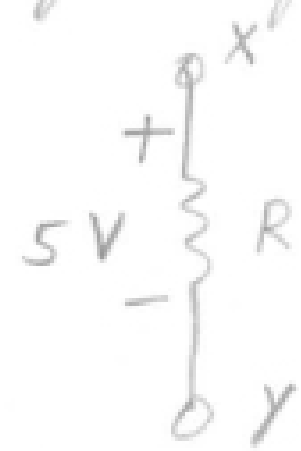
A. Basic nodal analysis

1. Still use KCL
2. But solve for node voltages
3. Voltage – potential between 2 points



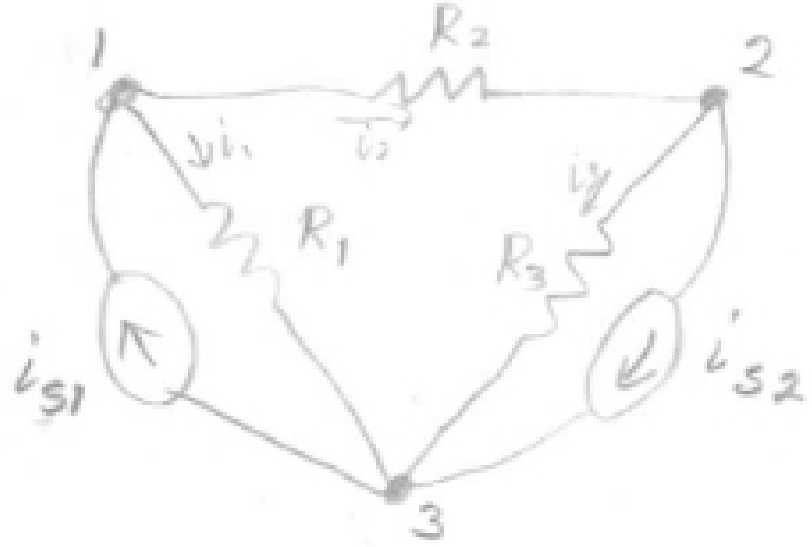
a) need a reference

b) x wrt y

c) or y wrt x

d) ⏚

4.



Essential node – a node which connects three or more circuit elements.

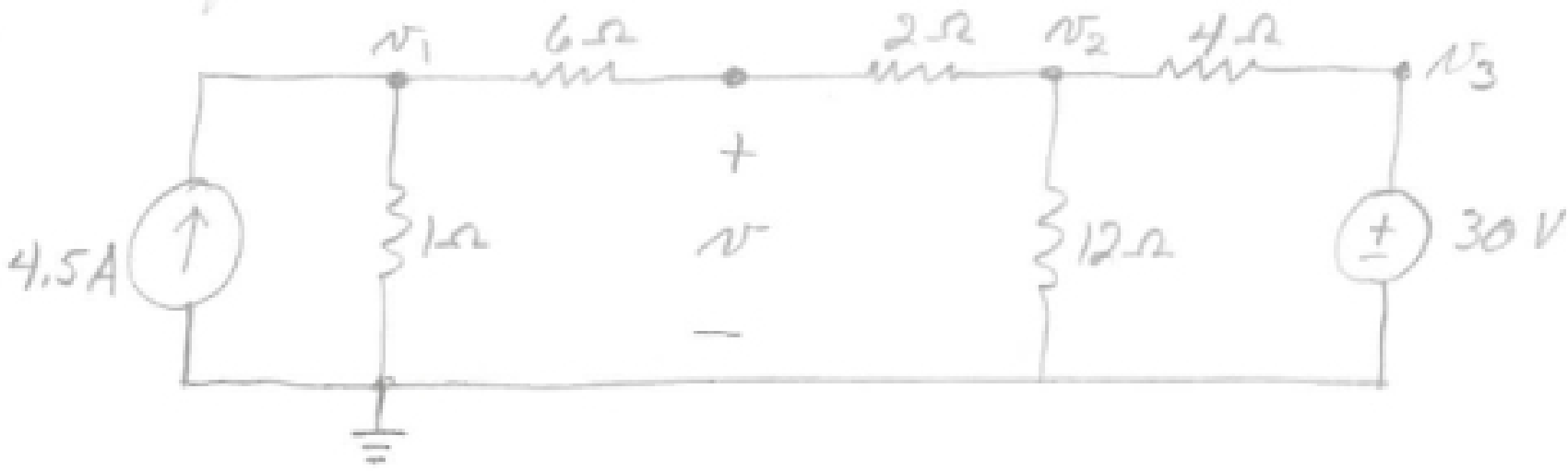
a) Circuit has 3 nodes

b) Pick a reference (n3)

c) $\therefore v_3$ wrt $v_3 = 0$

d) Find v_1 and v_2

Example (Drill 4.16)



Find v :

$$-4.5 + \frac{v_1}{1} + \frac{v_1 - v}{6} = 0$$

$$\frac{v - v_1}{6} + \frac{v - v_2}{2} = 0$$

$$\frac{v_2 - v}{2} + \frac{v_2}{12} + \frac{v_2 - v_3}{4} = 0$$

$$v_3 = 30$$

$$\begin{bmatrix} 7 & -1 & 0 \\ -1 & 4 & -3 \\ 0 & -6 & 10 \end{bmatrix} \begin{bmatrix} v_1 \\ v \\ v_2 \end{bmatrix} = \begin{bmatrix} 27 \\ 0 \\ 90 \end{bmatrix}$$

$$v = \frac{\begin{vmatrix} 7 & 27 & 0 \\ -1 & 0 & -3 \\ 0 & 90 & 10 \end{vmatrix}}{\begin{vmatrix} 7 & -1 & 0 \\ -1 & 4 & -3 \\ 0 & -6 & 10 \end{vmatrix}} = \frac{(7)(270) - (-1)(270)}{(7)(22) - (-1)(-10)} = \frac{2160}{144}$$

$$= 15 \text{ V}$$

Hwk 4.3, 4.7

Make currents entering − and those leaving + to avoid confusion with shortcut procedure (i.e., voltage at node minus voltage away)

e) at node 1:

KCL: or $i_1 + i_2 - i_{s1} = 0$

ohm's law: $i_1 = \frac{\Delta v}{R_1} = \frac{v_1 - 0}{R_1} = \frac{v_1}{R_1}$

$$i_2 = \frac{v_1 - v_2}{R_2}$$

$$\therefore \boxed{\frac{v_1}{R_1} + \frac{v_1 - v_2}{R_2} - i_{s1} = 0}$$

f) at node 2:

KCL: $-i_2 + i_3 + i_{s2} = 0$

ohm's law: $-i_2 = \frac{\Delta v}{R_2} = -\frac{v_1 - v_2}{R_2} = \frac{v_2 - v_1}{R_2}$

$$i_3 = \frac{\Delta v}{R_3} = \frac{v_2 - 0}{R_3} = \frac{v_2}{R_3}$$

$$\therefore \boxed{\frac{v_2 - v_1}{R_2} + \frac{v_2}{R_3} + i_{s2} = 0}$$

g) Voltage at this node minus the voltage at ...

h) Rearrange equations

$$\left(\frac{1}{R_1} + \frac{1}{R_2}\right) v_1 - \frac{1}{R_2} v_2 = i_{s1}$$

$$-\frac{1}{R_2} v_1 + \left(\frac{1}{R_2} + \frac{1}{R_3}\right) v_2 = -i_{s2}$$

could use G or

$$\begin{bmatrix} \frac{1}{R_1} + \frac{1}{R_2} & -\frac{1}{R_2} \\ -\frac{1}{R_2} & \frac{1}{R_2} + \frac{1}{R_3} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} i_{s1} \\ -i_{s2} \end{bmatrix}$$