring 2024
Course Code: CSE250
Circuits And Electronics

Assessment: *Final Exam*
Duration: 1 hour 40 minutes
Date: May 12, 2024
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 the invigilator.
- ✓ All **3 questions** are compulsory. Marks allotted for each question are mentioned beside each question.
- ✓ Draw the plot associated with the question **1(f)** in the grid provided on the question paper.
- ✓ Symbols have their usual meanings.

■ Question 1 of 3 *[CO3] [20 marks]*

The switch in the following circuit closes at t = 0.



Analyze the Transient Behavior to answer the following questions–

(a) ***[3 marks]*** Determine the voltage $v_C(0)$ across the capacitor before swicthing.

(b) ***[3 marks]*** Determine the final stable voltage $v_C(\infty)$ across the capacitor after switching.

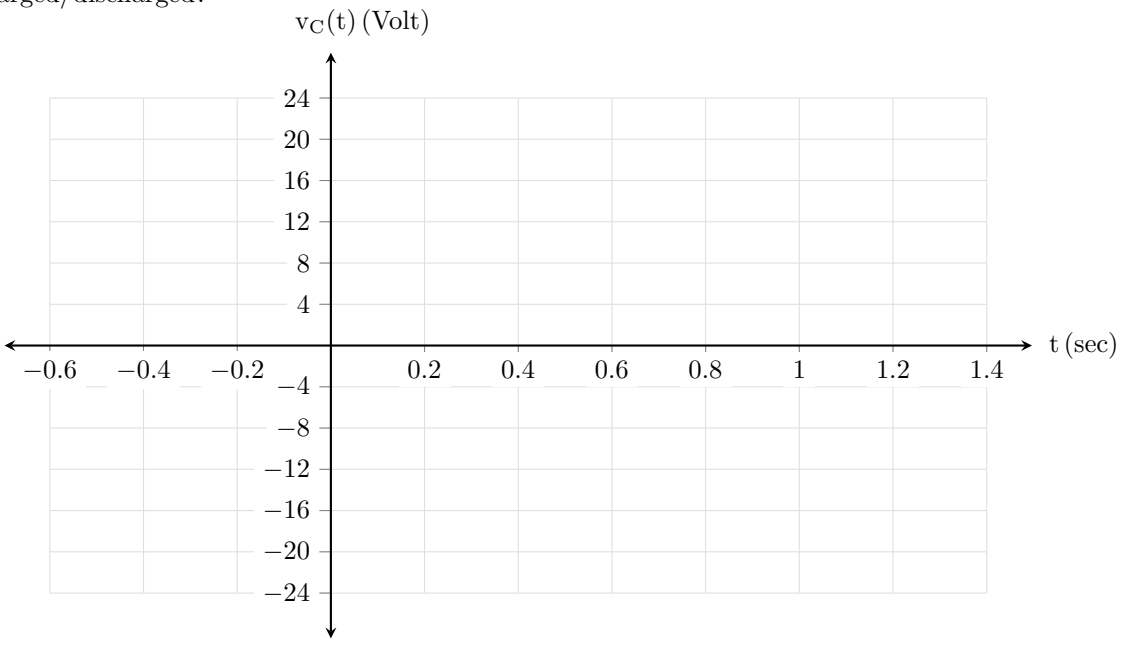
(c) ***[3 marks]*** How much time is required for the capacitor voltage to reach steady-state from its initial value in (a)?

(d) ***[3 marks]*** Write an expression of the voltage $v_C(t)$ as a function of time t for both $t < 0$ and $t \geq 0$.

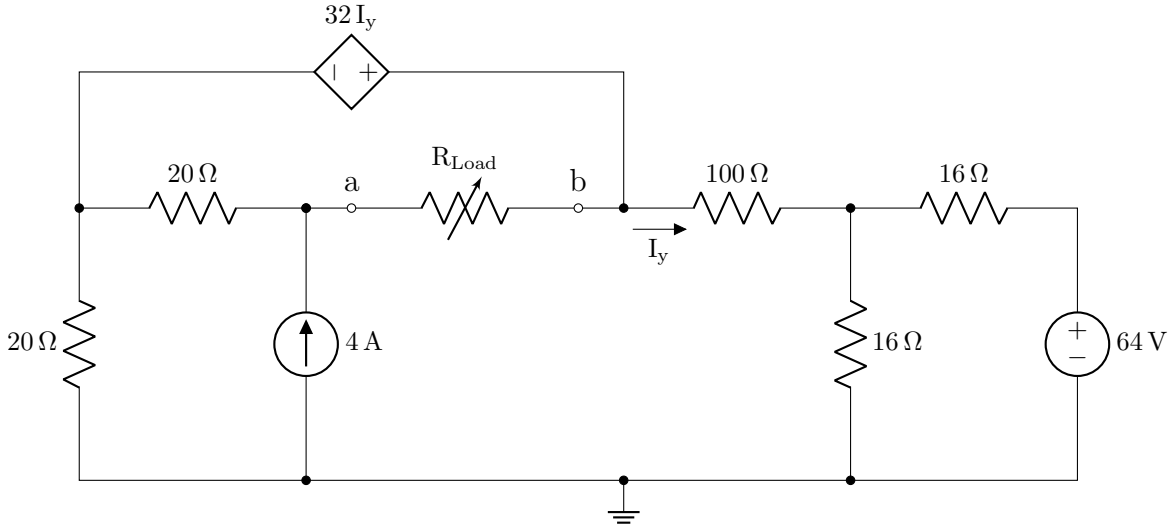
(e) ***[2 marks]*** Determine an expression of the capacitor current $i_C(t)$ as a function of time t for both $t < 0$ and $t \geq 0$.

(f) ***[3 marks]*** Plot $v_C(t)$ found in (d) as a function of time t for both $t < 0$ and $t \geq 0$ on the grid provided below. Mark the time constant point on the curve.

(g) ***[3 marks]*** If the arrow in the switch pointed in the opposite direction, how much time would the capacitor take to be fully charged/discharged?



■ Question 2 of 3 *[CO2] [15 marks]*



Apply Thevenin's/Norton's Theorem to answer the following queries–
(You may use any circuit theorem or technique to simplify the circuit.)

(a) ***[7 marks]*** Determine the value of R_{Load} connected between a and b so that the circuit delivers maximum power to it.

(b) ***[8 marks]*** Determine the value of the maximum power.

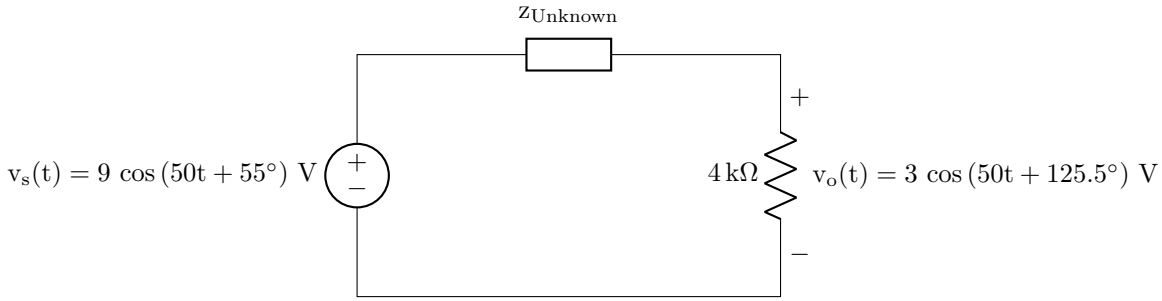
■ Question 3 of 3 *[CO2] [20 marks]*

(a) $z_{Unknown}$ in the following circuit is composed of one or more passive circuit elements. If the input voltage to the following circuit is $v_s(t) = 9\cos(50t + 55°)$ V and the voltage across the 4 kΩ resistor is $v_o(t) = 3\cos(50t + 125.5°)$ V as labeled in the diagram,

(i) ***[4 marks]*** Determine the impedance of $z_{Unknown}$.

(ii) ***[1 mark]*** What type of circuit element(s) (R and/or L and/or C) does $z_{Unknown}$ consist of?

(iii) ***[1 mark]*** Determine the value of the circuit element indentified in (ii) with appropriate units.



(b) ***[14 marks]*** For the circuit shown below, determine the current $i_x(t)$.