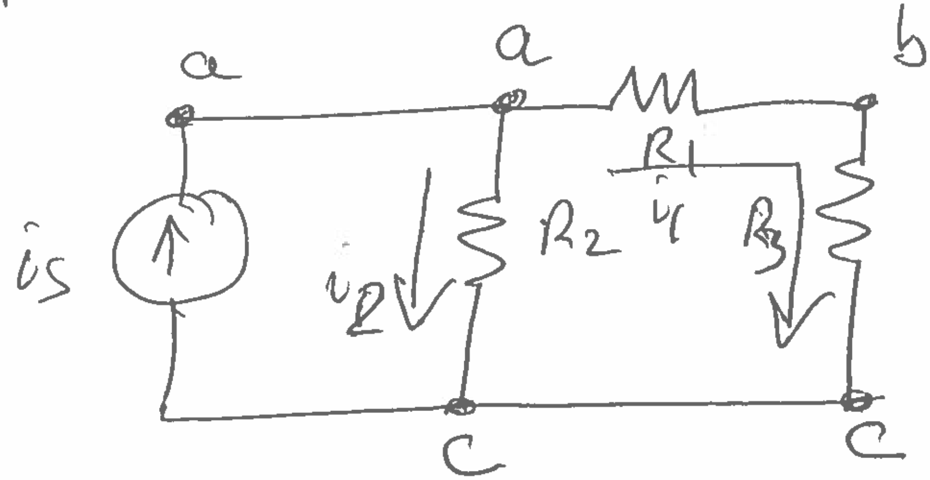
In reality both are specialized ways of doing Kirchhoff equations.

But you do less thinking and they are very easy to put into MATLAB.

Voltage Nodes are points between two or more circuit elements.

Consider



$V_c = 0 \Rightarrow$ Ground point

at a $\quad i_s = i_1 + i_2$

$$i_1 = \frac{V_a - V_b}{R_1} = \frac{V_b}{R_3} \qquad i_2 = \frac{V_a}{R_2}$$

$$i_s = \frac{V_a - V_b}{R_1} + \frac{V_a}{R_2}$$

at node b

$$i_1 = i_1$$

$$\frac{V_a - V_b}{R_1} = \frac{V_b}{R_3}$$

$$i_s = V_a\left(\frac{1}{R_1} + \frac{1}{R_2}\right) - V_b\left(\frac{1}{R_1}\right)$$

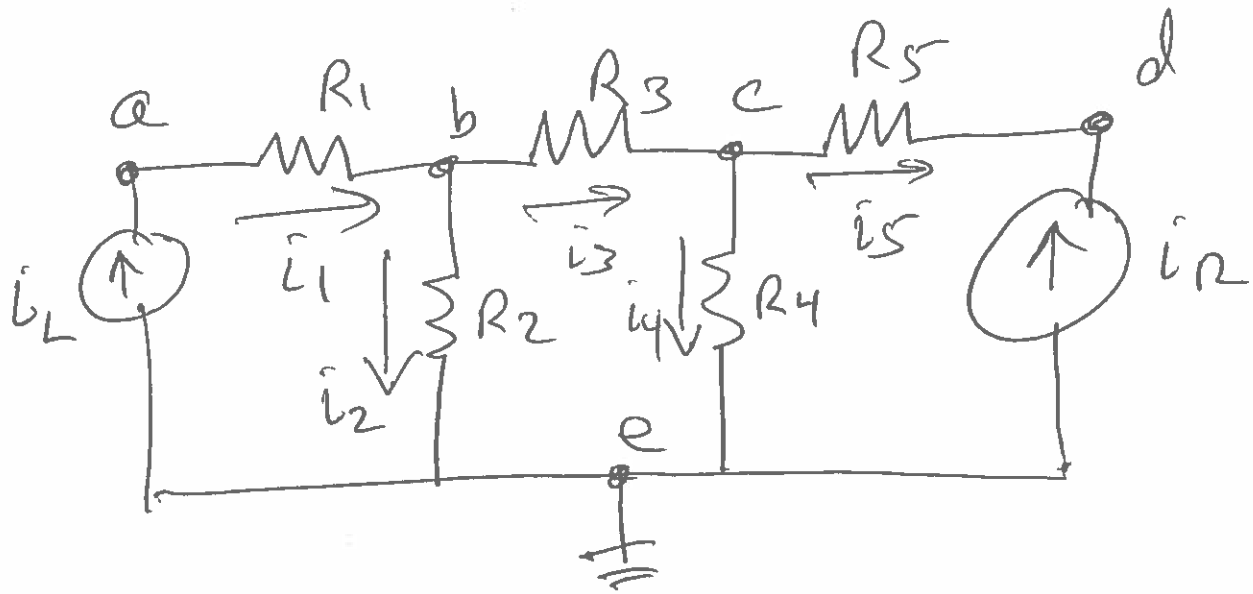
$$0 = -V_a\left(\frac{1}{R_1}\right) + V_b\left(\frac{1}{R_1} + \frac{1}{R_3}\right)$$

Plug in values for R_1, R_2, R_3, and i_s

Get V_a, V_b

$$\left[\frac{1}{R}\right]\left[V\right] = \left[i\right]$$

$$V = \left[\tfrac{1}{R}\right] \backslash \left[i\right]$$



at a

$$i_L = v_a \left(\frac{1}{R_1}\right) - v_b \left(\frac{1}{R_1}\right)$$

at b

$$0 = v_b \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) - v_a \left(\frac{1}{R_1}\right) - v_c \left(\frac{1}{R_3}\right)$$

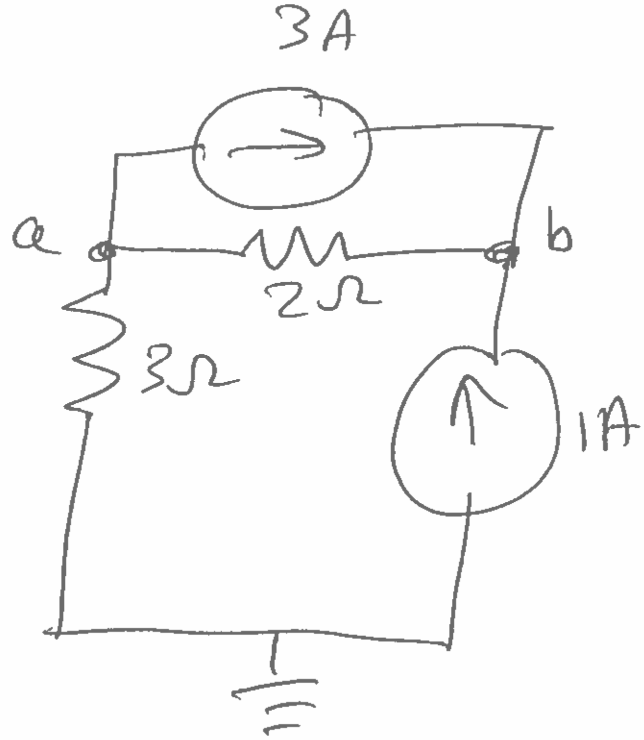
at c

$$0 = v_c \left(\frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}\right) - v_b \left(1/R_3\right) - v_d \left(1/R_5\right)$$

at d

$$i_R = v_d \left(\frac{1}{R_5}\right) - v_c \left(1/R_5\right)$$

Voltage Node example 1



v_a, v_b ?

node a

$$-3A = v_a\left(\frac{1}{2\Omega}+\frac{1}{3\Omega}\right) - v_b\left(1/2\Omega\right)$$

node b

$$3A + 1A = v_b\left(\frac{1}{2\Omega}\right) - v_a\left(\frac{1}{2\Omega}\right)$$

$$-3A = v_a\left(\frac{1}{2\Omega}+\frac{1}{3\Omega}\right) - v_b\left(\frac{1}{2\Omega}\right)$$

$$4A = -v_a\left(\frac{1}{2\Omega}\right) + v_b\left(\frac{1}{2\Omega}\right)$$

add 2 above eqns

$$1A = v_a\left(\frac{1}{3\Omega}\right) \Rightarrow v_a = 3\Omega(1A)$$

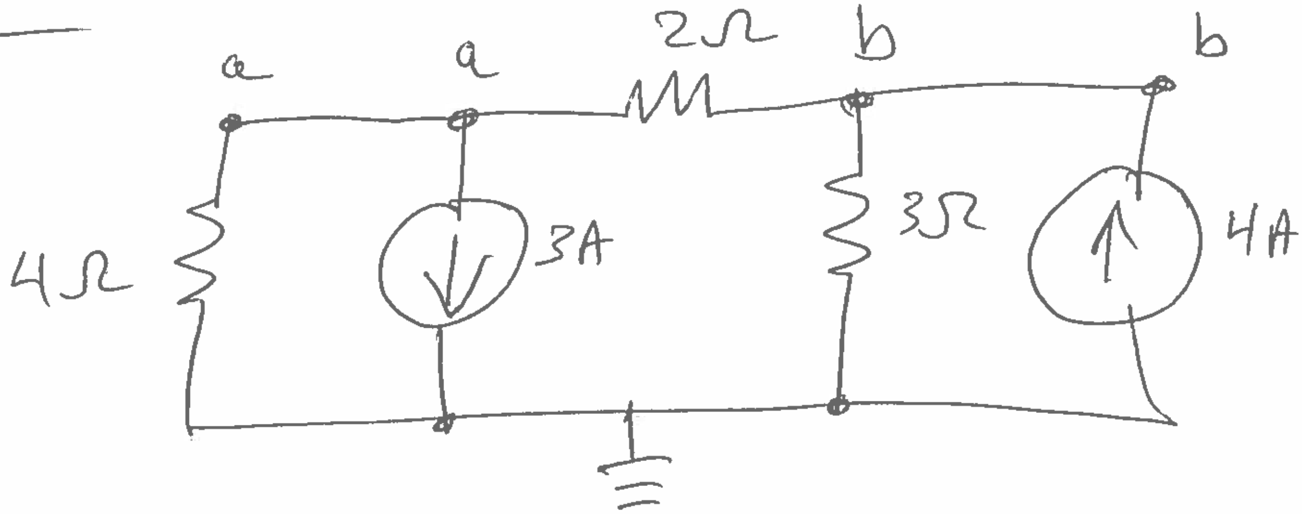
$$\boxed{v_a = 3V}$$

$$4A = v_b\left(\frac{1}{2\Omega}\right) - v_a\left(\frac{1}{2\Omega}\right)$$

$$8V = v_b - v_a = v_b - 3V$$

$$\boxed{v_b = 11V.}$$

ex 2



a/ $-3A = v_a\left(\frac{1}{4\Omega} + \frac{1}{2\Omega}\right) - v_b\left(\frac{1}{2\Omega}\right)$

b/ $4A = v_b\left(\frac{1}{2\Omega} + \frac{1}{3\Omega}\right) - v_a\left(\frac{1}{2\Omega}\right)$

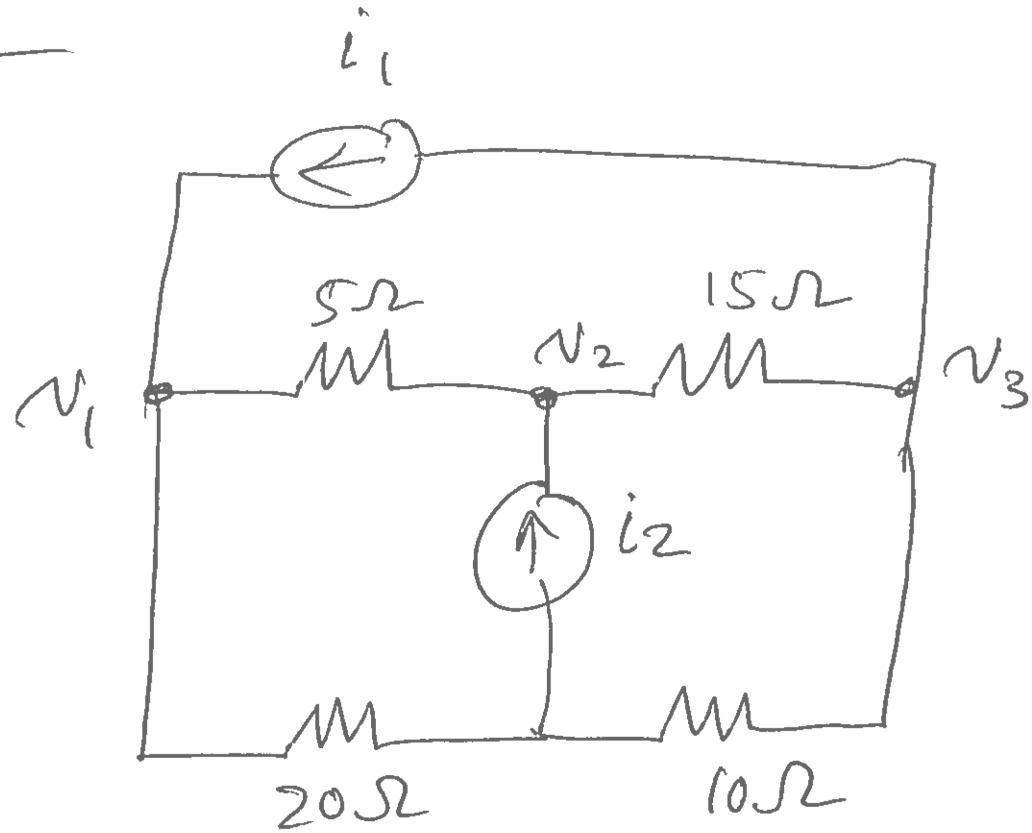
$\frac{1}{R} = G \qquad G = \begin{bmatrix} (1/2 + 1/4) & -(1/2) \\ -(1/2) & (\frac{1}{2} + 1/3) \end{bmatrix}$

$ii = [-3 \quad 4]'$

$V = G \backslash ii \Rightarrow v_a = -\frac{4}{3}V$

$v_b = +4V$

Ex 3



$v_1 = 4V$, $v_2 = 15V$, $v_3 = 18V$

$i_1 = ?$ $\quad i_2 = ?$

v_1/ $$i_1 = v_1\left(\frac{1}{20\Omega} + \frac{1}{5\Omega}\right) - v_2\left(\frac{1}{5\Omega}\right)$$

v_2/ $$i_2 = v_2\left(\frac{1}{15\Omega} + \frac{1}{5\Omega}\right) - v_3\left(\frac{1}{15\Omega}\right) - v_1\left(1/5\Omega\right)$$

v_3/ $-i_1 = v_3\left(\frac{1}{15\Omega} + \frac{1}{10\Omega}\right) - v_2\left(1/15\Omega\right)$

---

use V_1
to solve
for i_1

$$i_1 = 4V\left(\frac{1}{20\Omega} + \frac{1}{5\Omega}\right) - \underbrace{15V\left(1/45\Omega\right)}_{3A}$$

$$\frac{1+4}{20\Omega} = \frac{5}{20} = \frac{1}{4}$$

$$i_1 = 1 - 3A = \boxed{-2A = i_1}$$

Use v_2
to solve
for i_2

$$i_2 = (15V)\left(\frac{1}{15\Omega} + \frac{1}{5\Omega}\right) - (18V)\left(\frac{1}{15\Omega}\right) - 4V\left(\frac{1}{5\Omega}\right)$$

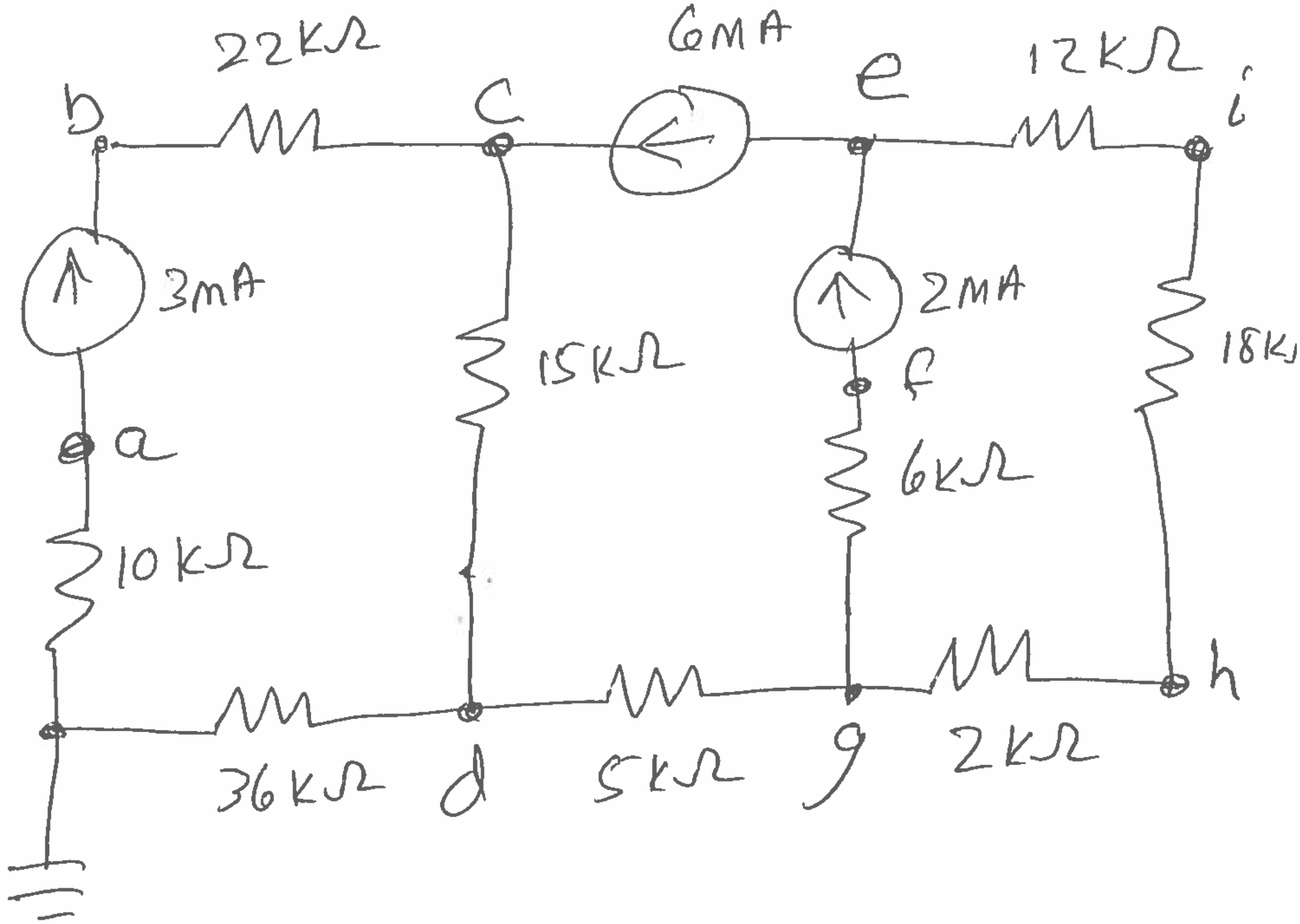
$$= 15V\left(\frac{4}{15\Omega}\right) - \frac{18V}{15\Omega} - \frac{4V}{5\Omega}$$

$$\frac{12V}{15\Omega}$$

~~Multiply by~~

$$i_2 = \frac{(60 - 18 - 12)V}{15\Omega} = \frac{30V}{15\Omega}$$

$$\boxed{i_2 = +2A}$$



a/ $-3\,mA = V_a \left(\frac{1}{10k\Omega}\right)$

b/ $+3\,mA = V_b \left(\frac{1}{22k\Omega}\right) - V_c \left(\frac{1}{22k\Omega}\right)$

c/ $+6\,mA = V_c \left(\frac{1}{22k\Omega} + \frac{1}{15k\Omega}\right) - V_b \left(1/22k\Omega\right)$
$- V_d \left(1/15k\Omega\right)$

d/ $0 = V_d \left(\frac{1}{5k\Omega} + \frac{1}{15k\Omega} + \frac{1}{36k\Omega}\right) - V_g \left(1/5k\Omega\right)$
$- V_c \left(1/15k\Omega\right)$

e/ $+2mA - 6mA = v_e\left(\frac{1}{12k\Omega}\right) - v_i\left(\frac{1}{12k\Omega}\right)$

f/ $-2mA = v_f\left(\frac{1}{6k\Omega}\right) - v_g\left(1/6k\Omega\right)$

g/ $0 = v_g\left(\frac{1}{6k\Omega} + \frac{1}{5k\Omega} + \frac{1}{2k\Omega}\right) - v_f\left(1/6k\Omega\right)$

$- v_d\left(\frac{1}{5k\Omega}\right) - v_h\left(1/2k\Omega\right)$