



VICTORIA UNIVERSITY OF
WELLINGTON
TE HERENGA WAKA

Test 1 (XMUT)

ECEN203

Analogue Electronics and Systems

Time allowed: Four Hours (from 10:00 to 14:00 Xiamen time)

Total number of questions: 4

Total marks: 40 marks

Instructions: Answer all questions. Not all questions have equal marks.

Write your name and student ID on each page of the answer papers.

Clearly label the question numbers and the corresponding parts of the questions.

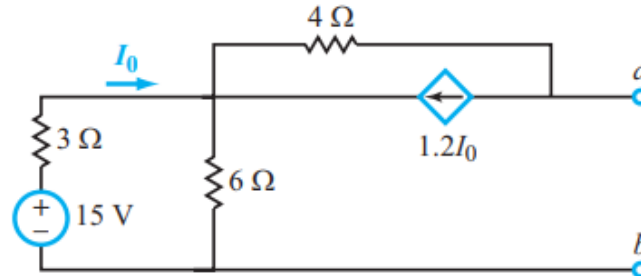
To get a full score you must write or type your answers neatly, showing your solution steps and reasoning clearly.

You must copy and include this statement on Page 1 of your answer sheets: "I hereby acknowledge that this work is my own."

Q1. Norton Equivalent Circuit [8 marks]

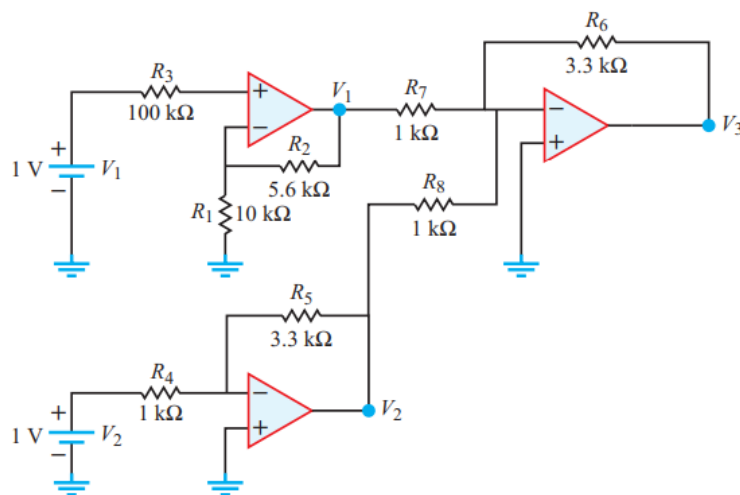
Find the Norton equivalent circuit at terminals (a, b) of the circuit shown here.

You must calculate the equivalent values and draw the final Norton equivalent circuit.

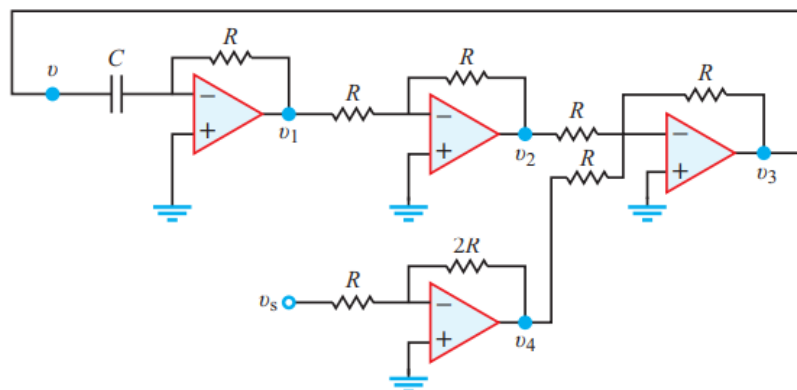


Q2. Op-amp Circuits [12 marks]

- (a) Find the voltage at each of the three op-amp outputs, V_1 , V_2 and V_3 , in the circuit below. You must name each of the op-amp amplifiers. **[6 marks]**

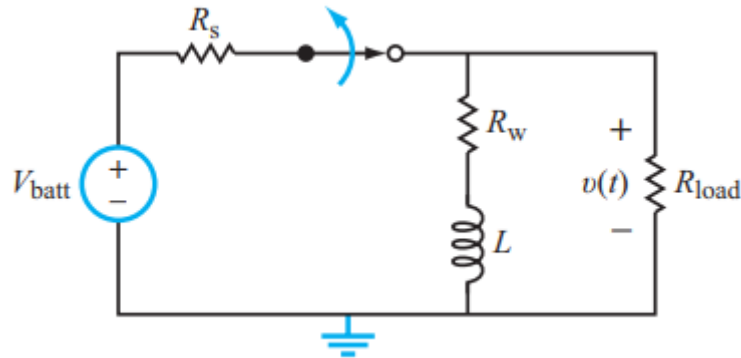


- (b) Show (steps by steps) that the op-amp circuit below (in which $R = 10\text{ k}$ and $C = 20\text{ }\mu\text{F}$) simulates the differential equation $\frac{dv}{dt} + 5v = 10v_s$. **[6 marks]**



Q3. Response of the RL Circuit [10 marks]

The circuit below demonstrates how an inductor can produce a high-voltage pulse across a load resistor R_{load} that is considerably higher than the circuit's power supply V_{batt} , a 1.5 V "AA" battery. High voltage pulses drive photo flash bulbs, strobe lights, and cardiac defibrillators, as examples.



Resistor R_s models the finite resistance of an electronic analog switch and R_w models the finite winding resistance of the inductor.

Component values are: $R_s = 16 \, \Omega$, $R_w = 90 \, \Omega$, $R_{\text{load}} = 680 \, \Omega$, $L = 33 \, \text{mH}$, and $V_{\text{batt}} = 1.5 \, \text{V}$.

- (a) Determine the load voltage v after the switch had been closed for a long time. [2 marks]
- (b) Determine the equation that describes $v(t)$ after the switch opens at time $t = 0$. [3 marks]
- (c) Determine the magnitude of the peak value of $v(t)$. How many times larger is this value compared to the battery voltage V_{batt} ? [2 marks]
- (d) State the value of the circuit time constant τ with the switch open. Sketch $v(t)$ over the time range $-\tau \leq t \leq 5\tau$. [3 marks]

Q4. Short Essay [10 marks]

Answer this question in a short essay of not less than 200 words (that is, the minimum word count is 200 words but you may write more). You can refer to lecture slides and textbooks, but do not just copy directly from them. You must **write in your own words**. You can use diagram(s), equation(s), sketch(es) to help your explanations. Your written texts may be examined using software to detect any copying/plagiarism.

"Discuss and explain the concepts of (a) **electric charge and current**, (b) **voltage and power**, and (c) **passive sign convention in relation to current, voltage and power**."

~~ End of Test 1 ~~