

Yıldız Technical University  
Computer Engineering Department  
2019-2020 Academic Year  
Spring Semester  
BLM1612 Circuit Theory

Take Home Quiz, Form:

Name: \_\_\_\_\_

Surname: \_\_\_\_\_

Student I.D.: \_\_\_\_\_

Signature: \_\_\_\_\_

Announcement Time: **17:00 30/April/2020**

Due Time: **08:59 04/May/2020**

Submission: Email your work, scanned (either with scanner or phone) to a **single PDF file** named as  $\langle group\ no \rangle - \langle student\ id \rangle .pdf$

to **ytudonanim@gmail.com** if you are in Gr.1 and

to **hamzailhan6@gmail.com** if you are in Gr.2,

with **20192\_BLM1612\_homework** subject field. (Ex. file name gr1\_19011000.pdf)

You must **show all of your work** for full credit.

A correct answer with nowork shown is worth no points.

Use the **methods mentioned in questions** for your answers.

### Section 1. Circuit Elements and Simple Resistive Circuits

1. Which quantity consists of a unit 1KWh ?

- (a) Time
- (b) Power
- (c) Energy
- (d) Charge
- (e) None of the above

2. A piece of resistive material has a length of  $10mm$ , a cross sectional area of  $7mm^2$  and a resistivity of  $4700 \times 10^{-8}\Omega \cdot m$ . What is its resistance?

- (a)  $67\mu\Omega$
- (b)  $67m\Omega$
- (c)  $30.4\Omega$
- (d)  $30.4k\Omega$
- (e) None of the above

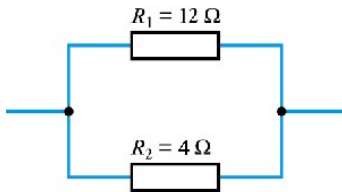
3. The internal conductance of ideal voltage source is

- (a) Infinite
- (b) Zero
- (c) Equal to internal resistance
- (d) Equal to external collector
- (e) None of the above

4. Calculate the effective resistance of the following combination.



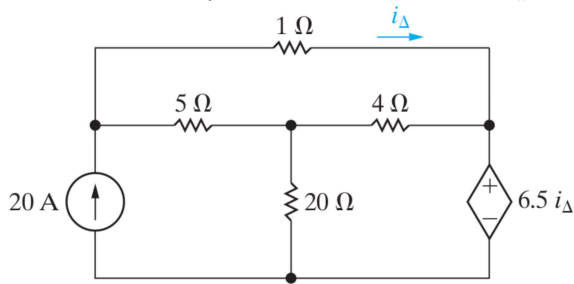
- (a)  $22\Omega$
  - (b)  $32\Omega$
  - (c)  $42\Omega$
  - (d)  $52\Omega$
  - (e) None of the above
5. Which of the followings is/are active element?
- (a) Voltage source
  - (b) Current source
  - (c) Both a and b
  - (d) Capacitor
  - (e) None of the above
6. Calculate the effective resistance of the following combination.



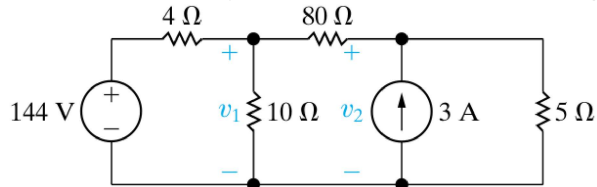
- (a)  $3\Omega$
  - (b)  $6\Omega$
  - (c)  $8\Omega$
  - (d)  $16\Omega$
  - (e) None of the above
7. The internal resistance of ideal current source is
- (a) Infinite
  - (b) Zero
  - (c) Equal to internal conductance
  - (d)  $100\Omega$
  - (e) None of the above

## Section 2. Circuit Analysis Techniques

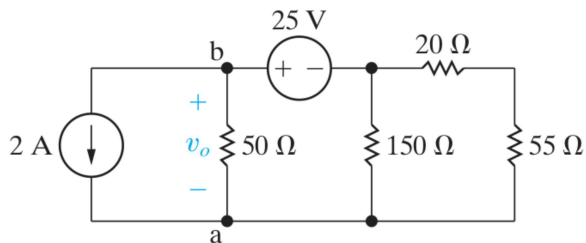
8. Use the mesh analysis to find the power dissipated by the independent current source.



- (a)  $120W$   
 (b)  $1560W$   
 (c)  $2400W$   
 (d)  $960W$   
 (e) None of the above
9. Use the nodal analysis to find the  $v_1$  and  $v_2$  voltages.

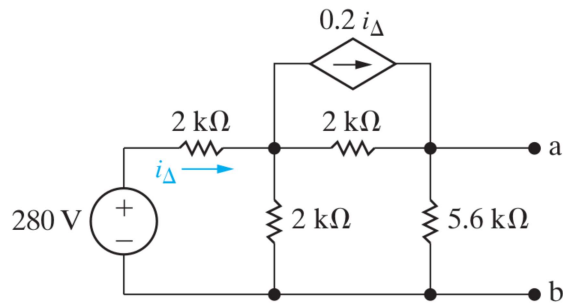


- (a)  $v_1 = 100.00V, v_2 = 20.00V$   
 (b)  $v_1 = 99.02V, v_2 = -8.29V$   
 (c)  $v_1 = 100.00V, v_2 = -20.00V$   
 (d)  $v_1 = -99.02V, v_2 = 8.29V$   
 (e) None of the above
10. Use the nodal analysis to find the  $v_o$ . Use node  $a$  as the reference node.

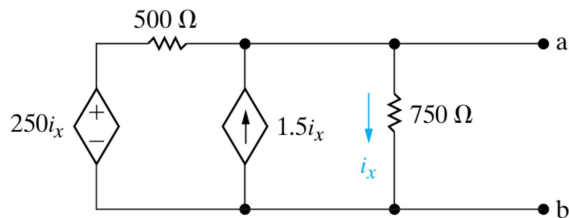


- (a)  $37.50V$   
 (b)  $-37.50V$   
 (c)  $-62.50V$   
 (d)  $-100.00V$   
 (e) None of the above

11. Find the Norton equivalent current ( $I_N$ ) and Norton equivalent resistance ( $R_N$ ) of the given circuit with respect to terminals a and b.

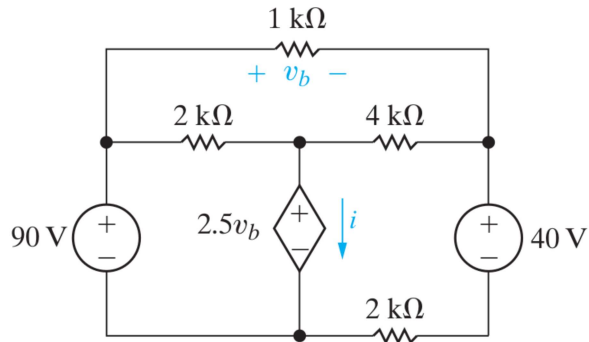


- (a)  $I_N = 60\text{mA}$ ,  $R_N = 1866.67\Omega$   
 (b)  $I_N = 260\text{mA}$ ,  $R_N = 430.77\Omega$   
 (c)  $I_N = 32.31\text{mA}$ ,  $R_N = 3466.67\Omega$   
 (d)  $I_N = 210\text{mA}$ ,  $R_N = 533.33\Omega$   
 (e) None of the above
12. Find the Norton equivalent current ( $I_N$ ) and Norton equivalent resistance ( $R_N$ ) of the given circuit with respect to terminals a and b.

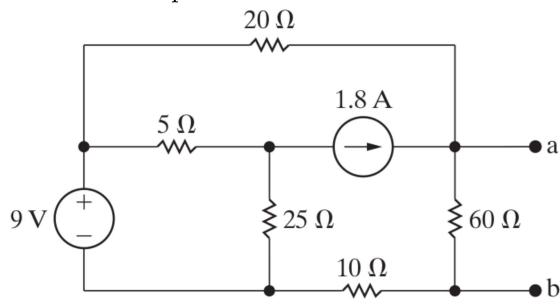


- (a)  $I_N = 3\text{A}$ ,  $R_N = 1.5\text{k}\Omega$   
 (b)  $I_N = 0\text{A}$ ,  $R_N = 1.5\text{k}\Omega$   
 (c)  $I_N = 0\text{A}$ ,  $R_N = 750\Omega$   
 (d)  $I_N = 3\text{A}$ ,  $R_N = 750\Omega$   
 (e) None of the above

13. Use the principle of superposition to find the current  $i$ .

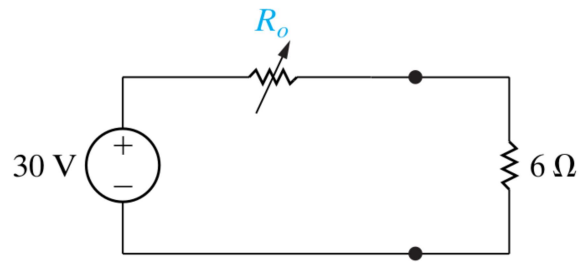


- (a)  $7.11mA$   
 (b)  $17.89mA$   
 (c)  $25.00mA$   
 (d)  $15.00mA$   
 (e) None of the above
14. Find the Thévenin equivalent voltage ( $V_{TH}$ ) and Thévenin equivalent resistance ( $R_{TH}$ ) of the given circuit with respect to terminals a and b.



- (a)  $V_{TH} = 30V, R_{TH} = 30\Omega$   
 (b)  $V_{TH} = 35V, R_{TH} = 23.33\Omega$   
 (c)  $V_{TH} = 20V, R_{TH} = 30\Omega$   
 (d)  $V_{TH} = 30V, R_{TH} = 20\Omega$   
 (e) None of the above

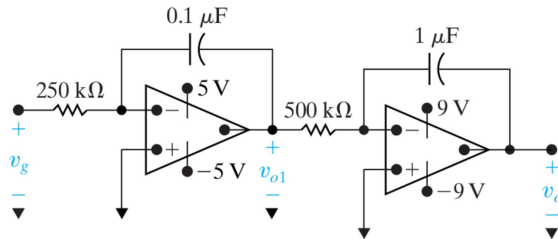
15. What is the maximum power that can be delivered to the  $6\Omega$  resistor using the variable resistor  $R_0$ ?



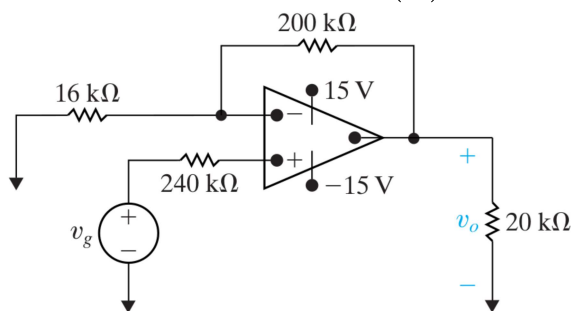
- (a)  $37.5W$
- (b)  $70W$
- (c)  $150W$
- (d)  $300W$
- (e) None of the above

### Section 3. Operational Amplifier

16. No energy is stored in the circuit given when the input voltage  $v_g$  jumps instantaneously from 0 to  $25mV$  at time  $t = 0$ . Drive the expression for  $v_o(t)$  for  $0 \leq t \leq t_{sat}$  ( $t_{sat}$  is the time required for any op amp to reach saturation).

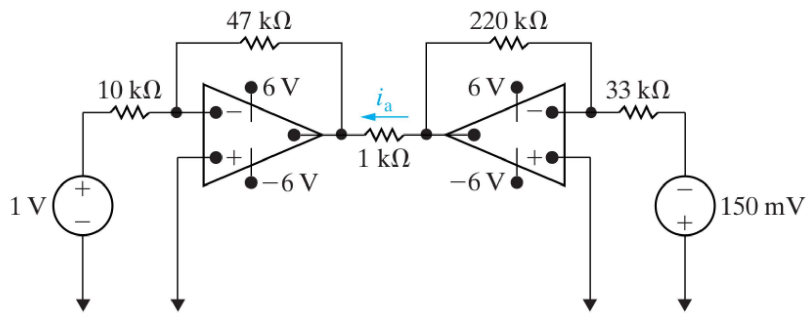


- (a)  $v_o(t) = t^2$   
 (b)  $v_o(t) = 2t$   
 (c)  $v_o(t) = 2$   
 (d)  $v_o(t) = 0$   
 (e) None of the above
17. The op amp in the noninverting amplifier circuit given has an input resistance of  $560k\Omega$ , an output resistance of  $8k\Omega$ , and an open-loop gain of 50,000. Assume that the op amp is operating in its linear region. Calculate the voltage gain  $\left(\frac{v_o}{v_g}\right)$ .



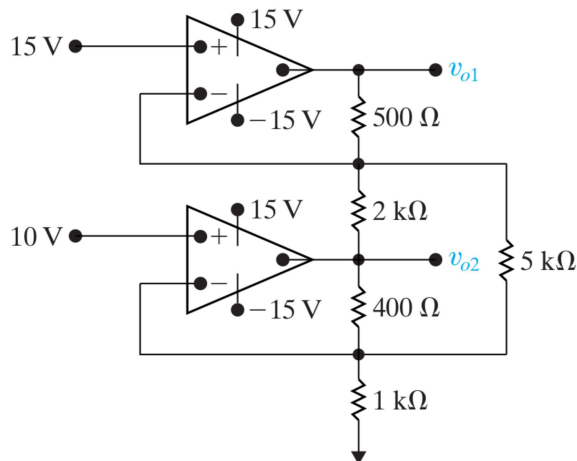
- (a) 1  
 (b) 2  
 (c) 6.75  
 (d) 13.49  
 (e) None of the above

18. The op amps in the circuit given are ideal. Find  $i_a$ .



- (a)  $0\text{mA}$
- (b)  $3.7\text{mA}$
- (c)  $5.7\text{mA}$
- (d)  $7.7\text{mA}$
- (e) None of the above

19. The two op amps are ideal in the given circuit. Calculate  $v_{o1}$  and  $v_{o2}$ .



- (a)  $v_{o1} = 9.10\text{V}$  and  $v_{o2} = 13.60\text{V}$
- (b)  $v_{o1} = 15.85\text{V}$  and  $v_{o2} = 13.60\text{V}$
- (c)  $v_{o1} = 14.75\text{V}$  and  $v_{o2} = 16.00\text{V}$
- (d)  $v_{o1} = 15.00\text{V}$  and  $v_{o2} = 10.00\text{V}$
- (e) None of the above

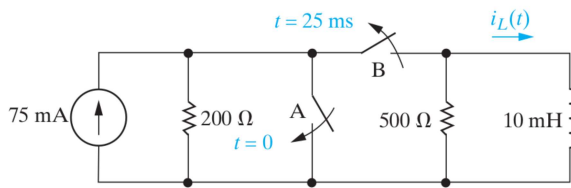


## Section 4. Capacitor, Inductor and RL/RC Circuits

20. The current in a  $150\text{mH}$  inductor is known to be  $i_L = 25te^{-500t}\text{A}$  for  $t \geq 0$ . Find the energy stored in the inductor at  $5\text{ms}$ .

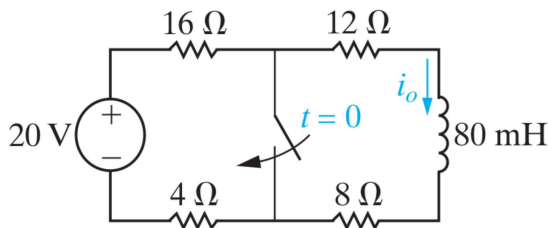
- (a)  $4.74\mu\text{J}$
- (b)  $7.9\text{nJ}$
- (c)  $10.26\text{mJ}$
- (d)  $461.73\mu\text{J}$
- (e) None of the above

21. In the circuit given, switch A has been open for a long time and switch B has been closed for a long time. At  $t = 0$  the switch A closes.  $25\text{ms}$  after switch A closes, switch B opens. Determine  $i_L(t)$  for  $t \geq 25\text{ms}$ .



- (a)  $i_L(t) = 75e^{-50000(t-0.025)}\text{mA}$
- (b)  $i_L(t) = 50e^{-50000(t-0.025)}\text{mA}$
- (c)  $i_L(t) = 50e^{-20(t-0.025)}\text{mA}$
- (d)  $i_L(t) = 75e^{-20(t-0.025)}\text{mA}$
- (e) None of the above

22. The switch in the given circuit has been open for a long time. At  $t = 0$  the switch is closed. Determine  $i_0(t)$  for  $t \geq 0$ .

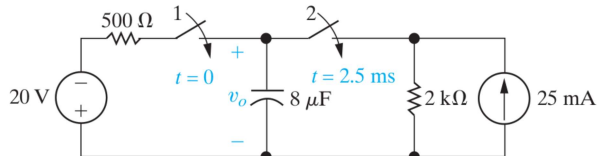


- (a)  $i_0(t) = 0.17e^{-250t}\text{A}$
- (b)  $i_0(t) = 0.5e^{-500t}\text{A}$
- (c)  $i_0(t) = 0.5e^{-250t}\text{A}$
- (d)  $i_0(t) = 0.17e^{-500t}\text{A}$
- (e) None of the above

23. A capacitor has plates  $15\text{mm} \times 30\text{mm}$  which have separation of  $10\mu\text{m}$ . If the gap between the plates filled with air, calculate the capacitance of the device.

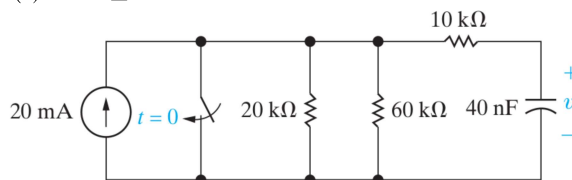
- (a)  $400\text{pF}$
- (b)  $400\text{nF}$
- (c)  $400\mu\text{F}$
- (d)  $400\text{mF}$
- (e) None of the above

24. There is no energy stored in the capacitor in the circuit given. Switch 1 closes at  $t = 0$ . Switch 2 closes at  $2.5\text{ms}$ . Find  $v_0(t)$  for i)  $0 \leq t < 2.5\text{ms}$  and ii)  $t \geq 2.5\text{ms}$ .



- (a) 
$$v_0(t) = \begin{cases} -20 + 20e^{-4t}\text{V} & , 0 \leq t < 2.5\text{ms} \\ -4 - 3.29e^{-2.4(t-0.0025)}\text{V} & , t \geq 2.5\text{ms} \end{cases}$$
- (b) 
$$v_0(t) = \begin{cases} -20 + 20e^{-4t}\text{V} & , 0 \leq t < 2.5\text{ms} \\ -6 - 3.29e^{-312.5(t-0.0025)}\text{V} & , t \geq 2.5\text{ms} \end{cases}$$
- (c) 
$$v_0(t) = \begin{cases} -4 + 4e^{-250t}\text{V} & , 0 \leq t < 2.5\text{ms} \\ -6 - 4.14e^{-312.5(t-0.0025)}\text{V} & , t \geq 2.5\text{ms} \end{cases}$$
- (d) 
$$v_0(t) = \begin{cases} -20 + 20e^{-250t}\text{V} & , 0 \leq t < 2.5\text{ms} \\ -6 - 3.29e^{-312.5(t-0.0025)}\text{V} & , t \geq 2.5\text{ms} \end{cases}$$
- (e) None of the above

25. The switch in the given circuit has been open for a long time. At  $t = 0$  the switch is closed. Determine  $v(t)$  for  $t \geq 0$ .



- (a)  $v(t) = 120e^{-277.78t}\text{V}$
- (b)  $v(t) = 300e^{-1000t}\text{V}$
- (c)  $v(t) = 300e^{-277.78t}\text{V}$
- (d)  $v(t) = 120e^{-1000t}\text{V}$
- (e) None of the above