Benha University
Benha Faculty of Engineering
Date:20 Dec 2017
Semester:1st
Examiner:Abdelhady Mahmoud
Total Points: 60

Department:Civil
Program: Undergraduate
Time: 3 hours
Subject:Electrical Eng. Tech.
Code: E1105
No. of Pages: 2

Answer All Questions

Question (1): [10 marks]

a)For given circuit in Fig.Q1 a, Find the equivalent resistor at ab terminal**(5 Marks)**

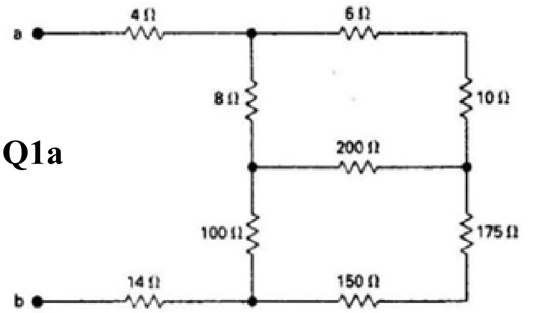


Fig. Q1a

b) Use a Δ-to-Y transformation to find the voltages v1 and v2 in the circuit in Fig.Q1b **(5 Marks)**

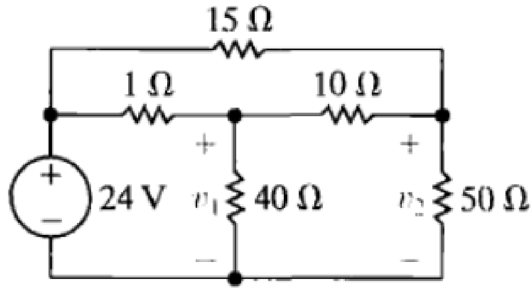


Fig.Q1 b

Question (2): [8 Marks]

Use the node-voltage method to find V_o in the circuit in Fig.Q2.**(8 Marks)**

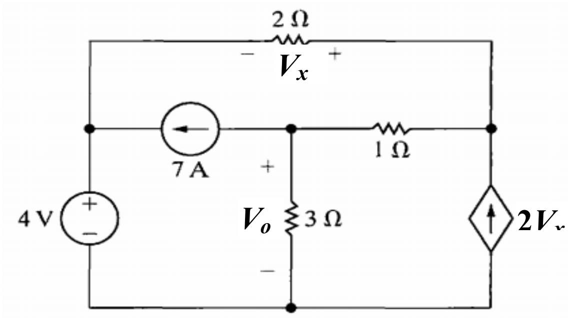


Fig. Q2

Question (3): [12 Marks]

Use the mesh-current method to find :

a) the branch currents i1, i2, and i3 in the circuit in Fig. Q3. **(6 Marks)**

b) Check your solution for i1, i2, and i3 by showing that the power dissipated in the circuit equals the power developed.**(6 Marks)**

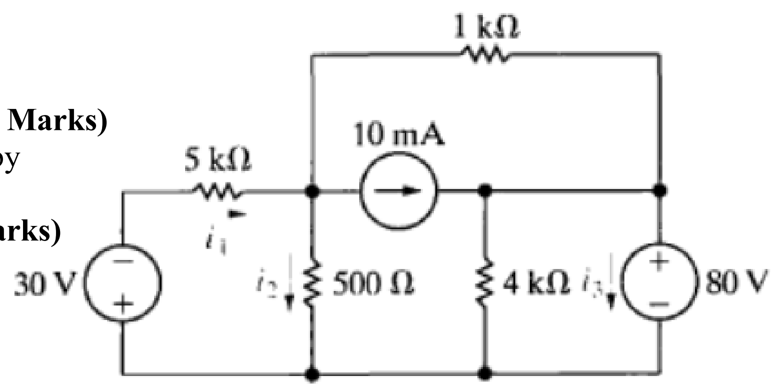


Fig. Q3

Question (4): [8 Marks]

Use the source transformations to find i_o in the circuit shown in Fig.Q4.

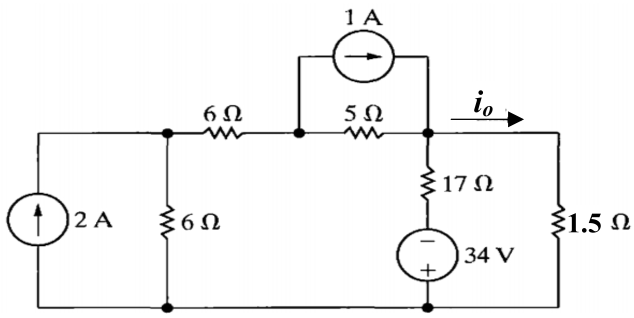


Fig. Q4

Question (5): [10 Marks]

The variable resistor in the circuit in Fig. Q5 is adjusted for maximum power transfer to Ro.
a) Find the value of Ro**.** **[7 Marks]**
b) Find the maximum powerthat can be delivered to Ro**[3 Marks]**

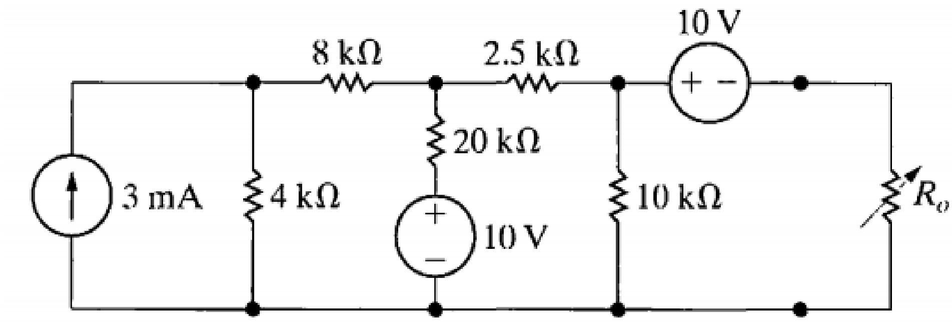


Fig. Q5

Question (6):[12 Marks]

The Ideal Op-Amp circuit is shown in Fig.Q6.
a) Find V_0 when $V_a = 1$ V, $V_b = 2$ V, $V_c = 2$ V and $V_d = 4$ V.**(4 Marks)**
b) If $V_a = 1$ V, $V_b = 2$ V, what values of V_c will not saturate the Op-Amp?**(4 Marks)**
c) Gives some applications of Op-Amp? **(4 Marks)**

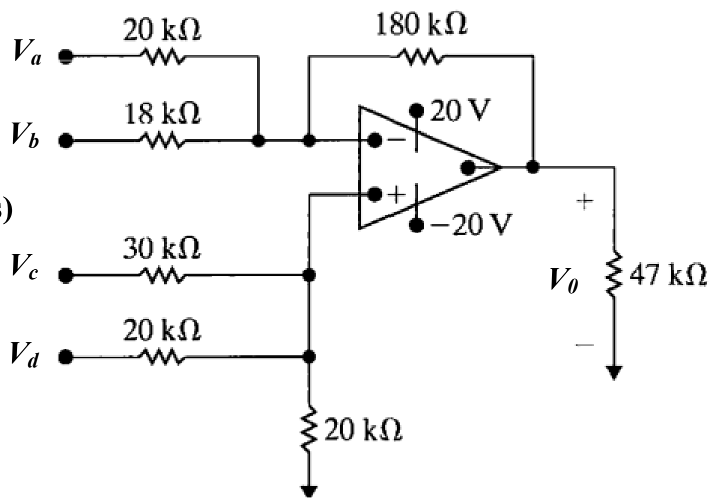


Fig.Q6

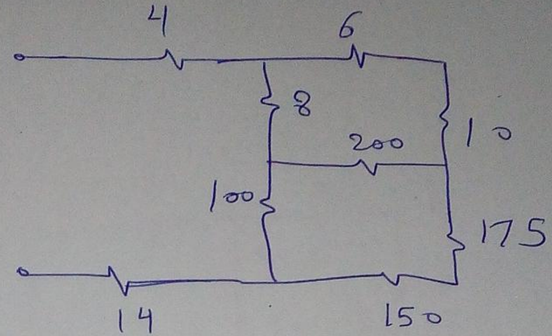
With my best wishes

Model answer for civil corrective 2017-2018

Q-1

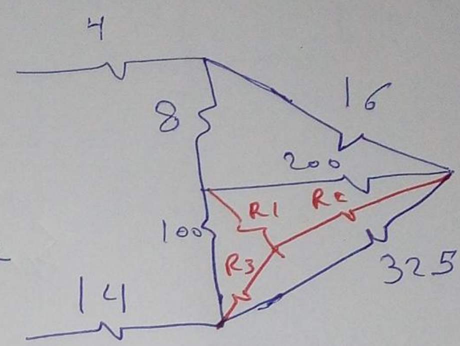
Q1/

(a)



$6+10=16$

$175+150=325$



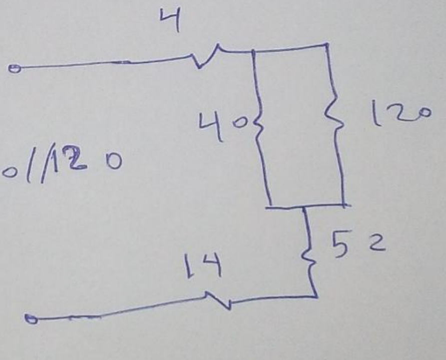
$R_1 = \frac{100\times200}{100+200+325} = 32\,\Omega$

$R_2 = \frac{200\times325}{625} = 104\,\Omega$

$R_3 = \frac{100\times325}{625} = 52\,\Omega$

$R_2+16 = 120\,\Omega$

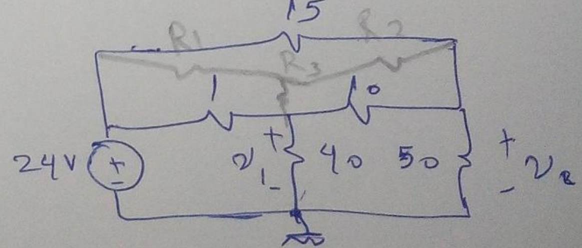
$R_1+8 = 40$



$R_{ab} = 14+4+52+40//120$

$= 100\,\Omega$

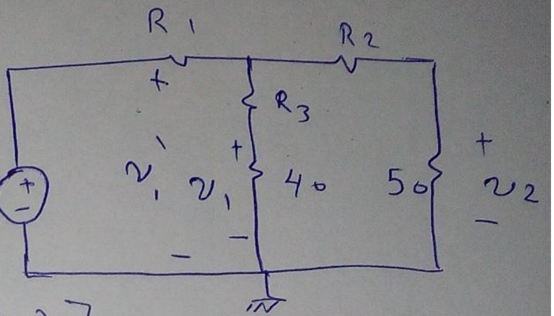
(b)



$R_1 = \frac{1\times15}{1+15+10} = \frac{15}{26}$

$R_2 = \frac{150}{26}$

$R_3 = \frac{100}{26}$



$$v_1' = 24 * \frac{(R_3+40)//(R_2+50)}{R_1+(R_3+40)//(R_2+50)}$$

~~I = 24 *~~

$$= 24 * \frac{\left[\left(40+\frac{100}{26}\right)//\left(50+\frac{150}{26}\right)\right]}{\frac{15}{26}+\left[\left(\frac{1140}{26}\right)//\left(\frac{1450}{26}\right)\right]}$$

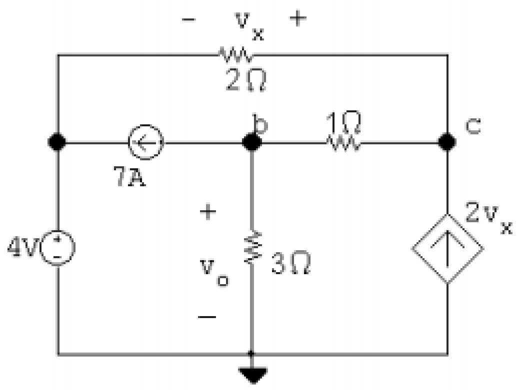
$$= 24 * \frac{\frac{638.22}{26}}{\frac{15}{26}+\frac{638.22}{26}}$$

$$v_1' = 32.448$$

$$v_1 = \frac{v_1' * 40}{40+R_3} = 21.39\ V$$

$$v_2 = \frac{v_1' * 50}{R_2+50} = 21.023\ V$$

Q-2



The two node voltage equations are:

$$7 + \frac{v_b}{3} + \frac{v_b - v_c}{1} = 0$$

$$-2v_x + \frac{v_c - v_b}{1} + \frac{v_c - 4}{2} = 0$$

The constraint equation for the dependent source is:
$v_x = v_c - 4$

Place these equations in standard form:

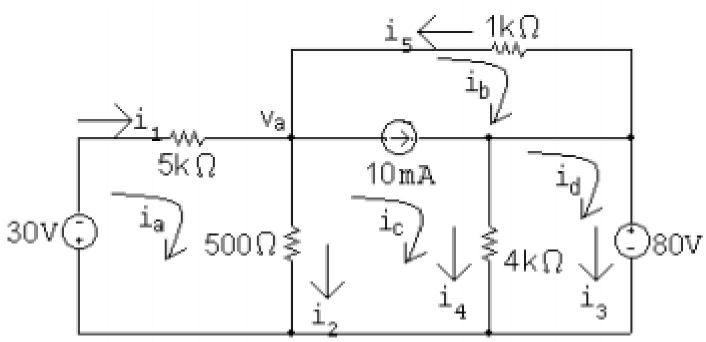
$$v_b\left(\frac{1}{3} + 1\right) + v_c(-1) + v_x(0) = -7$$

$$v_b(-1) + v_c\left(1 + \frac{1}{2}\right) + v_x(-2) = \frac{4}{2}$$

$$v_b(0) + v_c(1) + v_x(-1) = 4$$

Solving, $v_c = 9$ V, $v_x = 5$ V, and $v_o = v_b = 1.5$ V

Q-3



Supermesh equations:

$$1000i_b + 4000(i_c - i_d) + 500(i_c - i_a) = 0$$

$$i_c - i_b = 0.01$$

Two remaining mesh equations:

$$5500i_a - 500i_c = -30$$

$$4000i_d - 4000i_c = -80$$

In standard form,

$$-500i_a + 1000i_b + 4500i_c - 4000i_d = 0$$

$$0i_a - 1i_b + 1i_c + 0i_d = 0.01$$

$$5500i_a + 0i_b - 500i_c + 0i_d = -30$$

$$0i_a + 0i_b - 4000i_c + 4000i_d = -80$$

Solving:

$$0i_a + 0i_b - 4000i_c + 4000i_d = -80$$

Solving:

$i_a = -10$ mA; $\quad i_b = -60$ mA; $\quad i_c = -50$ mA; $\quad i_d = -70$ mA

Then,

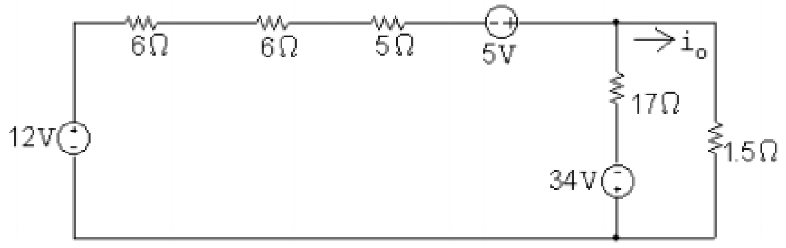
$i_1 = i_a = -10$ mA; $\quad i_2 = i_a - i_c = 40$ mA; $\quad i_3 = i_d = -70$ mA

[b] $p_{\text{sources}} = 30(-0.01) + [1000(-0.06)](0.01) + 80(-0.07) = -6.5$ W

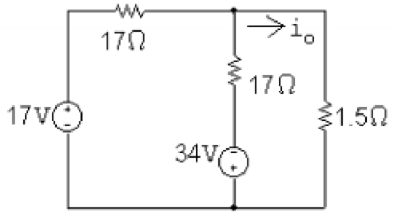
$$p_{\text{resistors}} = 1000(0.06)^2 + 5000(0.01)^2 + 500(0.04)^2$$
$$+4000(-0.05 + 0.07)^2 = 6.5 \text{ W}$$

Q-4

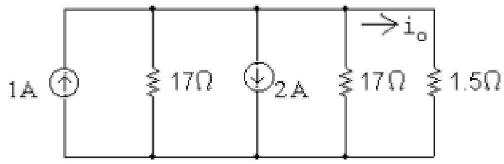
[a] Applying a source transformation to each current source yields



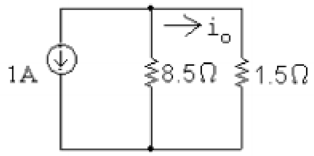
Now combine the 12 V and 5 V sources into a single voltage source and the 6 Ω, 6 Ω and 5 Ω resistors into a single resistor to get



Now use a source transformation on each voltage source, thus

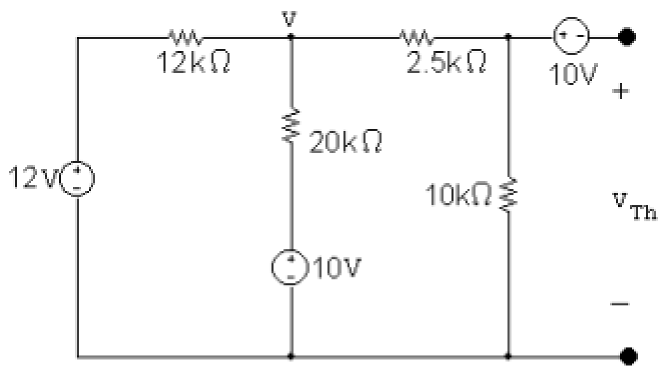


which can be reduced to



$$\therefore \quad i_o = -\frac{8.5}{10}(1) = -0.85 \text{ A}$$

Q-5

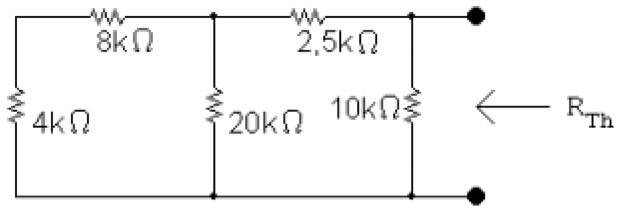


$$\frac{v-12}{12{,}000} + \frac{v-10}{20{,}000} + \frac{v}{12{,}500} = 0$$

Solving, $\quad v = 7.03125 \text{ V}$

$$v_{10k} = \frac{10{,}000}{12{,}500}(7.03125) = 5.625 \text{ V}$$

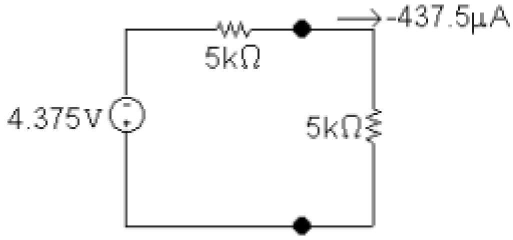
$$\therefore \quad V_{Th} = v - 10 = -4.375 \text{ V}$$



$$R_{Th} = [(12{,}000\|20{,}000) + 2500] = 5\ \text{k}\Omega$$

$$R_o = R_{Th} = 5\ \text{k}\Omega$$

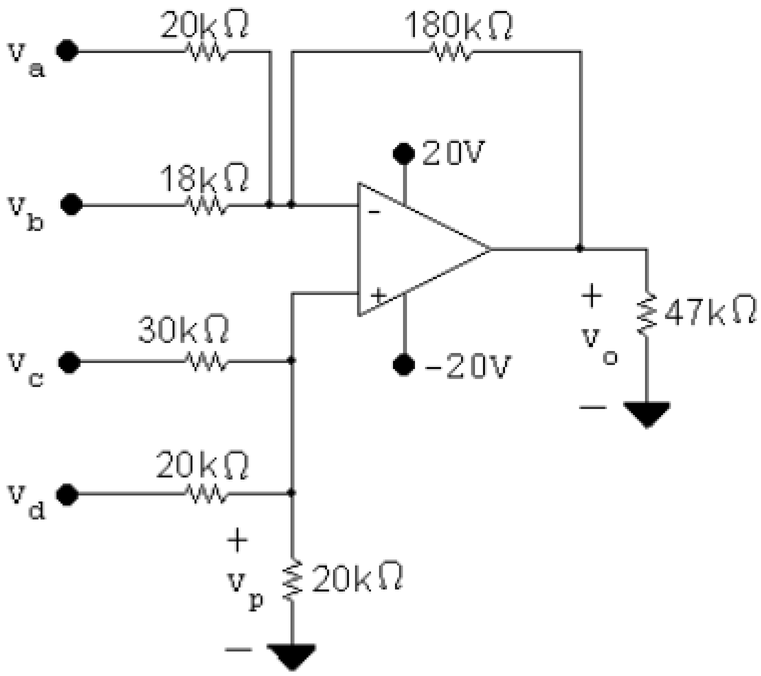
[b]



$$p_{max} = (-437.5 \times 10^{-6})^2(5000) = 957\,\mu\text{W}$$

Q-6

[a]



$$\frac{v_p}{20{,}000} + \frac{v_p - v_c}{30{,}000} + \frac{v_p - v_d}{20{,}000} = 0$$

$$\therefore \quad 8v_p = 2v_c + 3v_d = 8v_n$$

$$\frac{v_n - v_a}{20{,}000} + \frac{v_n - v_b}{18{,}000} + \frac{v_n - v_o}{180{,}000} = 0$$

$$\begin{aligned} \therefore \quad v_o &= 20v_n - 9v_a - 10v_b \\ &= 20[(1/4)v_c + (3/8)v_d] - 9v_a - 10v_b \\ &= 20(0.75 + 1.5) - 9(1) - 10(2) = 16 \text{ V} \end{aligned}$$

[b] $v_o = 5v_c + 30 - 9 - 20 = 5v_c + 1$

$$\pm 20 = 5v_c + 1$$

$$\therefore \quad v_b = -4.2 \text{ V} \qquad \text{and} \qquad v_b = 3.8 \text{ V}$$

$$\therefore \quad -4.2 \text{ V} \le v_b \le 3.8 \text{ V}$$

[c] Applications of Op-Amp

Multiplier- Inverter- Subtracter-Adder