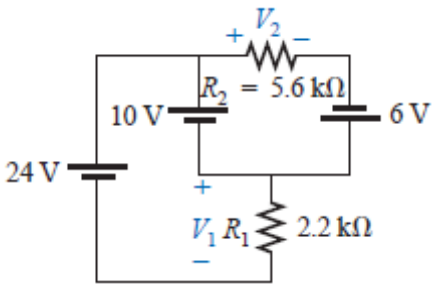
Kafrelsheikh University
Faculty of Engineering
Electrical Engineering Dept.

Academic Number:

Date: 24/12/2017
Time allowed: 90 minutes
Year: 1st. Year
Subject Name: Electric Circuits
Final Exam
Pages : 2

Question No. 1 [15 Marks]

A-) Determine the unknown voltages using Kirchhoff's voltage law. **[6 Marks]**

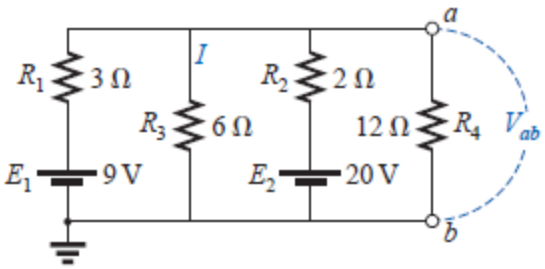


$$\text{KVL: } 24\text{ V} - 10\text{ V} - V_1 = 0$$
$$V_1 = \mathbf{14\text{ V}}$$
$$10\text{ V} - V_2 + 6\text{ V} = 0$$
$$V_2 = 10\text{ V} + 6\text{ V} = \mathbf{16\text{ V}}$$

B-) Find the voltage V_{ab} and the polarity of points *(a)* and (*b)* in the following circuit. **[6 Marks]**

$$I_T\downarrow = 10\text{ A} - 3\text{A} = 7\text{A},\ R_T = 3\ \Omega \parallel 6\ \Omega \parallel 2\Omega \parallel 12\ \Omega$$
$$= 2\ \Omega \parallel 2\ \Omega \parallel 12\ \Omega$$
$$= 1\ \Omega \parallel 12\ \Omega$$
$$= 0.9231\ \Omega$$
$$V_{\underset{+-}{ab}} = -I_T R_T = -(7\text{ A})(0.9231\ \Omega) = \mathbf{-6.462\text{ V}}$$

C-) Find the magnitude and direction of the current I in the 6Ω resistor. **[3 Marks]**



$$I\uparrow = \frac{6.462\text{ V}}{6\ \Omega} = \mathbf{1.077\text{ A}}$$

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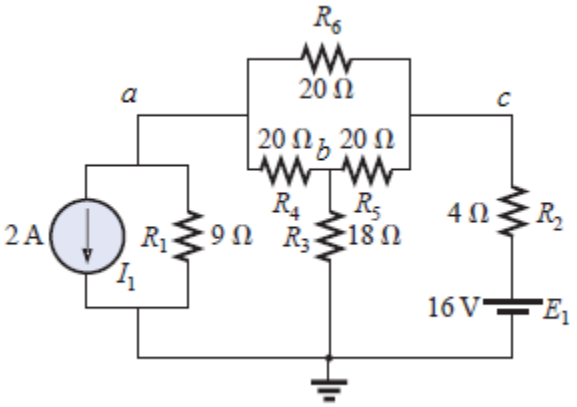
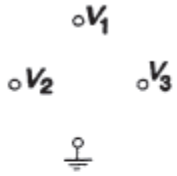
Question No. 2 [20 Marks]

A-) Write the nodal equations and solve for the nodal voltages (a, b, c) of the following circuit: **[7 Marks]**





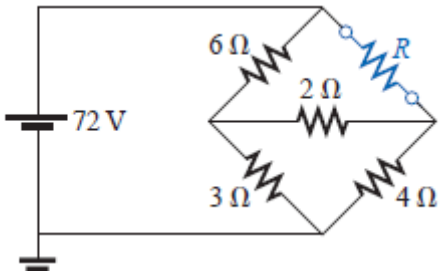
$$V_1\left[\frac{1}{3}+\frac{1}{6}+\frac{1}{6}\right]-\frac{1}{6}V_2-\frac{1}{6}V_3=5$$

$$V_2\left[\frac{1}{6}+\frac{1}{4}+\frac{1}{5}\right]-\frac{1}{6}V_1-\frac{1}{5}V_3=-3$$

$$V_3\left[\frac{1}{6}+\frac{1}{5}+\frac{1}{7}\right]-\frac{1}{5}V_2-\frac{1}{6}V_1=0$$

$$V_1 = 7.238\ \text{V},\ V_2 = -2.453\ \text{V},\ V_3 = 1.405\ \text{V}$$

B-) Find the Thévenin equivalent circuit for the network external to the resistor *R* in the following Circuit: **[7 Marks]**



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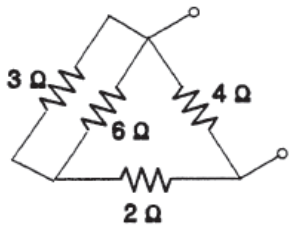
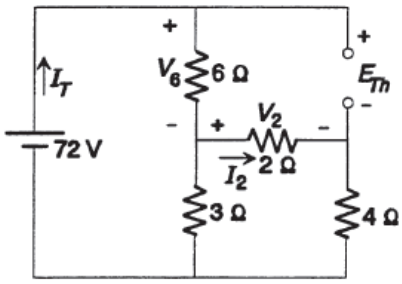
R_{Th}:



$$R_{Th} = 4\ \Omega \| (2\ \Omega + 6\ \Omega \| 3\ \Omega) = 2\ \Omega$$

E_{Th}:



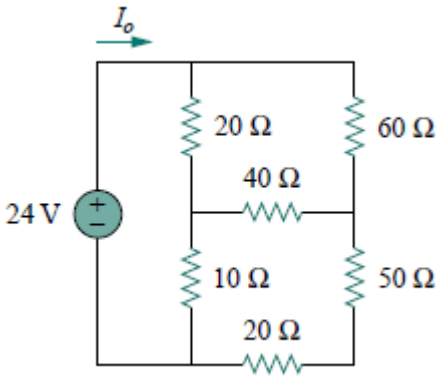
$$I_T = \frac{72\ \text{V}}{6\ \Omega + 3\ \Omega \| (2\ \Omega + 4\ \Omega)} = 9\ \text{A}$$

$$I_2 = \frac{3\ \Omega (I_T)}{3\ \Omega + 6\ \Omega} = \frac{3\ \Omega (9\ \text{A})}{9\ \Omega} = 3\ \text{A}$$

$$E_{Th} = V_6 + V_2 = (I_T)(6\ \Omega) + I_2(2\ \Omega)$$
$$= (9\text{A})(6\ \Omega) + (3\ \text{A})(2\ \Omega) = 60\ \text{V}$$

C-) Calculate I_o in the circuit of the following Fig.: **[6 Marks]**

By using Δ-Y transformation,



Io= 0.9974 A

Question No. 3 [10 Marks]

Determine the voltages at the nodes 1, 2, 3 in the following circuit: **[7 Marks]**

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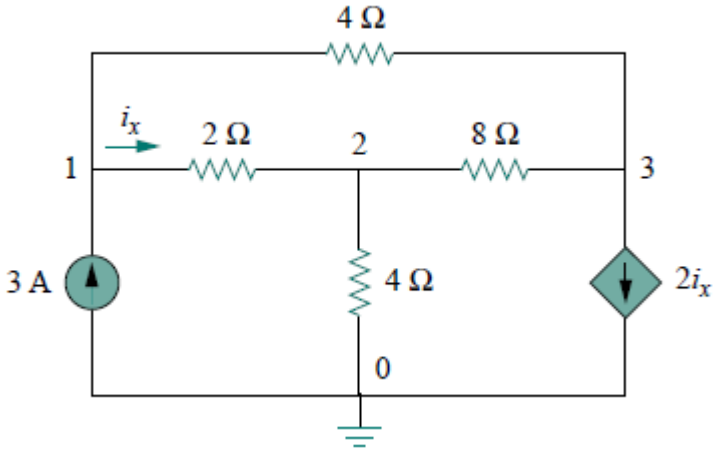

At node 1,

$$3 = i_1 + i_x \quad \Longrightarrow \quad 3 = \frac{v_1 - v_3}{4} + \frac{v_1 - v_2}{2}$$

Multiplying by 4 and rearranging terms, we get

$$3v_1 - 2v_2 - v_3 = 12 \qquad (1)$$

At node 2,

$$i_x = i_2 + i_3 \quad \Longrightarrow \quad \frac{v_1 - v_2}{2} = \frac{v_2 - v_3}{8} + \frac{v_2 - 0}{4}$$

Multiplying by 8 and rearranging terms, we get

$$-4v_1 + 7v_2 - v_3 = 0 \qquad (2)$$

At node 3,

$$i_1 + i_2 = 2i_x \quad \Longrightarrow \quad \frac{v_1 - v_3}{4} + \frac{v_2 - v_3}{8} = \frac{2(v_1 - v_2)}{2}$$

Multiplying by 8, rearranging terms, and dividing by 3, we get

$$2v_1 - 3v_2 + v_3 = 0 \qquad (3)$$

From 1, 2, and 3:

$$v_1 = 4.8 \text{ V}, \qquad v_2 = 2.4 \text{ V}, \qquad v_3 = -2.4 \text{ V}$$