



Eastern Mediterranean University

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Faculty of Engineering

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

INFE221 – Electrical Circuits

**Midterm Exam
Spring 2016-17**

18 April 2017

Duration: 100 minutes

Instructor: M. K. Uyguroğlu

STUDENT'S	
NUMBER	
NAME	SOLUTIONS
SURNAME	
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 $t > 0$.

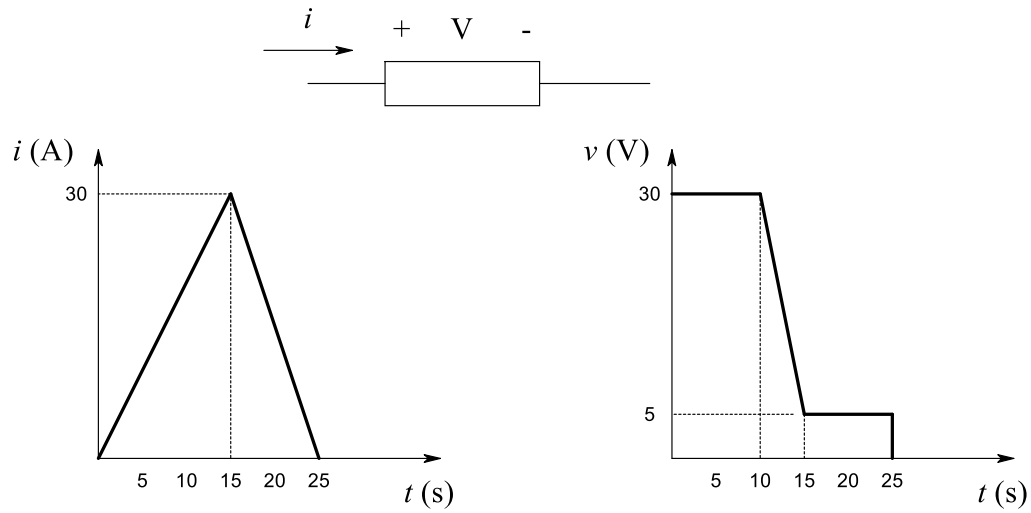
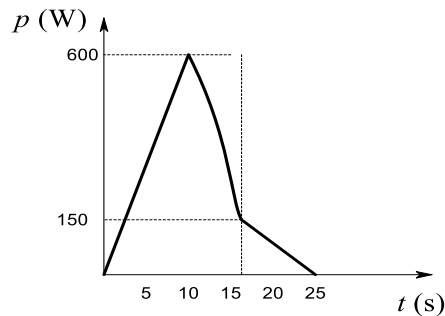


Figure P1

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

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

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



Problem 2

Find V_0 and the power supplied by 8 V voltage source in the circuit of Fig. P2.

- Using Nodal Analysis.
- Using Mesh Analysis.

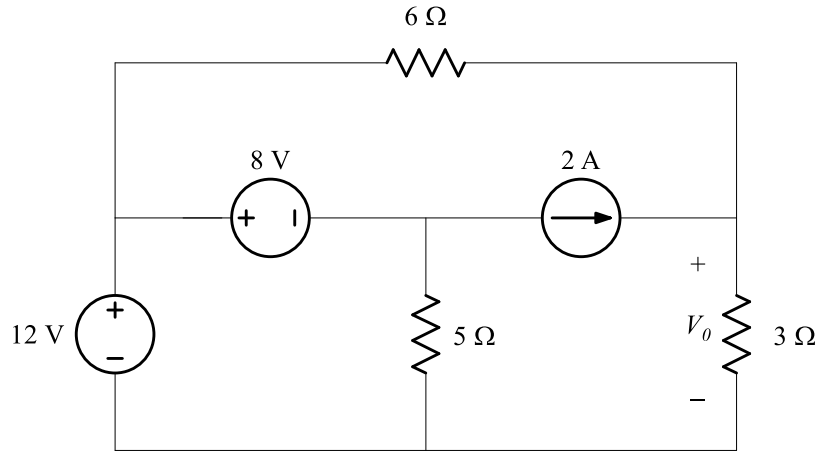
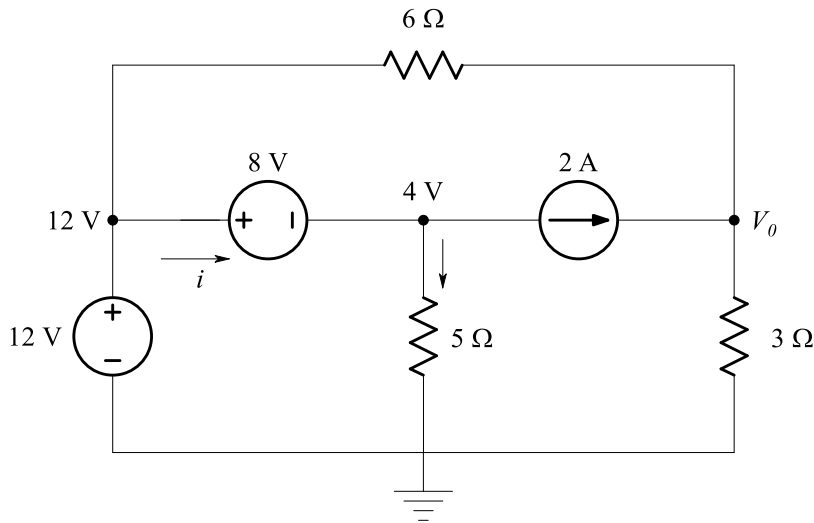


Figure P2

a) Nodal Analysis



KCL at V_0 :

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

Multiply both sides by 6 yields:

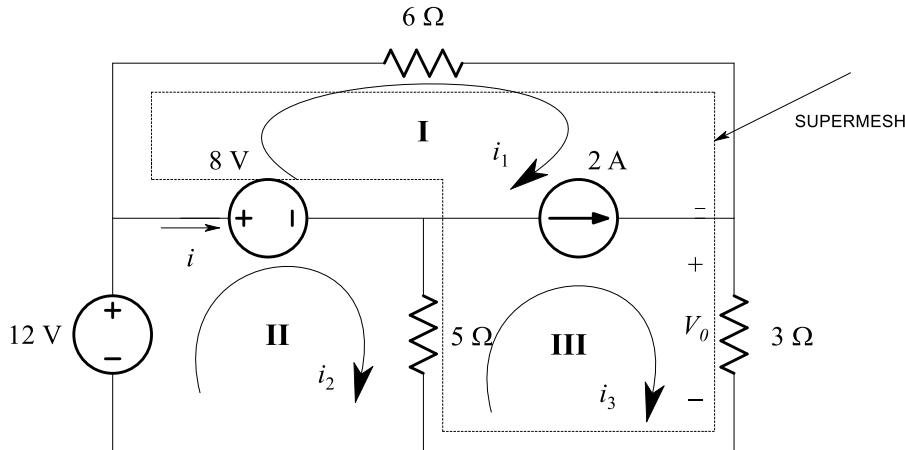
$$2V_0 + V_0 = 12 + 12 = 24$$

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

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:

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

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

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

$$9i_1 = 6$$

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

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

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

Power supplied by 8V Voltage source:

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

Problem 3

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

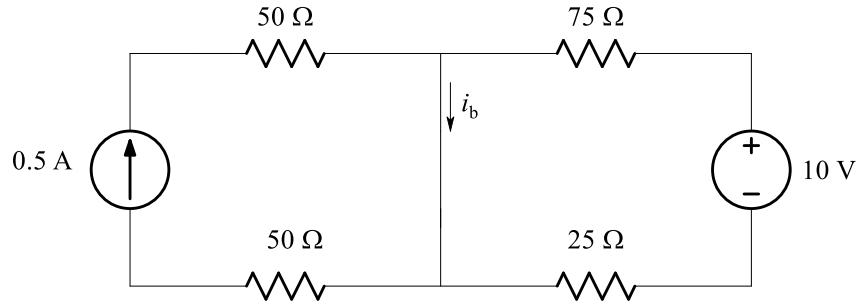
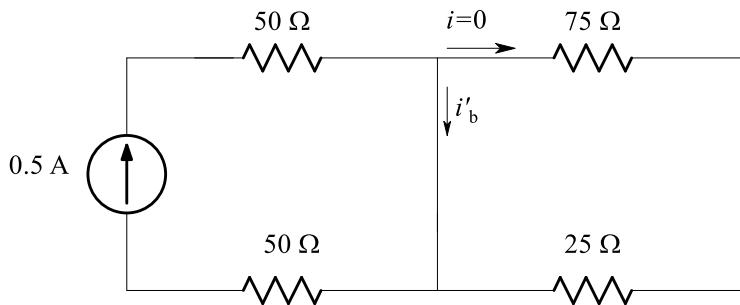


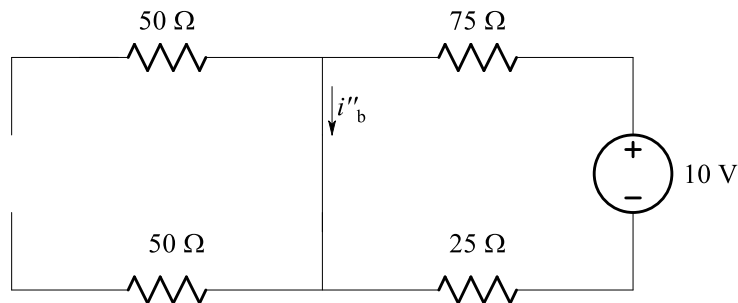
Figure P3

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



Since $i = 0$, then $i'_b = 0.5A$

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



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

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

Problem 4

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

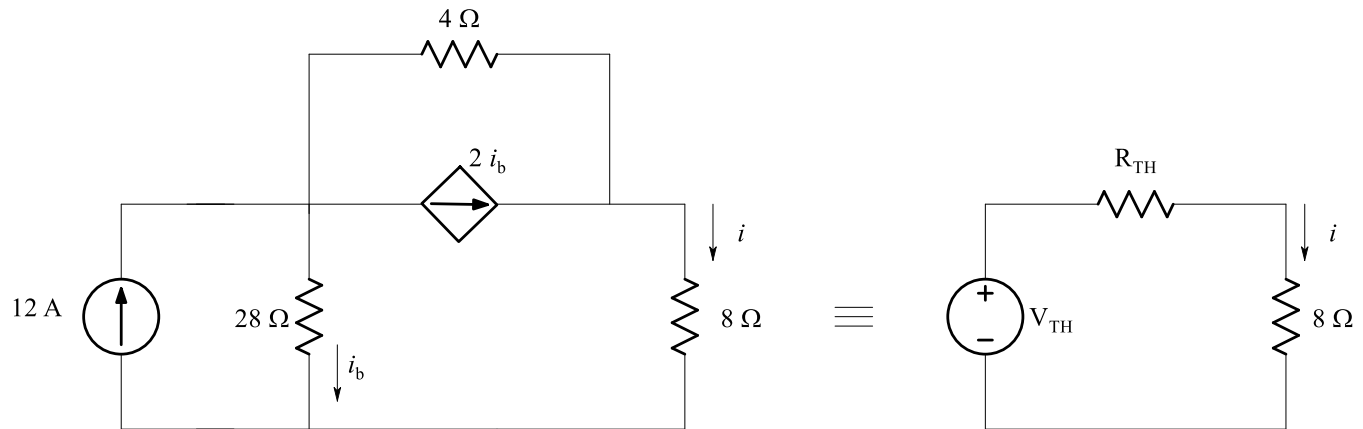
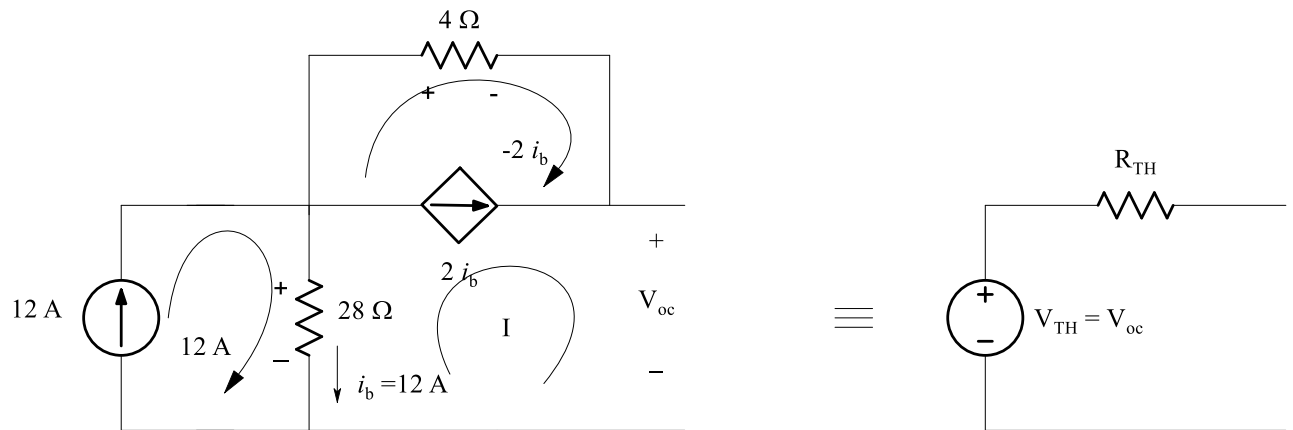


Figure P4



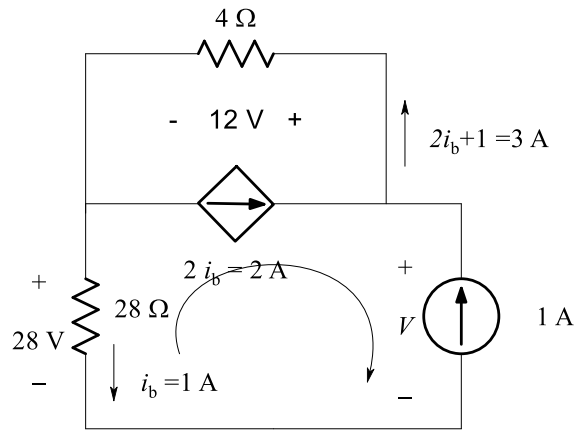
KVL around I

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

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

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

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KVL around the loop:

$$-28 - 12 + V = 0$$

$$V = 40\ \text{V}$$

$$R_{TH} = \frac{V}{1} = 40\ \Omega$$

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