

NODE - VOLTAGE METHOD

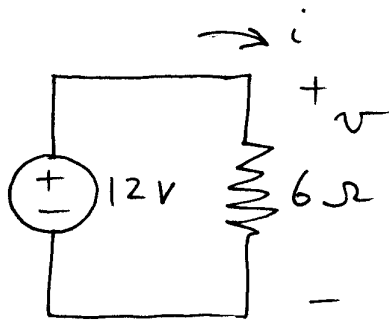
UNKNOWNNS ARE VOLTAGE DIFFERENCES
BETWEEN CIRCUIT NODES AND A
GROUND REFERENCE MODE.

KCL GENERATES EQUATIONS.

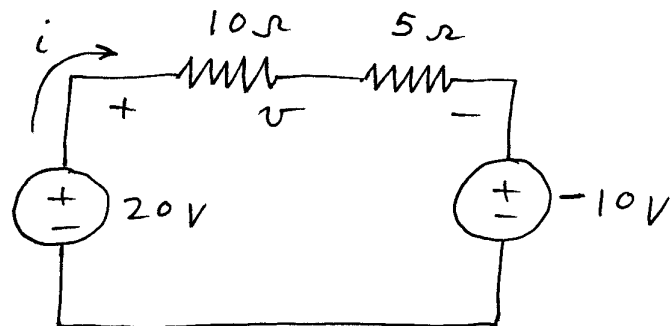
MESH - CURRENT METHOD

UNKNOWNNS ARE CIRCULATING
CURRENTS IN "WINDOW PANES"

SOME PRELIMINARIES



$$v = 12 \quad i = \frac{12V}{6\Omega} = 2A$$

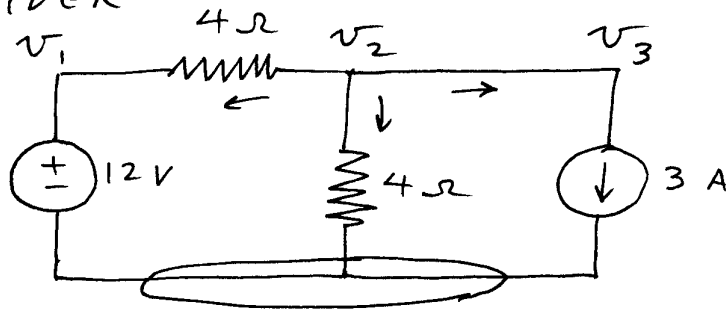


$$v = 20 - (-10) \\ = 30V$$

$$i = \frac{v}{10+5} = \frac{30}{15} = 2A$$

NODE VOLTAGE NOT NEEDED FOR
SIMPLE LOOPS OR THINGS IN SERIES

CONSIDER



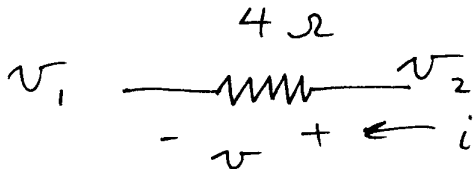
"GROUND REFERENCE"

$$v_1 = 12V \quad v_3 = v_2$$

$$\text{KCL} \quad \frac{v_2 - v_1}{4} + \frac{v_2}{4} + 3 = 0$$

$$\frac{v_2 - 12}{4} + \frac{v_2}{4} + 3 = 0$$

$$\text{SOL'N} \quad v_2 = 0$$



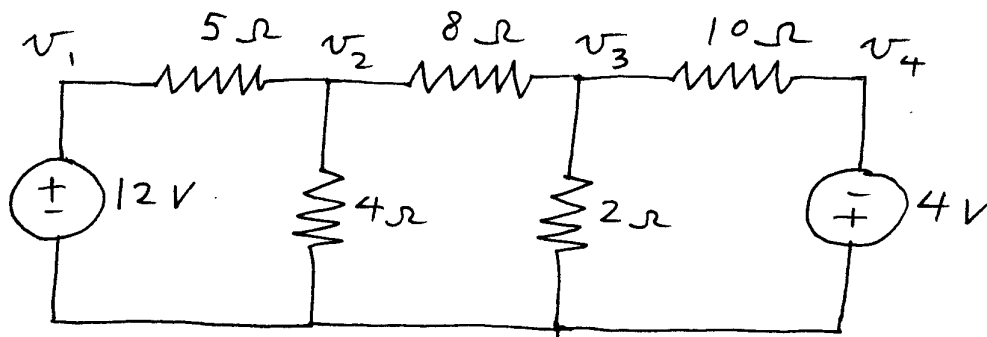
$$v = v_2 - v_1$$

$$v_1 = 12V$$

$$v = iR$$

$$i = \frac{v}{R} = \frac{v_2 - v_1}{4}$$

$$= \frac{v_2 - 12}{4}$$



$$v_1 = 12$$

$$v_4 = -4$$

GROUND
REFERENCE

NODE
EQUATIONS

$$\frac{v_2 - 12}{5} + \frac{v_2}{4} + \frac{v_2 - v_3}{8} = 0$$

$$\frac{v_3 - v_2}{8} + \frac{v_3}{2} + \frac{v_3 - (-4)}{10} = 0$$

$$\left(\frac{1}{5} + \frac{1}{4} + \frac{1}{8}\right)v_2 + \left(-\frac{1}{8}\right)v_3 = \frac{12}{5}$$

$$\left(-\frac{1}{8}\right)v_2 + \left(\frac{1}{8} + \frac{1}{2} + \frac{1}{10}\right)v_3 = -\frac{4}{10}$$

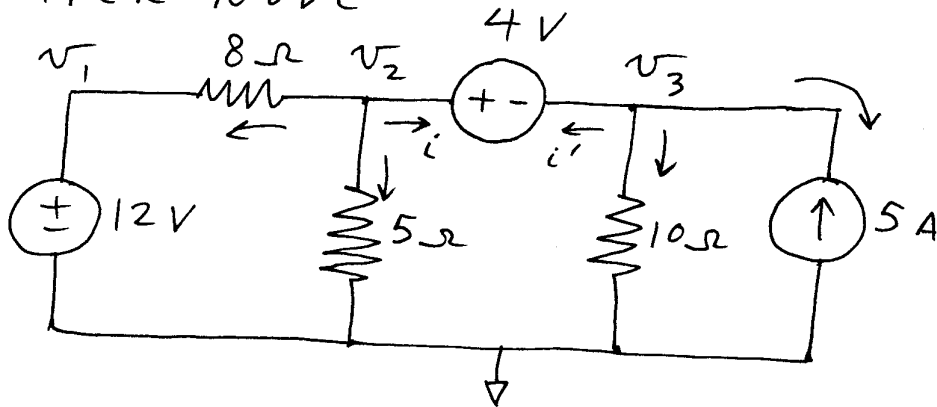
$$.575 v_2 - .125 v_3 = 2.4$$

$$-.125 v_2 + .725 v_3 = -.4$$

$$v_2 = \frac{\begin{vmatrix} 2.4 & -.125 \\ -.4 & .725 \end{vmatrix}}{\begin{vmatrix} .575 & -.125 \\ -.125 & .725 \end{vmatrix}} = \frac{1.69}{.401} = 4.214$$

$$v_3 = .1748$$

"SUPER NODE"

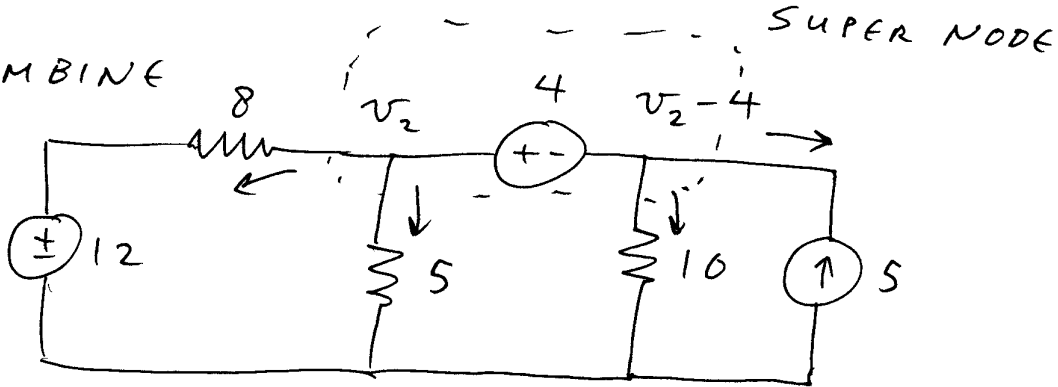


$$v_1 = v_2 \quad v_3 = v_2 - 4 \quad i' = -i$$

$$\frac{v_2 - 12}{8} + \frac{v_2}{5} + i = 0$$

$$i' + \frac{v_3}{10} - 5 = 0$$

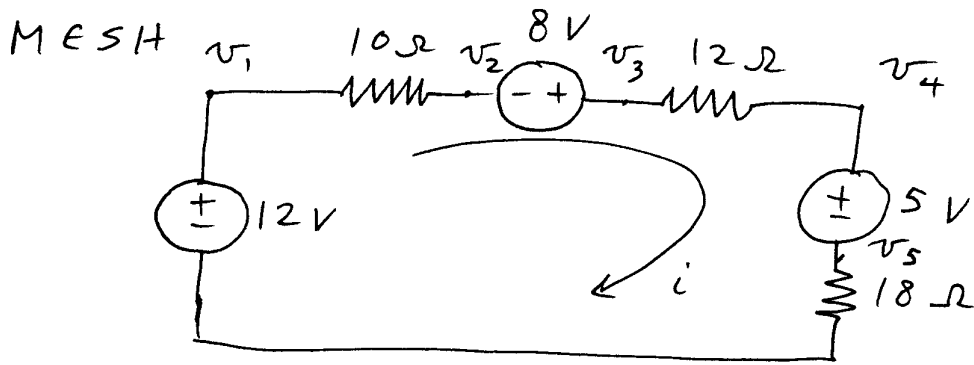
COMBINE



$$\frac{v_2 - 12}{8} + \frac{v_2}{5} + \frac{v_2 - 4}{10} - 5 = 0$$

$$\left(\frac{1}{8} + \frac{1}{5} + \frac{1}{10} \right) v_2 = \frac{12}{8} + \frac{4}{10} + 5$$

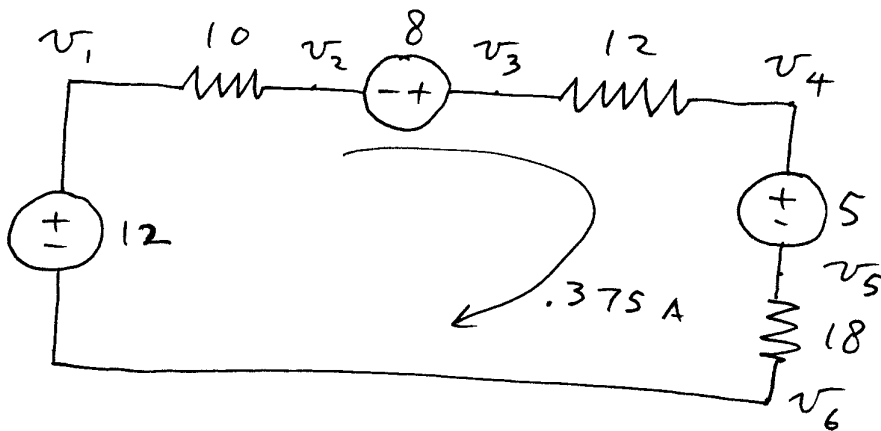
$$v_2 = 16.23 \text{ V}$$



$$-12 + 10i - 8 + 12i + 5 + 18i = 0$$

$$(10 + 12 + 18)i = 12 + 8 - 5$$

$$i = \frac{15}{40} = .375$$



$$v_1 = 12 \quad v_2 = 12 - (10)(.375) = 8.25$$

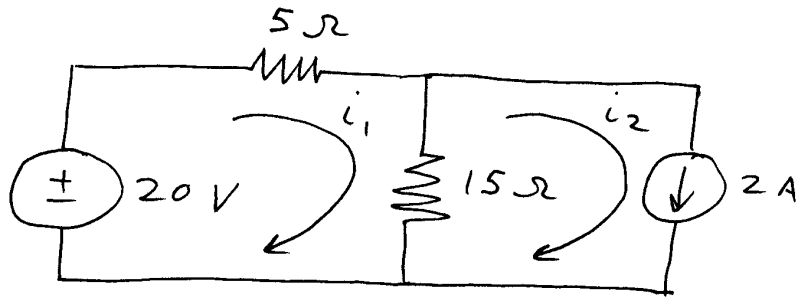
$$v_3 = 8.25 + 8 = 16.25$$

$$v_4 = 16.25 - (12)(.375) = 11.75$$

$$v_5 = 11.75 - 5 = 6.75$$

$$v_6 = 6.75 - (18)(.375) = 0$$

CURRENT-SOURCED MESH



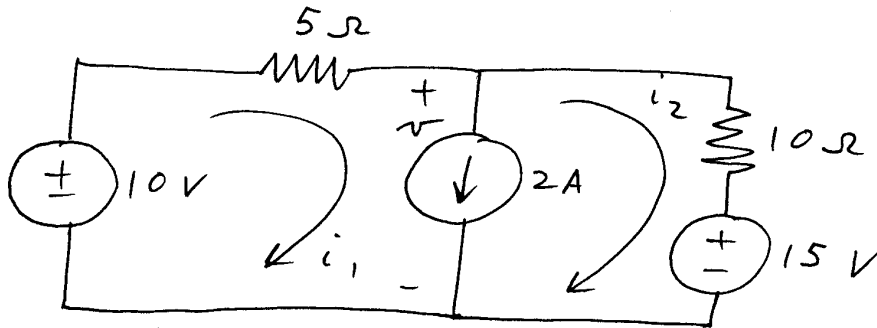
MESH EQ $-20 + 5i_1 + 15(i_1 - i_2) = 0$

CONSTRAINT $i_2 = 2$

SOL'N $(5 + 15)i_1 = 20 + 30$

$$i_1 = \frac{50}{20} = 2.5 \text{ A}$$

SUPER MESH



$$-10 + 5i_1 + v = 0$$

$$-v + 10i_2 + 15 = 0$$

COMBINE

$$-10 + 5i_1 + 10i_2 + 15 = 0$$

CONSTRAINT $i_1 - i_2 = 2 \quad i_2 = i_1 - 2$

$$-10 + 5i_1 + 10(i_1 - 2) + 15 = 0$$

$$(15)i_1 = 10 + 20 - 15 \quad i_1 = 1 \text{ A}$$