Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

Eeng223 Circuit Theory I

Midterm Exam
Fall 2019-20

18 November 2019
Duration: 100 minutes

Instructor: M. K. Uyguroğlu

STUDENT'S	
NUMBER	
NAME	SOLUTIONS
SURNAME	

Problem		Points
1		15
2		10
3		15
4		60
TOTAL		100

Problem 1

For the circuit shown in Fig.P1, Calculate the power absorbed or supplied by each element and using **conservation of power** determine V_s.

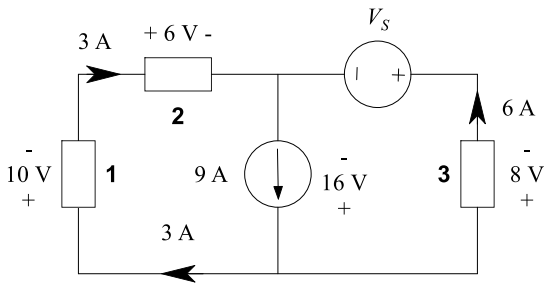


Figure P 1

$P_1 = 10 \times 3 = 30$ W absorbs

$P_2 = 6 \times 3 = 18$ W absorbs

$P_{9A} = -9 \times 16 = -144\,\text{W} \Rightarrow 144$ W Supplies

$P_{V_s} = V_s \times 6$

$P_3 = 8 \times 6 = 48$ W absorbs

$\sum P_i = 0 = 30 + 18 - 144 + 6V_s + 48$

$6V_s = 144 - 30 - 18 - 48 = 48$ W absorbs

$$\Rightarrow \boxed{V_s = \frac{48}{6} = 8 \text{ V}}$$

Problem 2

Find R_{AB} in the circuit in Fig.P2.

12Ω and 6Ω are in parallel. $\frac{12\times 6}{12+6}=4\Omega$

4Ω and 2Ω are in series 4+2=6Ω

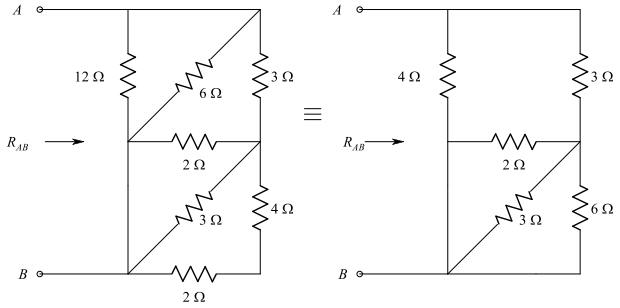
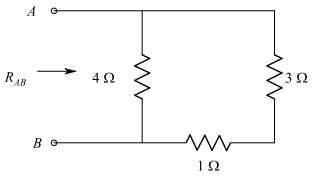


Figure P 2

6Ω, 3Ω, and 2Ω are in parallel $\frac{1}{R}=\frac{1}{2}+\frac{1}{3}+\frac{1}{6}=1\Rightarrow R=1\Omega$



$$\boxed{R_{AB}=4//(1+3)=2\Omega}$$

Problem 3

The 3-A current source in Fig. P3 is absorbing 12 W. Determine *R*.

P=VI
V=P/I=12/3=4 V

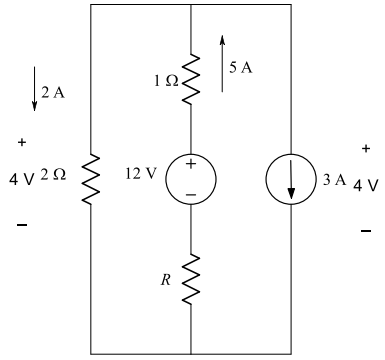


Figure P 3

KVL around the right mesh:

$$5(1+R)-12+4=0$$

$$5R=3$$

$$R=\frac{3}{5}=0.6\Omega$$

Problem 4

Find V_0 in the circuit in Fig. P4 using

a) Nodal analysis. (15 pts.)
b) Mesh analysis. (20 pts.)
c) Superposition principle. (25 pts.)

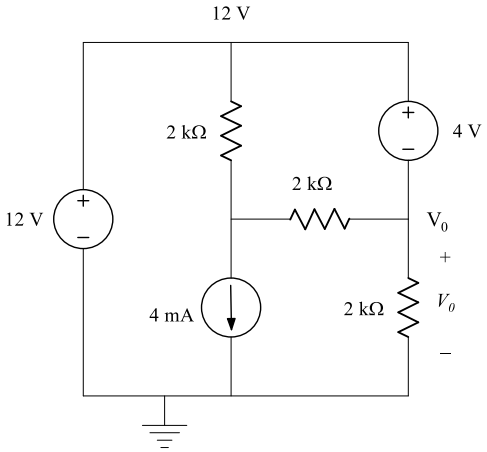
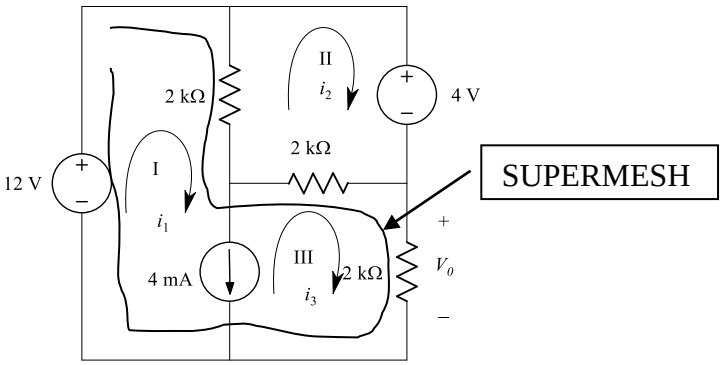


Figure P 4

$12 - V_0 = 4 \Rightarrow \boxed{V_0 = 8\ \text{V}}$

MESH ANALYSIS



$i_1 - i_3 = 4mA$

$i_1 = i_3 + 4m$

$V_0 = 2k \times i_3$

KVL around mesh II:

$2k(i_2 - i_3 - 4m) + 4 + 2k(i_2 - i_3) = 0$

$4ki_2 - 4ki_3 = 4 ...(1)$

KVL around the supermesh:

$-12 + 2k(4m + i_3 - i_2) + 2k(i_3 - i_2) + 2ki_3 = 0$

$-4ki_2 + 6ki_3 = 4 ....(2)$

Addition of Eqns. (1) and (2) gives:

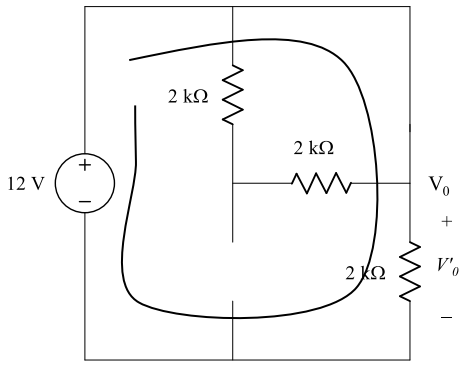
$2ki_3 = 8$

$i_3 = 4mA$

$\therefore V_0 = 8V$

SUPERPOSITION:

12 V is active

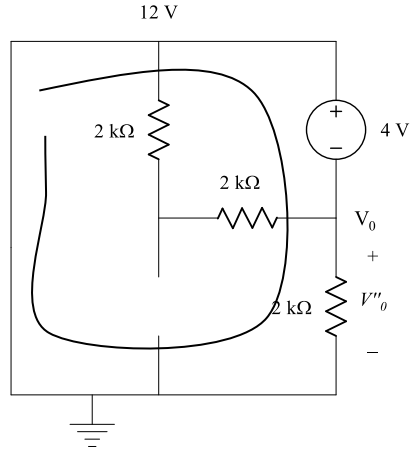


KVL around the loop gives:

$-12+V_0'=0$

$V_0'=12\ \text{V}$

4 V is active

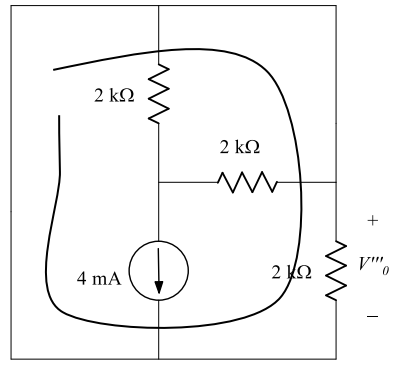


KVL around the loop gives:

$-V_0''-4=0$

$V_0''=-4\text{V}$

4mA is active:



KVL around the loop gives:

$V_0'''=0$

$\therefore V_0=V_0'+V_0''+V_0'''=8-4+0=8V$