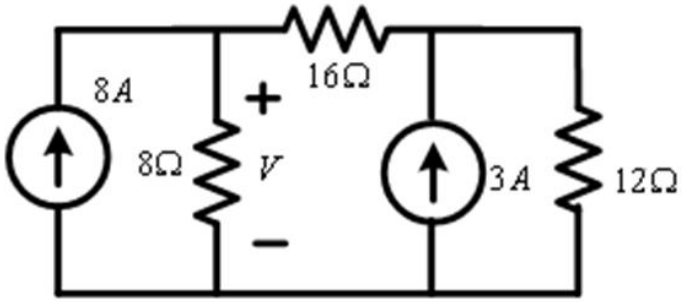
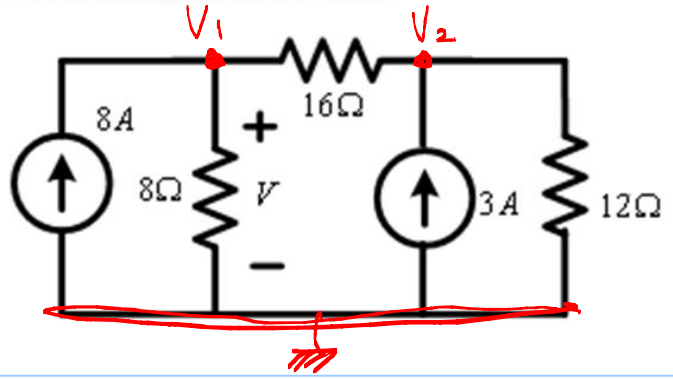
Tentukan V dengan analisis node !



Tentukan V dengan analisis node !



Node V_1 :

$$\frac{V_1-0}{8}+\frac{V_1-V_2}{16}-8=0$$

$$2V_1+V_1-V_2-128=0$$

$$3V_1-V_2=128 \quad \ldots (1)$$

Node V_2 :

$$\frac{V_2-0}{12}+\frac{V_2-V_1}{16}-3=0$$

$$4V_2+3V_2-3V_1-144=0$$

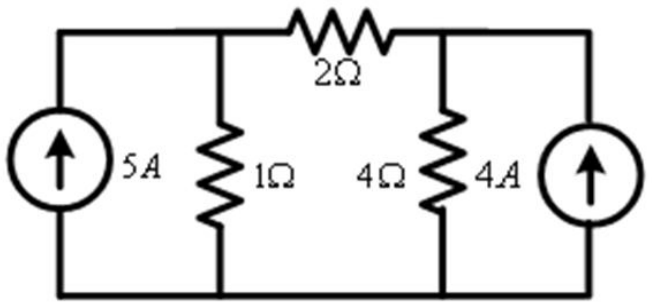
$$-3V_1+7V_2=144 \quad \ldots (2)$$

$$\begin{array}{l|l} 3V_1-V_2=128 & \times 7 \\ -3V_1+7V_2=144 & \times 1 \end{array} \Rightarrow \begin{array}{l} 21V_1-7V_2=896 \\ -3V_1+7V_2=144 \quad + \end{array}$$

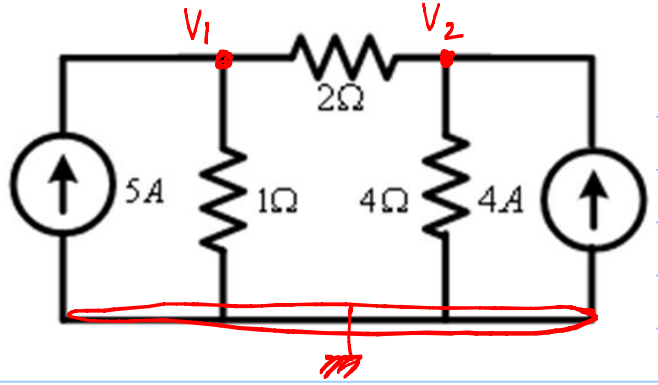
$$18V_1=1040$$

$$V_1=57{,}8 \Rightarrow V=V_1-0=57{,}8\ V$$

Tentukan arus pada 2 Ohm analisis node !



Tentukan arus pada 2 Ohm analisis node !



Node V_1 :

$$\frac{V_1-0}{1}+\frac{V_1-V_2}{2}-5=0$$

$$2V_1+V_1-V_2-10=0$$

$$3V_1-V_2=10 \quad \cdots (1)$$

Node V_2 :

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

$$2V_2-2V_1+V_2-16=0$$

$$-2V_1+3V_2=16 \quad \cdots (2)$$

$$\begin{array}{l|l} 3V_1-V_2=10 & \times 3 \\ -2V_1+3V_2=16 & \times 1 \end{array} \Rightarrow \begin{array}{l} 9V_1-3V_2=30 \\ -2V_1+3V_2=16 \\ \hline \end{array} +$$

$$7V_1=46 \Rightarrow 3V_1-V_2=10$$

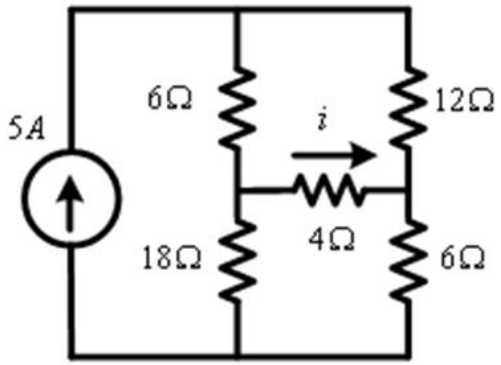
$$V_1=\frac{46}{7}$$

$$V_2=3V_1-10=3.\frac{46}{7}-10=$$

$$V_2=\frac{138-70}{7}=\frac{68}{7}$$

$$i=\frac{V_2-V_1}{2}=\frac{\frac{68}{7}-\frac{46}{7}}{2}=\frac{22}{14}=\frac{11}{7}\,A$$

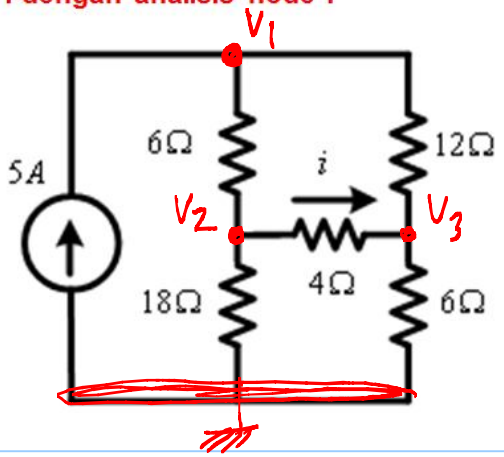
Tentukan i dengan analisis node !



$$\begin{pmatrix} 3 & -2 & -1 \\ -6 & 17 & -9 \\ -1 & -3 & 6 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \\ V_3 \end{pmatrix} = \begin{pmatrix} 60 \\ 0 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 45 \\ V_2 = 27 \\ V_3 = 21 \end{matrix}$$

$$i = \frac{V_2 - V_3}{4} = \frac{27-21}{4} = \frac{6}{4} = 1{,}5\ A$$

Tentukan i dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{6} + \frac{V_1 - V_3}{12} - 5 = 0$$

$$2V_1 - 2V_2 + V_1 - V_3 - 60 = 0$$

$$3V_1 - 2V_2 - V_3 = 60 \ldots (1)$$

Node V_2 :

$$\frac{V_2 - V_3}{4} + \frac{V_2 - V_1}{6} + \frac{V_2 - 0}{18} = 0$$

$$9V_2 - 9V_3 + 6V_2 - 6V_1 + 2V_2 = 0$$

$$-6V_1 + 17V_2 - 9V_3 = 0 \ldots (2)$$

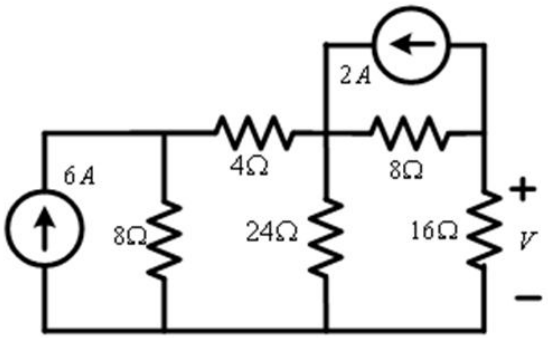
Node V_3 :

$$\frac{V_3 - V_2}{4} + \frac{V_3 - V_1}{12} + \frac{V_3 - 0}{6} = 0$$

$$3V_3 - 3V_2 + V_3 - V_1 + 2V_3 = 0$$

$$-V_1 - 3V_2 + 6V_3 = 0 \ldots (3)$$

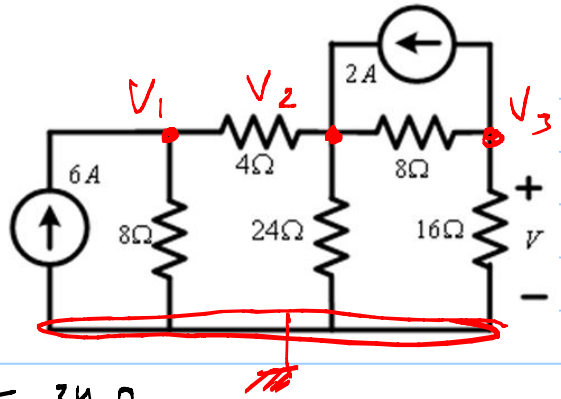
Tentukan V dengan analisis node !



$$\begin{pmatrix} 3 & -2 & 0 \\ -6 & 10 & -3 \\ 0 & -2 & 3 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \\ V_3 \end{pmatrix} = \begin{pmatrix} 48 \\ 48 \\ -32 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 34{,}7 \\ V_2 = 28 \\ V_3 = 8 \end{matrix}$$

$V = V_3 = 8V$

Tentukan V dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{4} + \frac{V_1 - 0}{8} - 6 = 0$$

$$2V_1 - 2V_2 + V_1 - 48 = 0$$

$$3V_1 - 2V_2 = 48 \quad \ldots (1)$$

Node V_2 :

$$\frac{V_2 - V_1}{4} + \frac{V_2 - 0}{24} + \frac{V_2 - V_3}{8} - 2 = 0$$

$$6V_2 - 6V_1 + V_2 + 3V_2 - 3V_3 - 48$$

$$-6V_1 + 10V_2 - 3V_3 = 48 \quad \ldots (2)$$

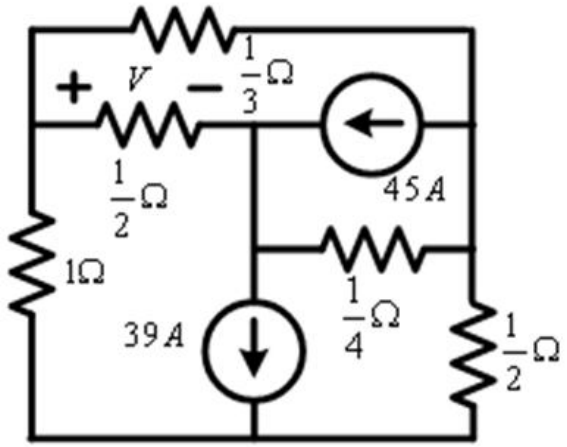
Node V_3 :

$$\frac{V_3 - V_2}{8} + \frac{V_3 - 0}{16} + 2 = 0$$

$$2V_3 - 2V_2 + V_3 + 32 = 0$$

$$-2V_2 + 3V_3 = -32 \quad \ldots (3)$$

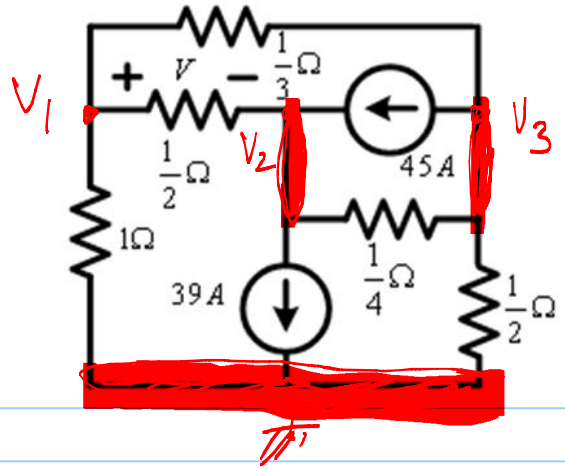
Tentukan V dengan analisis node !



$$\begin{pmatrix} 6 & -2 & -3 \\ -2 & 6 & -4 \\ -3 & -4 & 9 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \\ V_3 \end{pmatrix} = \begin{pmatrix} 0 \\ 45 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 15 \\ V_2 = 22{,}5 \\ V_3 = 15 \end{matrix}$$

$V = V_1 - V_2 = 15 - 22{,}5 = -7{,}5\ V$

Tentukan V dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{\frac{1}{2}} + \frac{V_1 - V_3}{\frac{1}{3}} + \frac{V_1 - 0}{1} = 0$$

$2V_1 - 2V_2 + 3V_1 - 3V_3 + V_1 = 0$

$6V_1 - 2V_2 - 3V_3 = 0 \quad \ldots (1)$

Node V_2 :

$$\frac{V_2 - V_1}{\frac{1}{2}} + \frac{V_2 - V_3}{\frac{1}{4}} - 45 = 0$$

$2V_2 - 2V_1 + 4V_2 - 4V_3 - 45 = 0$

$-2V_1 + 6V_2 - 4V_3 = 45 \quad \ldots (2)$

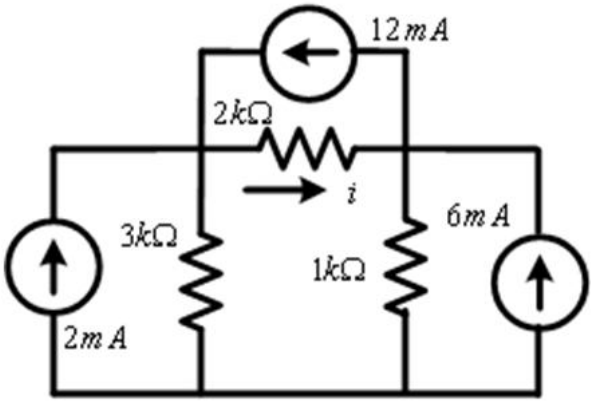
Node V_3 :

$$\frac{V_3 - V_1}{\frac{1}{3}} + \frac{V_3 - V_2}{\frac{1}{4}} + \frac{V_3 - 0}{\frac{1}{2}} = 0$$

$3V_3 - 3V_1 + 4V_3 - 4V_2 + 2V_3 = 0$

$-3V_1 - 4V_2 + 9V_3 = 0 \quad \ldots (3)$

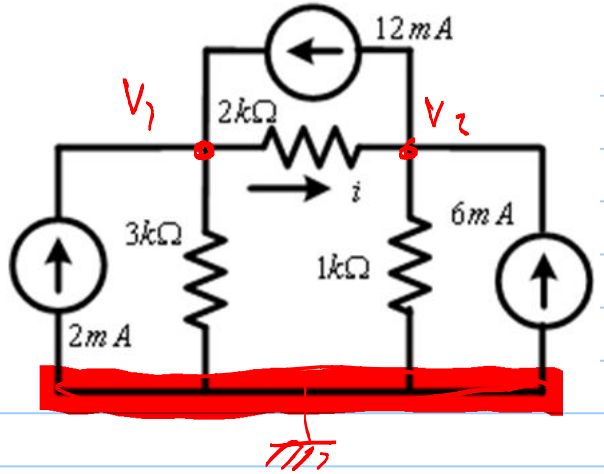
Tentukan i dengan analisis node !



$$\begin{pmatrix} 5 & -3 \\ -1 & 3 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 84 \\ -12 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 18 \\ V_2 = 2 \end{matrix}$$

$$i = \frac{V_1 - V_2}{2k} = \frac{18 - 2}{2k} = 8\,mA$$

Tentukan i dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{2k} + \frac{V_1 - 0}{3k} - 2\,mA - 12\,mA = 0$$

$$3V_1 - 3V_2 + 2V_1 - 12 - 72 = 0$$

$$5V_1 - 3V_2 = 84 \quad \ldots (1)$$

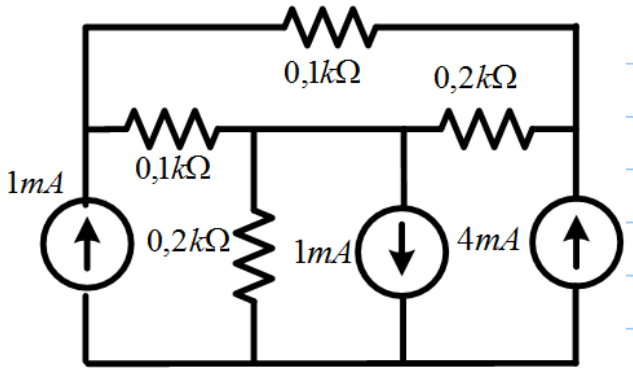
Node V_2 :

$$\frac{V_2 - V_1}{2k} + \frac{V_2 - 0}{1k} + 12\,mA - 6mA = 0$$

$$V_2 - V_1 + 2V_2 + 24 - 12 = 0$$

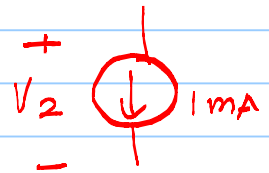
$$-V_1 + 3V_2 = -12 \quad \ldots (2)$$

Tentukan daya yang diserap sumber arus 1 mA dengan analisis node !

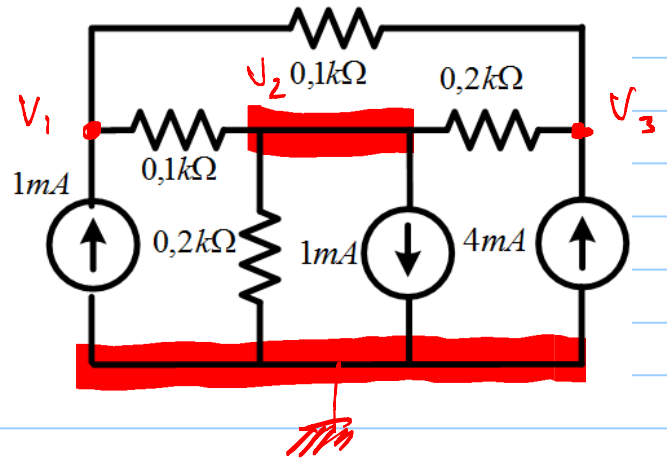


$$\begin{pmatrix} 20 & -10 & -10 \\ -10 & 20 & -5 \\ -10 & -5 & 15 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ V_3 \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \\ 4 \end{pmatrix}$$

$\Rightarrow$ $V_1 = 1{,}075\ V$
$V_2 = 0{,}8\ V$
$V_3 = 1{,}25\ V$



Tentukan daya yang diserap sumber arus 1 mA dengan analisis node !



$-10V_1 - 5V_2 + 15V_3 = 4 \quad \ldots(3)$

$P = V_2 I = 0{,}8 \cdot 1\ mA = 0{,}8\ mW$

Menyerap

Node V_1 :

$$\frac{V_1 - V_2}{0{,}1k} + \frac{V_1 - V_3}{0{,}1k} - 1\ mA = 0$$

$$10V_1 - 10V_2 + 10V_1 - 10V_3 - 1 = 0$$

$$20V_1 - 10V_2 - 10V_3 = 1 \quad \ldots(1)$$

Node V_2 :

$$\frac{V_2 - V_1}{0{,}1k} + \frac{V_2 - V_3}{0{,}2k} + \frac{V_2 - 0}{0{,}1k} + 1\ mA = 0$$

$$10V_2 - 10V_1 + 5V_2 - 5V_3 + 5V_2 + 1 = 0$$

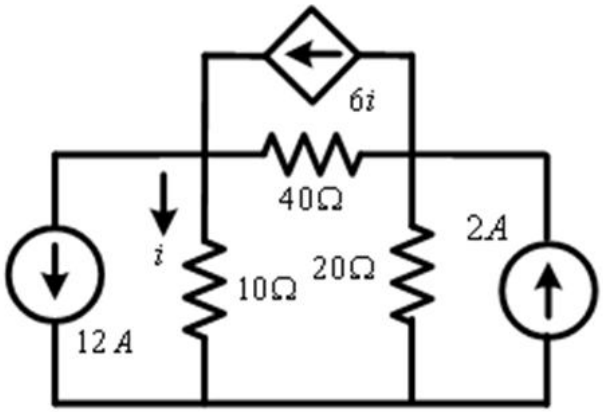
$$-10V_1 + 20V_2 - 5V_3 = -1 \quad \ldots(2)$$

Node V_3 :

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

$$10V_3 - 10V_1 + 5V_3 - 5V_2 - 4 = 0$$

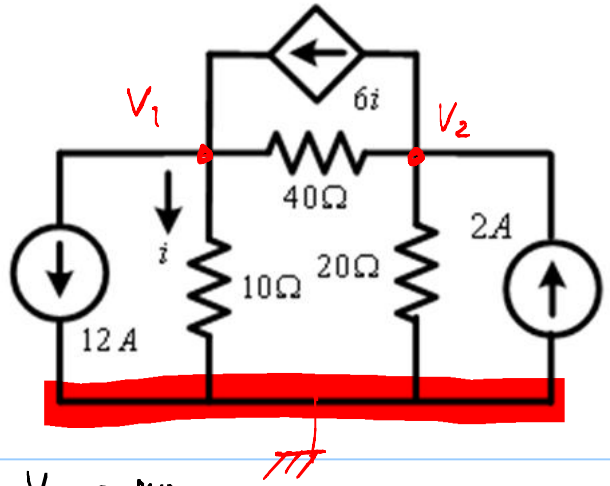
Tentukan i dengan analisis node !



$$\begin{pmatrix} 5 & -1 & -240 \\ -1 & 3 & 240 \\ 1 & 0 & -10 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ i \end{pmatrix} = \begin{pmatrix} -480 \\ 80 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 40 \\ V_2 = -280 \\ i = 4 \end{matrix}$$

$i = 4A$

Tentukan i dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{40} + \frac{V_1 - 0}{10} - 6i + 12 = 0$$

$$V_1 - V_2 + 4V_1 - 240i + 480 = 0$$

$$5V_1 - V_2 - 240i = -480 \quad \ldots (1)$$

Node V_2 :

$$\frac{V_2 - V_1}{40} + \frac{V_2 - 0}{20} + 6i - 2 = 0$$

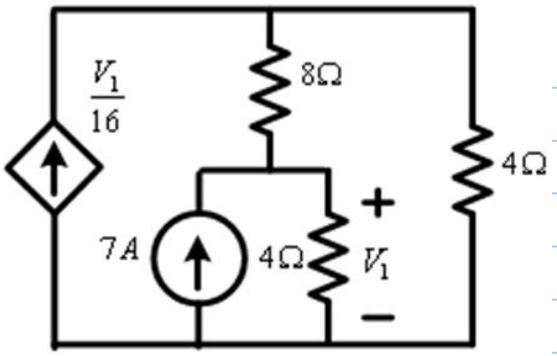
$$V_2 - V_1 + 2V_2 + 240i - 80 = 0$$

$$-V_1 + 3V_2 + 240i = 80 \quad \ldots (2)$$

$$i = \frac{V_1 - 0}{10}$$

$$V_1 - 10i = 0 \quad \ldots (3)$$

Tentukan V_1 dengan analisis node !



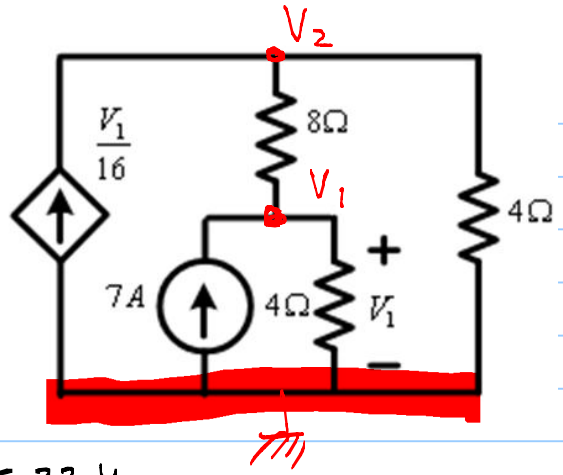
$$\begin{pmatrix} 3 & -1 \\ -3 & 6 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 56 \\ 0 \end{pmatrix} \Rightarrow$$

$V_1 = 22{,}4$

$V_2 = 11{,}2$

$V_1 = 22{,}4V$

Tentukan V_1 dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_2}{8} + \frac{V_1 - 0}{4} - 7 = 0$$

$$V_1 - V_2 + 2V_1 - 56 = 0$$

$$3V_1 - V_2 = 56 \quad \ldots (1)$$

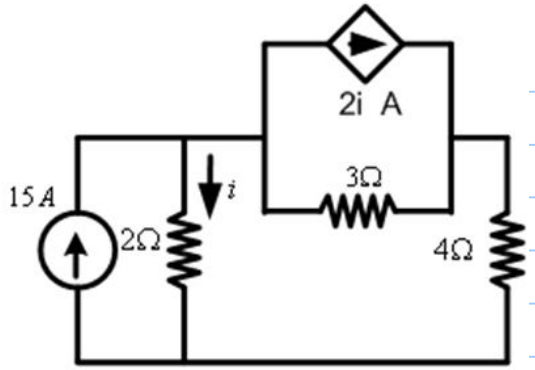
Node V_2 :

$$\frac{V_2 - V_1}{8} + \frac{V_2 - 0}{4} - \frac{V_1}{16} = 0$$

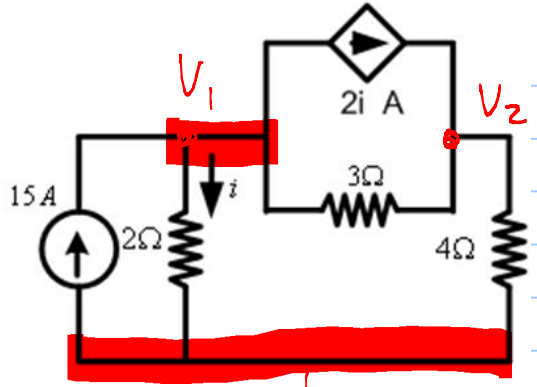
$$2V_2 - 2V_1 + 4V_2 - V_1 = 0$$

$$-3V_1 + 6V_2 = 0 \quad \ldots (2)$$

Tentukan i dengan analisis node !



Tentukan i dengan analisis node !



$$\begin{pmatrix} 5 & -2 & 12 \\ -4 & 7 & -24 \\ 1 & 0 & -2 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \\ i \end{pmatrix} = \begin{pmatrix} 90 \\ 0 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 14 \\ V_2 = 32 \\ i = 7 \end{matrix}$$

$i = \boxed{7A}$

Node V_1 :

$$\frac{V_1-0}{2} + \frac{V_1-V_2}{3} + 2i - 15 = 0$$

$$3V_1 + 2V_1 - 2V_2 + 12i - 90 = 0$$

$$5V_1 - 2V_2 + 12i = 90 \quad \ldots (1)$$

Node V_2 :

$$\frac{V_2-V_1}{3} + \frac{V_2-0}{4} - 2i = 0$$

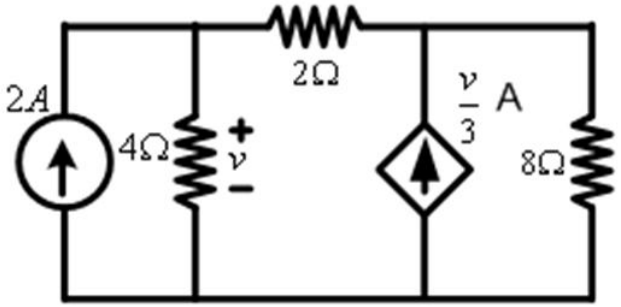
$$4V_2 - 4V_1 + 3V_2 - 24i = 0$$

$$-4V_1 + 7V_2 - 24i = 0 \quad \ldots (2)$$

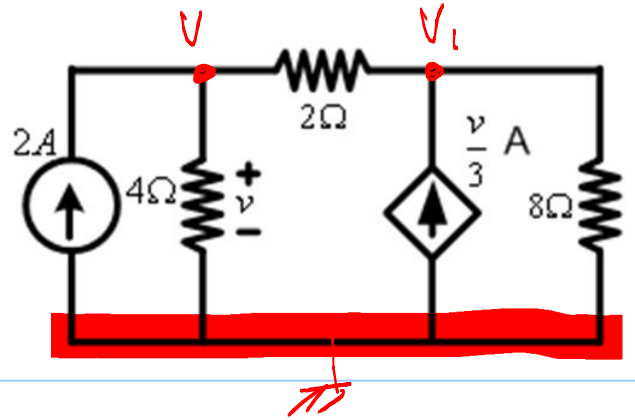
$$i = \frac{V_1-0}{2}$$

$$V_1 - 2i = 0 \quad \ldots (3)$$

Tentukan v dengan analisis node !



Tentukan v dengan analisis node !



Node V :

$\frac{V-0}{4} + \frac{V-V_1}{2} - 2 = 0$

$V + 2V - 2V_1 - 8 = 0$

$3V - 2V_1 = 8 \quad \ldots (1)$

Node V_1 :

$\frac{V_1 - V}{2} + \frac{V_1 - 0}{8} - \frac{V}{3} = 0$

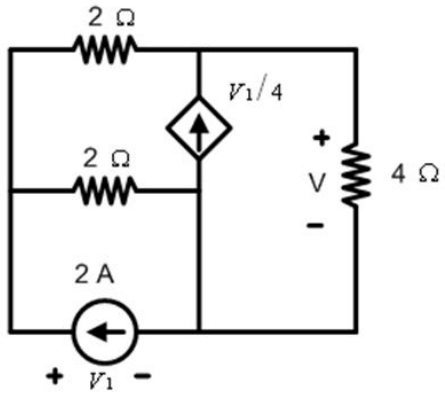
$12V_1 - 12V + 3V_1 - 8V = 0$

$-20V + 15V_1 = 0 \ldots (2)$

$$\begin{pmatrix} 3 & -2 \\ -20 & 15 \end{pmatrix} \begin{pmatrix} V \\ V_1 \end{pmatrix} = \begin{pmatrix} 8 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V = 24 \\ V_1 = 32 \end{matrix}$$

$V = 24\,V$

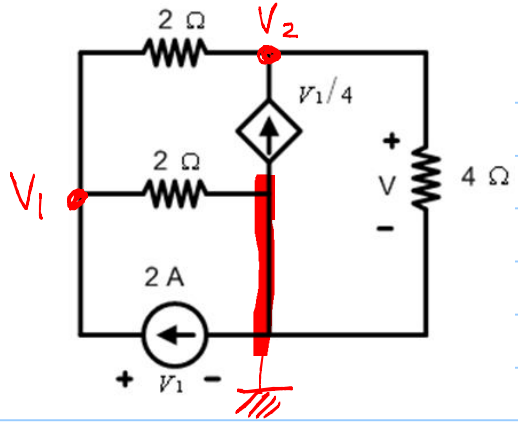
Tentukan V_1 dengan analisis node !



$$\begin{pmatrix} 2 & -1 \\ -3 & 3 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 4 \\ V_2 = 4 \end{matrix}$$

$V_1 = 4$ volt

Tentukan V_1 dengan analisis node !



Node V_1 :

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

$$V_1 - V_2 + V_1 - 4 = 0$$

$$2V_1 - V_2 = 4 \quad \ldots (1)$$

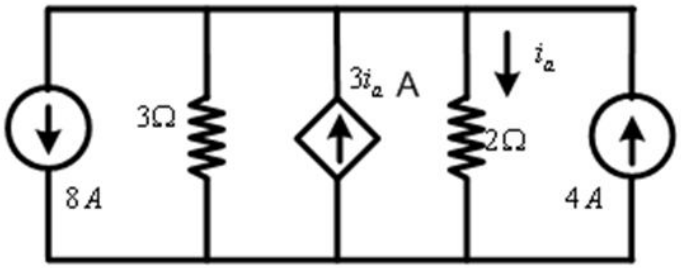
Node V_2 :

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

$$2V_2 - 2V_1 + V_2 - V_1 = 0$$

$$-3V_1 + 3V_2 = 0 \quad \ldots (2)$$

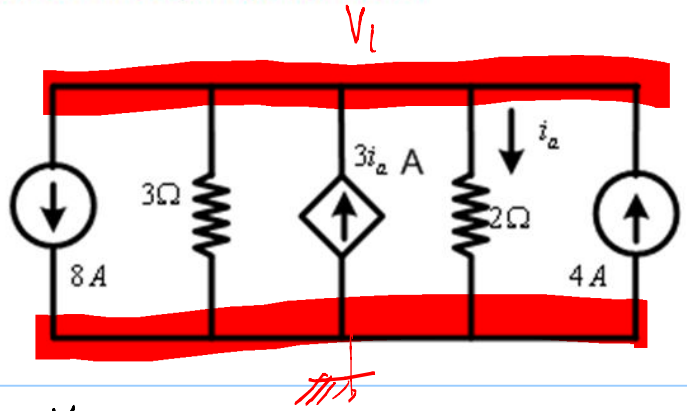
Tentukan i_a dengan analisis node !



$$\begin{pmatrix} 3 & -18 \\ 1 & -2 \end{pmatrix} \begin{pmatrix} V_1 \\ i_a \end{pmatrix} = \begin{pmatrix} -24 \\ 0 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 4 \\ i_a = 2 \end{matrix}$$

$i_a = \boxed{2A}$

Tentukan i_a dengan analisis node !



Node V_1 :

$$\frac{V_1 - 0}{3} + \frac{V_1 - 0}{2} + 8 - 4 - 3i_a = 0$$

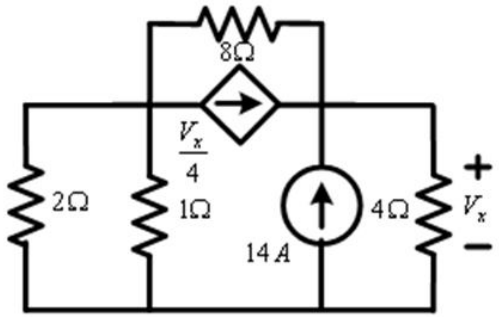
$$2V_1 + 3V_1 + 48 - 24 - 18i_a = 0$$

$$3V_1 - 18i_a = -24 \ldots\ldots (1)$$

$$i_a = \frac{V_1 - 0}{2}$$

$$V_1 - 2i_a = 0 \ldots\ldots (2)$$

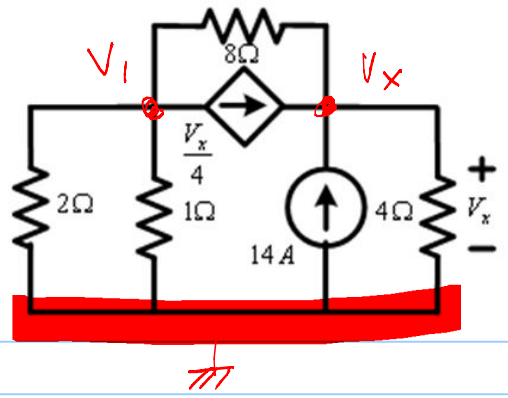
Tentukan V_x dengan analisis node !



$$\begin{pmatrix} 13 & 1 \\ -1 & 1 \end{pmatrix}\begin{pmatrix} V_1 \\ V_x \end{pmatrix} = \begin{pmatrix} 0 \\ 112 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = -8 \\ V_x = 104 \end{matrix}$$

$V_x = 104\ V$

Tentukan V_x dengan analisis node !



Node V_1 :

$$\frac{V_1 - V_x}{8} + \frac{V_1 - 0}{2} + \frac{V_1 - 0}{1} + \frac{V_x}{4} = 0$$

$$V_1 - V_x + 4V_1 + 8V_1 + 2V_x = 0$$

$$13V_1 + V_x = 0 \quad \ldots (1)$$

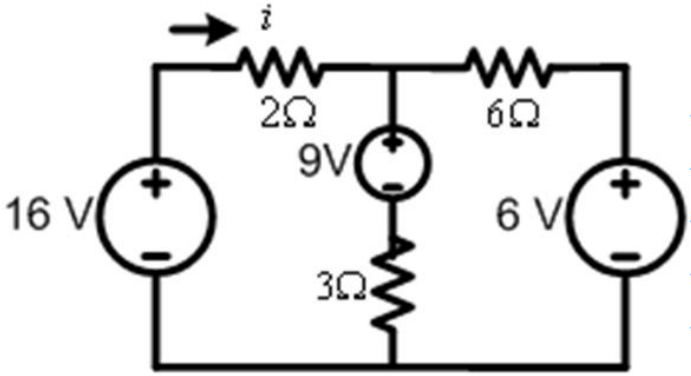
Node V_x :

$$\frac{V_x - 0}{4} + \frac{V_x - V_1}{8} - \frac{V_x}{4} - 14 = 0$$

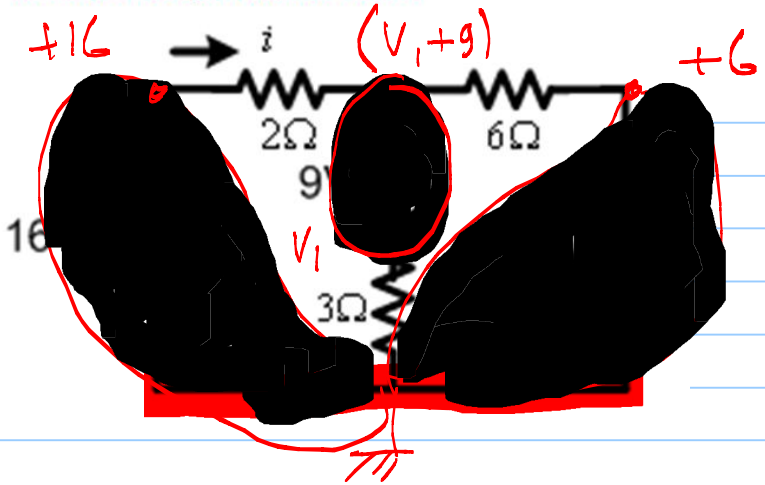
$$2V_x + V_x - V_1 - 2V_x - 112 = 0$$

$$-V_1 + V_x = 112 \quad \ldots (2)$$

Tentukan i dengan analisis node !



Tentukan i dengan analisis node !



Node V_1 :

$$\frac{(V_1+9)-16}{2}+\frac{(V_1+9)-6}{6}+\frac{V_1-0}{3}=0$$

$$3V_1-15+V_1+3+2V_1=0$$

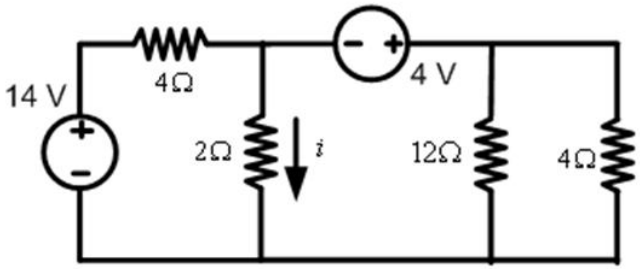
$$6V_1-12=0$$

$$V_1=\frac{12}{6}=2$$

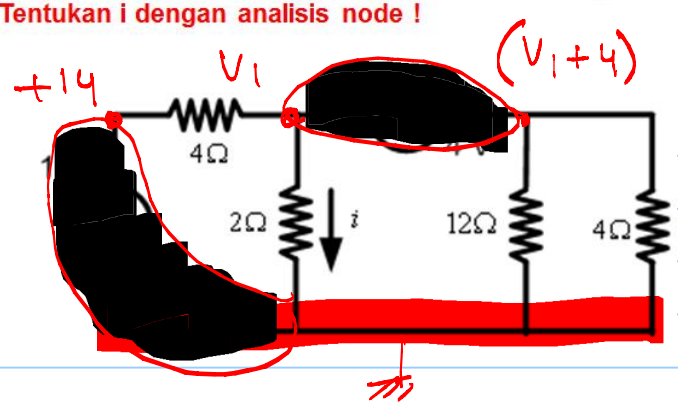
$$i=\frac{16-(V_1+9)}{2}$$

$$i=\frac{16-(2+9)}{2}=2{,}5A$$

Tentukan i dengan analisis node !



Tentukan i dengan analisis node !



Node V_1 :

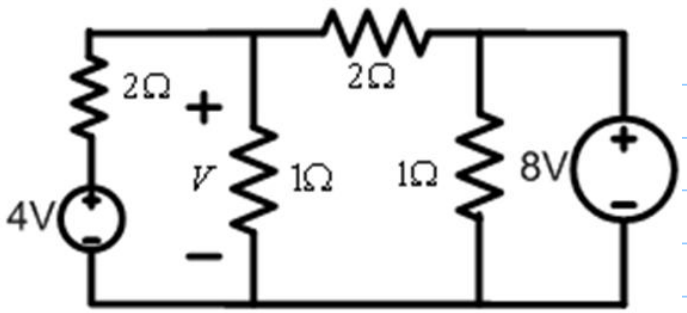
$$\frac{V_1-14}{4}+\frac{V_1-0}{2}+\frac{V_1+4-0}{12}+\frac{(V_1+4)-0}{4}=0$$

$$3V_1-42+6V_1+V_1+4+3V_1+12=0$$

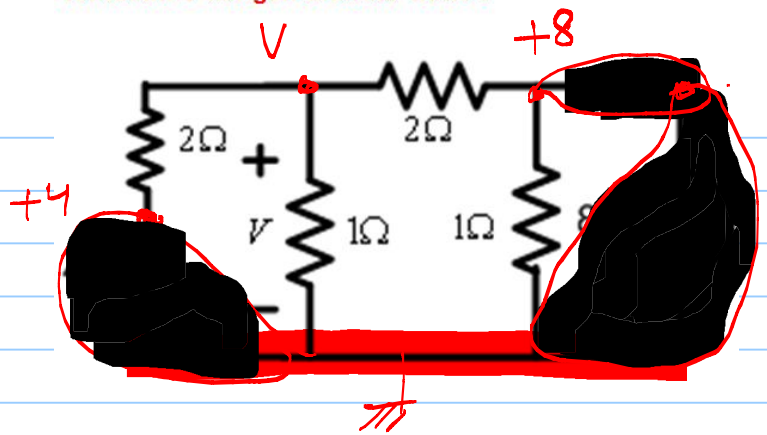
$$13V_1-26=0$$

$$V_1=\frac{26}{13}=2 \Rightarrow i=\frac{V_1-0}{2}=\frac{2-0}{2}=1A$$

Tentukan V dengan analisis node !



Tentukan V dengan analisis node !



Node V:

$$\frac{V-4}{2} + \frac{V-0}{1} + \frac{V-8}{2} = 0$$

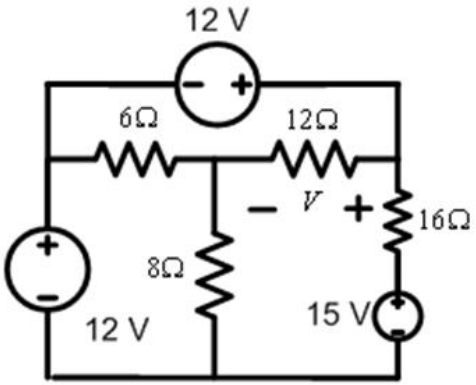
$$V - 4 + 2V + V - 8 = 0$$

$$3V - 12 = 0$$

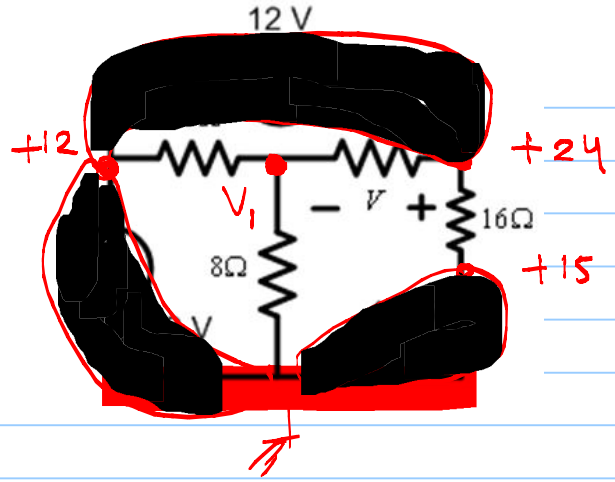
$$V = \frac{12}{3} = 4$$

$V = 4$ volt

Tentukan V dengan analisis node !



Tentukan V dengan analisis node !



Node V_1 :

$$\frac{V_1-12}{6}+\frac{V_1-0}{8}+\frac{V_1-24}{12}=0$$

$$4V_1-48+3V_1+2V_1-48=0$$

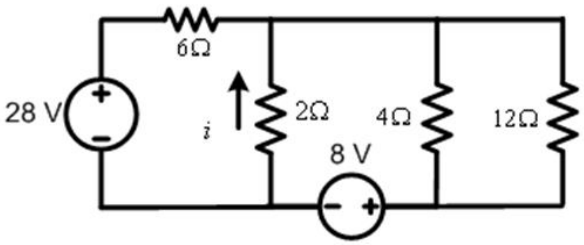
$$9V_1-96=0 \Rightarrow V_1=\frac{96}{9}=\frac{32}{3}$$

$$V=24-V_1=24-\frac{32}{3}$$

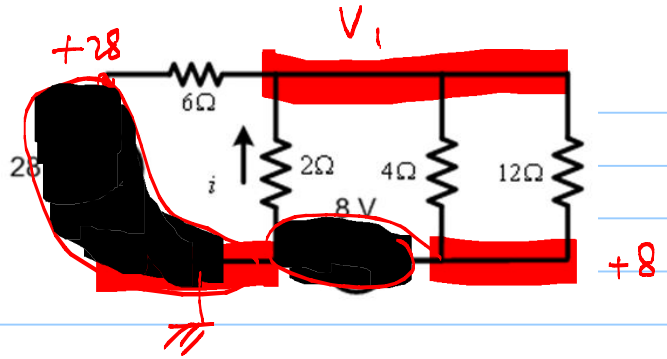
$$=\frac{72-32}{3}$$

$$V=\frac{40}{3}\ \text{volt}$$

Tentukan i dengan analisis node !



Tentukan i dengan analisis node !



Node V_1 :

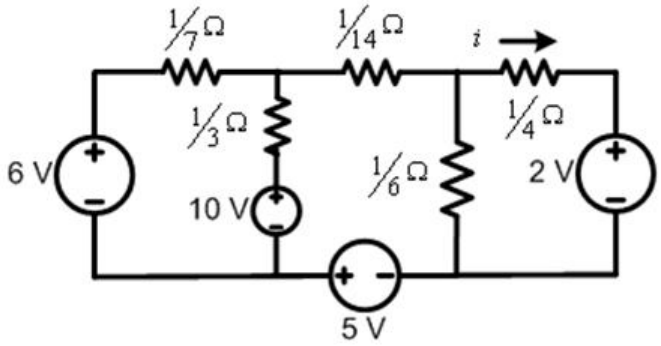
$$\frac{V_1-28}{6}+\frac{V_1-0}{2}+\frac{V_1-8}{4}+\frac{V_1-8}{12}=0$$

$$2V_1-56+6V_1+3V_1-24+V_1-8=0$$

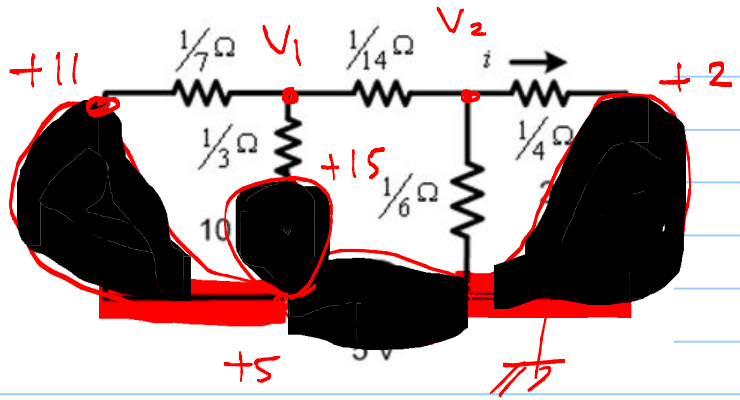
$$12V_1-88=0$$

$$V_1=\frac{88}{12} \Rightarrow i=\frac{0-\frac{88}{12}}{2}=-\frac{44}{12}=\frac{-22}{6}=\frac{-11}{3}\,A$$

Tentukan i dengan analisis node !



Tentukan i dengan analisis node !



Node V_1 :

$$\frac{V_1-11}{\frac{1}{7}} + \frac{V_1-15}{\frac{1}{3}} + \frac{V_1-V_2}{\frac{1}{14}} = 0$$

$$7V_1-77+3V_1-45+14V_1-14V_2=0$$

$$24V_1-14V_2=112 \quad \ldots (1)$$

Node V_2 :

$$\frac{V_2-V_1}{\frac{1}{14}} + \frac{V_2-2}{\frac{1}{4}} + \frac{V_2-0}{\frac{1}{6}} = 0$$

$$14V_2-14V_1+4V_2-8+6V_2=0$$

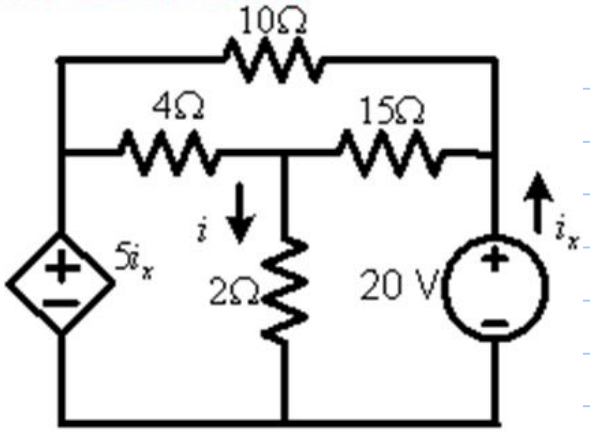
$$-14V_1+24V_2=8 \quad \ldots (2)$$

$$\begin{pmatrix} 24 & -14 \\ -14 & 24 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} 112 \\ 8 \end{pmatrix}$$

$$\Rightarrow V_1 = 7{,}37$$
$$V_2 = 4{,}63$$

$$i = \frac{V_2-2}{\frac{1}{4}} = \frac{4{,}63-2}{\frac{1}{4}} = 10{,}52\ A$$

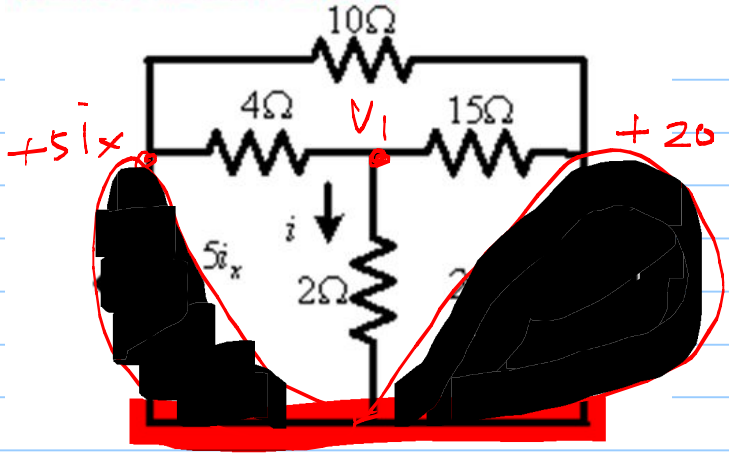
Tentukan i dengan analisis node !
(sumber $5i_x$ dalam Ampere)



$$\begin{pmatrix} 49 & -75 \\ -2 & -45 \end{pmatrix}\begin{pmatrix} V_1 \\ i_x \end{pmatrix} = \begin{pmatrix} 80 \\ -40 \end{pmatrix} \Rightarrow \begin{matrix} V_1 = 2{,}8 \\ i_x = 0{,}76 \end{matrix}$$

$$i = \frac{V_1 - 0}{2} = \frac{2{,}8 - 0}{2} = 1{,}4\ A$$

Tentukan i dengan analisis node !
(sumber $5i_x$ dalam Ampere)



Node V_1 :

$$\frac{V_1 - 5i_x}{4} + \frac{V_1 - 0}{2} + \frac{V_1 - 20}{15} = 0$$

$$15V_1 - 75i_x + 30V_1 + 4V_1 - 80 = 0$$

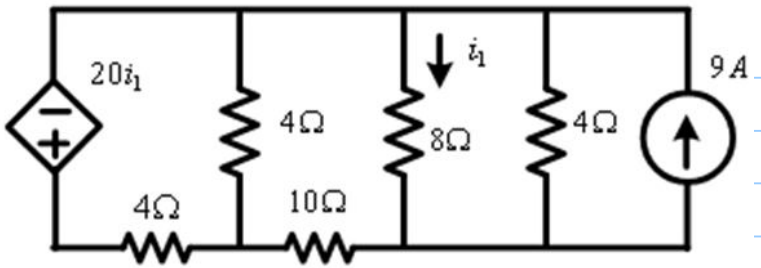
$$49V_1 - 75i_x = 80 \quad \ldots (1)$$

$$i_x = \frac{20 - V_1}{15} + \frac{20 - 5i_x}{10}$$

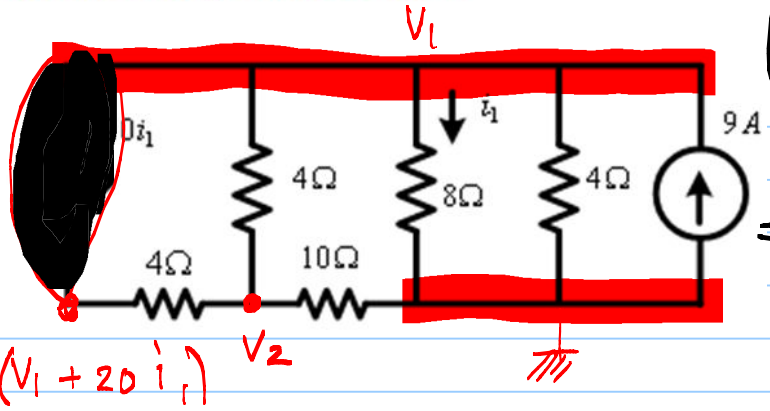
$$30i_x = 40 - 2V_1 + 60 - 15i_x$$

$$-2V_1 - 45i_x = -40 \quad \ldots (2)$$

Tentukan i_1 dengan analisis node !



Tentukan i_1 dengan analisis node !



$$\begin{pmatrix} 7 & -4 & 40 \\ -10 & 12 & -150 \\ 1 & 0 & -8 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ i_1 \end{pmatrix} = \begin{pmatrix} 72 \\ 0 \\ 0 \end{pmatrix}$$

$V_1 = 16$

$\Rightarrow V_2 = 30$

$i_1 = 2$

$i_1 = 2A$

$+(V_1 + 20\,i_1)$

Node V_1

$$\frac{V_1 - V_2}{4} + \frac{V_1 - 0}{8} + \frac{V_1 - 0}{4} - 9 + \frac{(V_1 + 20i_1) - V_2 = 0}{4}$$

$$2V_1 - 2V_2 + V_1 + 2V_1 - 72 + 2V_1 + 40i_1 - 2V_2 = 0$$

$$7V_1 - 4V_2 + 40i_1 = 72 \quad \cdots (1)$$

Node V_2 :

$$\frac{V_2 - V_1}{4} + \frac{V_2 - 0}{10} + V_2 - \frac{(V_1 + 20i_1)}{4} = 0$$

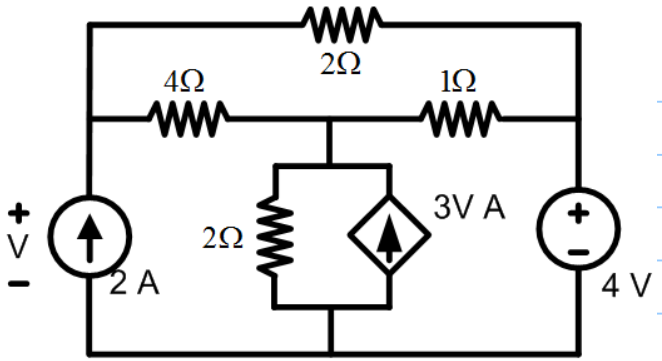
$$5V_2 - 5V_1 + 2V_2 + 5V_2 - 5V_1 - 100i_1 = 0$$

$$-10V_1 + 12V_2 - 100i_1 = 0 \quad \cdots (2)$$

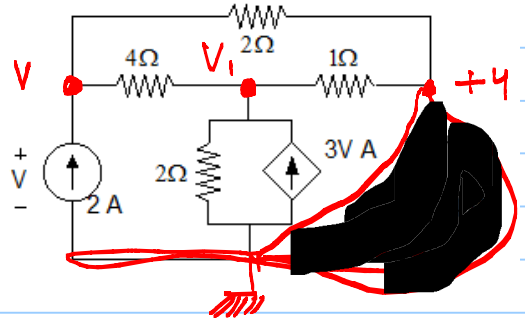
$$V_1 = 8i_1$$

$$V_1 - 8i_1 = 0 \quad \cdots (3)$$

Tentukan V dengan analisis node !



16. Tentukan tegangan V dengan analisis node !



Node V :

$$\frac{V-V_1}{4}+\frac{V-4}{2}-2=0$$

$$V-V_1+2V-8-8=0$$

$$3V-V_1=16 \quad \ldots (1)$$

Node V_1

$$\frac{V_1-V}{4}+\frac{V_1-4}{1}+\frac{V_1-0}{2}-3V=0$$

$$V_1-V+4V_1-16+2V_1-12V=0$$

$$-13V+7V_1=16 \quad \ldots (2)$$

$$\begin{array}{rl|l} 3V-V_1=16 & \times 7 & \Rightarrow \quad 21V-7V_1=112 \\ -13V+7V_1=16 & \times 1 & \quad -13V+7V_1=16 \; + \end{array}$$

$$8V=128$$

$$V=\boxed{16\,V}$$