King Fahd University of Petroleum and Minerals
Department of Electrical Engineering

EE 201 Electric Circuits I
First Semester (111)

Exam I
Wednesday, 12 October 2011
6:00 pm – 7:30 pm (90 minutes)

Ser #	**Solution**
ID #	
Name	
Section #	

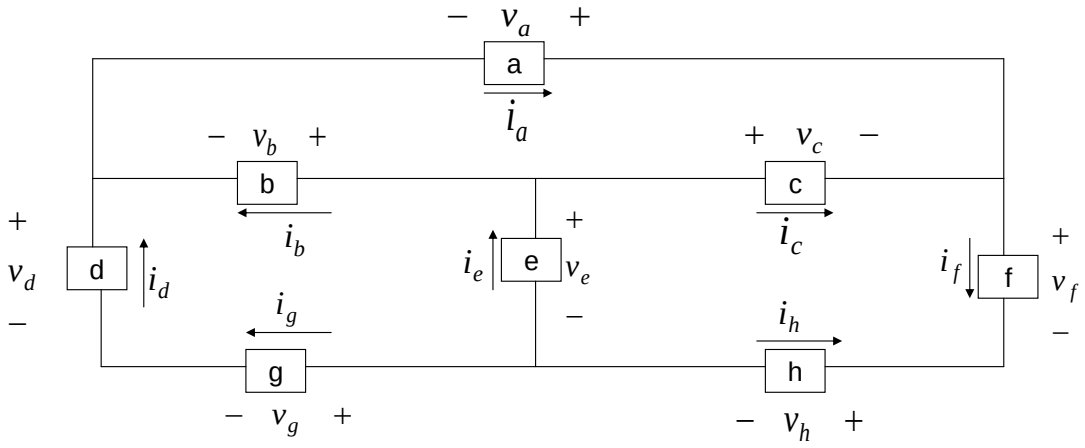
Instructors	Sections
Dr. Adil Balghonaim	1
Dr. Mesbah Wessam	2
Dr. Abdelmalek Zidouri	3
Dr. Kamal Harb	4, 12
Dr. Abdallah Al-Ahmari	5, 10
Dr. Jamil Bakhashwain	6, 11
Dr. Hussain Al-Duwaish	7, 9
Dr. Zaki Al-Akhdhar	8
Dr. Ali Al-Awami	13

	Maximum Score	Score
Q1	**20**	
Q2	**20**	
Q3	**30**	
Q4	**30**	
TOTAL	**100**	

Question 1: **[20 points]**

Some of the numerical values of the voltages and currents of the circuit shown below are given in the table.

a) Use KVL and KCL to find the missing voltages and currents and write them in the table.
b) Find the power (dissipated or generated) by every element and write it in the table.



Solution:

1.25 marks for every missing cell. The value and sign are one entity (No partial credit for have one of them right). For the voltage and current cells, both the value and sign have to be right to get the mark (1.25). For the power cells, the value and type (dissipate or generated) have to be right to get the mark (1.25). The missing cells has white color background and larger font.

Element	Voltage (V)	Current (A)	Power (W) Dissipated or generated
a	-25	**12**	**300 dissipated**
b	5	**20**	**100 dissipated**
c	**30**	5	**150 dissipated**
d	**10**	-8	**80 dissipated**
e	**12**	**25**	**300 Generated**
f	-7	**17**	**119 Generated**
g	3	**-8**	**24 Generated**
h	-11	-17	**187 Generated**

Question 2: [20 points]

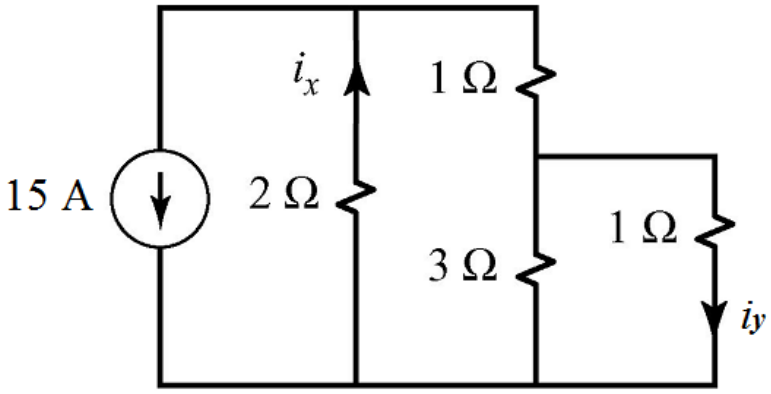
In the circuit shown apply circuit reduction and the current divider rule to determine the currents:

a) i_x , and
b) i_y.

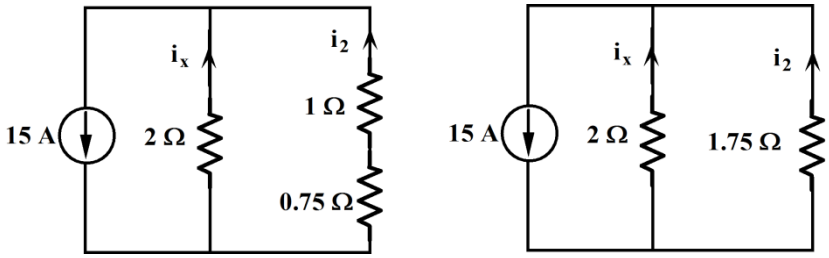
Solution:

a) i_x =

b) i_y =



Solution:
step 1:
[4 marks for circuit # 1]
[4 marks for circuit # 2]
simplify the circuit to the following two stages.
Use parallel combination or resistors: 3 Ω // 4 Ω = 0.75 Ω
Use the series combination of resistors: 1 + 0.75 = 1.75 Ω



Step2:
[4 marks] Use CDR in the third circuit to get

$$ix = \frac{1.75}{2+1.75}(15) = 7 \text{ A}$$

[4 marks] Use CDR in the third circuit to get

$$i2 = \frac{2}{2+1.75}(15) = 8 \text{ A}$$

[4 marks] Use the CDR in the first circuit

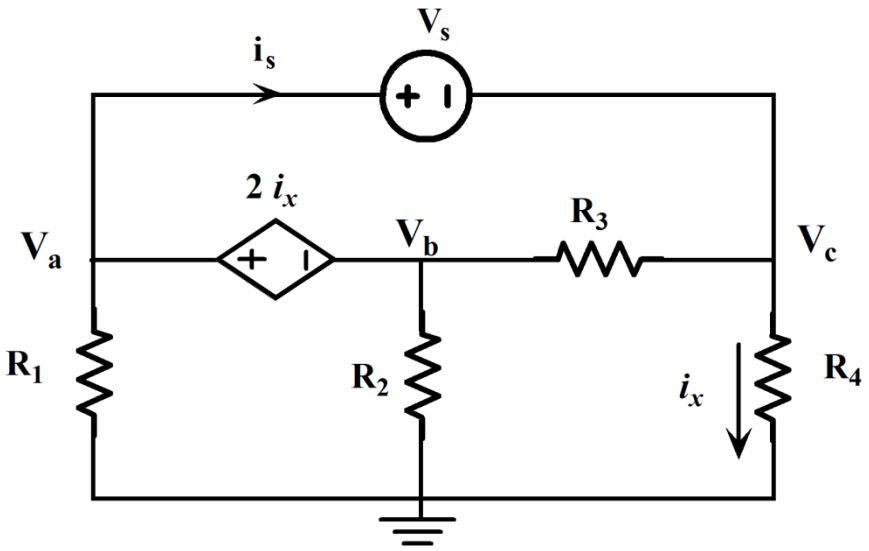
$$iy = \frac{-3}{1+3}(i2) = \frac{-3}{1+3}(8) = -6 \text{ A}$$

Question 3: **[30 points]**

For the circuit shown below V_s =12*V*, R_1 = 4Ω, R_2 = 1Ω, R_3 = 2Ω, and R_4 = 4Ω:

a) Determine *Va*, *Vb*, *Vc*, in the circuit shown below using nodal analysis.

b) How much power in the independent source?



Solution:

Part a:

For the following 4 equations, a mistake in **one term (value or sign)** will result in deducting the marks of two terms (4 marks) and the minimum marks for every equation should not be less than ZERO.

[**4 marks; 2 terms**] From the independent source:

(Va – Vc) = 12 ---------- (1)

[**4 marks; 2 terms**] From the dependent source:

(Va – Vb) = 2 ix ---------- (2)

[**6 marks; 3 terms**] From a supernode around Va,Vb, and Vc

$$\frac{Va}{4}+\frac{Vb}{1}+\frac{Vc}{4}=0 \quad \text{---------- (3)}$$

[**4 marks; 2 terms**] The current ix:

ix = Vc/4 ---------- (4)

[**3 marks**] If we substitute (4) in 2 and simplify into matrix form we will get

$$\begin{bmatrix} 1 & 0 & -1 \\ 2 & -2 & -1 \\ 1 & 4 & 1 \end{bmatrix}\begin{bmatrix} Va \\ Vb \\ Vc \end{bmatrix}=\begin{bmatrix} 12 \\ 0 \\ 0 \end{bmatrix}$$

[**3 marks**] Solving the above matrix of equations, we will get
Va = -3.0, Vb = 4.5, and Vc = -15.0

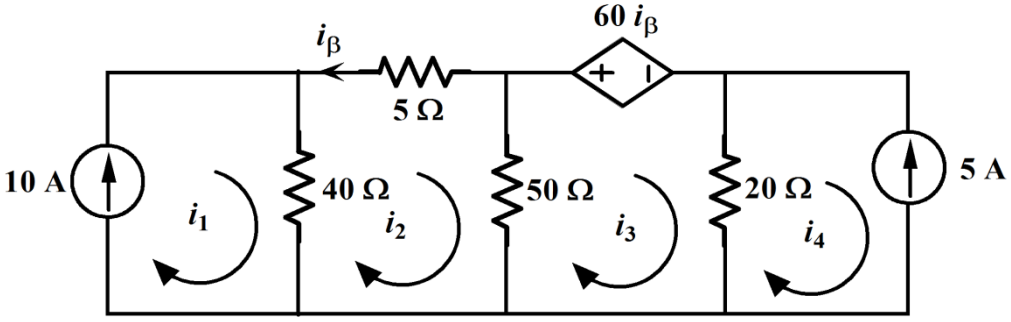
Part b:

[**3 marks**] Find the current in the independent source i
is = Vc/4 + (Vc-Vb)/2 = -15/4 + (-15-4.5)/2 = - 27/2 = -13.5 A
[**3 marks**] The power of the independent source = v i_s = 12 is = -162 W = 162 W generated

Question 4: [30 points]

For the circuit show below:

a) Use mesh analysis to find i_1, i_2, i_3, and i_4.
b) Find the power of the dependent source.



Solution:

A mistake in **one term (value or sign)** will result in deducting the marks of two terms (4 marks) and the minimum points in every equation should not be less than ZERO.

Part a:

From the two current sources

$i_1 = 10$ ---------- (1) [**2 marks**]

$i_4 = -5$ ---------- (2) [**2 marks**]

For the following 3 equations, a mistake in **one term (value or sign)** will result in deducting the marks of two terms (4 marks) and the minimum marks for every equation should not be less than ZERO.

KVL in the 2nd mesh

[**6 marks; 3 terms**] $40(i_2-i_1) + 5\,i_2 + 50\,(i_2-i_3) = 0$ ---------- (3)

KVL in the 3rd mesh:

[**6 marks; 3 terms**] $50(i_3-i_2) + 60\,i_\beta + 20\,(i_3-i_4) = 0$ ---------- (4)

The current i_β

[**4 marks; 2 terms**] $i_\beta = -i_2$ ---------- (5)

[**4 marks**] If we substitute (1), (2), and (5) in (3) and (4) and simplify the two equations:

$$\begin{bmatrix} 95 & -50 \\ -110 & 70 \end{bmatrix} \begin{bmatrix} i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 400 \\ -100 \end{bmatrix}$$

[**2 marks**] With the following solution:

$i_2 = 20$ A

$i_3 = 30$ A

Part b:

[**4 marks**] The power of the dependent source = $vi = (60\ i_x)\ i_3 = -60(-i_2)(i_3)$

= 36 kW generated