KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

EE 201_102

EXAM I

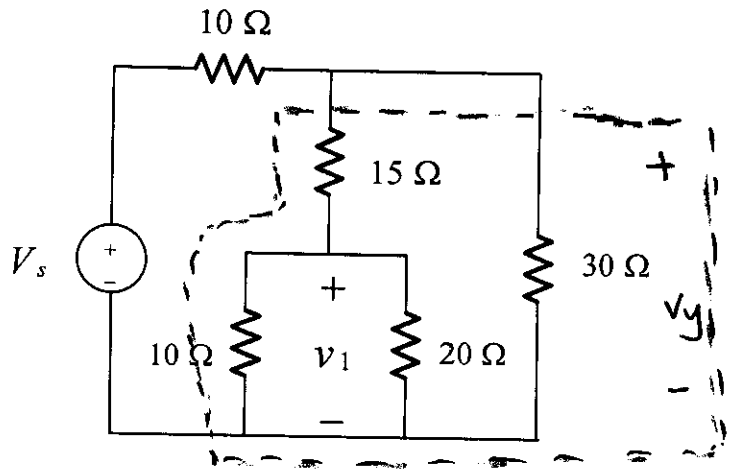
DATE: Wednesday 16/3/2011

TIME: 6:30 PM-8:00 PM

SER#	
ID#	
Name	KEY
Section#	

	Maximum Score	Score
Q1	20	
Q2	20	
Q3	25	
Q4	35	
TOTAL	100	

Q1 (20)



$R_{eq} = 30 \,//\, [15 + (20 \,//\, 10)]$

$= 30 \,//\, [15 + 6.67]$

$= 30 \,//\, (21.67)$

$= 12.58\ \Omega$

For the circuit shown above find the voltage v_1 in terms or as a function of the voltage source V_s ?

$$V_y = \frac{R_{eq}}{R_{eq}+10} V_s = \frac{12.58}{10+12.58} V_s = 0.5572\, V_s$$

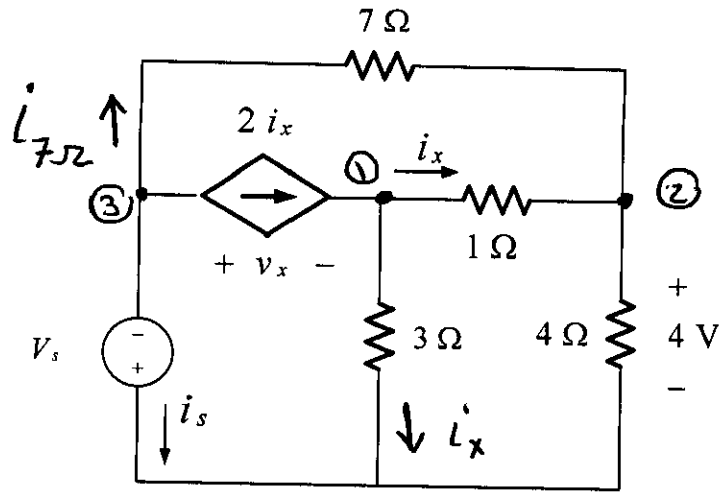
$$V_1 = \frac{(10 \,//\, 20)}{15 + (10 \,//\, 20)} V_y$$

$$= \frac{6.67\ V_y}{21.6667}$$

$$= \frac{6.67}{21.6667} (0.5572\, V_s)$$

$$= 0.17145\, V_s$$

Q2 (20)



For the circuit shown above , **without using nodal analysis** (use KCL, KVL and Ohms Law) find the followings:

(a) i_x ?

(b) v_x ?

(c) i_s ?

(d) V_s ?

(a) KCL at ① $i_{3\Omega} = i_x$

$\Rightarrow$ KVL: $1i_x + 4 - 3i_x = 0 \Rightarrow \boxed{i_x = 2A}$

(b) KCL at ② $i_{7\Omega} + i_x - \frac{4}{4} = 0 \Rightarrow \boxed{i_{7\Omega} = -1\,A}$

KVL $\Rightarrow -v_x + 7i_{7\Omega} - 1i_x = 0$

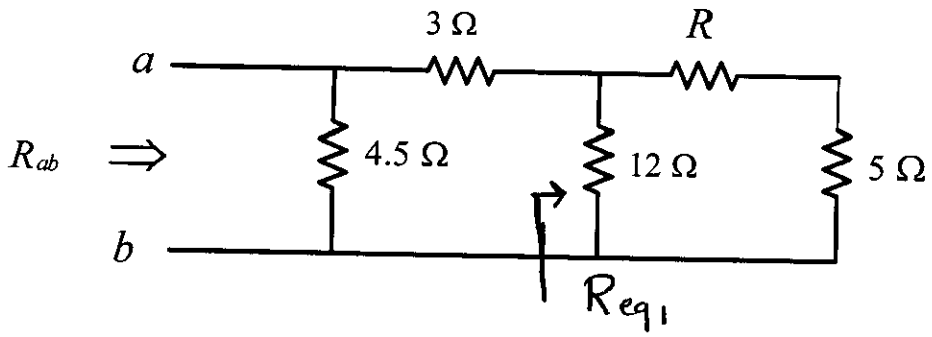
$\Rightarrow \boxed{v_x = -9\ V}$

(c) KCL at ③ $i_{7\Omega} + 2i_x + i_s = 0$

$\Rightarrow \boxed{i_s = -3A}$

(d) KVL $\Rightarrow v_s + v_x + 3i_x = 0 \Rightarrow \boxed{V_s = 3V}$

Q3 (25)



Find the resistant R such that the equivalent resistor R_{ab} equal 3 Ω ?

$$R_{eq1} = 12 \,//\, (R+5)$$

$$= \frac{12(R+5)}{12+R+5} = \frac{12R+60}{17+R}$$

$$\frac{1}{R_{ab}} = \frac{1}{4.5} + \frac{1}{3+R_{eq1}}$$

$$\frac{1}{3} = \frac{1}{4.5} + \frac{1}{3+\frac{12R+60}{R+17}}$$

$$\frac{1}{3} - \frac{1}{4.5} = \frac{R+17}{3R+51+12R+60}$$

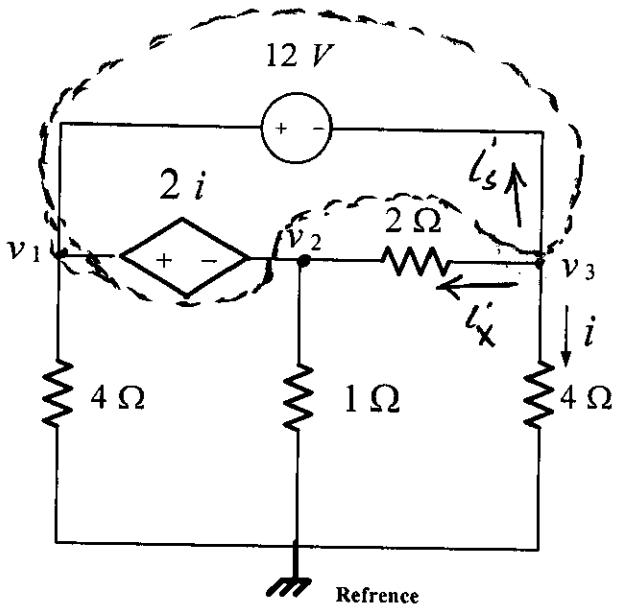
$$0.111 = \frac{R+17}{15R+111}$$

$$\Rightarrow 1.666R + 12.333 = R+17$$

$$0.666R = 4.6667$$

$$\Rightarrow R = 7\,\Omega$$

Q4 (35)



Using **nodal analysis** and **supper node principle** find the followings :

(a) The nodes voltages V_1, v_2, v_3 ?

(b) The power absorbed or delivered by the independent voltage source ?

(a) KCL on supper node:

$$\frac{V_1}{4} + \frac{V_2}{1} + \frac{V_2 - V_3}{2} + \frac{V_3 - V_2}{2} + \frac{V_3}{4} = 0$$

$$\Rightarrow \quad V_1 + 4V_2 + V_3 = 0 \quad \text{— (1)}$$

$$V_1 - V_3 = 12 \quad \text{— (2)}$$

$$V_1 - V_2 = 2i = 2\frac{V_3}{4} = \frac{V_3}{2}$$

$$\Rightarrow \quad V_1 - 2V_2 - \frac{V_3}{2} = 0 \quad \Rightarrow \quad 2V_1 - 2V_2 - V_3 = 0 \quad \text{— (3)}$$

$$\Rightarrow \begin{bmatrix} 1 & 4 & 1 \\ 1 & 0 & -1 \\ 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 12 \\ 0 \end{bmatrix}$$

Solving $\quad V_1 = -3\ V \quad V_2 = 4.5\ V \quad V_3 = -15V$

OR $\quad v_1 - v_2 = 2i = 2\frac{v_3}{4} = \frac{v_3}{2} = \frac{-12+v_1}{2}$

$$\Rightarrow \quad v_1 - 2v_2 = -12$$

$$\begin{bmatrix} 1 & 4 & 1 \\ 1 & 0 & -1 \\ 1 & -2 & 0 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 12 \\ -12 \end{bmatrix}$$

Solving $\quad v_1 = -3\,V \quad v_2 = 4.5\,V \quad v_3 = -15\,V$

(b) $\quad i_x = \frac{v_3 - v_2}{2} = \frac{-15 - 4.5}{2} = -9.75\ A$

$$i_s + i_x + i = 0$$

$$i_s = -(i_x + i) = -(9.75 + -\tfrac{15}{4}) = 13.5\ A$$

$$p_{12V} = -(12)(13.5) = -162\ W$$

$\Rightarrow$ delivering Power