Eastern Mediterranean University

"For Your International Career"

Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

EENG223 – Circuit Theory I

Midterm Exam
Spring 2016-17

18 April 2017
Duration: 100 minutes

Instructor: M. K. Uyguroğlu

STUDENT'S	
NUMBER	
NAME	
SURNAME	SOLUTIONS
GROUP NO.	

Problem		**Points**
1		25
2		30
3		20
4		25
TOTAL		100

Problem 1

The current through and voltage across an element is shown in Figure P1. Sketch the power delivered to the element for $t > 0$.
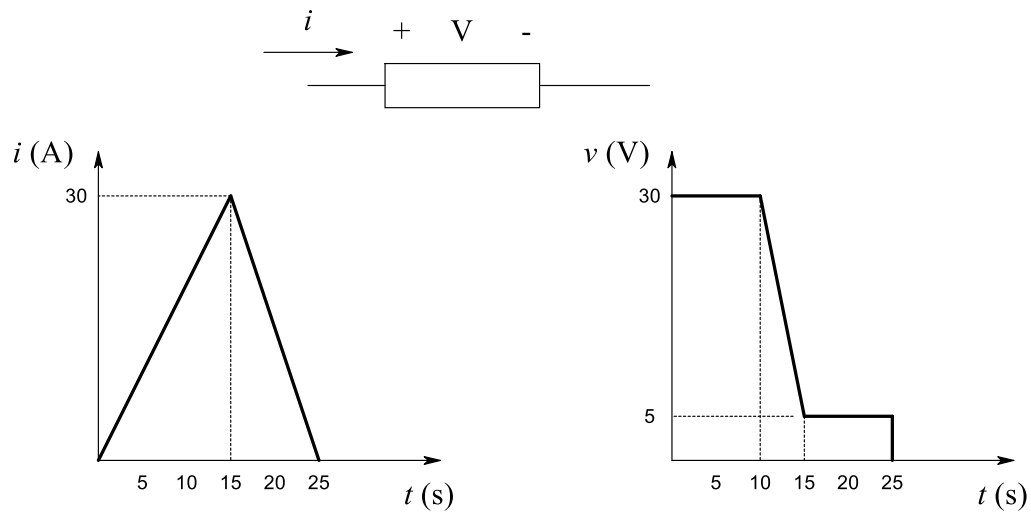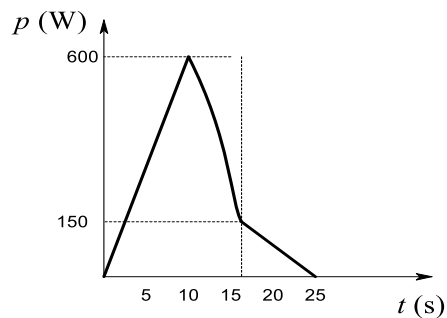

Figure P1

$$i(t) = \begin{cases} 2t & 0 < t < 15s \\ -3t + 75 & 15s < t < 25s \end{cases}$$

$$v(t) = \begin{cases} 30V & 0 < t < 10s \\ -5t + 80 & 10s < t < 15s \\ 5V & 15s < t < 25s \end{cases}$$

$$p(t) = i(t)v(t) = \begin{cases} 60t & 0 < t < 10s \\ -10t^2 + 160t & 10s < t < 15s \\ -15t + 375 & 15s < t < 25s \end{cases}$$

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Problem 2

Find V_0 and the power supplied by 8 V voltage source in the circuit of Fig. P2.
   a) Using Nodal Analysis.
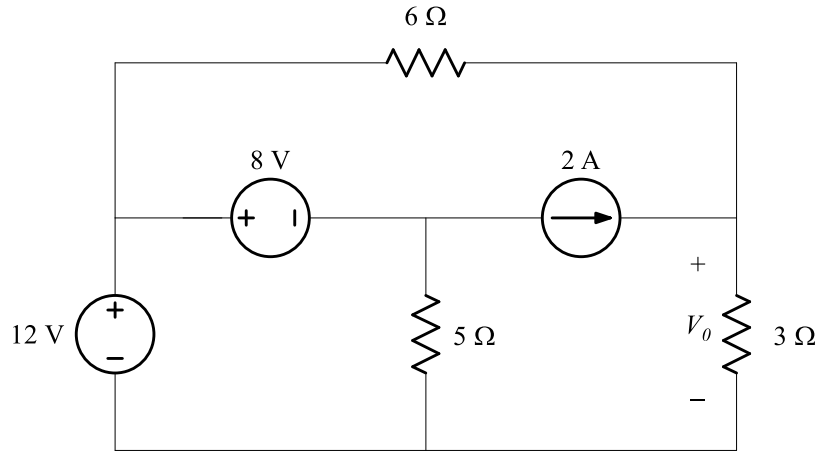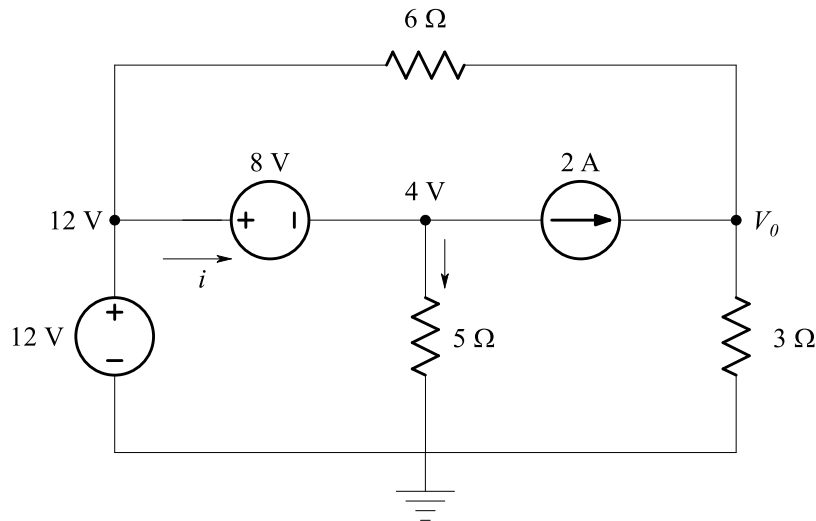   b) Using Mesh Analysis.

Figure P2

a) Nodal Analysis

KCL at V_0:

$$\frac{V_0}{3} + \frac{V_0 - 12}{6} = 2$$

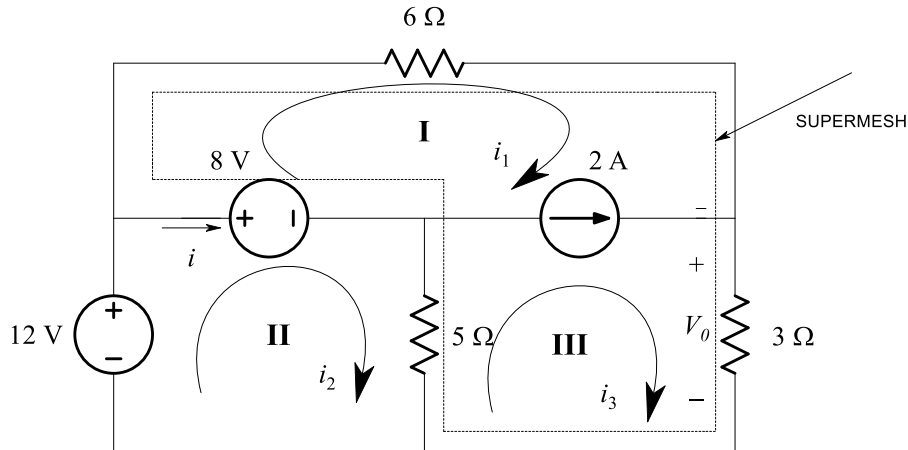Multiply both sides by 6 yields:

$$2V_0 + V_0 = 12 + 12 = 24$$

$$\boxed{V_0 = 8\,\text{V}}$$

Power supplied by 8V Voltage source:

$$p = 8i = 8\left(\frac{4}{5}+2\right) = \frac{32}{5}+16 = \frac{112}{5} = 22.4 \text{ W absorbes}$$

b) Mesh Analysis

There is a current source between mesh I and mesh III. These two meshes constitutes a SUPERMESH.

$$i_3 - i_1 = 2 \Rightarrow i_3 = 2 + i_1$$

KVL around the SUPERMESH:

$$6i_1 + 3(2+i_1) + 5(2+i_1-i_2) = 8$$

$$14i_1 - 5i_2 = -8 \dots\dots (1)$$

KVL around mesh II:

$$-12 + 8 + 5(i_2 - 2 - i_1) = 0$$

$$-5i_1 + 5i_2 = 14 \dots (2)$$

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

$$9i_1 = 6$$

$$i_1 = \frac{2}{3}A \qquad 5i_2 = 14 + 5\times\frac{2}{3} = \frac{52}{3} \Rightarrow \boxed{i_2 = \frac{52}{15}A}$$

$$i_3 = 2 + \frac{2}{3} = \frac{8}{3}A$$

$$V_0 = \frac{8}{3}\times 3 = 8 \text{ V}$$

Power supplied by 8V Voltage source:

$$p = 8i = 8(i_2 - i_1) = 8\left(\frac{52}{15}-\frac{2}{3}\right) = 8\left(\frac{42}{15}\right) = 8\left(\frac{14}{5}\right) = \frac{112}{5} = 22.4 \text{ W absorbes}$$

Problem 3

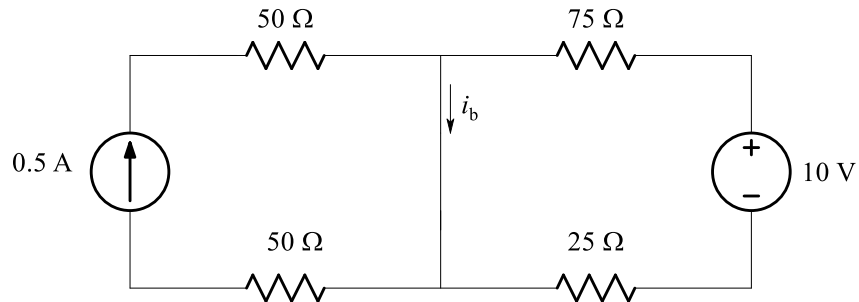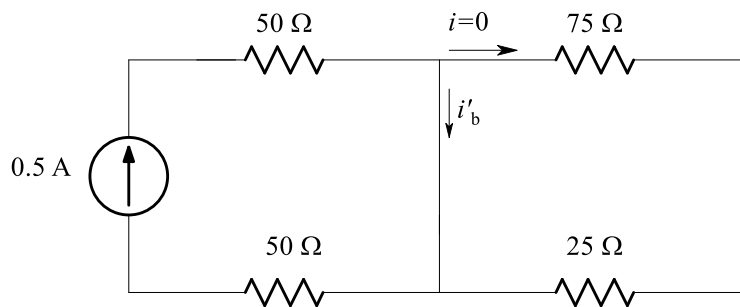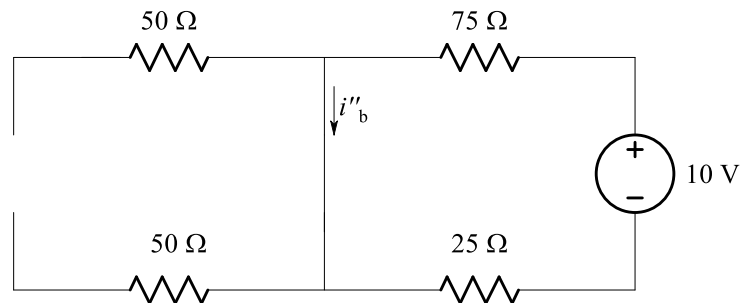Find i_b for the circuit shown in Fig. P3 using the superposition principle.

0.5 A Current source is active, 10 V voltage source is diactive.

Since $i = 0$, then $i'_b = 0.5\text{A}$

10 V voltage source is active and 0.5 A Current source is .

$$i''_b = \frac{10}{(25+75)} = 0.1\text{A}$$

$$\boxed{i_b = i'_b + i''_b = 0.5 + 0.1 = 0.6 \text{ A}}$$

Problem 4

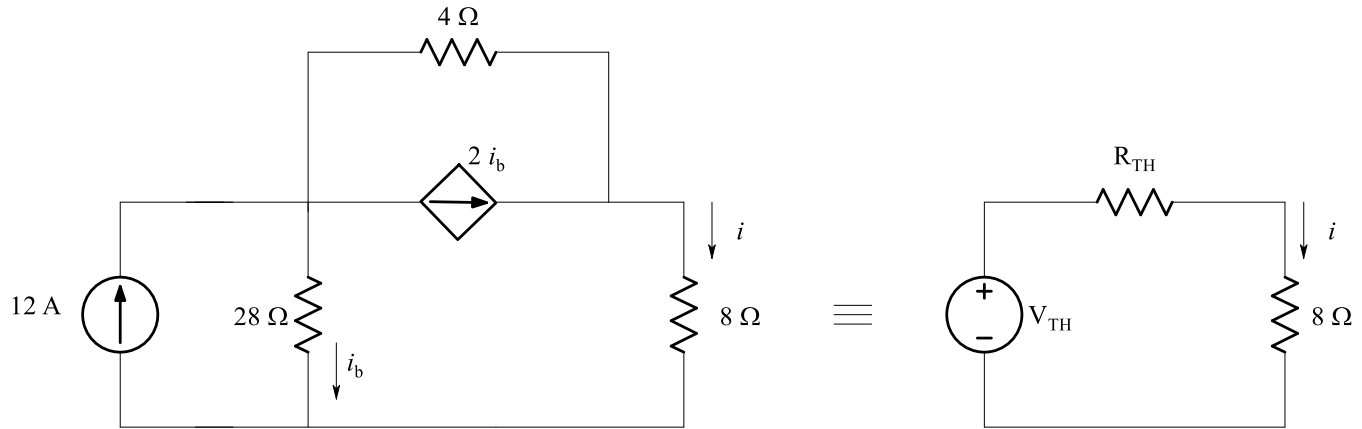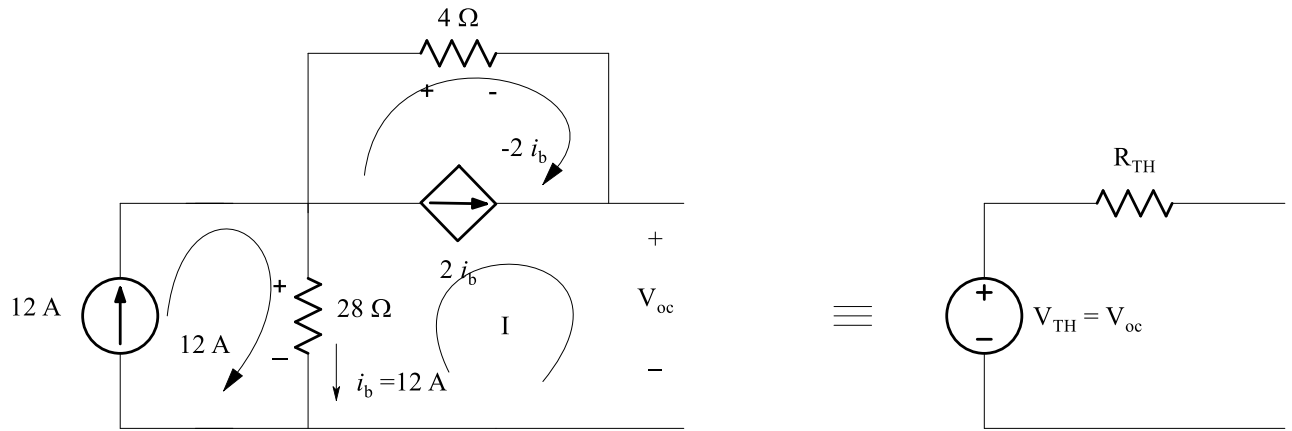Use Thevenin's theorem to find i in the circuit shown in Fig. P4.
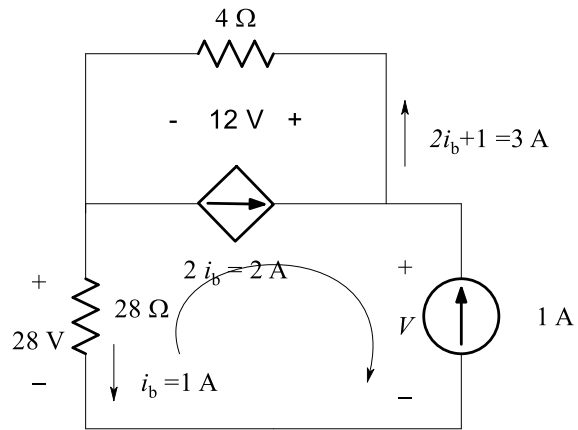
Figure P4

KVL around I

$$-28 \times 12 + 4\left(-2\left(12\right)\right) + V_{oc} = 0$$

$$\boxed{V_{oc} = 432 \text{ V} = V_{TH}}$$

In order to determine R_{TH}, set all independent source values to zero and connect a 1 A current source as a test source.

KVL around the loop:

$-28 - 12 + V = 0$

$V = 40$ V

$R_{TH} = \dfrac{V}{1} = 40\,\Omega$

$$\boxed{\,i = \dfrac{V_{TH}}{R_{TH} + 8} = \dfrac{432}{40 + 8} = 9 \text{ A}\,}$$