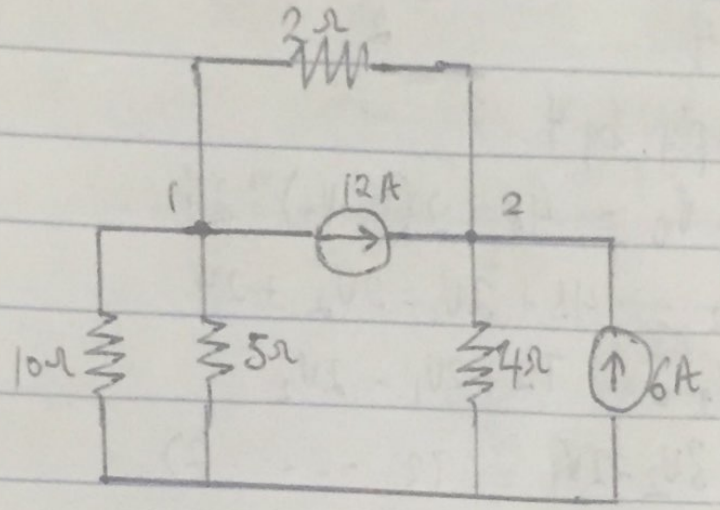
Name: Mba Jonah Abali
Matric Number: 17/mhts01/187
Department. Computer Engineering

Quiz

1 Solution




At node 1 with KCL

$I_1 = I_2 + I_3 + I_4$

$\frac{V_0 - V_1}{10} = \frac{V_1 - V_2}{2} + \frac{V_1 - V_0}{5} + 12A$

multiply through by 10

$V_0 - V_1 = 5(V_1 - V_2) + 2(V_1 - V_0) + 120$

$V_0 - V_1 = 5V_1 - 5V_2 + 2V_1 - V_0 + 120$

$V_0 - V_1 = 7V_1 - 5V_2 + 3V_0 + 120$

$-V_1 = 7V_1 - 5V_2 + V_0 - V_0 + 120$

$-V_1 = 7V_1 - 5V_2 + 120$

$-8V_1 + 5V_2 = 120 \quad \ldots (1)$

At node 2

$I_4 = -I_2 - I_5 + I_6$

$I_6 = I_4 + I_2 + I_5$

$\frac{V_2 - V_0}{4} = 12 + \frac{V_1 - V_2}{2} + 6V$

multiply by 4

$V_2 - V_0 = 48 + 2(V_1 - V_2) + 24$

$V_2 = 48 + 2V_1 - 2V_2 + 24$

$V_3 = 72 + 2V_1 - 2V_2$

$3V_2 - 2V_1 = 72$ ---- (2)

Applying elimination method

$5V_2 - 8V_1 = 120$ ---- (1)

$3V_2 - 2V_1 = 72$ ---- (2)

$10V_2 - 16V_1 = 240$

$+ \underline{24V_2 - 16V_1 = 576}$

$34V_2 = 816$

$V_2 = 24V$

Putting the value of $V_2$ in eqn (1)

$5(24) - 8V_1 = 120$

$-8V_1 = 120 - 120$

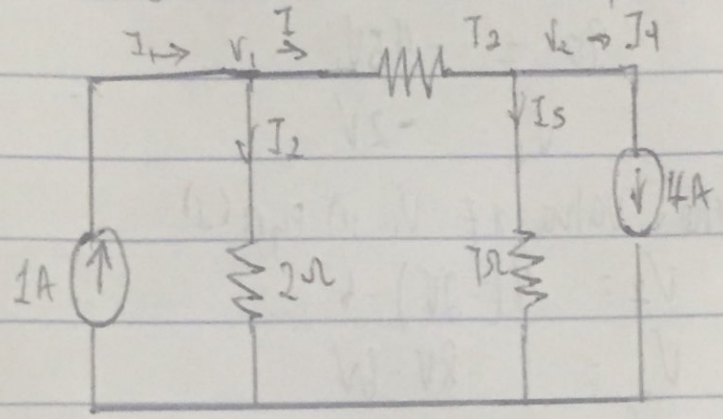
$-8V_1 = 0$

$V_1 = 0$

$I_1 = 0A, \quad I_2 = 0A, \quad I_3 = 6A, \quad I_4 = 12A$

(i) Obtain $V_1$ and $V_2$ and the currents through, those resistors

(ii) if the 2A current source was replaced by a 1A current source




At node 1

$I_1 = I_2 + I_3$

$I = \frac{V_1 - V_2}{6} + \frac{V_1}{2}$

$6 = V_1 - V_2 + 3V_1$

$6 = 4V_1 - V_2 \quad ------ (1)$

At node 2

$I_2 = I_3 + I_5$

$\frac{V_1 - V_2}{6} = 4 + \frac{V_2}{7}$

$7(V_1 - V_2) = 6(28 + V_2)$

$7V_1 - 7V_2 = 168 + 6V_2$

$168 = 7V_1 - 13V_2 \quad \text{---} (2)$

From eqn (1) $V_2 = 4V_1 - 6$

put eqn (1) in eqn (2)

$168 = 7V_1 - 13(4V_1 - 6)$

$168 = 7V_1 - 52V_1 + 78$

$90 = -45V_1$

$V_1 = -2V$

put the value of $V_1$ in eqn (1)

$V_2 = 4(-2V) - 6$

$V_2 = -8V - 6V$

$V_2 = -14V$

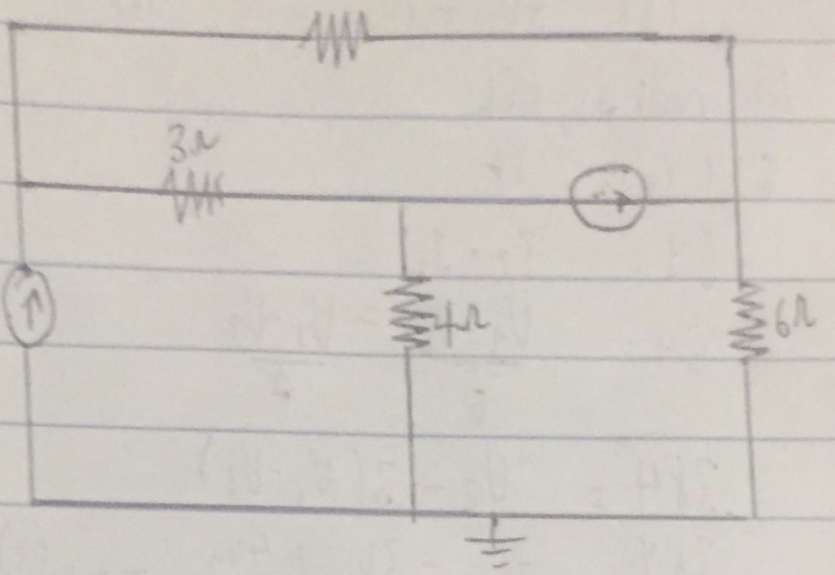
Current ~~follow~~ flowing through the resistor

$I_2 = \frac{V_1 - V_2}{6} = \frac{-2 + 14}{6} = 2A$

$I_3 = \frac{V_1}{2} = \frac{-2}{2} = -1A$

$I_6 = \frac{V_2}{7} = \frac{-14}{7} = -2A$

2




At node 1 using KCL

$10A = i_1 + i_2$

$10A = \frac{V_1 - V_3}{2} + \frac{V_1 - V_2}{3}$

multiply through by 6.

$60A = 3(V_1 - V_3) + 2(V_1 - V_2)$

$60A = 3V_1 - 3V_3 + 2V_1 - 2V_2$

$60 = 5V_1 - 2V_2 - 3V_3$

At node 2 using KCL

$I_2 = I_3 + 64$

$64 = I_2 - I_1$

$64 = \frac{V_1 - V_2}{3} - \frac{V_2 - 0}{4}$

$768 = 4(V_1 - V_2) - 3(V_2)$

$$768 = 4V_1 - 7V_2 \quad \text{---} \quad (ii)$$

At node 3, KCL

$$64 + i_1 = I_3$$

$$64 = I_3 - I_1$$

$$64 = \frac{V_3 - V_0}{6} - \frac{V_1 - V_3}{2}$$

$$384 = V_3 - 3(V_1 - V_3)$$

$$384 = -3V_1 + 4V_3 \quad \text{---} \quad (iii)$$

in matrix form

$$\begin{bmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 60 \\ 768 \\ 384 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{bmatrix}$$

$$= 5(-28) + 2(16+0) - 3(0-21)$$

$$\Delta = -45$$

$$\Delta_1 = \begin{bmatrix} 60 & -2 & -3 \\ 768 & -7 & 0 \\ 384 & 0 & 4 \end{bmatrix}$$

$$= 60(-28) + 2(3072) - 3(0+2688)$$

$$= -3600$$

$$V_1 = \frac{\Delta_1}{\Delta} = \frac{-3600}{-45} = 80V$$

$$\Delta_2 = \begin{bmatrix} 5 & 60 & -3 \\ 4 & 768 & 0 \\ -3 & 384 & 4 \end{bmatrix}$$

$$= 5(3072) - 60(16) - 3(1536 + 2304)$$

$$= 2880$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{2880}{-45} = -64V$$

$$\Delta_3 = \begin{bmatrix} 5 & -2 & 60 \\ 4 & -7 & 768 \\ -3 & 0 & 384 \end{bmatrix}$$

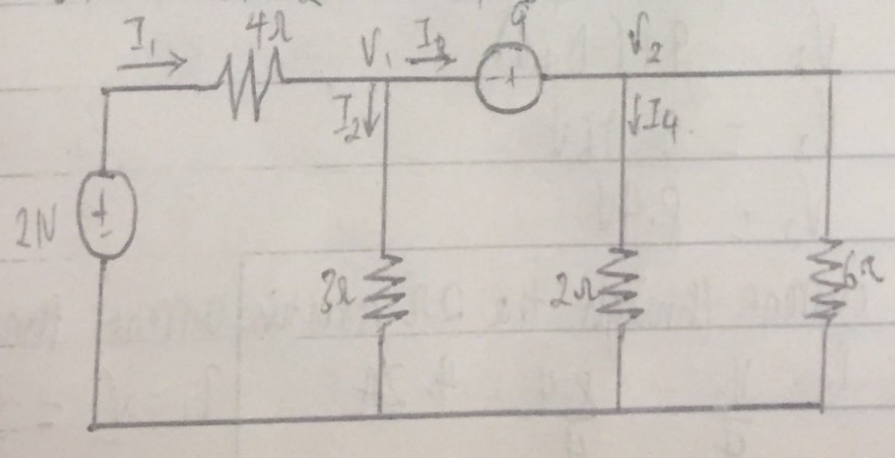
$$= 5(-2688) + 2(1536 + 2304) + 60(21)$$

$$= -7020$$

$$V_3 = \frac{\Delta_3}{\Delta} = \frac{-7020}{-45} = 156V$$

$V_1 = 80V$, $V_2 = -64V$, $V_3 = 156V$

3



Using KCL at nodal

$I_1 + I_2 + I_3 + I_4 = 0$

$\frac{V_1 - 2V}{4} + \frac{V_1}{3} + \frac{V_2}{6} + \frac{V_2}{2}$

$7V_1 + 8V_2 - 63 = 0$ --- (i)

Using KVL for loop 1

$-V_1 - 9 + V_2 = 0$

$-V_1 + V_2 = 9$ --- (ii)

$7V_1 + 8V_2 = 63$ --- (i)

$-V_1 + V_2 = 9$ --- (ii)

$V_2 = 9 + V_1$

Sub $V_2 = 9 + V_1$ in eqn (i)

$7V_1 + 8(9 + V_1) = 63$

$7V_1 + 72 + 8V_1 = 63$

$15V_1 = -9$

$V_1 = -0.6V$

Put the value of $V_1$

$V_2 = 9 + (-0.6V)$

$V_2 = 9 - 0.6V$

$V_2 = 8.4V$

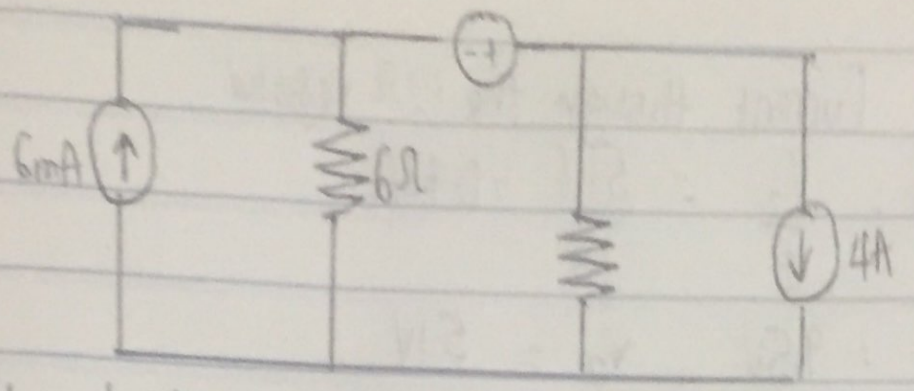
Current through the 2Ω resistor

$i_4 = \frac{V_2}{4} = \frac{8.4}{4} = 4.2A$

Current through the 3Ω resistor

$I_1 = \frac{V_1}{3} = \frac{-0.6}{3} = -0.2A$

4




At node 1, using KCL

$6mA = I_1 + I_2$

$6mA = \frac{V_1 - 0}{6} + (V_1 - V_2)$

$36 = V_1 + 6(V_1 - V_2)$

$36 = V_1 + 6V_1 - 6V_2$

$36 = 7V_1 - 6V_2$ ---(i)

At node 2

$i_1 = I_2 + i_4$

$V_1 - V_2 = 4mA + \frac{V_2 - 0}{12}$

$12(V_1 - V_2) = 48 + V_2$

$48 = 12V_1 - 12V_2 - V_2$

$48 = 12V_1 - 13V_2$ ---(ii)

Solving $V_1$ and $V_2$ simultaneously,

$V_1 = 9.5V$ and $V_2 = 5.1V$

Current through the 6Ω resistor

$I_1 = \frac{V_1}{6} = \frac{9.5}{6} = 1.58A$, $i_2 = V_1 - V_2 = 9.5 - 5.1 = 4.4A$

Current through the 12Ω resistor

$I_4 = \frac{V_2}{12} = \frac{5.1}{12} = 0.43A$

$V_1 = 9.5V$ , $V_2 = 5.1V$

$I_2 = 1.58A$ $I_4 = 0.43A$