Super Position

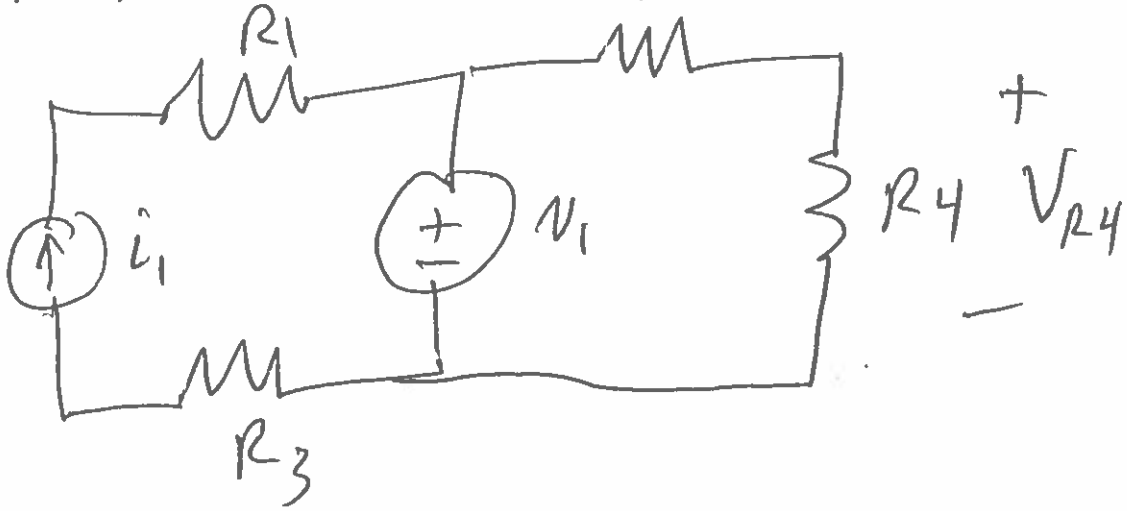
Super Position is the idea that if you have multiples sources Then you find is the sum of individual sources.

i_1 is created by V_1

i_2 is created by V_2

$$i_{TOT} = i_1 + i_2 = f(V_1 + V_2)$$

So imagine circuit R2



$$V_{R4} = f(i_1, V_1)$$

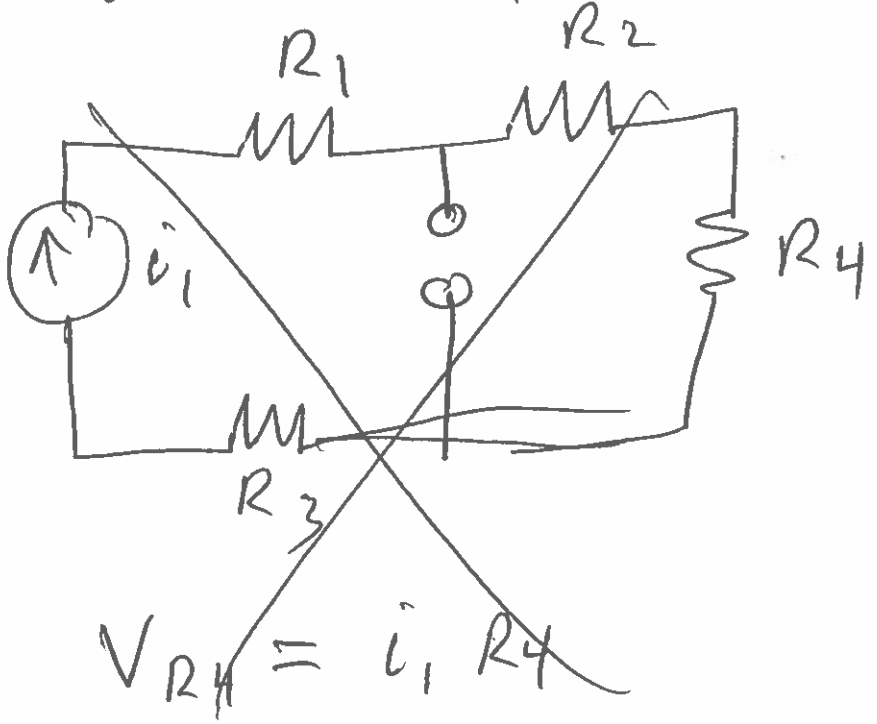
Find by Deactivating all sources but 1.

$$V_{R4} = f_1(i_1) + f_2(v_1)$$

To Deactivate a current source
replace current source with ~~short~~ open circuit.

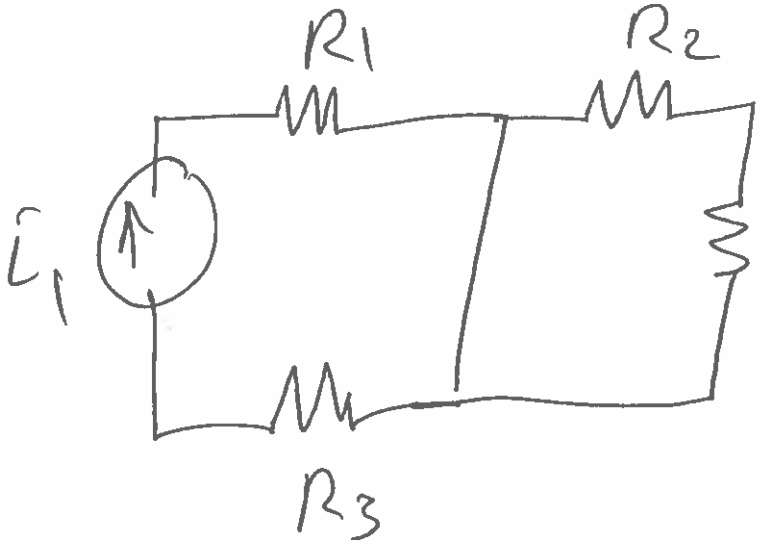
To Deactivate a voltage source
replace voltage source with ~~open~~ short circuit.

So Deactivate V_1



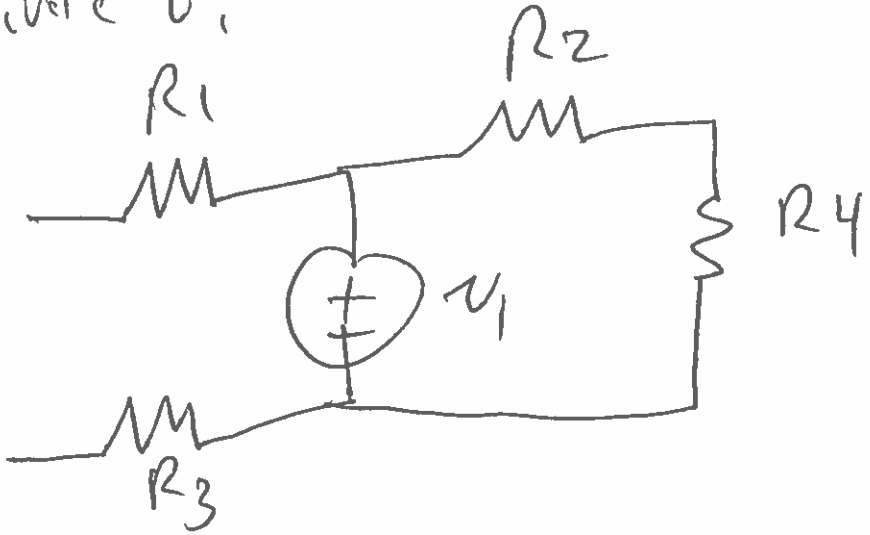
$V_{R4} = i_1 R_4$

Deactivate V_1



$V_4 = 0\, i_1$

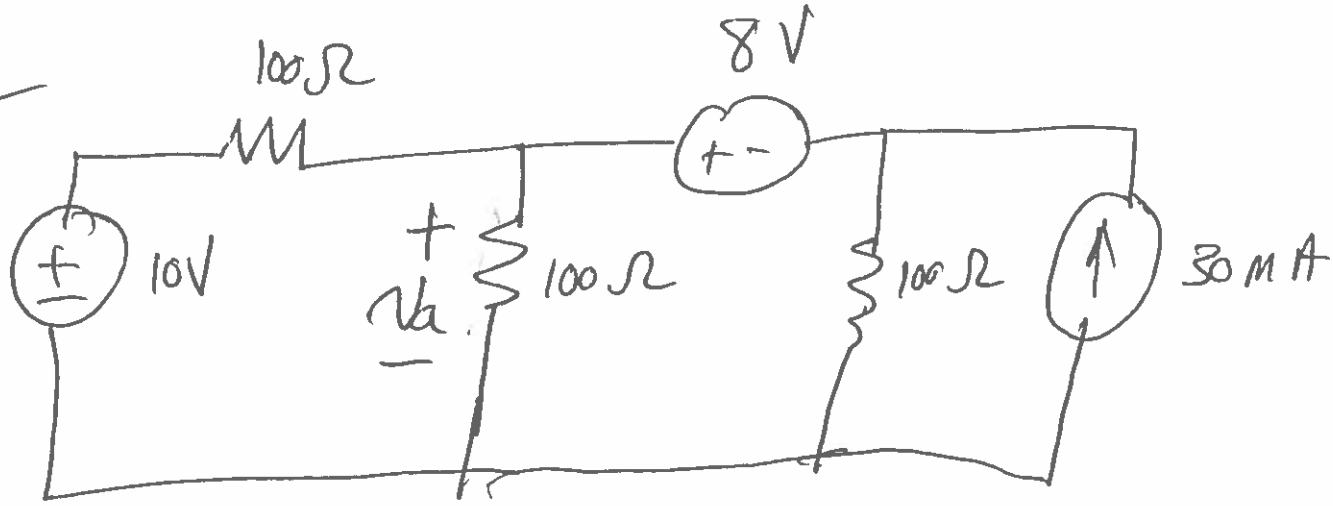
Deactivate i_1



$$V_{R4} = V_1 \frac{R4}{R2+R4}$$

$$V_{Th\,R4} = 0\, i_1 + \left(\frac{R4}{R2+R4}\right) v_1$$

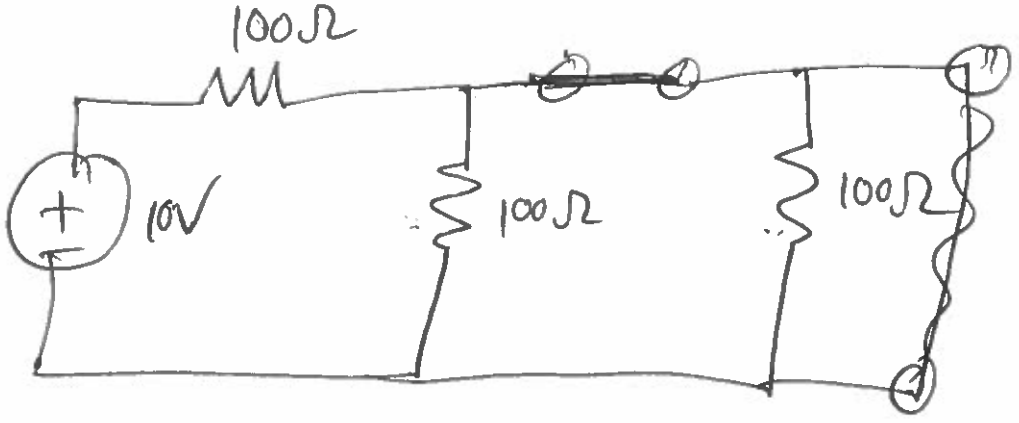
EX



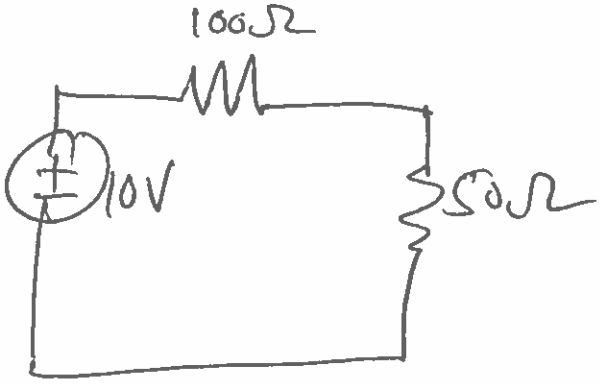
$V_a = ?$

$$V_a = V_{10V} + V_{8V} + V_{30mA}$$

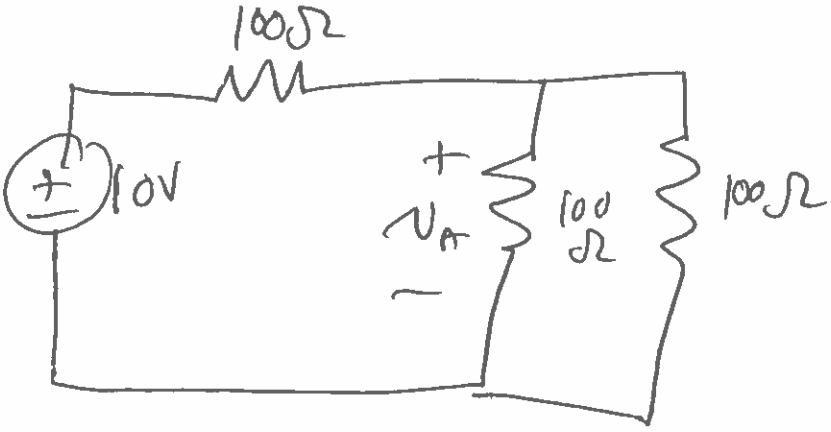
V_{10V} Deactivate 8V 30mA



$$V_{10V} = \frac{10V}{2} = 5V$$

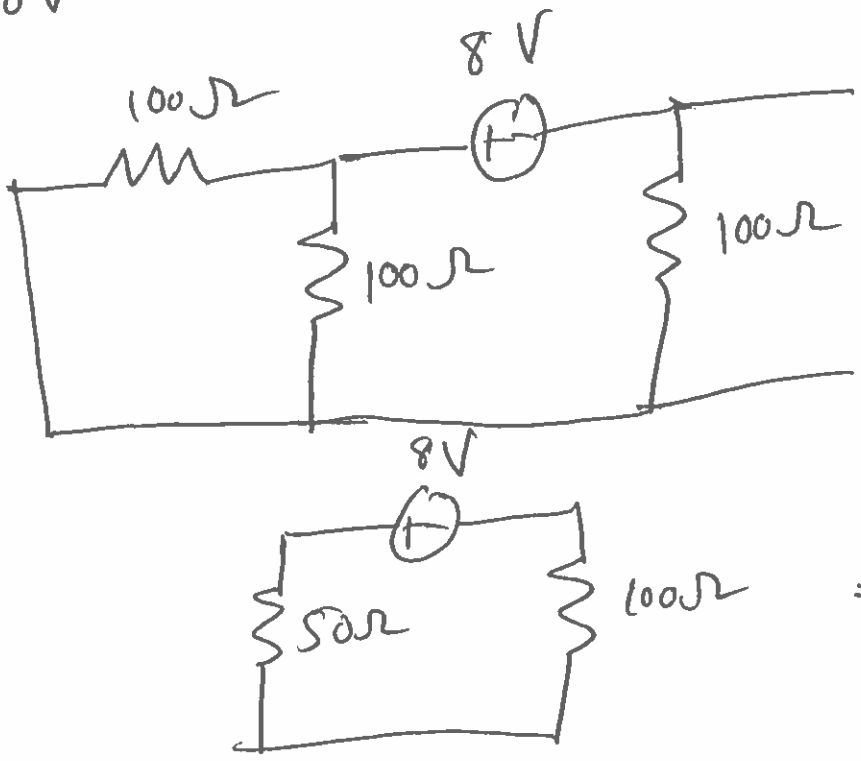


$$V_{50\Omega} = \frac{50\Omega}{150\Omega}(10V) = \frac{10}{3}V$$



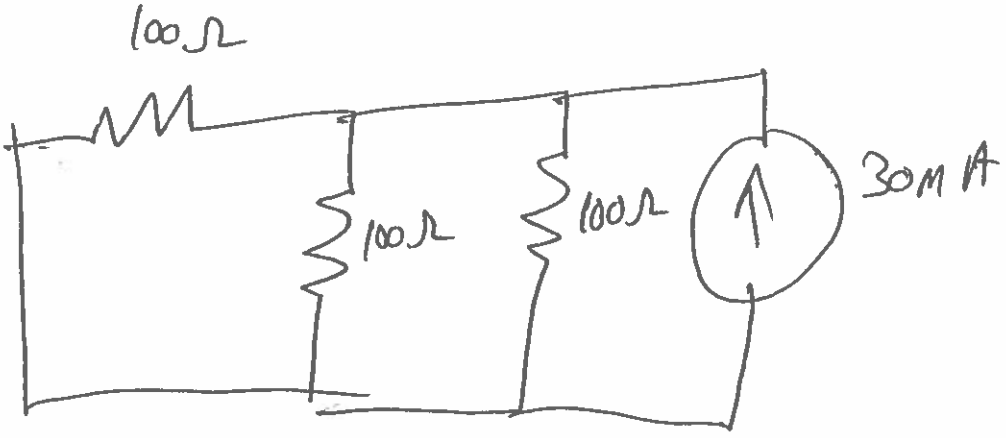
$$V_{10V} = +\frac{10}{3}V$$

V_{8V} Deactivate 10V and 30mA



$$\Rightarrow V_{8V} = \frac{8}{3}V$$

30mA Deactivate 10V, 8V



$$V_A = i\,100\Omega = \frac{30mA}{3}(100\Omega) = 1000mV$$

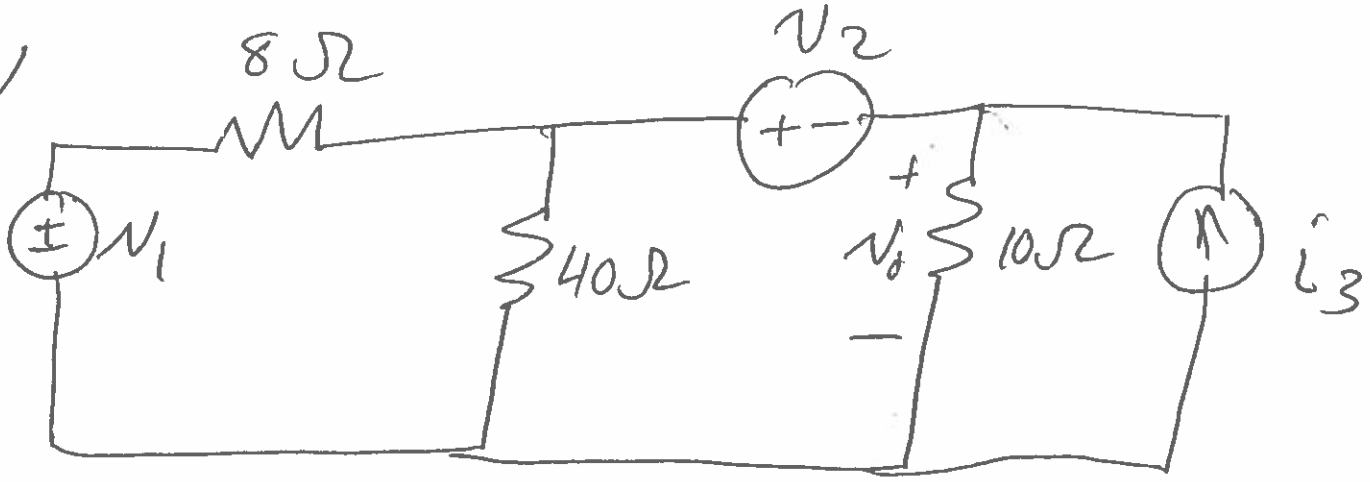
$$V_{30mA} = +1\,V$$

$$V_A = +\frac{10}{3}V + \frac{8}{3}V + 1V = \frac{18}{3}V + 1V$$

$$\boxed{V_A = 7V}$$

or $V_A = +\frac{10}{3}(V_{10V}) + \frac{8}{3}(V_{8V}) + 1V\left(i_{30mA}R_{1\Omega}\right)$

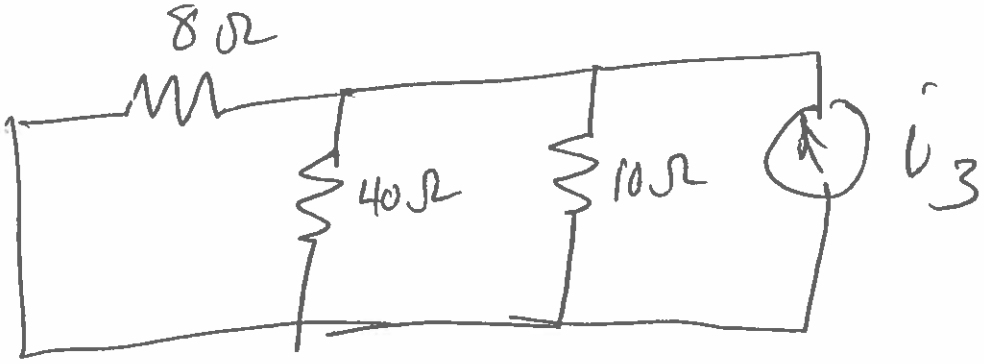
ex



find a, b, C such that

$$v_o = a v_1 + b v_2 + C i_3$$

find C Deactivate: v_1, v_2



$$v_o = (10\Omega)\, i_{10}$$

$i_{10} = ?$

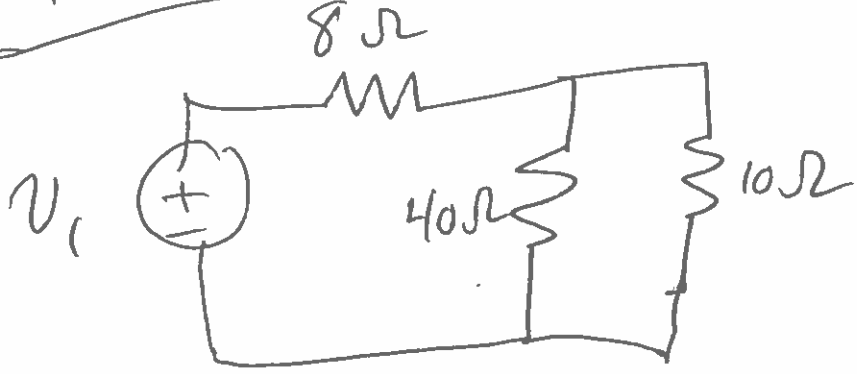
$$i_{10} = \frac{\frac{1}{10\Omega}\, i_3}{\frac{1}{8\Omega} + \frac{1}{40\Omega} + \frac{1}{10\Omega}}$$

$$i_{10} = \frac{\frac{1}{10\Omega}}{\frac{5+1+4}{40\Omega}} i_3 = \frac{\frac{40\Omega}{10\Omega}}{10\Omega} i_3 = 0.4\, i_3$$

$$v_o = (10\Omega)\, i_{10} = 10\Omega\,(.4\, i_3) = \underline{(4\Omega)\, i_3}$$

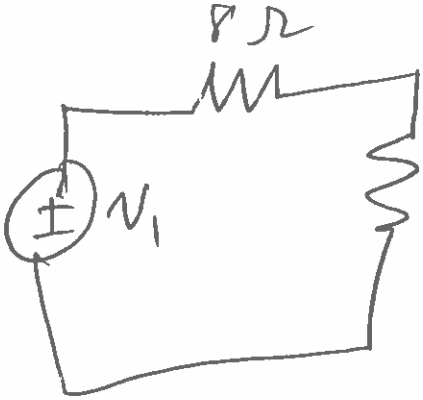
$$\boxed{C = 4\Omega}$$

find a Deactivate v_2, i_3



$$\frac{1}{40\Omega} + \frac{1}{10\Omega} = \frac{1+4}{40\Omega}$$

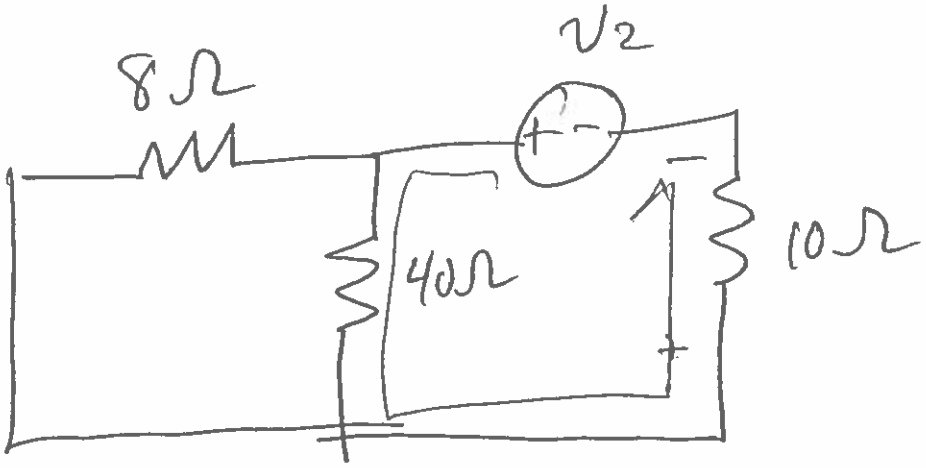
$$\frac{5}{40\Omega} \Rightarrow \frac{1}{8\Omega}$$



$$v_{10\Omega} = \frac{1}{2} v_1$$

$$v_o = \frac{1}{2} v_1 \Rightarrow \boxed{a = \frac{1}{2}}$$

Find b Perspective V_1, i_3



$$\frac{1}{8\Omega} + \frac{1}{40\Omega} = \frac{5+1}{40\Omega} = \frac{6}{40\Omega} = \frac{3}{20\Omega}$$

$$\frac{20}{3}\Omega \Rightarrow v_0 = \frac{10\Omega}{\frac{20}{3}\Omega + 10\Omega} v_2$$

$$\frac{10}{\frac{50}{3}} = \frac{30}{50} = \frac{3}{5}$$

$$v_0 = -\frac{3}{5} v_2$$

$$b = \frac{-3}{5}$$

$$v_0 = \frac{1}{2} v_1 - \frac{3}{5} v_2 + 4\Omega i_3$$