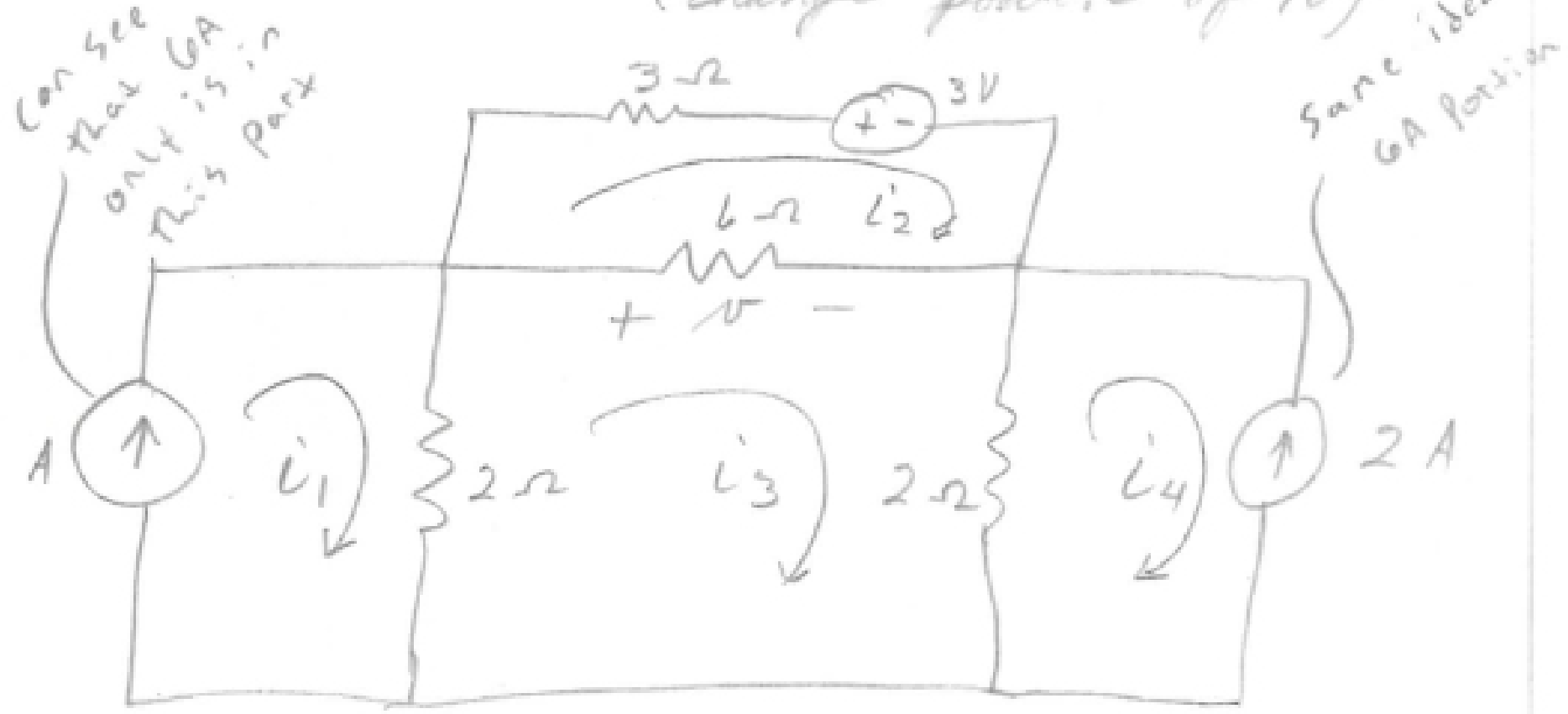
Example

PROB 4.14 Solve 4.6 by mesh analysis (change powers of 10)

J.H.J.



Find v

$$i_1 = 6$$

$$i_4 = -2$$

M2: $3i_2 + 3 + 4(i_2 - i_3) = 0$

M3: $2(i_3 - i_1) + 4(i_3 - i_2) + 2(i_3 - i_4) = 0$

$$\boxed{\begin{aligned} 9i_2 - 4i_3 &= -3 \\ -4i_2 + 10i_3 &= 8 \end{aligned}}$$

$2(i_1 + i_4)$

$\therefore \quad i_2 = -\frac{1}{3} + \frac{2}{3} i_3$

$i_3 = \frac{4}{5} + \frac{3}{5} i_2$

$= \frac{4}{5} - \frac{1}{5} + \frac{2}{5} i_3$

$\frac{3}{5} i_3 = \frac{3}{5}$

$\boxed{i_3 = 1}$

$\therefore \quad i_2 = -\frac{1}{3} + \frac{2}{3}(1)$

$\boxed{i_2 = \frac{1}{3}}$

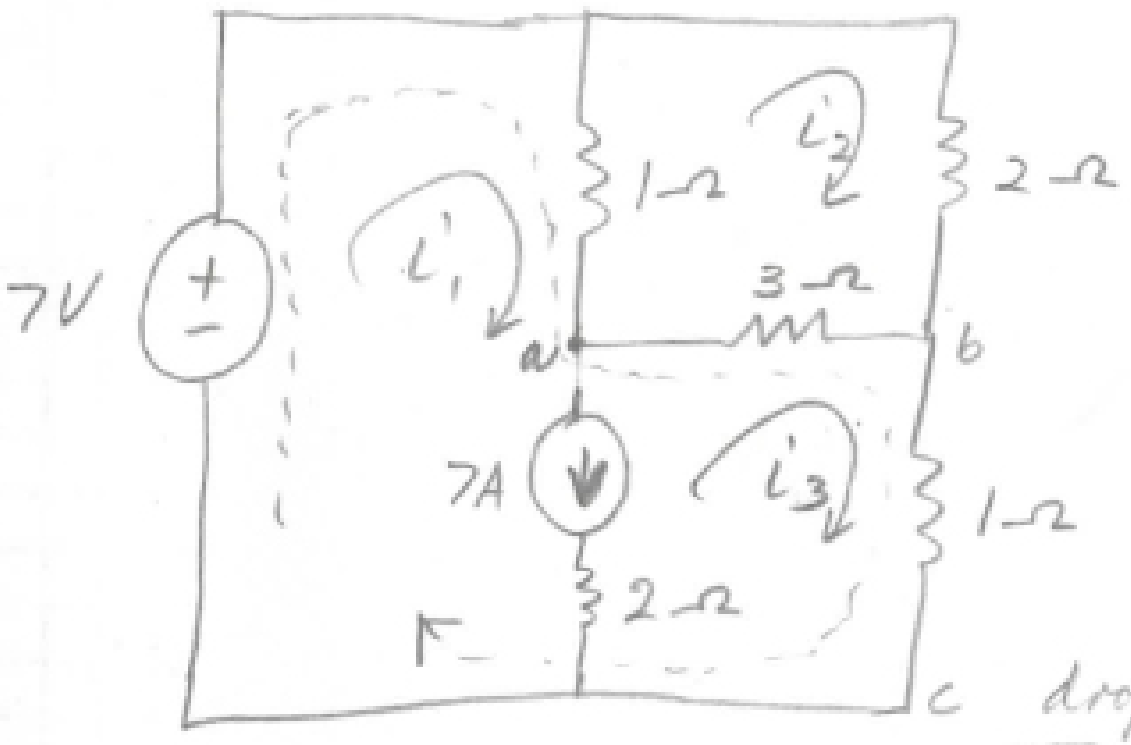
$\therefore \quad v = 4(i_3 - i_2)$

$= 4(1 - \frac{1}{3})$

$\boxed{v = 4 \text{ V}}$

B. Circuits containing current sources

1. Can't use a current source in a KVL eqn.



The 7A source does not solely exist in its own circuit, have to create supermesh

drop for (a b c)

a) KVL: M1 $\quad -7 + 1(i'_1 - i'_2) + 3(i'_3 - i'_2) + i'_3 = 0$ ①

M2 $\quad 1(i'_2 - i'_1) + 2i'_2 + 3(i'_2 - i'_3) = 0$ ②

M3 same as for M1

Get 3rd eqn from current source relation

$$i'_1 - i'_3 = 7 \quad \text{or} \quad i'_3 = i'_1 - 7 \qquad ③$$

b) Trick: open current source to get "supermesh"

c) Substituting for i'_3 gives: (or could solve 3rd order)

$$-7 + (i'_1 - i'_2) + 3(i'_1 - 7 - i'_2) + (i'_1 - 7) = 0$$

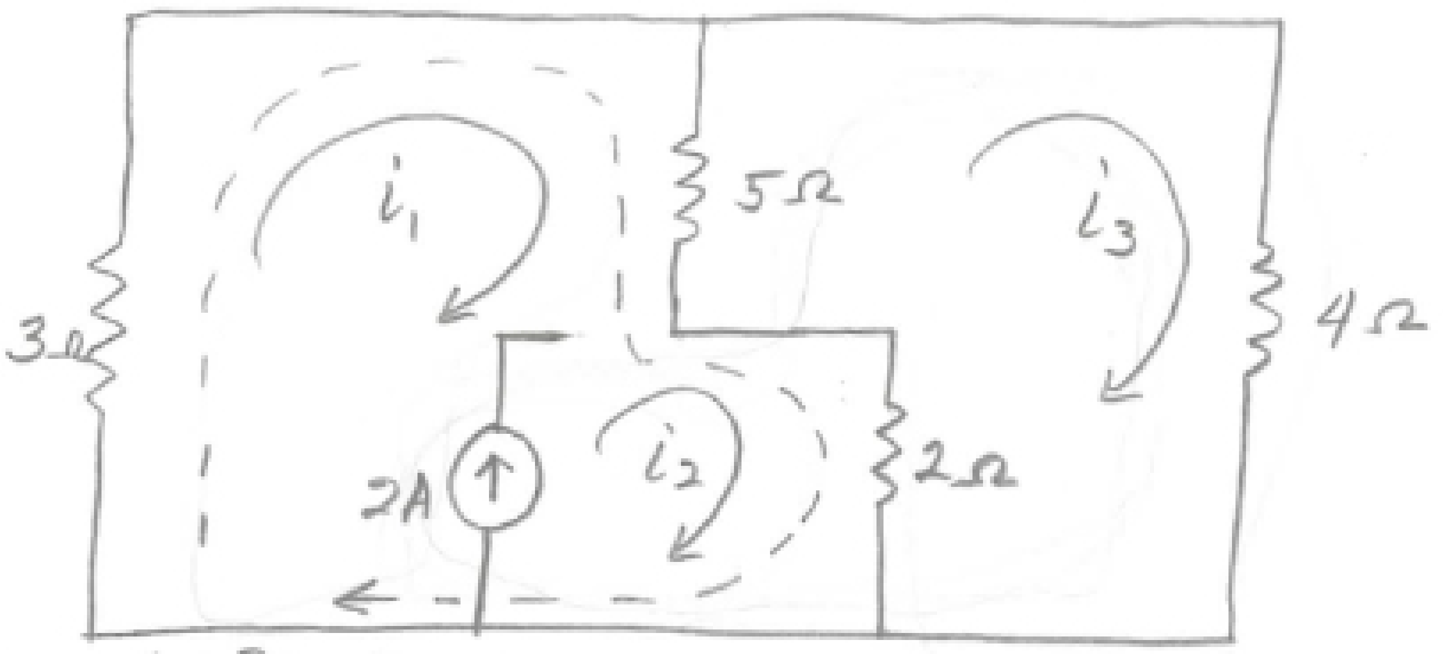
$$(i'_2 - i'_1) + 2i'_2 + 3(i'_2 - i'_1 + 7) = 0$$

or $\begin{bmatrix} 5 & -4 \\ -4 & 6 \end{bmatrix} \begin{bmatrix} i'_1 \\ i'_2 \end{bmatrix} = \begin{bmatrix} 3 \\ -21 \end{bmatrix}$

$i'_1 - 7$

$i'_1 = 9\,A \;;\; i'_2 = 2.5\,A \;;\; i'_3 = 2\,A$

Concept of the supermesh



Hwk
~~4.26, 4.3~~
(4.27), (4.3
Reg Mesh
SF

Find $P_{4\Omega}$:

1. The 2A source cannot be expressed in terms of a single mesh current.

∴ Open source to form supermesh

2.

$$M3: \quad 5(i_3 - i_1) + 4i_3 + 2(i_3 - i_2) = 0$$

$$SM: \quad 3i_1 + 5(i_1 - i_3) + 2(i_2 - i_3) = 0$$

$$i_2 - i_1 = 2$$

$$p = I^2 \cdot R$$

$$-7i_1 + 11i_3 = 4$$

$$10i_1 - 7i_3 = -4$$

$$\therefore i_3 = \frac{\begin{vmatrix} -7 & 4 \\ 10 & -4 \end{vmatrix}}{\begin{vmatrix} -7 & 11 \\ 10 & -7 \end{vmatrix}} = \frac{28-40}{49-110} = \frac{12}{61} = 0.197\,A$$

$$\therefore P_{4\Omega} = (0.197)^2(4) = 0.155\,W$$