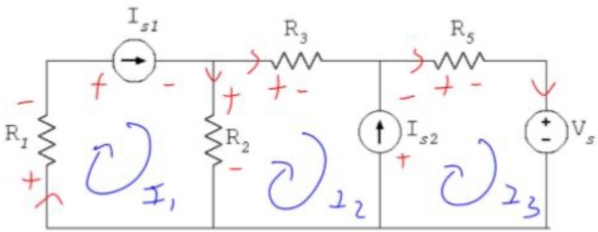
- Example #6-cont: Use the loop-current method to obtain all loop currents



Assume $R_i = 2\Omega$ for all i

$V_s = 4V$

$I_{s_1} = 2A$

$I_{s_2} = 6A$

$$2 = I_1 \quad (1)$$

$$6 = I_3 - I_2 \quad (2)$$

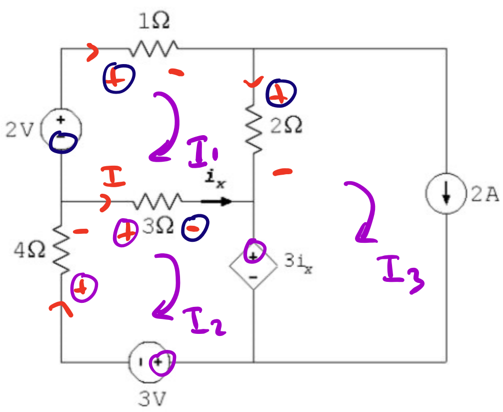
$$4 = 2I_1 - 4I_2 - 2I_3 \quad (3)$$

$\vdots$

$I_2 = -2A$

$I_3 = 4A$

- Example #7: Use the loop-current method to obtain all loop currents



From the current source: $I_3 = 2$ (1)

KVL on loop 2:

$$+4(I_2) + 3(I_2 - I_1) + 3i_x + 3 = 0$$

KVL on loop 1:

$$-2 + 1(I_1) + 2(I_1 - I_3) - 3(\underbrace{I_2 - I_1}_{I}) = 0$$

$$i_x = I_2 - I_1$$

⋮

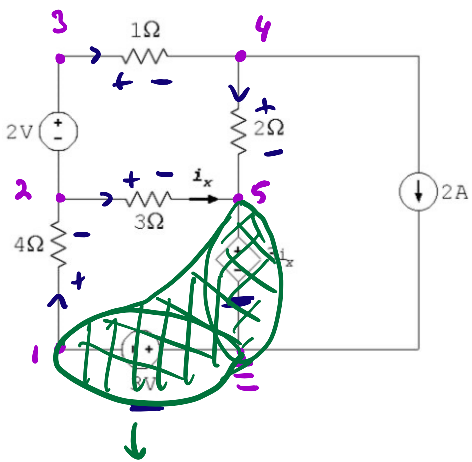
solving...

$$I_3 = 2A$$

$$I_2 = \frac{6}{14}A$$

$$I_1 = \frac{17}{14}A$$

- Example #7-cont: Use the node-voltage method to determine all node voltages in this circuit



$2 = V_3 - V_2 \quad (1)$

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

$3i_x = V_5 - 0 \quad (3)$

KCL @ (4):

$$\frac{V_3 - V_4}{1} = \frac{V_4 - V_5}{2} + 2 \quad (4)$$

$$i_x = \frac{V_2 - V_5}{3}$$

Supernode 5-0-1:

$$\frac{V_1 - V_2}{4} = \frac{V_2 - V_5}{3} + \frac{V_4 - V_5}{2} + 2$$

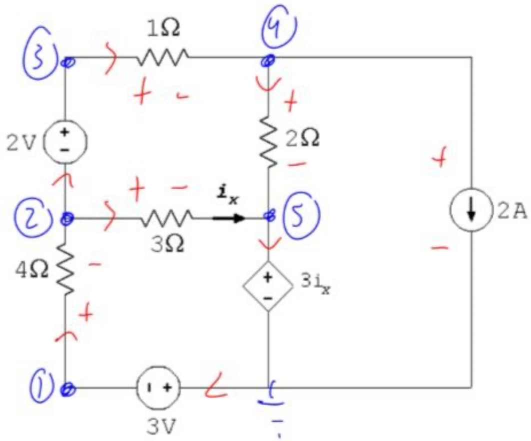
$V_1 = -3\ V$

$V_2 = -\frac{33}{7}\ V$

$V_3 = -\frac{19}{7}\ V$

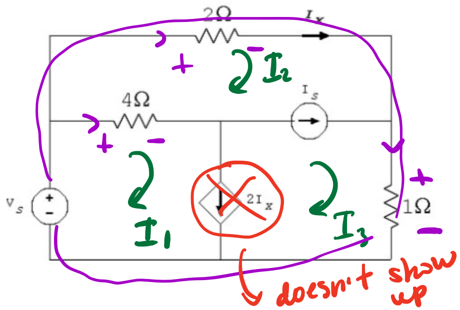
$V_5 = -\frac{33}{14}\ V$

- Example #7-cont: Use the node-voltage method to determine all node voltages in this circuit



- Superposition

- Example #8: Use the loop-current method to determine all loop currents in this circuit



$I_s = I_3 - I_2$ (1)

$2I_x = I_1 - I_3$ (2)

KVL on outer loop:

$-V_s + 2I_2 + 1\cdot I_3 = 0$ (3)

$I_x = I_2$

Simplifying equations:

$I_s = -I_2 + I_3$

$0 = I_1 - 2I_2 - I_3$

$V_s = 2I_2 + I_3$

Solution:

$$\left.\begin{aligned} I_1 &= V_s \\ I_2 &= \frac{1}{3}V_s - \frac{1}{3}I_s \\ I_3 &= \frac{1}{3}V_s + \frac{2}{3}I_s \end{aligned}\right\}$$ linear combination of independent sources

⇓

can look at effect of each source indiviually

• Superposition principle

Let $V_{s1}, V_{s2},\dots, V_{sn}, I_{s1}, I_{s2},\dots, I_{sm}$ be the complete set of independent sources in a resistive circuit.

Then, any electrical response y in the circuit (v or i) can be expressed as

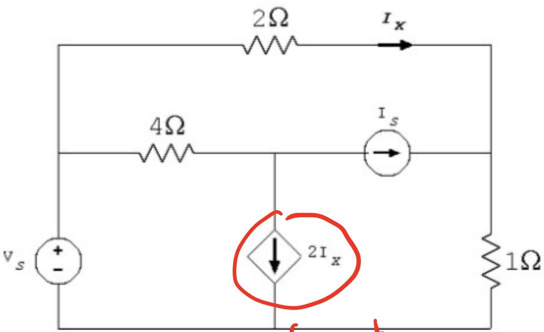
$$y = k_1 V_{s1} + k_2 V_{s2} + \dots + k_n V_{sn} + \widehat{k_1} I_{s1} + \widehat{k_2} I_{s2} + \dots + \widehat{k_m} I_{sm},$$

where the constants $k_1,\dots k_n, \widehat{k_1},\dots \widehat{k_m}$ are unique to each response y.

- weighted linear superposition of independent sources
- can look at effect of each source individually without effect of the other sources by making other sources 0 (to leave one active source at a time)

- current source → open circuit
- Voltage source → short circuit

- Example #8-cont: Use superposition to determine I_x in this circuit



don't touch :)

1) Keep V_s

2) Keep I_s

- Example #8-cont: Use superposition to determine I_2 in this circuit