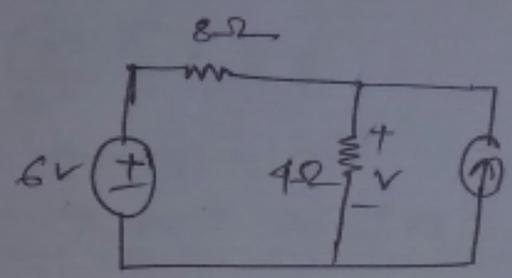
Super position Theorem: The current through or voltage drops in any elements of a network is equal to the algebric sum of the currents or voltages produced independently by each source.

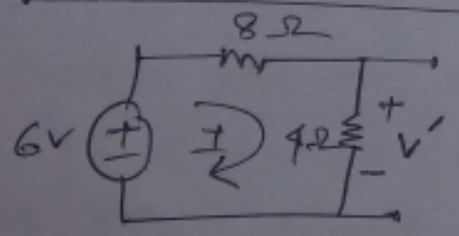
Ex:



Find v ?

Soln:

When 6V is active:

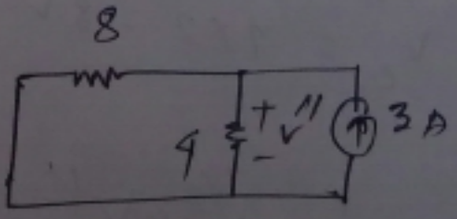


$$6V - 8I - 4I = 0$$

$$\Rightarrow I = 6/12 = 0.5\ A$$

$$\therefore v' = 4 \times 0.5 = 2\ V$$

When 3A active:

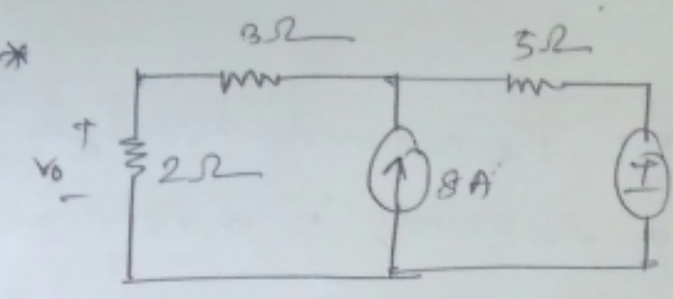


$$\therefore I_4 = \frac{8}{8+4} \times 3 = 2A$$

$$\therefore v'' = 2 \times 4 = 8A$$

$$\therefore V = v' + v'' = 10\ V$$

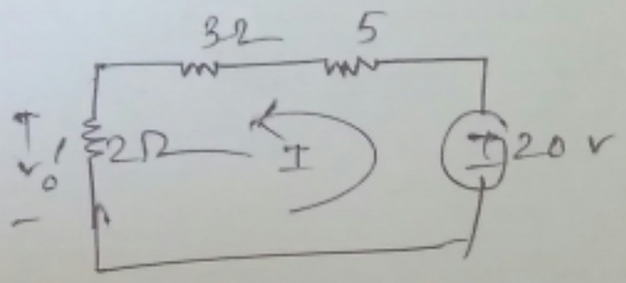
*



Find V_o

Soln:

When, 20V active

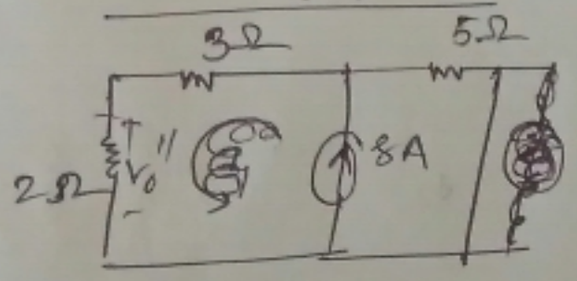


$$20 - (5+3+2)I = 0$$

$$\Rightarrow I = \frac{20}{10} = 2A$$

$$\therefore V_o' = 2 \times 2 = 4V$$

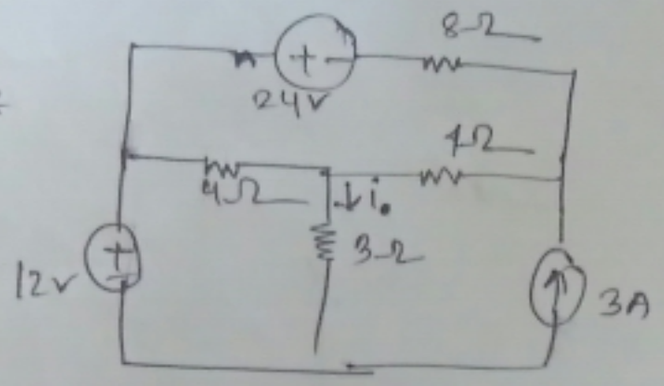
When 8A active:



$$\therefore I_{2\Omega} = \frac{5}{5+(3+2)} \times 8 = \frac{40}{10} = 4$$

$$\therefore V_o'' = 4 \times 2 = 8V$$

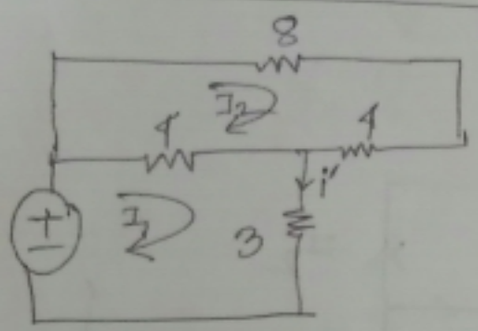
$$\therefore V_o = V_o' + V_o'' = 8 + 4 = 12V$$

* 

Find i using superposition th^m

Sol^n:

When 12V active:



using KVL at loop-1

$12 - 1I_1 + 1I_2 - 3I_1 = 0$

$\Rightarrow \boxed{7I_1 - 1I_2 = 12}$ —(I)

using KVL at loop-2

$-(8+1)I_2 - 1(I_2 - I_1) = 0$

$\Rightarrow 1I_1 - 16I_2 = 0$

$\Rightarrow \boxed{I_1 - 1I_2 = 0}$ —(II)

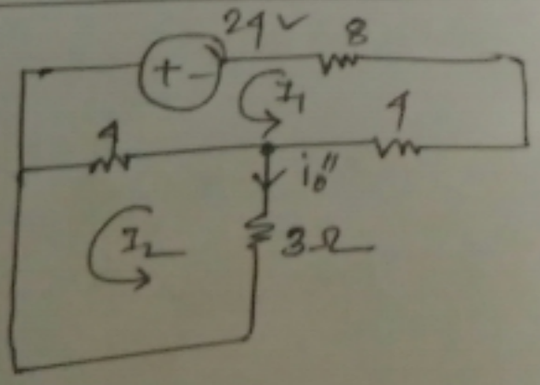
From (I) & (II)

$I_1 = 2A$

$I_2 = \frac{1}{2}A$

$\therefore i' = -I_1 = -2A$

When 24V active:



using KVL at loop-1

$24 - 1(I_1 - I_2) - 12I_1 = 0$

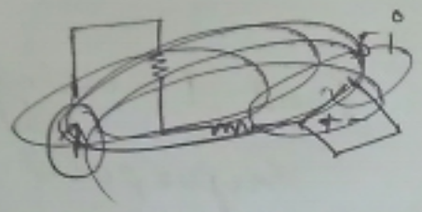
$\Rightarrow 13I_1 - I_2 = 6$

using KVL at loop-2

$1(I_2 - I_1) - 3I_2 = 0$

$\Rightarrow \boxed{1I_1 - 7I_2 = 0}$

*

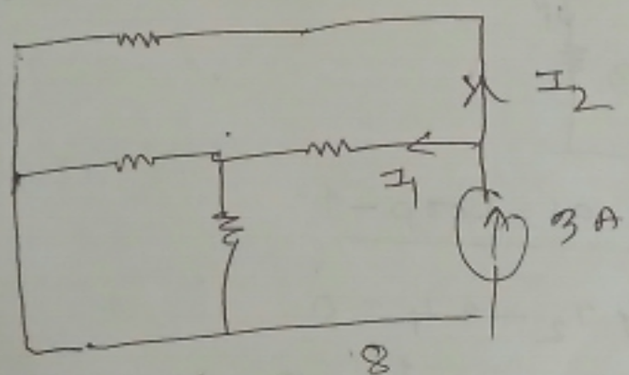


$\therefore I_1 = 1.75$

$I_2 = 1$

$\therefore i_0'' = -I_2 = -1$

When, 3 A active:

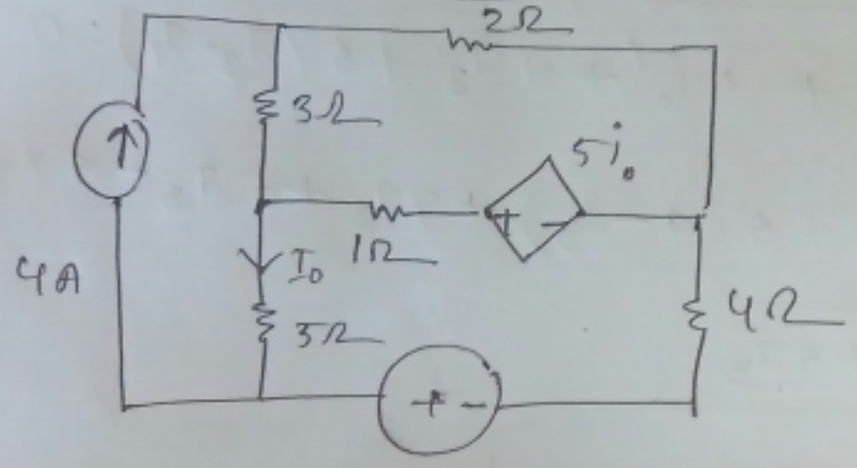


$\therefore I_1 = \frac{8}{[(4 \| 3) + 4] + 8} \times 3 = 1.75$

$\therefore I_{4\Omega}''' = \frac{4}{3+4} \times 1.75 = \frac{7}{4} = 1\ A$

$\therefore I = I' + I'' + I''' = 2 - 1 + 1 = 2A$

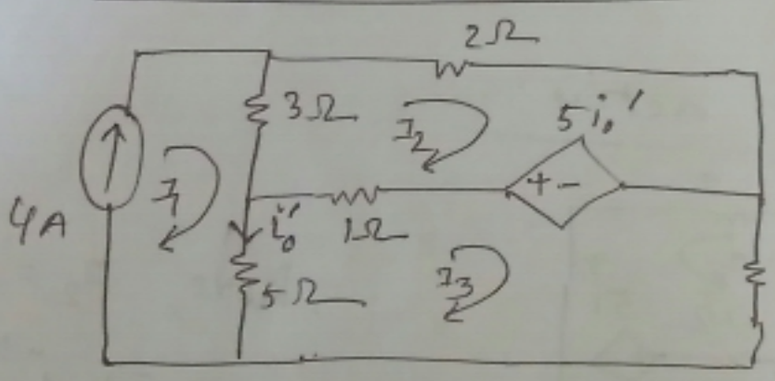
Ex: (superposition)



Find I_o ?

Soln:

When, 4A active:



here,

$I_1 - I_3 = i_o$

$\Rightarrow i_o = 4 - I_3$

Applying KVL at loop-2

$2I_2 - 5i + 3(I_2 - I_3) + 3(I_2 - I_1) = 0$

$\Rightarrow 2I_2 - 5(4 - I_3) + 3(I_2 - I_3) + 3I_2 - 3 \times 4 = 0$

$\Rightarrow 8I_2 + 4I_3 = 32$

$\Rightarrow 3I_2 + 2I_3 = 16$

KVL at loop-3

$$(I_3 - I_2) + 5i_o' + 4I_3 + 5(I_3 - I_1) = 0$$

$$\Rightarrow I_3 - I_2 + 5(4 - I_3) + 4I_3 + 5I_3 - 5 \times 4 = 0$$

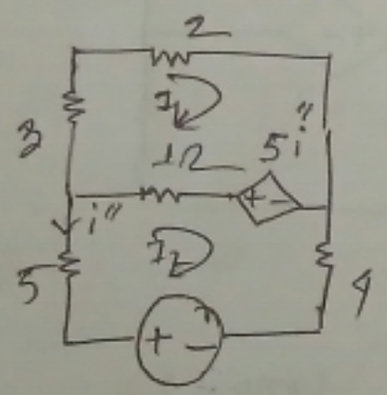
$$\Rightarrow \boxed{-I_2 + 5I_3}$$

$\therefore I_1 = 80/70$

$I_2 = 16/17$

$\therefore i' = 4 - I_3 = 4 - 16/17 = 52/17$ A

When, 20 V active:



here, $I_2 = -i_o''$

$\Rightarrow i'' = -I_2$

KVL at loop-1

$$2I_1 - 5i_o'' + (I_1 - I_2) + 3I_1 = 0$$

$$\Rightarrow 2I_1 + 5I_2 + I_1 - I_2 + 3I_1 = 0$$

$$\Rightarrow 6I_1 + 4I_2 = 0$$

$$\Rightarrow 3I_1 + 2I_2 = 0$$

KVL at loop-2

$$(I_2 - I_1) + 5I_o'' + 4I_2 - 20 + 5I_2 = 0$$

$$\Rightarrow I_2 - I_1 - 5I_2 + 4I_2 + 5I_2 = 20$$

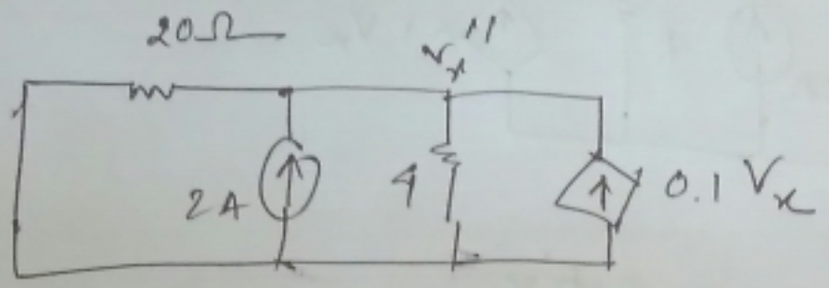
$$\Rightarrow -I_1 + 5I_2 = 20$$

$\therefore I_1 = -40/17$, $I_2 = 60/17$

$\therefore i'' = -60/17$

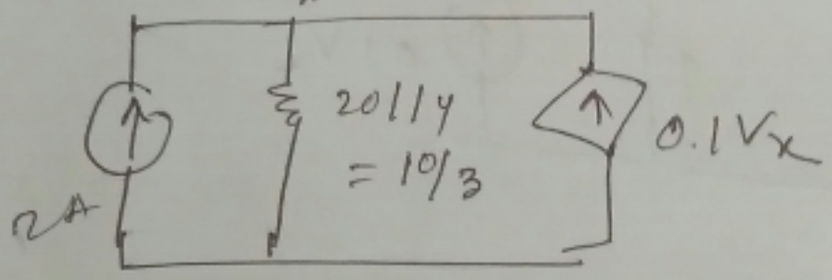
$\therefore i_o = 52/17 - 60/17 = -8/17$ (Ans)

When, 2A active:



using KCL at node -

v_x''



using KCL at node

$$2 + 0.1 v_x'' = \frac{v_x''}{10/3}$$

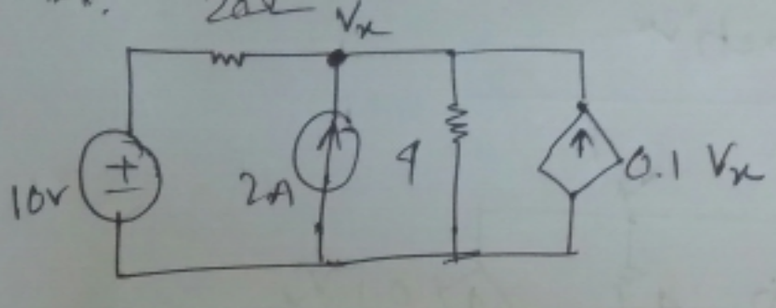
$$\Rightarrow 2 + 0.1 v_x'' = 0.3 v_x''$$

$$\Rightarrow 0.2 v_x'' = 2$$

$$\Rightarrow v_x'' = 10$$

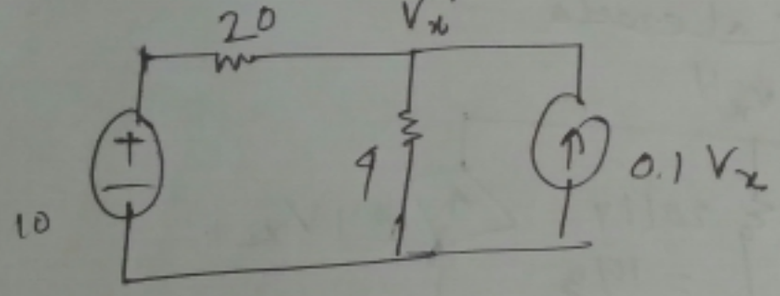
$$\therefore v_x = v_x' + v_x'' = 2.5 + 10 = 12.5 \text{ V}$$

Ex. (super position)



Find = V_x?

When, 10V active:



using KCL

$$\frac{10 - V_x'}{20} + 0.1 V_x = \frac{V_x'}{4}$$

$$\Rightarrow \frac{10 - V_x'}{20} + 0.1 V_x - \frac{V_x'}{4} = 0$$

$$\Rightarrow \frac{10 - V_x' + 2V_x' - 5V_x'}{20} = 0$$

$$\Rightarrow -4V_x' = -10$$

$$\Rightarrow V_x' = 2.5$$