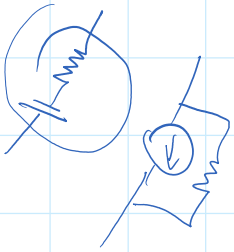
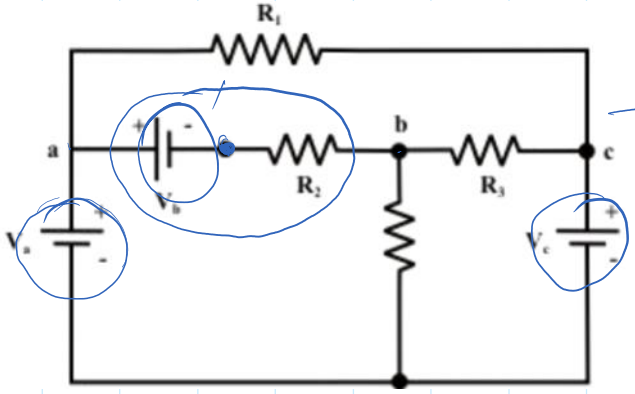
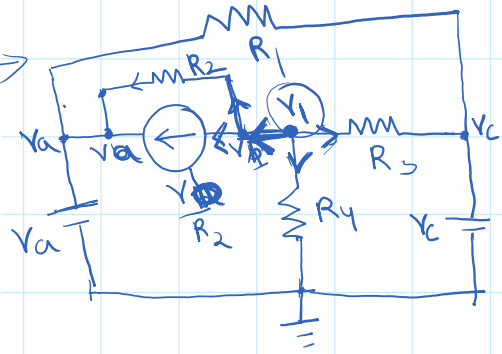
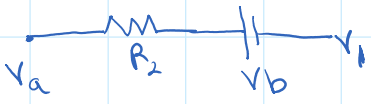
NODAL ANALYSIS

Friday, November 5, 2021 10:39 AM

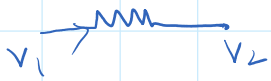


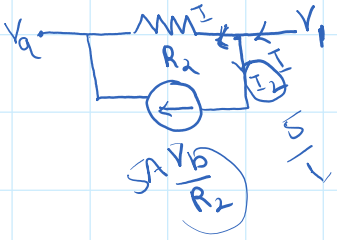






$$\frac{V_1 - 0}{R_4} + \frac{V_1 - V_c}{R_3} + \frac{V_b}{R_2} + \frac{V_1 - V_a}{R_2} = 0$$





$$I = I_1 + I_2$$

$$I_2 = \frac{V_b}{R_2}$$

$$I_1 = \frac{V_1 - V_a}{R_2}$$

$$I = \frac{V_b}{R_2} + \frac{V_1 - V_a}{R_2}$$

Exercise1

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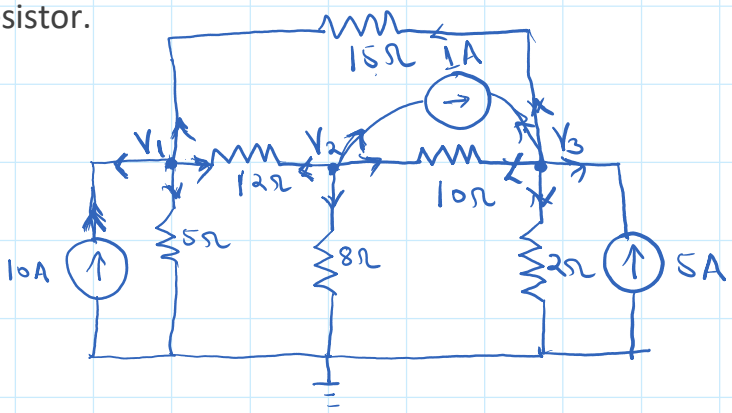
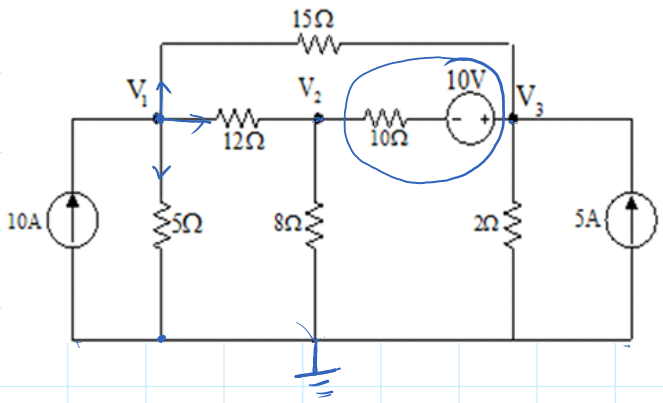
Determine the current through the 15Ω resistor.





$$\frac{V_1-0}{5}+\frac{V_1-V_2}{12}+\frac{V_1-V_3}{15}-10=0$$

$$V_1\left[\frac{1}{5}+\frac{1}{12}+\frac{1}{15}\right]-\frac{V_2}{12}-\frac{V_3}{15}=10 \quad -(1)$$

$$\frac{V_2-0}{8}+\frac{V_2-V_1}{12}+\frac{V_2-V_3}{10}+1=0$$

$$-\frac{V_1}{12}+V_2\left[\frac{1}{8}+\frac{1}{12}+\frac{1}{10}\right]-\frac{V_3}{10}=-1 \quad -(2)$$

$$-\frac{V_1}{15}-\frac{V_2}{10}+V_3\left[\frac{1}{2}+\frac{1}{10}+\frac{1}{15}\right]=6 \quad -(3)$$

$V_1 = 33.69 \quad V_2 = 10.38 \quad V_3 = 13.92$

$$I_{15}=\frac{V_1-V_3}{15}=\frac{33.69-13.92}{15}=1.32A$$

3) $\frac{V_3-0}{2}+\frac{V_3-V_2}{10}-1-5+\frac{V_3-V_1}{15}=0$

$\$ -1 + 12^{-1} + 15^{-1}$

(9)

-12^{-1}

33.69 ✓

33.88 ✓

Exercise2

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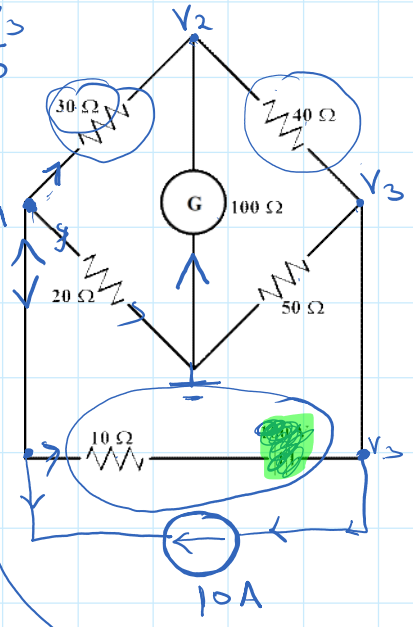
- Determine the current through the galvanometer "**G**". Also, write network equations using inspection method



$$V_1\left[\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right]-\frac{V_2}{30}-\frac{V_3}{10}$$

$$=$$

$$-\frac{V_1}{30}+V_2\left[\frac{1}{40}+\frac{1}{100}+\frac{1}{30}\right]-\frac{V_3}{40}=0$$

$$\frac{V_1-0}{2}+\frac{V_1-V_2}{30}+\frac{V_1-V_3}{10}-10=0$$

$$V_1\left[\frac{1}{20}+\frac{1}{30}+\frac{1}{10}\right]-\frac{V_2}{30}-\frac{V_3}{10}=10 \quad (1)$$

$$\frac{V_2-V_1}{30}+\frac{V_2-0}{100}+\frac{V_2-V_3}{40}=0$$

$$-\frac{V_1}{30}+V_2\left[\frac{1}{30}+\frac{1}{100}+\frac{1}{40}\right]-\frac{V_3}{40}=0$$

$$-\frac{V_1}{10}-\frac{V_2}{40}+V_3\left[\frac{1}{50}+\frac{1}{40}+\frac{1}{10}\right]=-10$$

$$\frac{V_3-V_2}{40}+\frac{V_3-0}{50}+\frac{V_3-V_1}{10}+10=0$$

$$-\frac{V_2}{40}+V_3\left[\frac{1}{40}+\frac{1}{50}+\frac{1}{10}\right]=-10$$

$$V_1=23.4 \qquad V_2=-8.44 \qquad V_3=-54.28$$

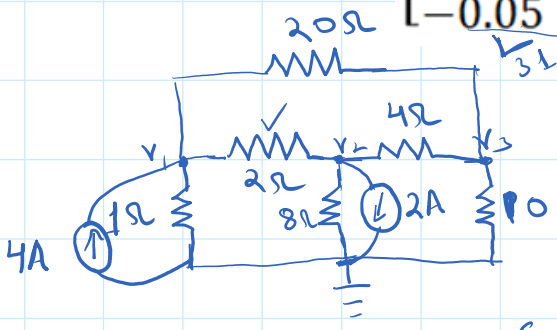
$$I_{100}=\frac{V_2}{100}=\frac{-8.44}{100}=-84.4\ mA$$

Exercise3

Tuesday, November 9, 2021 4:29 PM

Realize the network defined by node voltage equation

$$\begin{bmatrix} 1.55 & -0.5 & -0.05 \\ -0.5 & 0.875 & -0.25 \\ -0.05 & -0.25 & 0.4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \\ 0 \end{bmatrix}$$



$R_{12} = \frac{1}{0.5} = 2\Omega$

$R_{13} = \frac{1}{0.05} = 20$

$G_1 = 1.55 - 0.5 - 0.05$

$= 1$

$R_1 = \frac{1}{G_1} = 1$

$R_{23} = \frac{1}{0.25} = 4$

$G_2 = 0.875 - 0.25 - 0.5$

$= 0.125$

$R_2 = \frac{1}{0.125} = 8\Omega$

$G_3 = 0.4 - 0.25 - 0.05$

$= 0.1$

$R_3 = 10$

Exercise4

Tuesday, November 9, 2021 4:30 PM

- Find the current through 40 V battery. Is the battery charging or discharging?