20

Notre Dame University
Department of Electrical, Computer and Communication Engineering

Sample Exam

EEN100
R. Jabr

Circuit Analysis I

Name:

ID #:

Section:

Notes:
Time = 50 Minutes.

Number of Pages = 5

This exam is Closed Book and Closed Notes.

All Questions Should be Answered on the Exam Sheet.

Scratch paper *will not* be collected.

Write neatly and show the *main steps* required to reach the final answer.

Underline your final answer and include units.

Grading:

Question Number	Grade
1	25 / 25
2	25 / 25
3	25 / 25
4	25 / 25
Total	100 / 100

Question # 1 (25 points):
Determine the power that is absorbed or supplied by the elements in the circuit shown in Figure 1. Is the principle of conservation of energy satisfied? Justify your answer.

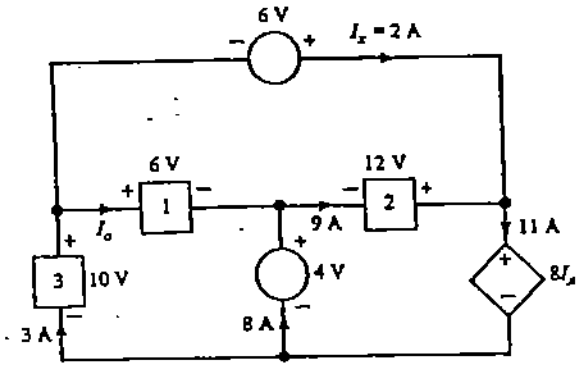


Figure 1

Solution:

$I_o = 3 - 2 = 1A$

$P_1 = 6 \times 1 = 6W$ absorbed

$P_2 = -12 \times 9 = -108W$ // $\Rightarrow$ delivers 108 W

$P_3 = -3 \times 10 = -30W$ // $\Rightarrow$ delivers 30 W

$P_{6V} = -6 \times 2 = -12W$ // $\Rightarrow$ delivers 12 W

$P_{4V} = -4 \times 8 = -32W$ // $\Rightarrow$ delivers 32 W

$P_{8I_x} = 8 \times 2 \times 11 = 176W$ //

$\Sigma P_{abs} = 176 + 6 = 182W$

$\Sigma P_{del} = 108 + 30 + 12 + 32 = 182W$

$\Rightarrow$ principle of conservation of energy is satisfied

Question # 2 (25 points):
Find the voltage Vo in the network in Figure 2.

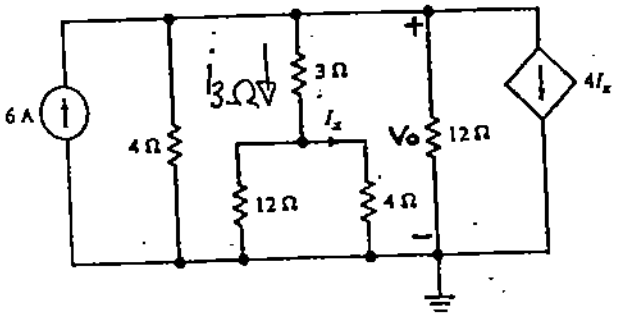


Figure 2

Solution:

$$I_x = \frac{12}{12+4}\, i_{3\Omega} = \frac{3}{4} i_{3\Omega} \Rightarrow i_{3\Omega} = \frac{4}{3} I_x .$$

$$V_o = 3\,\frac{4}{3} I_x + 4 I_x = 8 I_x$$

$$\text{KCL} \Rightarrow -6 + \frac{8I_x}{4} + \frac{4}{3} I_x + \frac{8I_x}{12} + 4I_x = 0 \Rightarrow I_x = 0.75\text{A}$$

$$\Rightarrow V_o = 8 I_x$$

$$V_o = \underline{\underline{6\text{ V}}}$$

Question #3 (25 points):
Given the circuit in Figure 3, if Vo = 12V, Find Is.

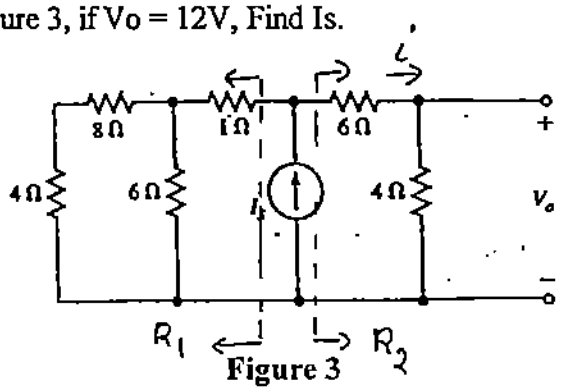


Figure 3

Solution:

$R_1 = 12//6+1 = 5\Omega$

$R_2 = 6+4 = 10\Omega$

$i = \frac{12}{4} = 3A = \frac{5}{5+10} I_s \Rightarrow \underline{\underline{I_s = 9A}}$

Question #4 (25 points):
Find Io in the network shown in Figure 4.

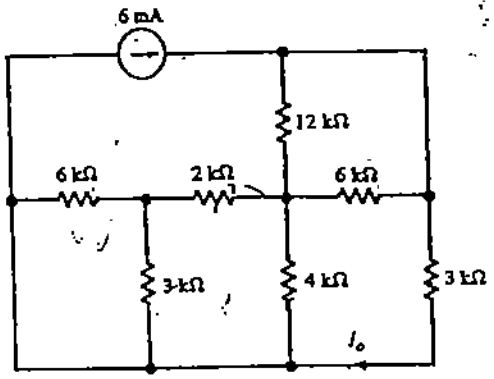
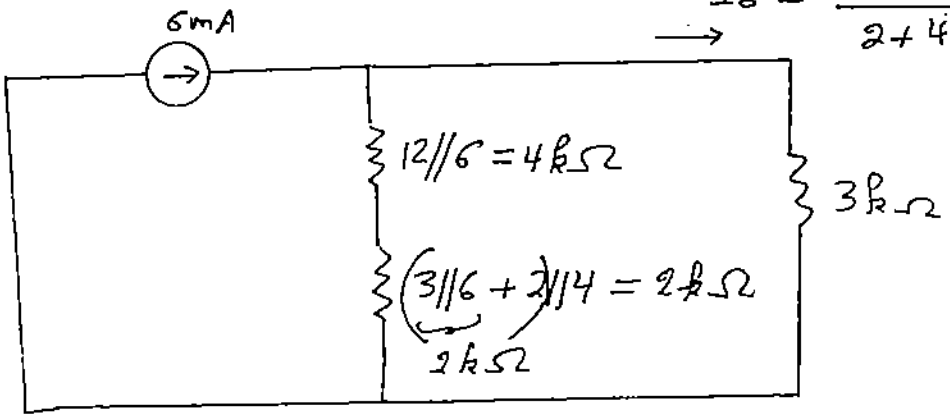


Figure 4

Solution:

$$I_o = \frac{2+4}{2+4+3}(6) = 4\,mA$$



EEN100 FALL2000 NDU
CIRCUIT TEST1 EE&CCE DEPTS.
ANALYSIS I 60 MINUTES S.C.ELMURR

NOTE1: OPEN BOOK, OPEN NOTES, CLOSED NEIGHBOURS
NOTE2: SHOW ALL WORK IN ORDER TO RECEIVE FULL CREDIT.

1. 15 Pts. In the circuit shown in Fig.P1, find the power absorbed or delivered by the circuit elements. Is the circuit valid?

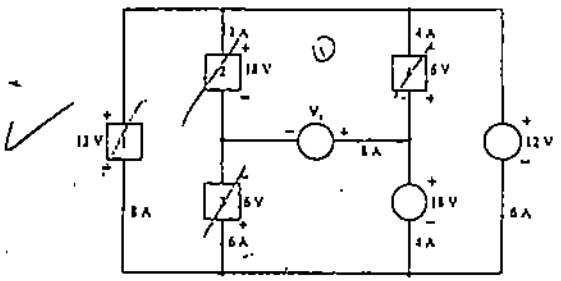


Fig.P1.

2. 15 Pts. Find the voltage gain v_o/v_s in the circuit shown in Fig.P2.

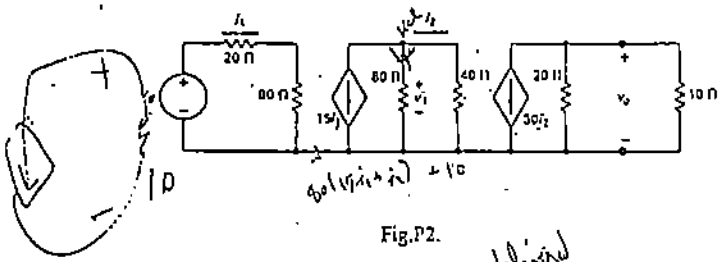


Fig.P2.

3. 20 Pts. In the network in Fig.P3, if the power generated by the 4-A source is 48W, Find V_o.

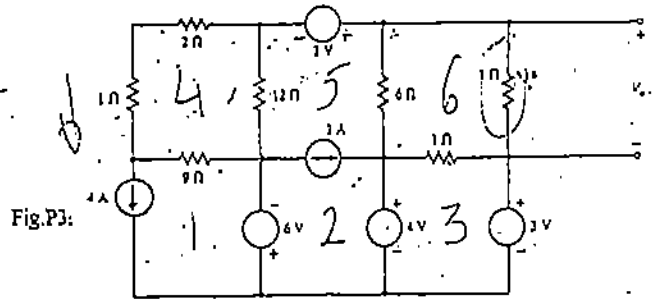


Fig.P3:

4) 15 Pts. The network in Fig.P4 is used in digital-to-analog converters. Find an expression for I_1, I_3, and I_5 in terms of I_o.

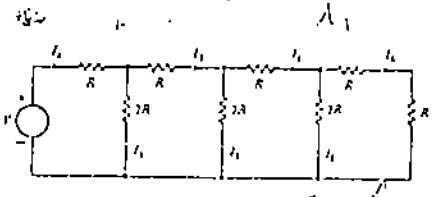


Fig.P4.

5) 15 Pts. Find V_o in the circuit shown in Fig. P5.

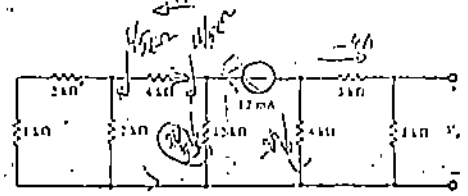


Fig.P5.

6. 20 Pts. Find the power absorbed by the 12-Ω resistor in the network shown in Fig.P6.

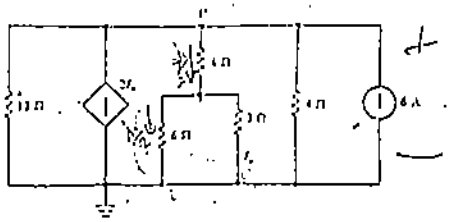


Fig.P6.

Solution Fall 2020

Test 1

$P_1 = 12(8) = 96\,w$ ABSORBED

$P_2 = 18(3) = 36\,w$ ABS

$P_3 = 6(6) = 36\,w$ ABS

$P_4 = 6(4) = 24\,w$ ABS

$P_{(12v)} = 12(-6) = -72\,w$ DEL $\Rightarrow$ 72w DEL

$P_{(15v,4A)} = 15(4) = 72\,w$ ABS

KVL $-18 - 6 + V_x = 0 \Rightarrow V_x = 24\,V$

$P = 24(-8) = -192\,w = 0.192\,w$ DEL

$\Rightarrow$ 264 ABS / 264 DEL $\Rightarrow$ Circuit is valid

2nd KVL $-V_g + 20i_1 + 80i_1 = 0$

$\Rightarrow \boxed{\frac{i_1}{V_g} = \frac{1}{100}}$

b) KCL $-15i_1 + I + i_2 = 0 \Rightarrow I = -i_2 - 15i_1$

KVL $-80I + 40i_2 = 0$

$-80(-i_2 - 15i_1) + 40i_2 = 0$

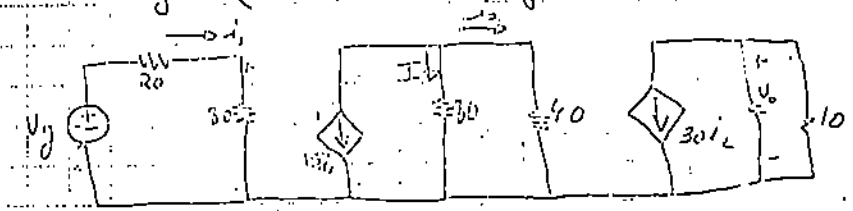
$\Rightarrow \boxed{\frac{i_2}{i_1} = -10}$

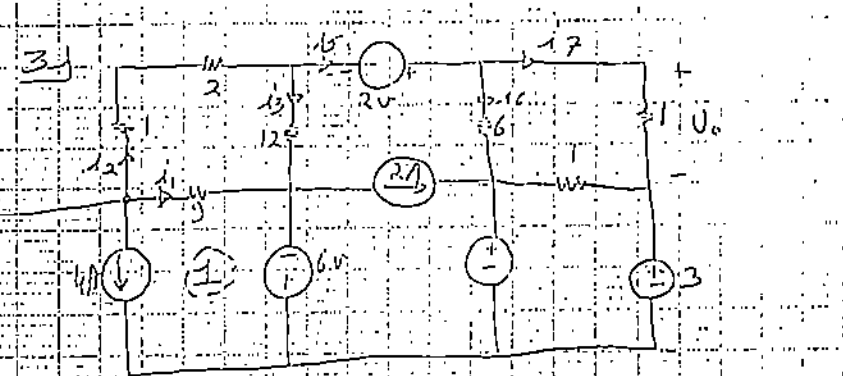
c) 20 Ω and 10 Ω are // $\Rightarrow R_{eq} = \frac{20 \times 10}{20+10} = \frac{200}{30} = \frac{20}{3}$

$V_o = Ri \Rightarrow V_o = \left(\frac{20}{3}\right)(-30i_2)$

$\Rightarrow \boxed{\frac{V_o}{i_2} = -200}$

$\frac{V_o}{V_g} = \left(\frac{V_o}{i_2}\right)\left(\frac{i_2}{i_1}\right)\left(\frac{i_1}{V_g}\right) = -200(-10)\frac{1}{100} = \boxed{20}$





generated / delivered $\Rightarrow P = -4.8\,w$

$P = Ui \Rightarrow U = \frac{P}{i} = \frac{-4.8}{4} = -1.2\,V$

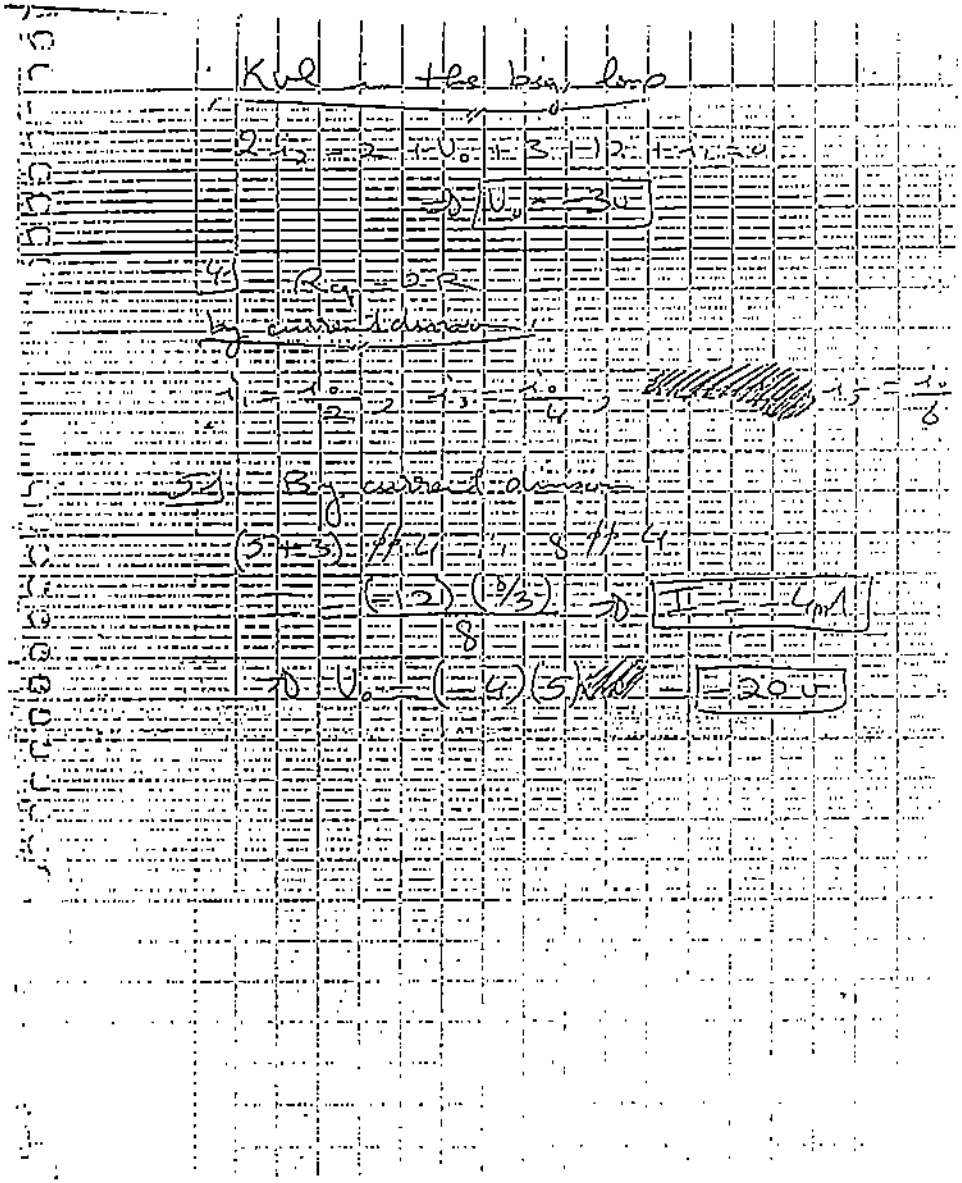
to find i_2

KVL(1) $9i_1 - 6 + 12 = 0 \Rightarrow \boxed{i_1 = -\frac{2}{3}\,A}$

KCL $i_2 - i_1 = 4$

$\Rightarrow i_2 = 4 + \frac{2}{3} \Rightarrow \boxed{i_2 = \frac{-10}{3}\,A}$

We can do 2 KVL in each loop to find the resistance of the circuit but the easiest way is



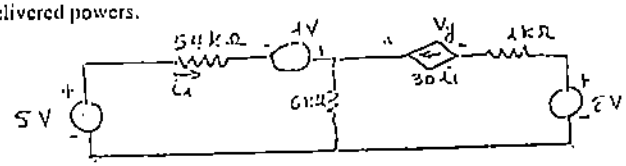
Notre Dame University
Faculty of Engineering
EE &CCE Department.

Date March 28th 01
90 Minutes

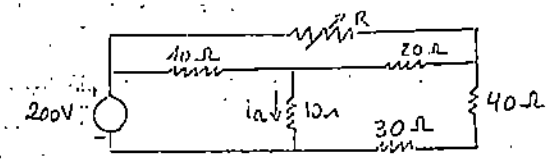
EEN 100 Circuit Analysis I- Test #1

1. 20 Pts. The voltage and current at the terminals of an element are given by:
   $v = 100\,e^{-100t}$ V, $i = 10 - 10e^{-100t}$ mA.
   a) Calculate the power received by this element at $t = 1$ ms.
   b) Calculate the total energy delivered to this element.

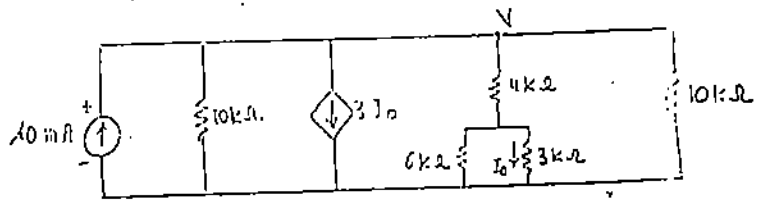
2. 20 Pts. Find the voltage v_x in the following circuit.
   Calculate the power delivered or absorbed by each element.
   Verify that the total of absorbed powers is equal to the total of delivered powers.



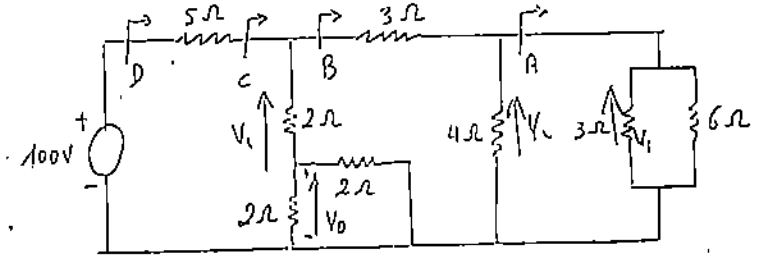
3. 20 Pts. The variable resistor R is adjusted until $i_a = 1$A. Find the value of R.



4. 20 Pts. Find the power absorbed by the 3 kΩ resistor in the following circuit.



5. 20 Pts. Find the equivalent resistance at points A, B, C, and D.
   By the voltage division method find V_0.
   By the current division method find V_0.



EEN 100	Fall 1997	Notre Dame University
Electric Circuit	Test I	EE Department
Analysis I	75 mn	S.C. Elmurr

Note1: Open Book; Open Notes, Closed neighbors.
Note2: Show all work in order to receive full credit.

1. 10 PTs. Determine the Power that is absorbed or supplied by the elements in Fig P1.

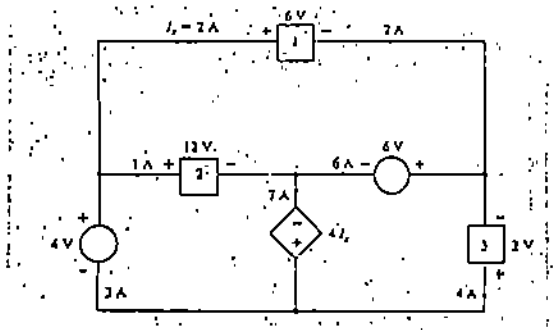


Fig P1

2. 10 Pts. Find the equivalent resistance of the network in Fig. P2.

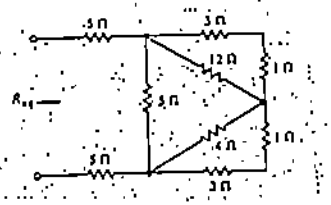


Fig P2

3. 10 Pts. Find Io in the circuit in Fig P3.

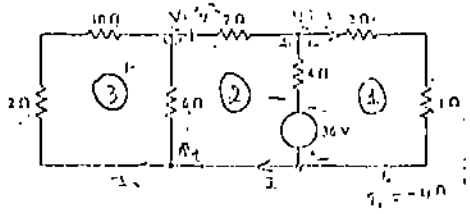


Fig P3

4. 10 Pts. Find Vo in the network in Fig. P4.

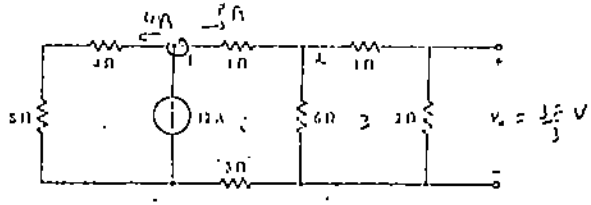


Fig P4

5. 20 Pts. In the network in Fig. P5, if the power generated by the 4-A source is 48-W, find Vo.

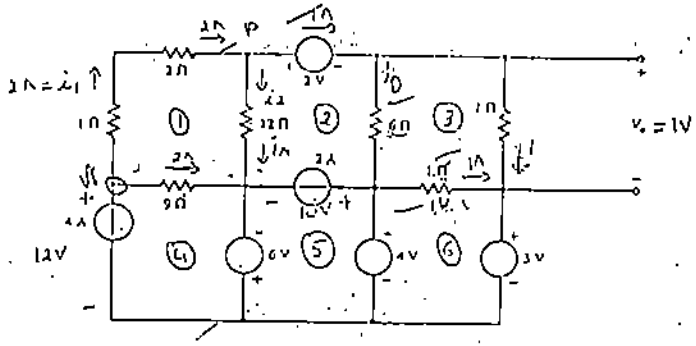


Fig P5

6. 15 Pts. Find the power absorbed by the 12-Ω resistor in the network in Fig. P6. 5.75 W

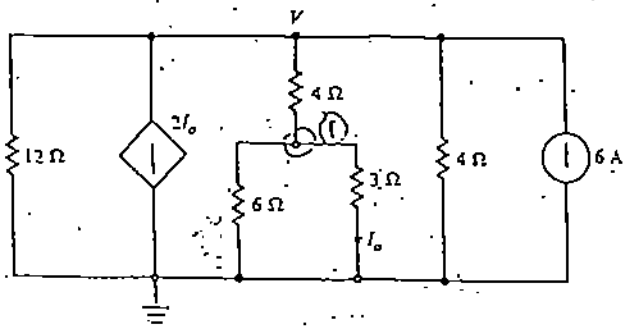


Fig P6

7. 25 Pts. Use Nodal analysis to find Io in the network in Fig. P7.

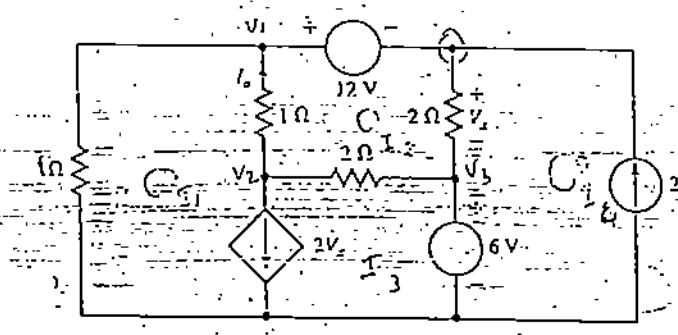


Fig P7

Solutions Fall 1997

Test 1

$P_{2\Omega} = 2(6) = 12\,w$

$P_{1\Omega} = 1(6) = 6\,w$

$P_{6\Omega} = 6(6) = 36\,w$

$P_{4\Omega} = 4(2) = 8\,w$

$P_{4w} = -3(4) = -12\,w$

$P_{6v} = -7(4 + x) = -7(8) = -56\,w$

$6.8\,w$ ABS } circuit is valid

$6.8\,w$ DEL

3) $3 + 1 = 4$

$4 \,//\, 2 = 3$

$4 \,//\, 4 = 2$

$2 + 3 = 5$

$5 \,//\, 5 = 2.5$

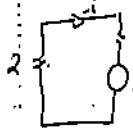
$R_{eq} = 5 + 2.5 + 5 = \boxed{12.5\,\Omega}$

3) $10 + 2 = 12\,\Omega$

$12 \,//\, 6 = 4\,\Omega$; $4 + 2 = 6\,\Omega$

$2 + 1 = 3\,\Omega$

$3 \,//\, 6 = 2\,\Omega = R_{eq}$



$U_4 = \frac{36 \times 4}{6} = 24\,v$ (voltage division)

or

$6i - 36 = 0 \Rightarrow i = 6$

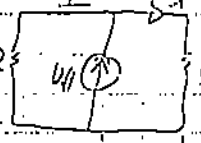
$\Rightarrow v_4 = 6(4) = 24\,v$

$36 - 24 + 3I_o = 0$

$\Rightarrow \boxed{I_o = -4A}$

4) $2 + 1 = 3\,\Omega$; $3 \,//\, 6 = 2\,\Omega$

$1 + 2 + 3 = 6$



current division

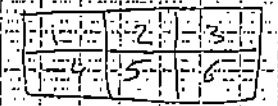
$I = 4$

$i = 8$

current division

$i = \frac{16}{3} \Rightarrow \boxed{U_o = \frac{32}{3}\,v}$

5)



KVL at 6: $4 - U_1 + 3 \Rightarrow U_1 = 6.1\,v$

$P = UI \Rightarrow U = \frac{-12}{4} = -3\,v$

KVL at 4: $-9 + 2i_{2\Omega} - 6 \Rightarrow i_{2\Omega} = 2A$

KCL at 4: $4A = 2 + i_4 \Rightarrow i_4 = 2$

KVL at 1: $-6 + P = 18 \Rightarrow i_2 = 1A$

$\Rightarrow \boxed{U_o = 1v}$

The calculations the same using as in Fall 2000

(But because of the change of the sign of the current the voltage