Name: _____ (please print)

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ENGR 065 Circuit Theory– Midterm Exam

March 11, 2020

Keep this exam closed and face up until you are told to begin.

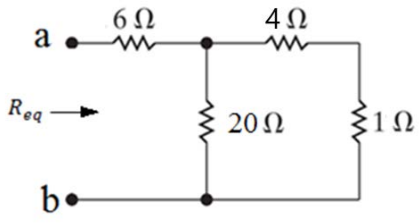
1. This exam is a closed-books, closed-notes exam. Calculators are allowed.
2. The multiple-choice questions, including the bonus question, are to be answered on your scantrons while the free response questions are to be completed on these pages.
3. Submit these pages with your scantrons.
4. You have 75 minutes to work on this exam.

Problems		Scores
Multiple Choices (80 pts)		
Free Response Problem 1 (10 pts)		
Free Response Problem 2 (10 pts)		
Bonus Question (10 pts)		
Total		

Choose one answer from each problem. Each problem has 5 points.

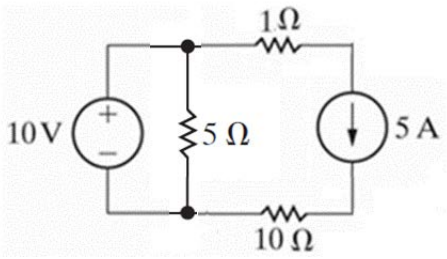
1) The equivalent resistance seen by the terminals **a** and **b** is

A. 4 Ω
B. 6 Ω
C. 8 Ω
D. 10 Ω



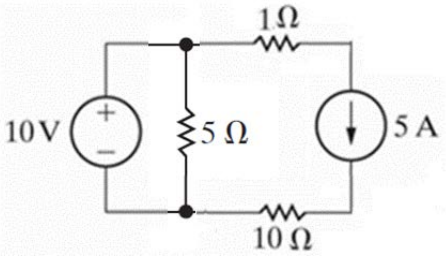
2) The power associated with 10 Ω resistor is

A. 25 W
B. - 25 W
C. 250 W
D. - 250 W



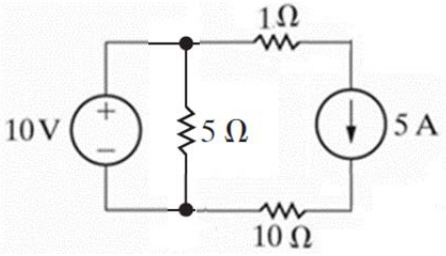
3) The power associated with 5Ω resistor is

A. 20 W
B. - 20 W
C. 125 W
D. - 125 W



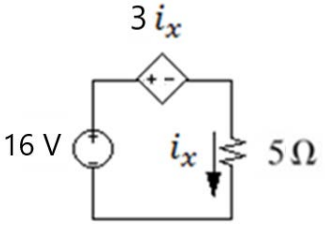
4) The power associated with 10 V voltage source is

E. 50 W
F. - 50 W
G. 70 W
H. - 70 W



5) The current i_x is

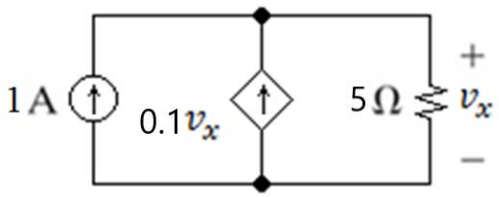
A. 2 A
B. - 2 A



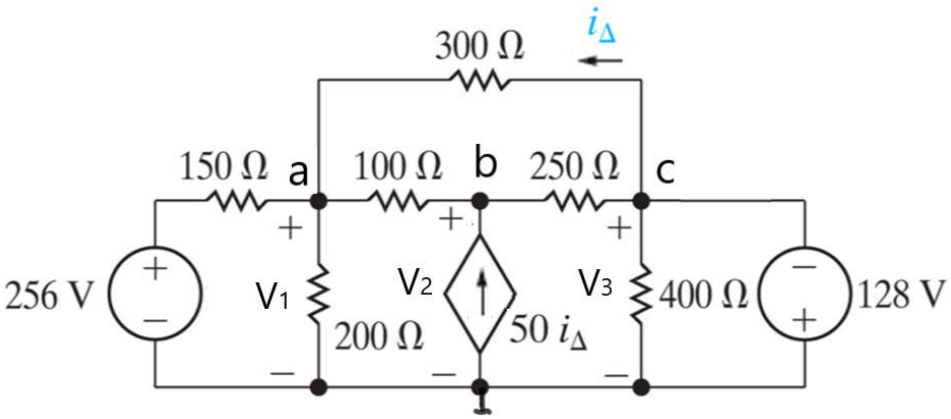
C. 3 A
D. -3 A

6) The voltage v_x is

A. 5 V
B. 10 V
C. 15 V
D. 20 V



Questions 7-10 are to be answered based on the following circuit:



7) The node voltage equation at node a in the circuit is

A. $\frac{V_1+256}{150}+\frac{V_1-V_2}{100}+\frac{V_1}{200}+\frac{V_1-V_3}{300}=0$
B. $\frac{V_1-256}{150}+\frac{V_1-V_2}{100}+\frac{V_1}{200}+\frac{V_1-V_3}{300}=0$
C. $\frac{V_1-256}{150}+\frac{V_1+V_2}{100}+\frac{V_1}{200}+\frac{V_1-V_3}{300}=0$
D. $\frac{V_1-256}{150}+\frac{V_1-V_2}{100}+\frac{V_1}{200}+\frac{V_1+V_3}{300}=0$

8) The node voltage equation at node b in the circuit is

A. $\frac{V_2-V_1}{100}-50i_\Delta+\frac{V_2-V_3}{250}=0$

B. $\frac{V_2-V_1}{100}+50i_\Delta+\frac{V_2-V_3}{250}=0$
C. $\frac{V_2-V_1}{100}-50i_\Delta+\frac{V_3-V_2}{250}=0$
D. $\frac{V_2+V_1}{100}+50i_\Delta+\frac{V_2-V_3}{250}=0$

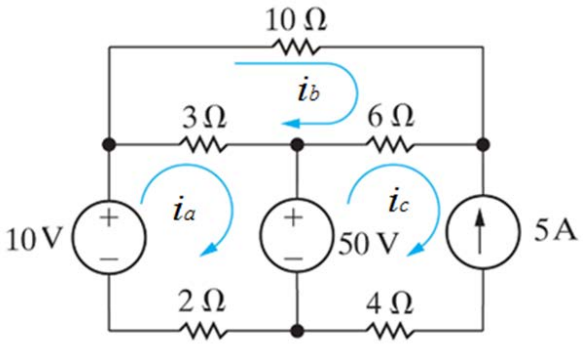
9) The node voltage equation at node c in the circuit is

A. $\frac{V_3-V_2}{250}+\frac{V_3}{400}+\frac{V_3-V_1}{300}=0$
B. $\frac{V_3-V_2}{250}+\frac{V_3}{400}+\frac{V_3-V_1}{300}+128=0$
C. $V_3=128$ V
D. $V_3=-128$ V

10) The i_Δ in the circuit is equal to

A. $\frac{V_3-V_1}{300}$
B. $\frac{V_1-V_3}{300}$
C. $\frac{V_2-V_1}{300}$
D. $\frac{V_3+V_1}{300}$

Questions 11 -13 are to be answered based on the following circuit.



11) The mesh-current equation of mesh **a** in the circuit is

A. $5i_a-3i_b+10=0$
B. $5i_a-3+40=0$
C. $5i_a-3i_b+50=0$
D. $5i_a-3i_b+60=0$

12) The mesh-current equation of mesh **b** in the circuit is

A. $3i_a-19i_b-6i_c=0$
B. $-3i_a+19i_b+6i_c=0$

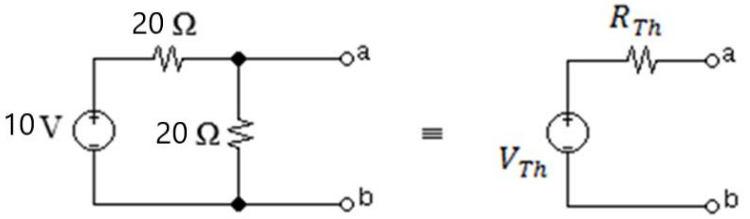
C. $-3i_a + 19i_b - 6i_c = 0$
D. $-3i_a - 19i_b - 6i_c = 0$

13) The mesh-current equation of mesh **c** in the circuit is

A. $10i_c - 6i_b - 50 = 0$
B. $10i_c + 6i_b + 50 = 0$
C. $i_c = -5\ A$
D. $i_c = 5\ A$

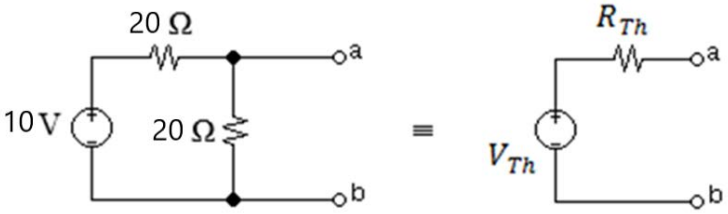
14) The Thévenin equivalent resistance at the terminals **a and b** in the circuit below is

A. 10 Ω
B. 20 Ω
C. 40 Ω
D. 50 Ω



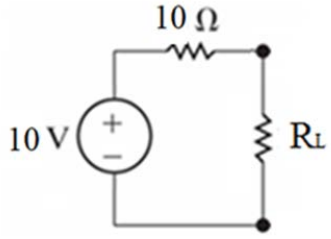
15) The Thévenin equivalent voltage V_{Th} at the terminals a and b in the circuit below is

A. - 5 V
B. 5 V
C. -10 V
D. 10 V



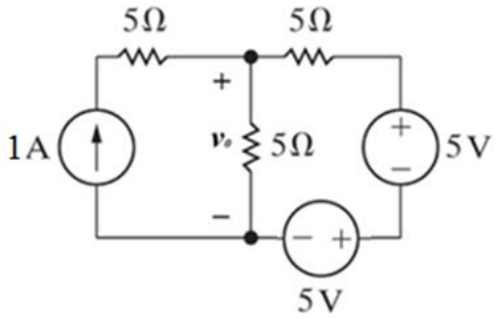
16) The maximum power transferred to the R_L in the circuit below is

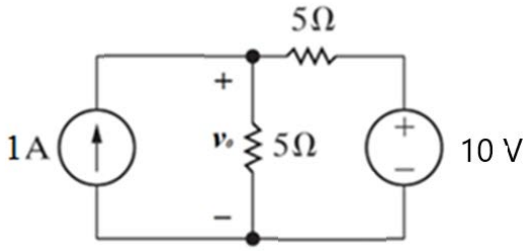
A. 2.5 W
B. 5 W
C. 10 W
D. 20 W



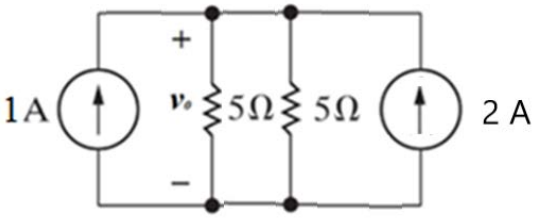
2. Free Response Questions (10 points/each)

1) **<u>Using the source transformation</u>** to find the voltage v_0 in the circuit below

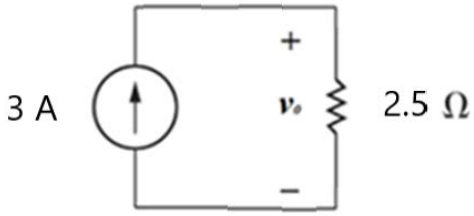


a. 

a. (+3)



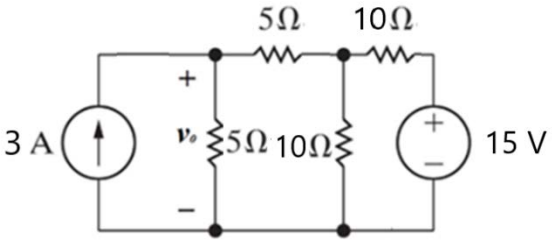
b. (+3)



c. (+3)

d. $v_0 = 3 \times 2.5 = 7.5\,V$ (+1)

2) **Using the superposition principle method** to find the voltage v_0 in the following circuit



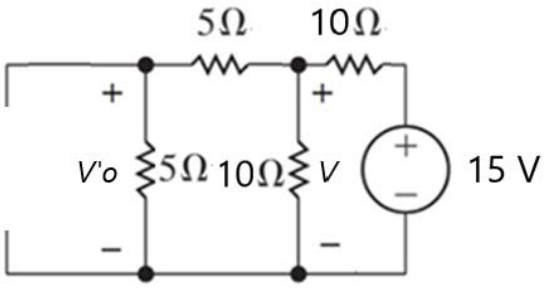
1) When the 15 V voltage source is applied to the circuit

$5 + 5 = 10\ \Omega$

$\frac{10\times10}{10+10} = 5\ \Omega$

$V = \frac{15\times5}{5+10} = 5\ V$

$V_o' = \frac{5\times5}{5+5} = 2.5\ V$ **(+2)**



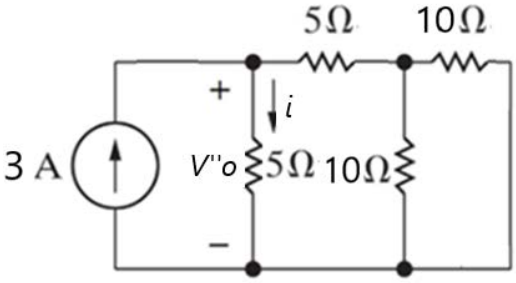
(+2)

When the 3 A current source is applied to the circuit

$\frac{10\times10}{10+10} = 5\ \Omega$

$5 + 5 = 10\ \Omega$

$i = \frac{3\times10}{5+10} = 2\ A$



$v_0'' = 10\ V$ **(+2)**

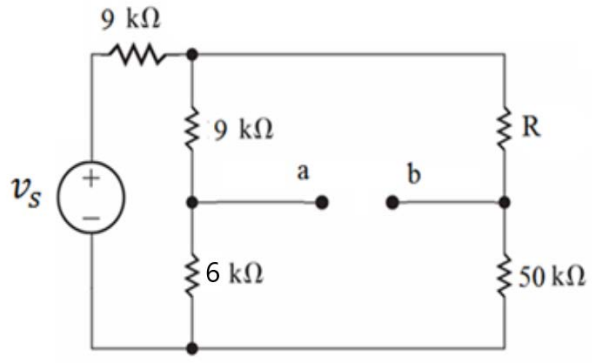
(+2)

$v_0 = v_0' + v_0'' = 2.5 + 10 = 12.5\ V$ **(+2)**

Bonus question (10 pts)

1 What is the value of R shown in the circuit below such that there is no voltage between the terminals **a** and **b** for any value of v_s?

A. 50 kΩ
B. 54 kΩ
C. 75 kΩ
D. 150 kΩ



$$R = 50 \times \frac{9}{6} = 75\ k\Omega$$