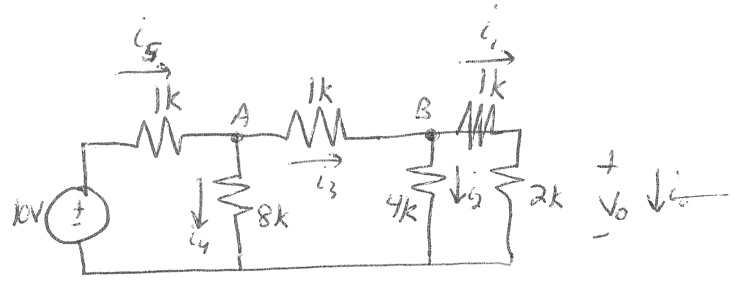


3-24

Assume $V_o = 1V$

$i_o = \frac{1V}{2k} = \frac{1}{2} mA$

$i_o = i_1 = \frac{1}{2} mA$

$V_1 = i_1(1k) = \frac{1}{2} V$

$V_2 = V_B = V_1 + V_o = \frac{3}{2} V$ $\quad i_2 = \frac{V_B}{4k} = \frac{3/2 V}{4k} = \frac{3}{8} mA$

KCL @ B $\quad i_3 = i_2 + i_1 = \frac{3}{8} + \frac{1}{2} = \frac{7}{8} mA$ $\quad V_3 = (\frac{7}{8} mA)(1k) = \frac{7}{8} V$

$V_4 = V_3 + V_2 = 7/8 + \frac{3}{2} = \frac{19}{8} V$ $\quad i_4 = \frac{V_4}{8k} = \frac{19}{64} mA$

KCL @ A $\quad i_5 = i_4 + i_3 = \frac{19}{64} + \frac{7}{8} = \frac{75}{64} mA$ $\quad V_5 = (\frac{75}{64} mA)(1k) = \frac{75}{64} V$

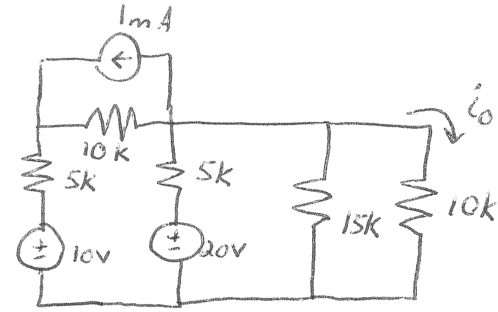
$V_{in} = V_5 + V_4 = \frac{75}{64} + \frac{19}{8} = \frac{227}{64} V$

3 work

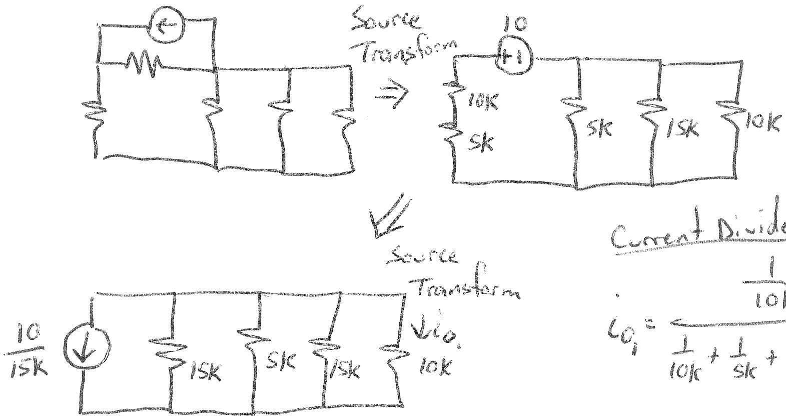
$K = \frac{V_o}{V_{in}} = \frac{1}{\frac{227}{64}} = 64/227$

$V_o = \left(\frac{64}{227}\right) 10V = \frac{640}{227} V$

$\boxed{V_o = 2.82V}$ 2



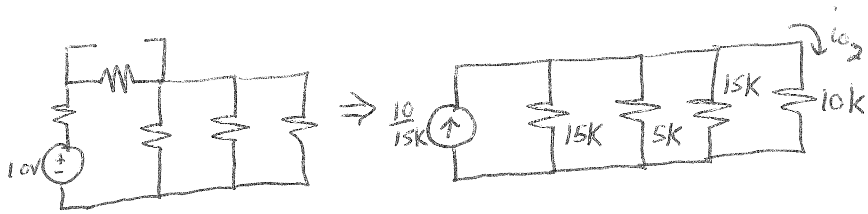
3-29 ① i_s ON



Current Divider

$$i_{o_1} = \frac{\frac{1}{10k}}{\frac{1}{10k}+\frac{1}{5k}+\frac{1}{15k}+\frac{1}{15k}}\left(\frac{-10}{15k}\right) = -0.1538mA \quad +1$$

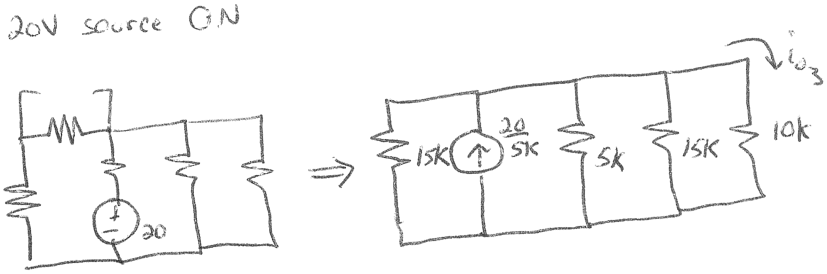
② 10V source ON



$$i_{o_2} = \frac{\frac{1}{10k}}{\frac{1}{10k}+\frac{1}{5k}+\frac{1}{15k}+\frac{1}{15k}}\left(\frac{10}{15k}\right) \quad +1$$

$$i_{o_2} = 0.1538mA$$

③ 20V source ON



$$i_{o_3} = \frac{\frac{1}{10k}}{\frac{1}{10k}+\frac{1}{15k}+\frac{1}{5k}+\frac{1}{15k}}\left(\frac{20}{5k}\right) \quad +1$$

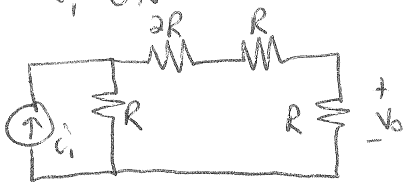
$$i_{o_3} = 0.923mA$$

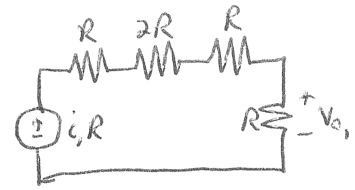
$$i_o = \sum_j i_{o_j} = i_{o_1}+i_{o_2}+i_{o_3} = i_{o_3} =$$

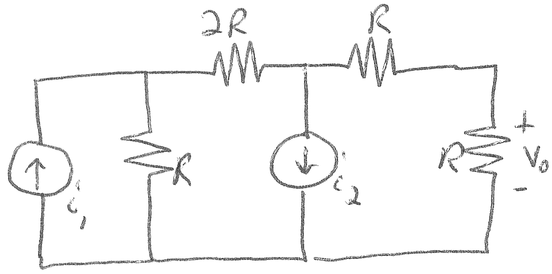
$$\boxed{i_o = 0.923mA} \quad +2$$

3-31

i_1 ON

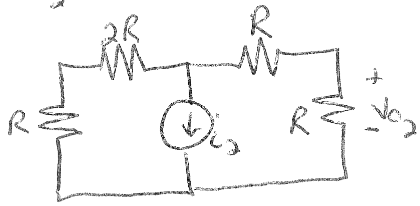


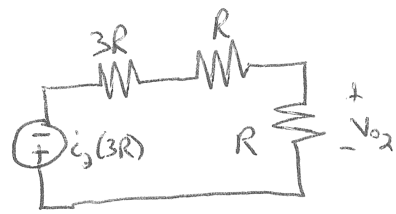




$$V_{o_1} = \frac{R}{R+R+2R+R}(i_1 R) = \underline{\frac{i_1 R}{5}} \quad +2$$

i_2 ON



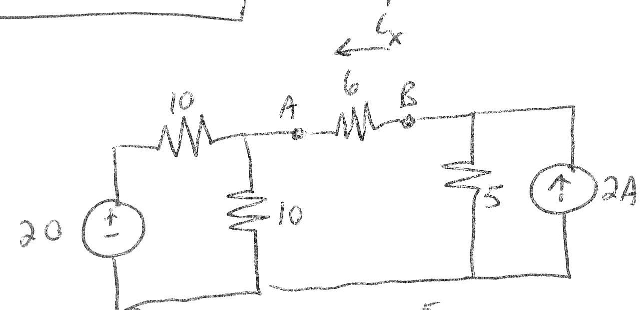


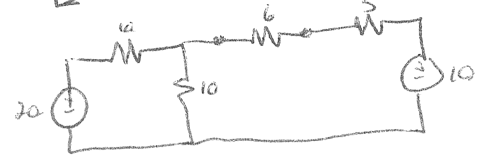
$$V_{o_2} = \frac{R}{R+3R+R}(-i_2(3R)) = \underline{\frac{-3i_2 R}{5}} \quad +2$$

$$V_o = \sum V_{o_j} = V_{o_1} + V_{o_2} \qquad \boxed{V_o = \frac{i_1 R}{5} - \frac{3 i_2 R}{5}} \quad +1$$

#4

Find V_{Th}, R_{Th} and i_x



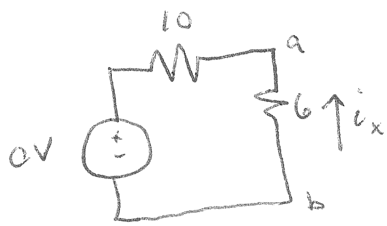


$V_{oc} = V_T = ?$

$V_{oc} = V_A - V_B = \frac{10}{10+10}(20) - 10$

$V_{oc} = \boxed{V_T = 0}$ 1

$R_{AB} = 10 \| 10 + 5 = \boxed{10\Omega = R_T}$



KVL $0 + (-i_x)10 - i_x(6) = 0$

$\boxed{i_x = 0}$ 1

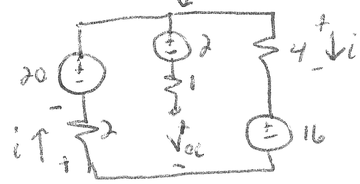
3 points for work

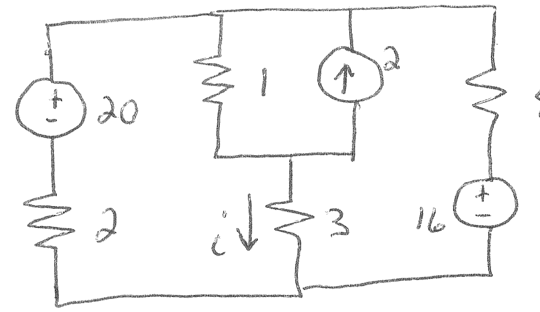
* This is a silly problem if you got that $V_T = 0$ and $i_x = 0$ then you will receive full credit

#5

Find i using Norton

Source Transformation





KVL around outside

$2(i) - 20 + 4i + 16 = 0$

$6i = 4$

$i = 2/3$

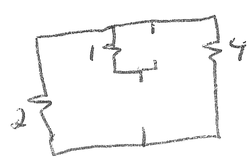
KVL around left loop

$2i - 20 + 2 + V_{oc} = 0$

$V_{oc} = 18 - \frac{4}{3} = \frac{50}{3} = 16.67V$

$R_{LB} = R_N = ?$ Turn off sources

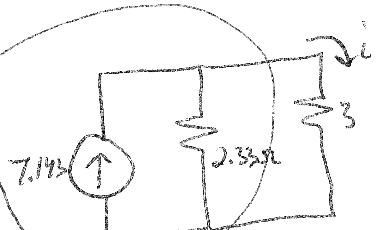
2 work



$R_{LB} = 1 + 2 // 4$

$R_{LB} = 7/3 = 2.33\Omega$

$I_{sc} = \frac{V_{Th}}{R_{LB}} = \frac{50/3}{7/3} = \frac{50}{7} = 7.143A$



Same.

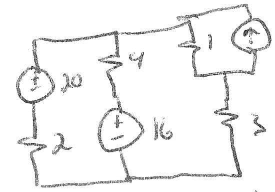
2 for Norton Equivalent

Current Divider

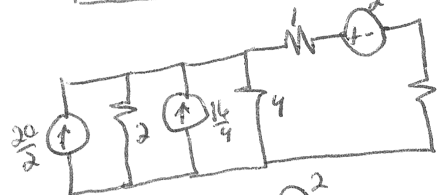
$i = \frac{\frac{1}{3}}{\frac{1}{3} + \frac{1}{2.33}}(7.143)$

$\boxed{i = 3.125A}$ +1

Another Way

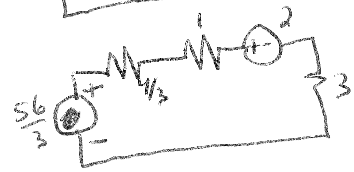


Transform all Sources

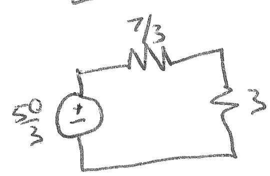


Combine ~~Para~~ Parallel Devices

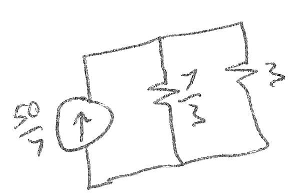
Source Transform



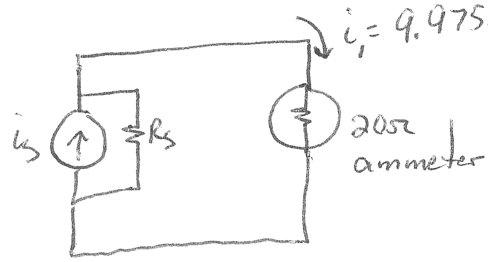
Combine Series ← thevenin Equivalent



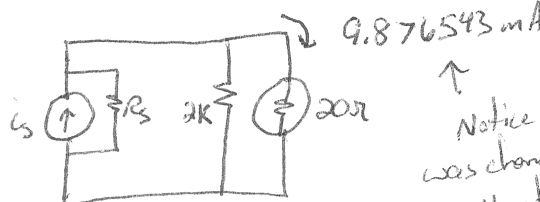
Source Transformation ← Norton Equiv.



#6 Current Divider



① $\frac{\frac{1}{20}}{\frac{1}{20}+\frac{1}{R_s}}\, i_s = i_1 = 9.975mA$



② $\frac{\frac{1}{20}}{\frac{1}{20}+\frac{1}{2k}+\frac{1}{R_s}}\, i_s = 9.876543mA$

Notice this was changed by Dr. Merat so the problem makes sense.

$\frac{R_s}{20+R_s}\, i_s = 9.975mA$

1a) $i_sR_s = 199.5mA + 9.975mA(R_s)$

2 work

$\frac{\frac{2kR_s}{2k+R_s}}{\frac{2kR}{2k+R_s}+20}\, i_s = 9.876543mA$

$\frac{2kR_si_s}{2kR_s+40k+20R_s} = 9.876543mA$

$2kR_si_s = 19.753086R_s + 395.06172 + 0.19753086R_s = 395.06172 + 19.95061686R_s$

Must keep lots of digits

1b) $2kR_si_s = 399 + 19.95R_s$ (1a x 2k)

1b−2a) $0 = 3.93828 - 6.1686\times10^{-4}R_s$

$\boxed{R_s = 6384\,\Omega}$ +1

This value can vary depending on how many digits were rounded above

$\frac{R_s}{20+R_s}\, i_s = 9.975mA$

$i_s = \frac{9.975mA\,(20+6384)}{6384}$

$\boxed{i_s = 10mA}$ +1

part b

$i = \frac{\frac{1}{20}}{\frac{1}{20}+\frac{1}{4k}+\frac{1}{6384}}(10mA)$

$\boxed{i = 9.919mA}$ +1