Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

EEE 223 Circuit Theory I

Instructors:

M. K. Uyguroğlu (Gr: 01)
E. Erdil (Gr: 02)

Midterm EXAMINATION

April 12, 2005

Duration : 90 minutes

Number of Problems: 4

Good Luck

STUDENT'S	
NUMBER	
NAME	
SURNAME	
GROUP NO	

Problem		**Points**
1		25
2		25
3		25
4		25
TOTAL		100

1. In the circuit in Fig.P1, find the equivalent resistance R_{ab} and the power delivered by the source.

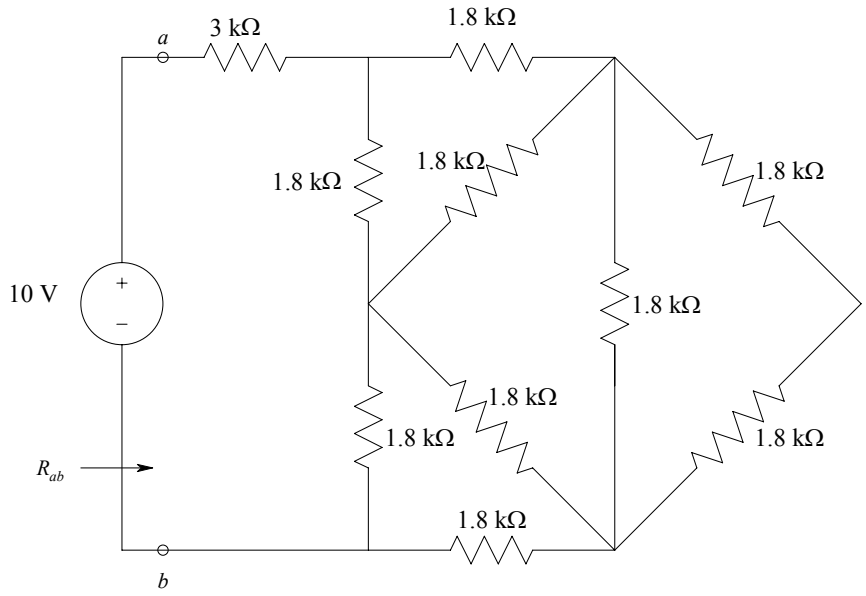
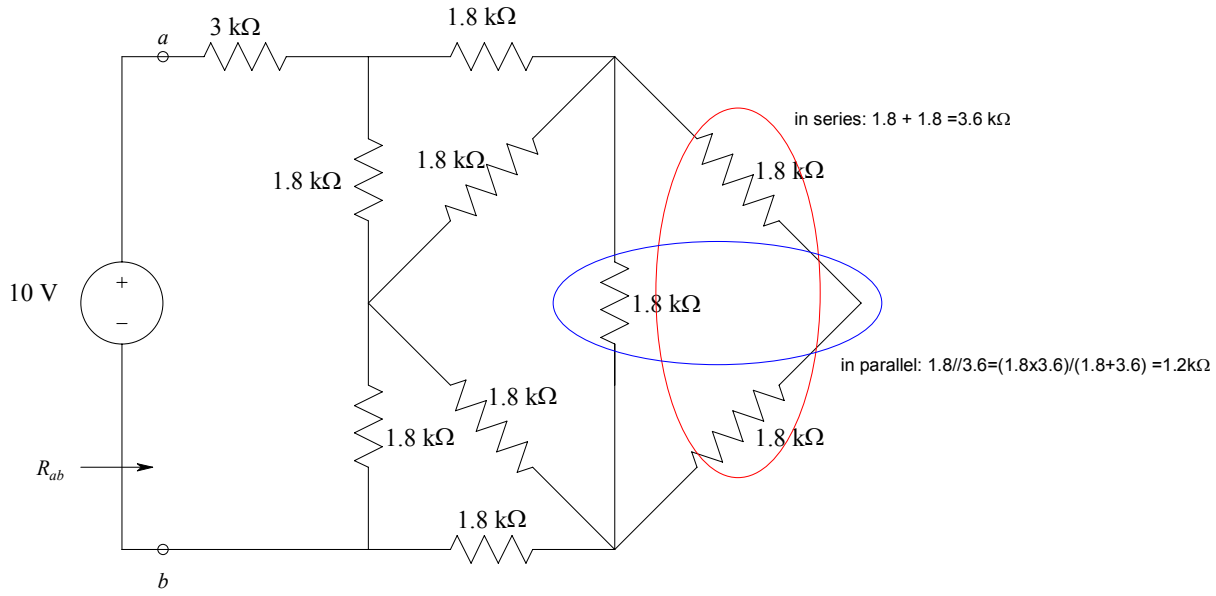
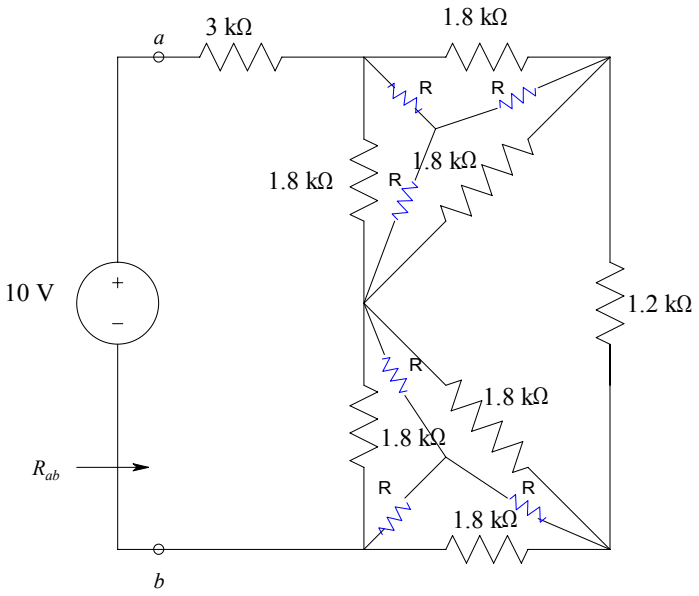
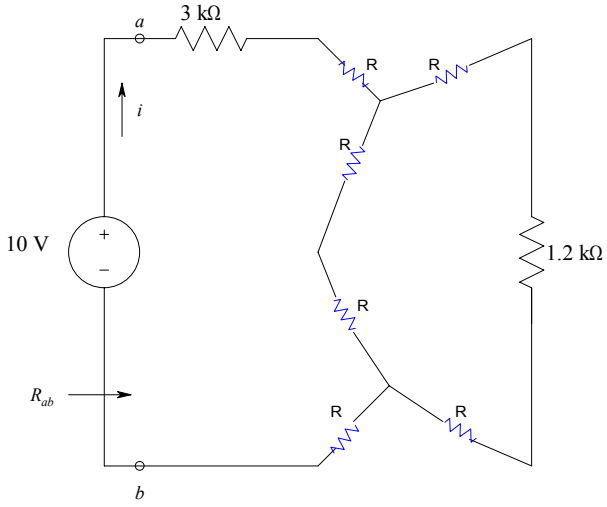


Figure P1





$$R = \frac{1.8 \times 1.8}{1.8 + 1.8 + 1.8} = 0.6k\Omega$$



$$R_{ab} = 3k + 0.6k + \underbrace{\left(0.6k + 0.6k\right) // \left(0.6k + 1.2k + 0.6k\right)}_{0.8k} + 0.6k$$

$$R_{ab} = 3k + 0.6k + 0.8k + 0.6k$$

$$R_{ab} = 5k$$

$$i = \frac{10}{5k} = 2mA$$

$$P_{10V} = 10 \times 2m = 20mW$$

2. Use the nodal analysis to find how much power the 10 mA current source delivers to the circuit in Fig. P2.

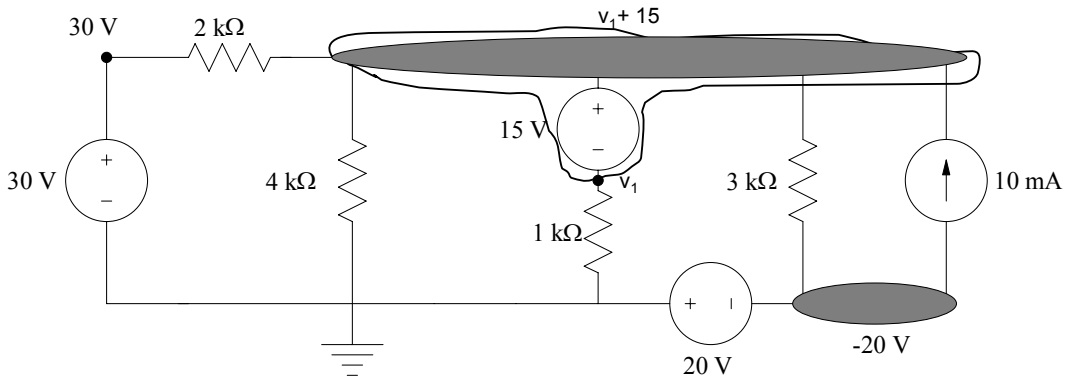


Figure P2

KCL at the supernode:

$$\frac{1}{1k}v_1+\left(\frac{1}{2k}+\frac{1}{3k}+\frac{1}{4k}\right)(v_1+15)-\frac{1}{2k}30-\frac{1}{3k}(-20)=10m$$

multiply both sides by $12k$

$$(12+6+4+3)v_1=120+180-80-195$$

$$25v_1=25$$

$$v_1=1V$$

$$p_{10mA}=10m\times((1+15)-(-20))=360mW$$

3. Use mesh analysis to find in the circuit in Fig. P3.

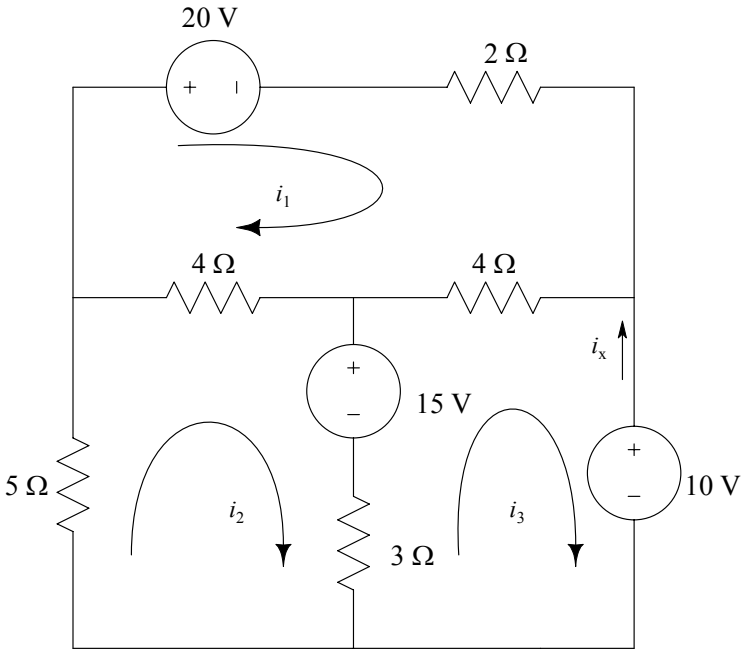


Figure P3

$i_x = -i_3$

KVL around i_1 :

$10i_1 - 4i_2 - 4i_3 = -20$.....(1)

KVL around i_2 :

$-4i_1 + 12i_2 - 3i_3 = -15$.....(2)

KVL around i_3 :

$-4i_1 - 3i_2 + 7i_3 = 5 \Rightarrow i_1 = -\frac{3}{4}i_2 + \frac{7}{4}i_3 - \frac{5}{4}$.....(3)

Subst. Eq.(3) into (1) gives:

$10\left(-\frac{3}{4}i_2 + \frac{7}{4}i_3 - \frac{5}{4}\right) - 4i_2 - 4i_3 = -20$

multiply both sides by 4 yields:

$-46i_2 + 54i_3 = -30$.....(4)

Subst. Eq.(3) into (2)

$-4\left(-\frac{3}{4}i_2 + \frac{7}{4}i_3 - \frac{5}{4}\right) + 12i_2 - 3i_3 = -15$

multiply both sides by 4 yields:

$60i_2 - 40i_3 = -80 \Rightarrow i_2 = -\frac{8}{6} + \frac{4}{6}i_3$.....(5)

Subst. Eq.(5) into (4) gives:

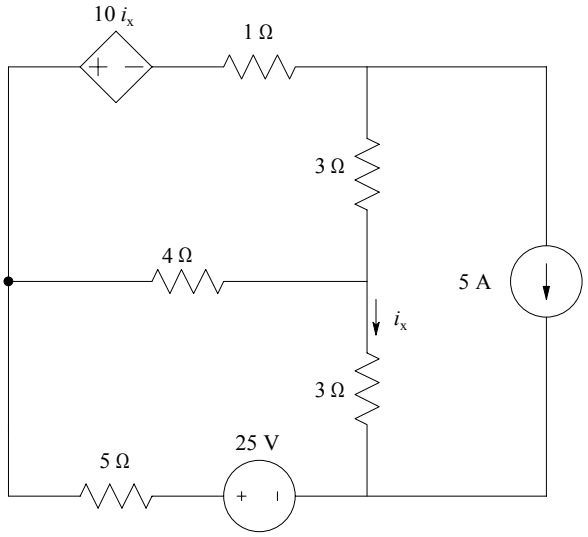
$-46\left(-\frac{8}{6} + \frac{4}{6}i_3\right) + 54i_3 = -30$

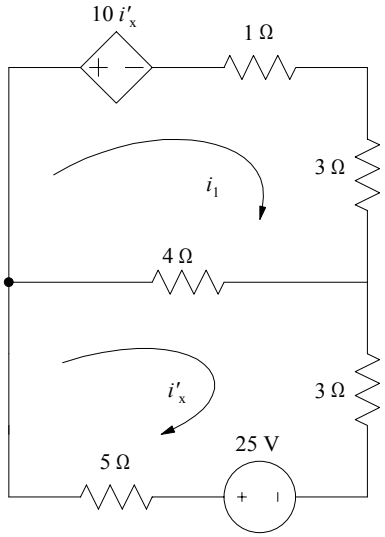
$\left(\frac{324 - 184}{6}\right)i_3 = -91.333$

$i_3 = -91/333 \times \frac{6}{140} = -3.9143$ A

$i_x = -i_3 = 3.9143A$

4. Use superposition method to calculate i_x in the circuit in Fig. P4.





KVL around i_1:

$$8i_1 - 4i'_x = -10i'_x$$

$$8i_1 = -6i'_x \Rightarrow i_1 = -\frac{6}{8}i'_x \text{.....(1)}$$

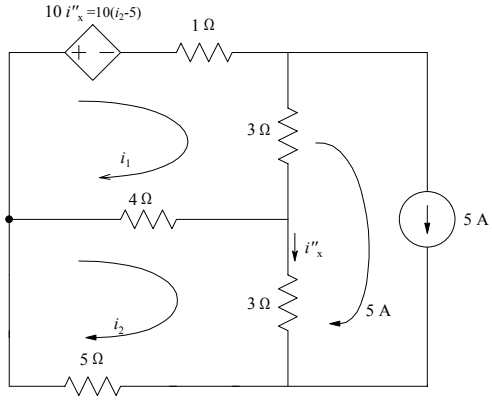
KVL around i'_x:

$$-4i_1 + 12i'_x = 25\text{.....(2)}$$

Subst. Eq.(1) into (2) yields:

$$-4\left(-\frac{6}{8}i'_x\right) + 12i'_x = 25$$

$$i'_x = \frac{25}{15} = \frac{5}{3}A$$



KVL around i_1:

$$8i_1 - 4i_2 - 3(5) = -10i'' = -10(i_2 - 5)$$

$$8i_1 = -6i_2 + 65 \Rightarrow i_1 = -\frac{6}{8}i_2 + \frac{65}{8}\text{.....(1)}$$

KVL around i_2 :

$-4i_1 + 12i_2 - 3(5) = 0$.....(2)

Subst. Eq.(1) into (2) yields:

$$-4\left(-\frac{6}{8}i_2 + \frac{65}{8}\right) + 12i_2 = 15$$

$$i_2 = \frac{15 + 32.5}{15} = \frac{47.5}{15}$$

$$i_x'' = i_2 - 5 = \frac{47.5}{15} - \frac{75}{15} = -\frac{27.5}{15}$$

$$i_x = i_x' + i_x'' = \frac{5}{3} - \frac{27.5}{15} = -\frac{2.5}{15} = -0.166A$$