Name _____

EE 2240

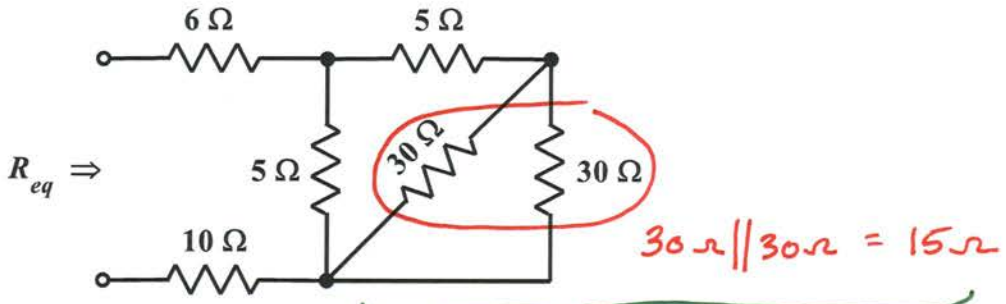
Exam #1

Thursday, February 18, 2016

LIBR B32 and TAB 115, 2:30PM – 3:45PM

[closed book – one two-sided 8½"×11" page of notes and calculator allowed, nothing else]

1. [Equivalent Resistance] Determine the value of R_{eq} for the collection of resistors shown.



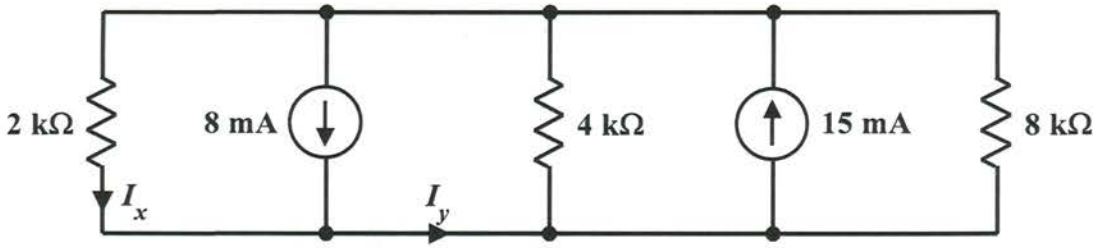
$30\Omega \| 30\Omega = 15\Omega$

$15\Omega + 5\Omega = 20\Omega$

$5\Omega \| 20\Omega = 4\Omega$

$R_{eq} = 6\Omega + 4\Omega + 10\Omega = 20\Omega$

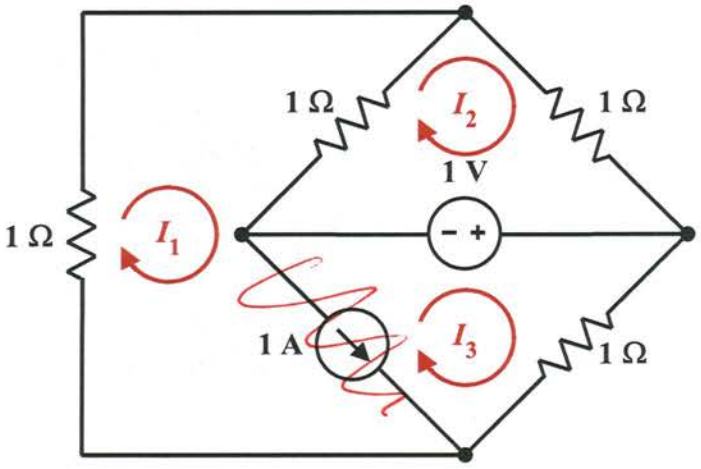
2. [Current Division] Determine the values of I_x and I_y in the circuit shown.



$$I_x = \frac{\frac{1}{2k\Omega}}{\frac{1}{2k\Omega} + \frac{1}{4k\Omega} + \frac{1}{8k\Omega}} \cdot (15mA - 8mA) = 4\ mA$$

$$I_y = I_x + 8mA = 12\ mA$$

3. [Mesh Analysis] Determine a set of equations that could be used to analyze the circuit shown by the mesh-analysis method, and express them in the standard matrix form. Use the mesh currents that are already assigned. ***Do not attempt to solve the equations.***



$I_1 - I_3 = 1A$ (constraint)

$1\Omega(I_2 - I_1) + 1\Omega(I_2) + 1V = 0$ (KVL for mesh 2)

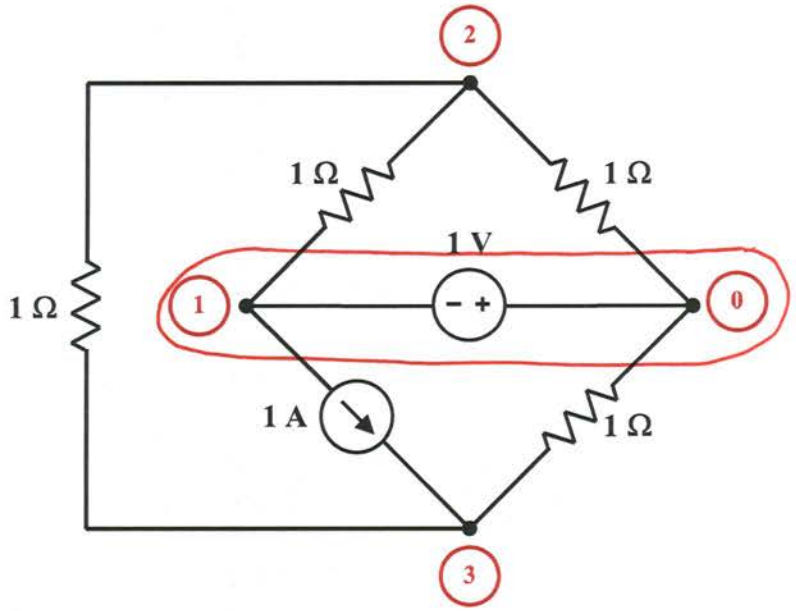
$1\Omega(I_1) + 1\Omega(I_1 - I_2) - 1V + 1\Omega(I_3) = 0$

(KVL for supermesh 1,3)

In matrix form:

$$\begin{bmatrix} 1 & 0 & -1 \\ -1 & 2 & 0 \\ 2 & -1 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$$

4. [Nodal Analysis] Determine a set of equations that could be used to analyze the circuit shown by the nodal-analysis method, and express them in the standard matrix form. Use te node labels that are already assigned. ***Do not attempt to solve the equations.***



$V_1 = -1V$ (constraint)

$\frac{V_2 - V_3}{1\Omega} + \frac{V_2 - V_1}{1\Omega} + \frac{V_2}{1\Omega} = 0$ (KCL for node 2)

$\frac{V_3 - V_2}{1\Omega} - 1A + \frac{V_3}{1\Omega} = 0$ (KCL for node 3)

In matrix form:

$$\begin{bmatrix} 1 & 0 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 2 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$$

5. A set of simultaneous linear equations is given in standard matrix form below. Use any method to determine the numerical value of z. ***Check your solution; there will be very little partial credit on this problem.***

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 2 & 3 \\ 4 & 4 & 7 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 8 \\ 23 \\ 53 \end{bmatrix}$$

From row 3: $4x + 4y + 7z = 53$ (1)

From row 2: $2x + 2y + 3z = 23$ (2)

or $4x + 4y + 6z = 46$ (3)

Subtract (3) from (1):

$z = 7$