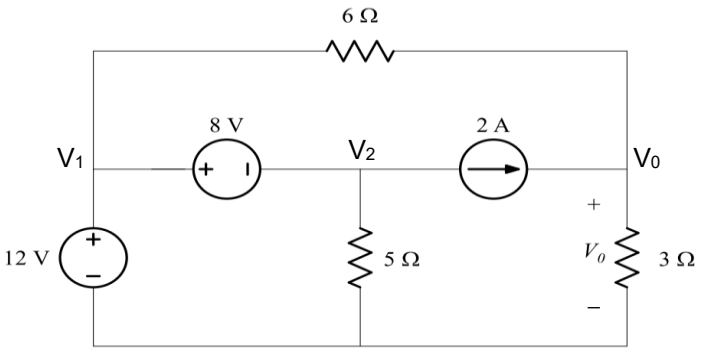
International University - VNUHCM
School of Electrical Engineering

Midterm Examination Solution

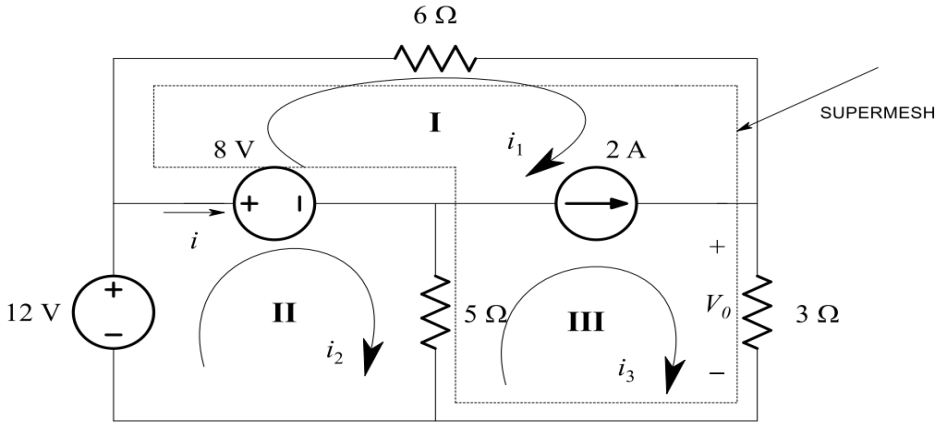
Question 1 (20 Marks)



a. Voltages V_1 and V_2 are given in the circuit. Give the values of V_1 and V_2. (5 Marks)
b. Use node-voltage method to find the voltage V_0. (10 Marks)
c. Determine the power of the current source 2 A. (5 Marks)

Question 2 (20 Marks)

In the circuit shown below, the mesh currents and super mesh are shown.

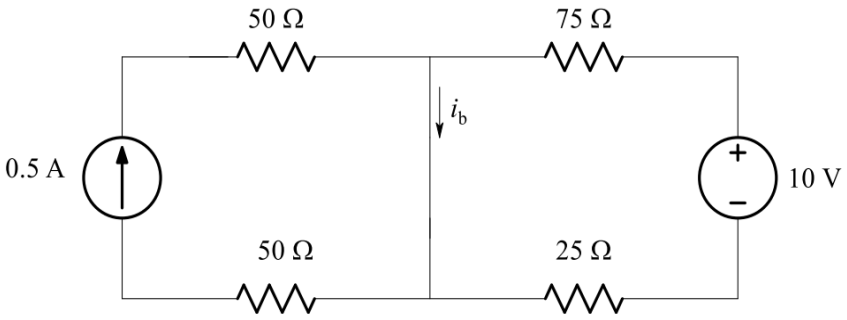


a. Establish the super mesh equation using mesh-current method. (5 Marks)
b. Establish the mesh current equation for i_2 using mesh-current method. (5 Marks)
c. Compute i_1, i_2 and i_3. (5 Marks)
d. Calculate the power of the voltage source 8V. (3 Marks)
e. Calculate the power of the current source 2A. (2 Marks)

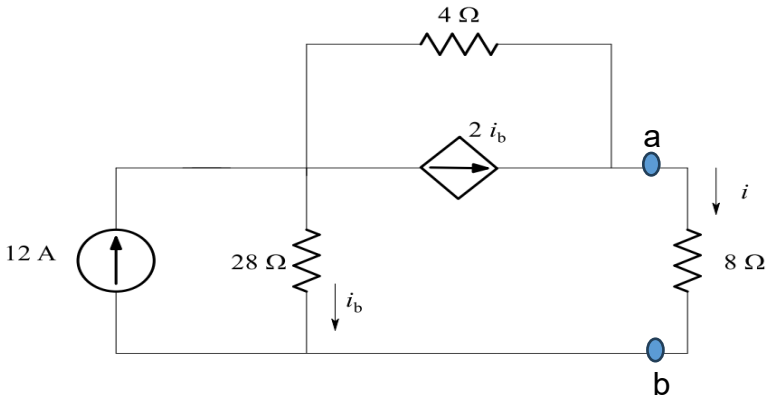
Question 3 (20 Marks)

The electric circuit is depicted in the following figure.

a. Draw the circuit if the voltage source 10 V is deactivated. Compute i_b for this case. (5 Marks).
b. Draw the circuit if the current source 0.5 A is deactivated. Compute i_b for this case. (5 Marks).
c. Use superposition method to determine i_b in the original circuit. (7 Marks)
d. Calculate the power of the voltage source 10V and current source 0.5 A. (3 Marks)

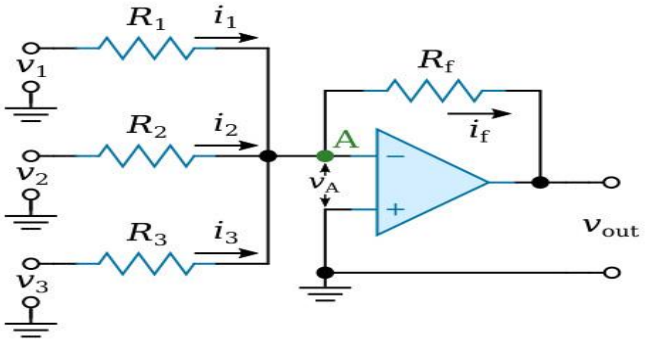


Question 4 (20 Marks)



a. Find Thevenin voltage for terminals a,b. (Hint: Remove the load) (10 Marks)
b. Find Thevenin resistance for terminals a,b. (5 Marks)
c. Compute the current i. (5 Marks)

Question 5 (20 Marks)



It is given that the power supplies for the ideal opamp in the circuit are $+V_{CC}$ = 10V and $-V_{CC}$ = -10V. The circuit elements are listed as R_1 = 2 KΩ, R_2 = 4 KΩ, R_3 = 5 KΩ, and R_f = 8 KΩ.

a. Find V_{out} if V_1 = 0.5 V, V_2 = 1 V and V_3 = 2 V. (10 Marks)
b. Find the range of V_2 to avoid amplifier saturation if V_1 = 0.5 V and V_3 =2 V. (5 Marks)
c. Find the voltage gain of the circuit if V_1, V_2 and V_3 are joined together as Vi. (5 Marks)

ANSWERS

Answer to Q1. (20 marks)

a. (5 Marks)

$V_1 = 12$ V and $V_2 = 12 - 8 = 4$ V

b. (10 Marks)

$$\frac{V_o}{3} + \frac{V_o - 12}{6} = 2$$

Thus, $V_o = 8$V

c. (5 Marks)

$P_{2A} = -(V_o - V_2)2 = -8$ w

Answer to Q2. (20 marks)

a. (5 Marks)

$6i_1 + 3i_3 + 5(i_3 - i_2) - 8 = 0$ or $6i_1 - 5i_2 + 8i_3 - 8 = 0$ (1)

And $2 = i_3 - i_1$ (2)

Combining (1) and (2) gives

$14i_1 - 5i_2 + 8 = 0$ (3)

b. (5 Marks)

$-12 + 8 + 5(i_2 - i_3) = 0$ (4)

c. (5 Marks)

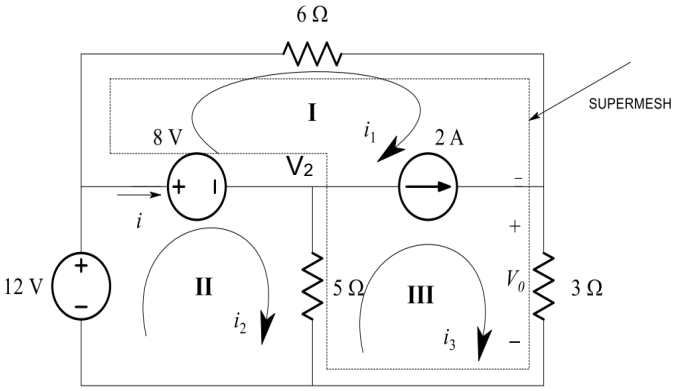
Solving (1), (2) and (4) yields

$i_1 = 2/3$ A = 0.67 A

$i_2 = 52/15$ A = 3.47 A

$i_3 = 8/3$ A = 2.67 A

d. (3 Marks) $P_{8V} = 8(i_2 - i_1) = 22.4$ w

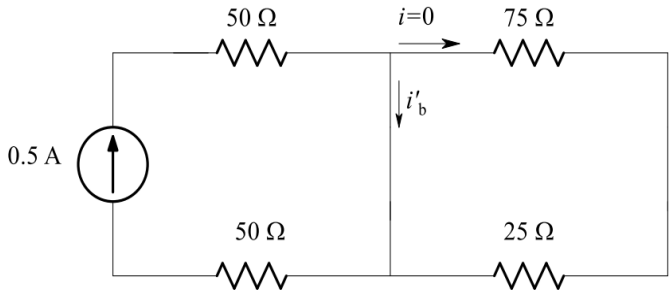


e. (2 Marks)

$P_{2A} = -(V_o - V_2)2 = -(3i_3 - 4)2 = -8$ w

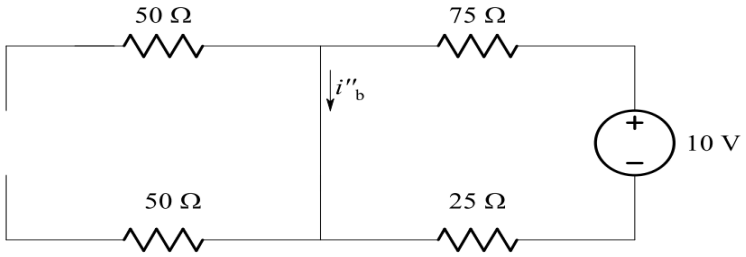
Answer to Q3. (20 marks)

a. (5 Marks)



i_b' = 0.5 A due to short circuit or use current divider

b. (5 Marks)



i_b" = 10/(75 + 25) = 0.1 A

c. (7 Marks)

Using superposition yields $i_b = 0.5 + 0.1 = 0.6$ A

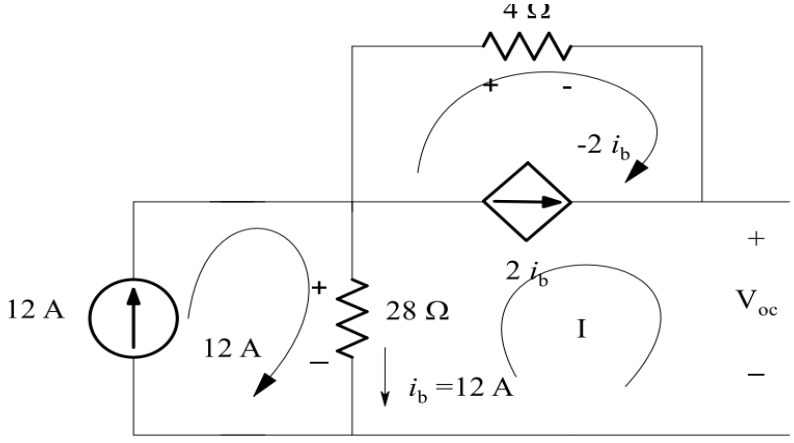
d. (3 Marks)

$P_{10V} = -10(0.1) = -1$ w

$P_{0.5A} = -(0.5x(50 + 50))0.5 = -25$ w

Answer to Q4. (20 marks)

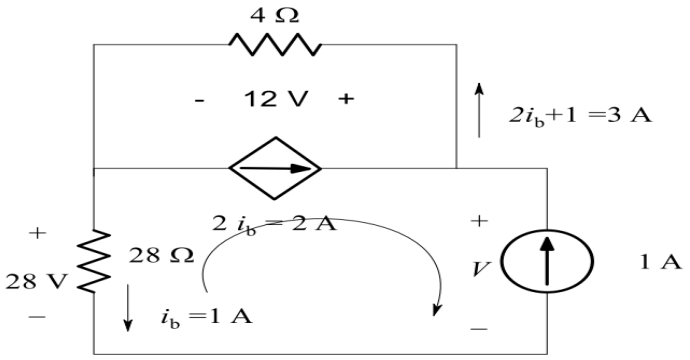
a. (10 Marks) Remove 8Ω resistor and let V_a be V_{th}, we have



V_{th} - 28x12 + 4(-2i_b) = 0

So V_{th} = 432 V

b. (5 Marks) Using test circuit 1A current source gives



V_T = 3(4) + 28 = 40 V, i_T = 1 A

R_{th} = 40/1 = 40 Ω

c. (5 Marks)

i = $V_{th}/(R_{th}$ + 8) = 9 A

Answer to Q5. (20 marks)

a. (10 Marks) Using summing amplifier formula gives

$V_{out} = -[(R_f/R_1)V_1 + (R_f/R_2)V_2 + (R_f/R_3)V_3] = -7.2$ V

b. (5 Marks) To avoid amplifier saturation, we have

$-Vcc \leq -[(R_f/R_1)V_1 + (R_f/R_2)V_2 + (R_f/R_3)V_3] \leq Vcc$

$-0 \leq -2V_2 - 5.2 \leq 10$

$-7.6\ V \leq V_2 \leq 2.4\ V$

c. (5 Marks) The circuit is inverting amplifier

so the voltage gain is – (R_f/(2k//4k//5k)) = - 8k/1.05k = -7.6