ECE 300
Spring Semester, 2004
HW Set #2

Desk Copy

Due: January 29, 2004 **Name**____________________
wlg Print (last, first)
PM Section

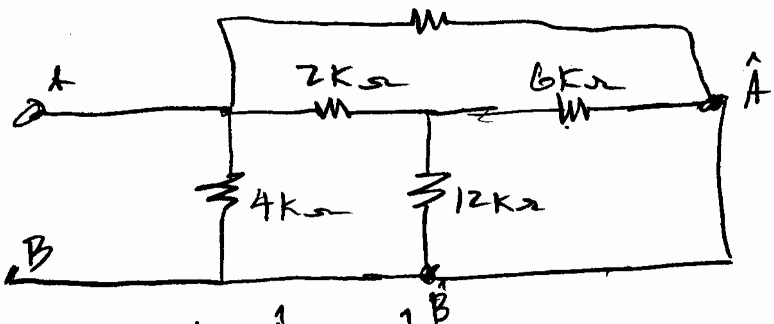
Use engineering paper. Work only on one side of the paper. Use this sheet as your cover sheet, placed on top of your work and stapled in the top left-hand corner. Number the problems at the top of the page, in the center of the sheet. **Do neat work. Underline your answers. Show how you got your equations. <u>Be sure to show how you got your answers.</u>** Each problem counts 5 points.

Work the following problem from the text.

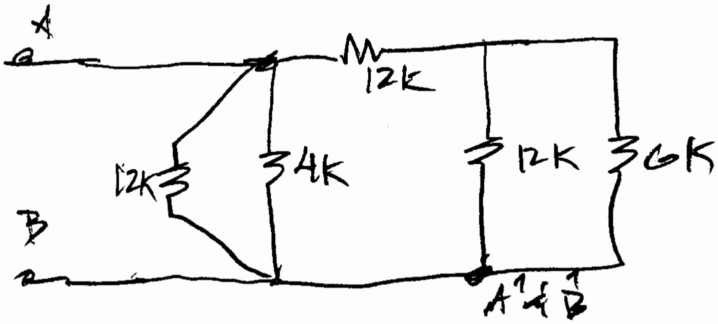
2.43	R_{AB} = 3 kohms
2.50	I_A = 3 mA
2.57	I_0 = 0.75 mA
2.61	V_S = 41 V
2.76	I_0 = 3 A
2.78	V_0 = 10 V
2.83	I_0 = - 20 mA
2FE-3	V_0 = 36 V
✓ 3.4	V_0 = - 7.28 V
✓ 3.10	V_1 = 2 mA
✓ 3.13	I_0 = - 1 mA
✓ 3.19	I_0 = - 1.59 mA
✓ 3.22	V_0 = - 7.71 V
✓ 3.31	V_0 = 9 V
3.37	V_0 = ~~(4/3) V~~ 15 V

2.43 wlg

Find R_{AB}

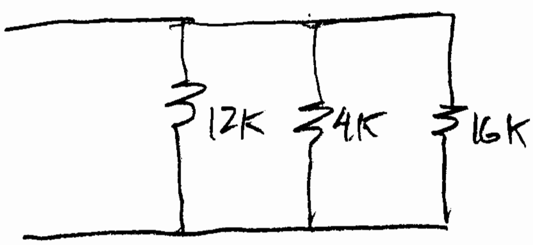


Move point Â to B̂.



$6 \| 12 = \frac{6 \times 12}{18}$

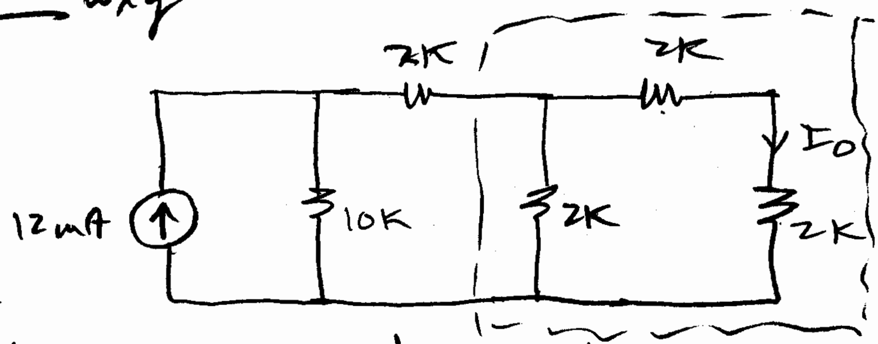
$= 4K$



$4K \| 16K$

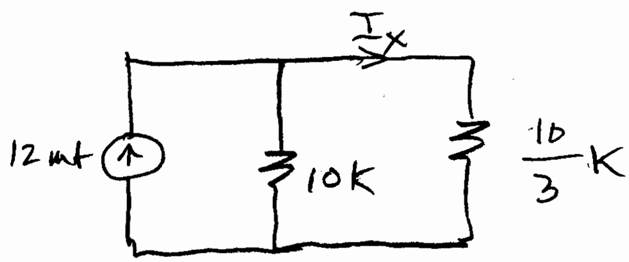
$= \frac{4 \times 16}{20}$

2.50 wlg



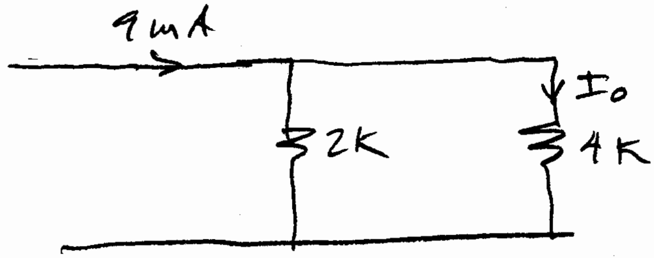
Using current splitting

$$2K \parallel 4K = \frac{8K}{6} = \frac{4}{3}K$$



$$I_x = \frac{(12\,mA)\,10K}{10 + \frac{10}{3}} = \frac{3 \times 12 \times 10}{40}$$

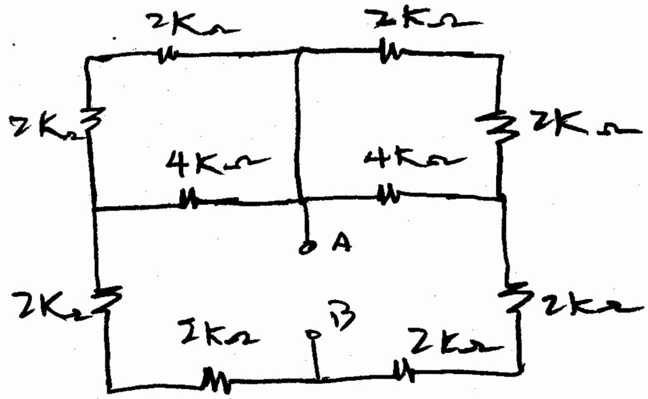
$$I_x = 9\,mA$$



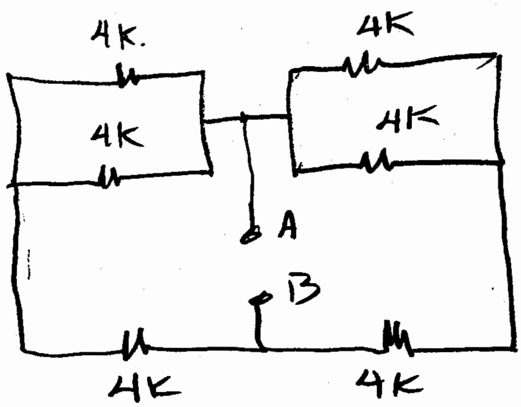
$$I_o = \frac{9\,mA \times 2K}{6K} = 3\,mA$$

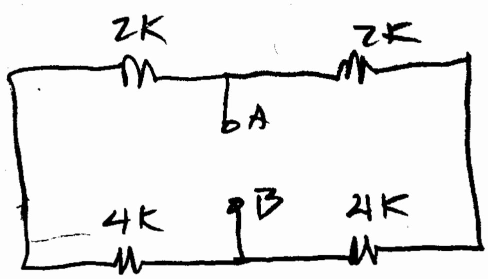
$$\boxed{I_o = 3\,mA}$$

2.43 wlg



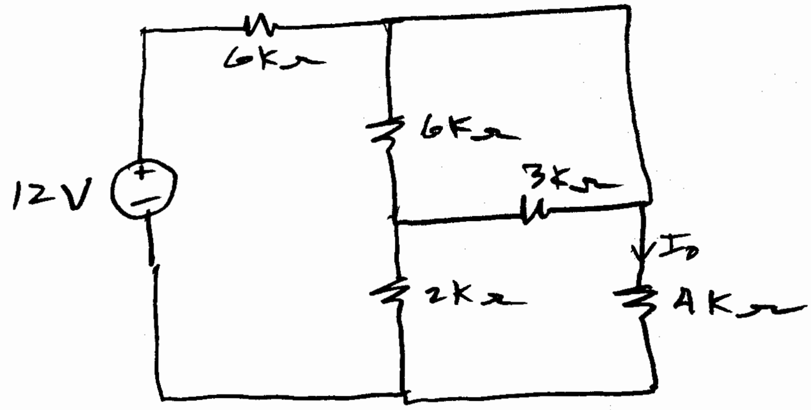
Becomes



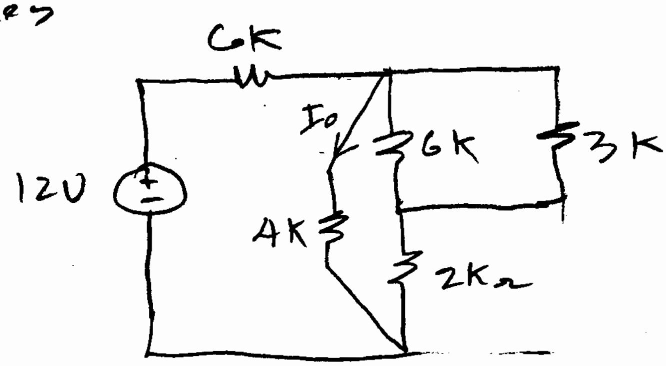


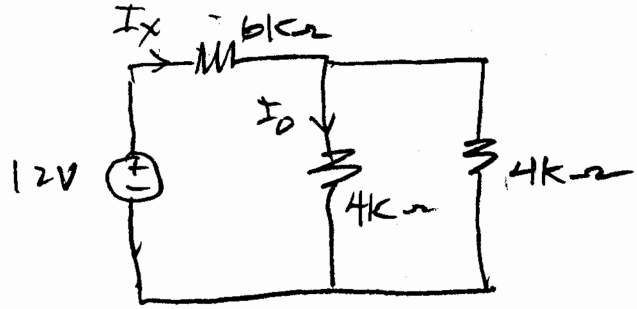
$$R_{AB} = 6K \parallel 6K = 3K$$

2.57 wlg



Becomes



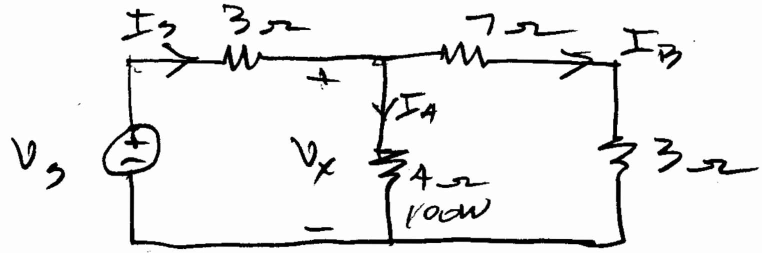


$$I_x = \frac{12}{6+2} = \frac{12}{8} = \frac{3}{2} = 1.5\text{ A}$$

$$I_o = \frac{I_x \times 4k}{8k} = 0.75\text{ A}$$

$$\boxed{I_o = 0.75\text{ A}}$$

2.61 wlg



Power absorbed by 4Ω resistor is 100W. Find V_s

$P = 100W = I_4^2 \times 4$

$I_4 = 5\ A$

$V_x = 5 \times 4 = 20\ V$

$I_B = \frac{20}{10} = 2A$

$I_s = I_A + I_B = 7A$

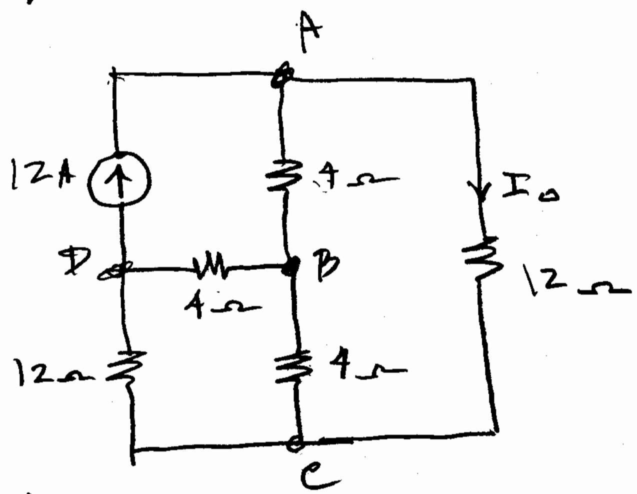
$V_s = 3 \times 7 + V_x$

$= 21 + 20$

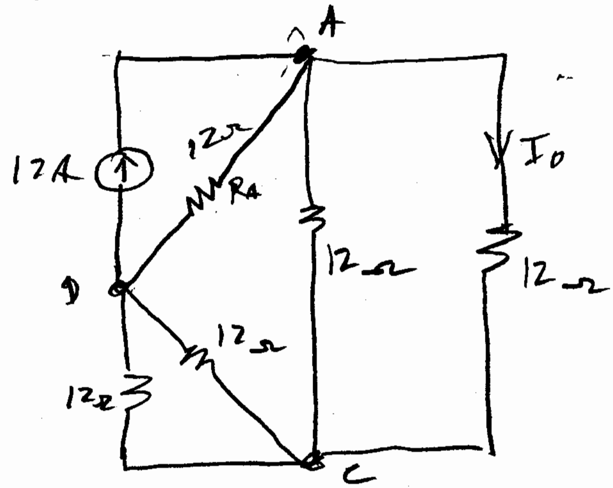
$V_s = 41\ V$

2.76 wly

$R \times R + R \times R +$



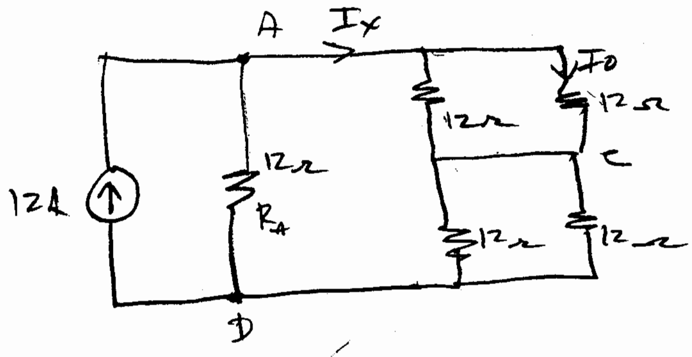
Find I_0



Since all arms of the Y are equal;

$R_\Delta = 3R_Y$

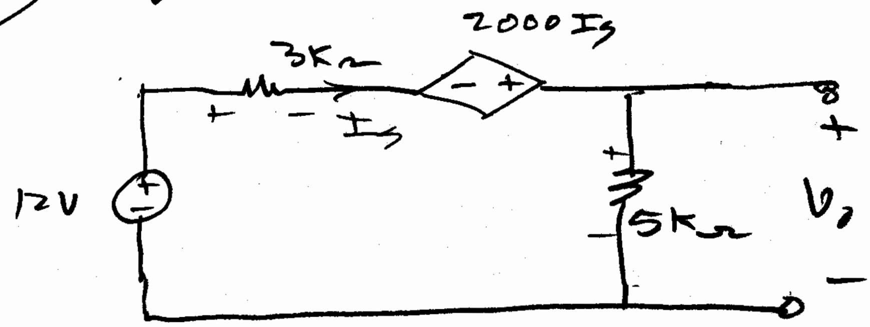
$R_\Delta = 3 \times 4 = 12\Omega$



$I_x = 6\text{ A}$ (inspection

$I_0 = \frac{I_x}{2} = 3\text{ A}$

2.78 wlg



Find V_o

KVL

$$-12 + (3K)I_s - 2000 I_s + 5K I_s = 0$$

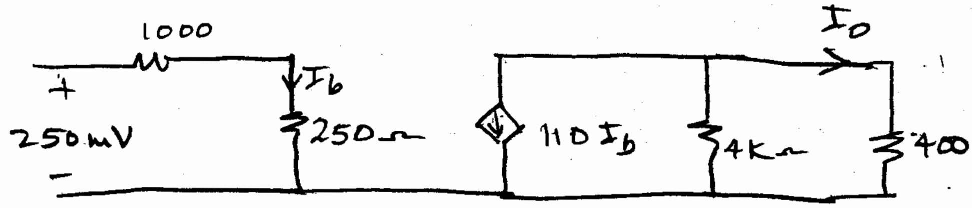
$$(6K)\, I_s = 12$$

$$I_s = 2\ mA$$

$$V_o = I_s \times 5K$$

$$\boxed{V_o = 10\ V}$$

2.83 wlg



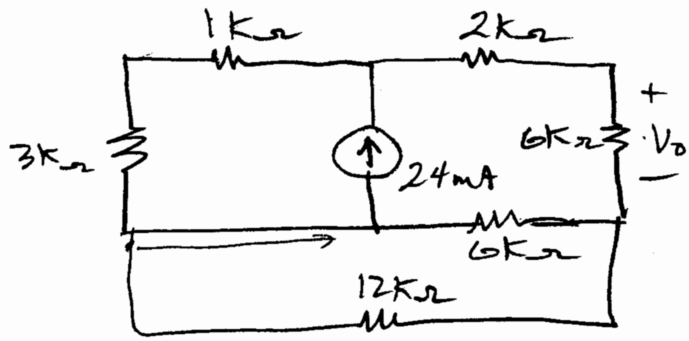
$$I_o = \frac{(-110 I_b)(4K)}{4.4K} = -100 I_b$$

$$I_b = \frac{0.25}{1250} = .2\ mA$$

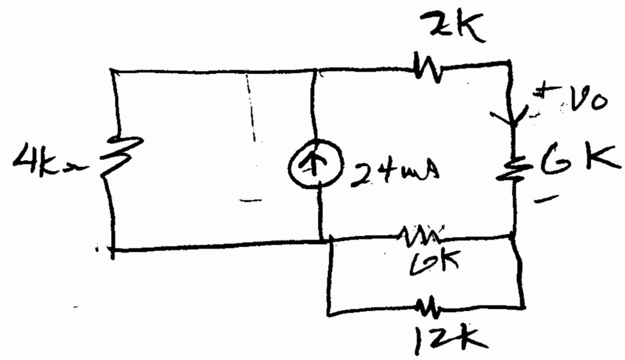
$$I_o = -100 \times .2 \times 10^{-3}$$

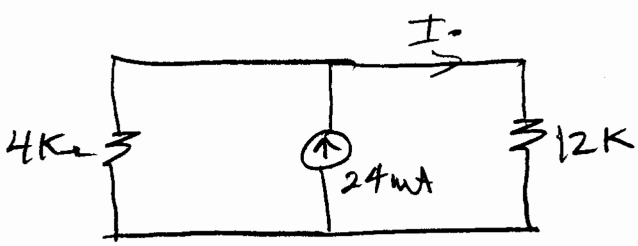
$$\boxed{I_o = -20\ mA}$$

2FE-3 wlg   Find V_o



$6 \| 12 = \frac{72}{18} = 4$



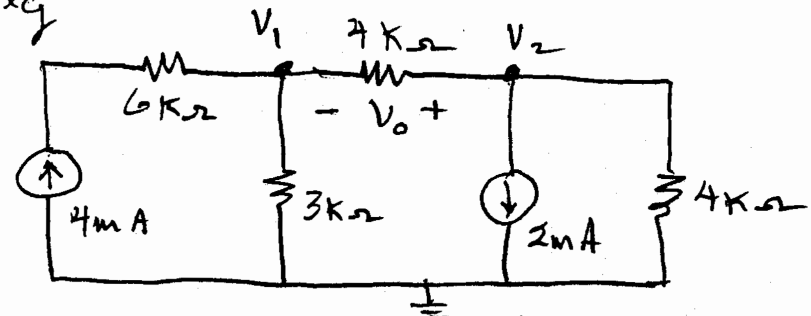


$$I_o = \frac{(24mA)(4K)}{16K} = 6mA$$

$$V_o = (6K)(I_o) = (6K)(6mA)$$

$$V_o = 36\ V$$

3.4 wlg



Use nodal analysis to find Vo.

At V_1

$$-\frac{4A}{1K} + \frac{V_1}{3K} + \frac{V_1 - V_2}{4K} = 0$$

$$4V_1 + 3V_1 - 3V_2 = 48$$

OR

$$\boxed{7V_1 - 3V_2 = 48}$$

At V_2

$$\frac{V_2 - V_1}{4K} + \frac{2A}{1\times10^3} + \frac{V_2}{4K} = 0$$

$$V_2 - V_1 + V_2 = -8$$

$$\boxed{-V_1 + 2V_2 = -8}$$

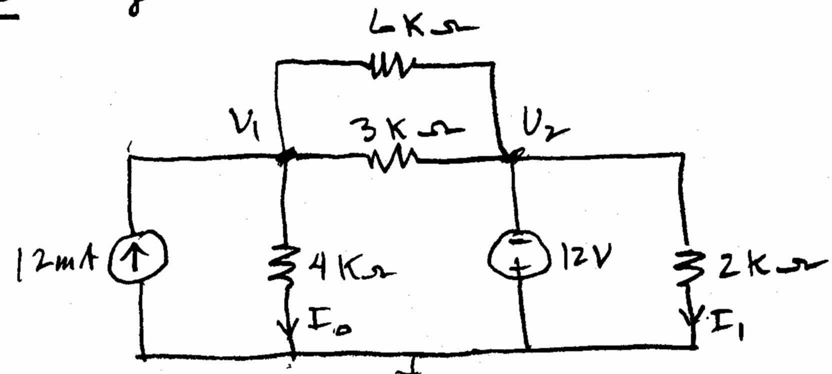
$$\begin{bmatrix} 7 & -3 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 48 \\ -8 \end{bmatrix}$$

$V_1 = 6.55$ V ; $V_2 = -0.727$

$V_o = V_2 - V_1 = -.727 - 6.55$

$$\boxed{V_o = -7.28 \text{ V}}$$ Ans

3.10 wlg



Find I_0 & I_1 using nodal analysis.

Solution:

Assign V_1 & V_2 as shown. Write nodal equations then solve for V_1 & V_2. Use V_1 and V_2 to find I_0 & I_1.

At V_1

12cd $$-\frac{12}{1\times K} + \frac{V_1}{4K} + \frac{V_1 - V_2}{3K} + \frac{V_1 - V_2}{6K} = 0 \qquad (1)$$

$$-144 + 3V_1 + 4V_1 - 4V_2 + 2V_1 - 2V_2 = 0$$

$$\boxed{9V_1 - 6V_2 = 144} \qquad (2)$$

At V_2

$V_2 = -12V$ by inspection;

∴ from (2)

$$9V_1 + 72 = 144$$

$$V_1 = 8\,V$$

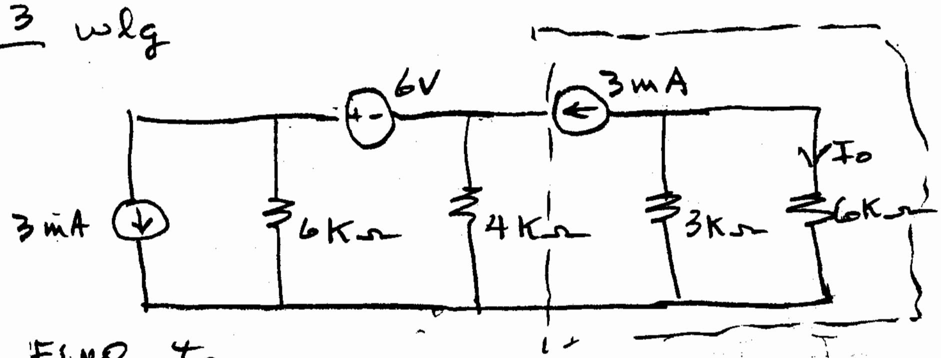
So

$$I_0 = \frac{V_1}{4K} = \frac{8}{4K} = 2\,mA$$

$\boxed{I_0 = 2\,mA}$ Ans

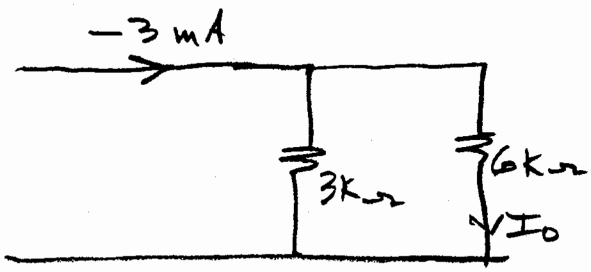
$\boxed{I_1 = \frac{-12}{2K} = -6\,mA}$ Ans

3.13 wlg



FIND I_o

Solution: The Author set this problem up to catch you off guard. You don't need to do nodal analysis. The dashed portion is all we need to consider. We have;



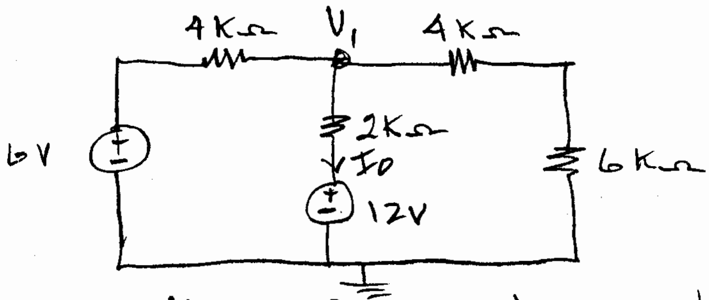
By current splitting;

$$I_o = \frac{(-3mA) \times 3K}{3K + 6K}$$

$$\boxed{I_o = -1mA}$$ ANS

3.19 wlg

Find I_o in the circuit below.



The author does not say to work by nodal analysis. I will however because it is straightforward: Assign node voltage V_1 as shown.

At V_1

$$\frac{V_1 - 6}{4K} + \frac{V_1 - 12}{2K} + \frac{V_1}{10K} = 0$$

20K

$$5V_1 - 30 + 10V_1 - 120 + 2V_1 = 0$$

$$17V_1 = 150$$

$$V_1 = 8.82$$

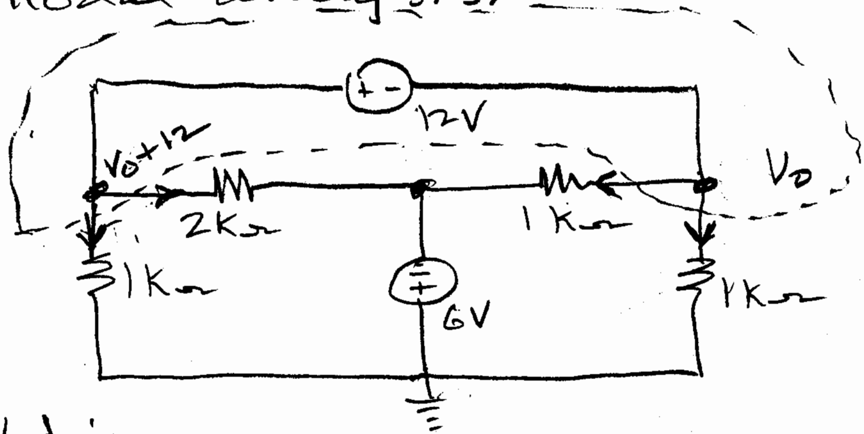
$$I_o = \frac{V_1 - 12}{2K} = \frac{8.82 - 12}{2K}$$

$$I_o = -1.59$$

Ans

3.22 wlq

Find V_o in the ckt below using nodal analysis.



Solution

We have a "supa node" to consider. This is indicated with dashed lines. Four currents leave the supernode as shown with arrows. The node on the left can be written as $V_o + 12$.

For the supernode:

$$\frac{V_o}{1K} + \frac{V_o+6}{1K} + \frac{V_o+12+6}{2K} + \frac{V_o+12}{1K} = 0$$

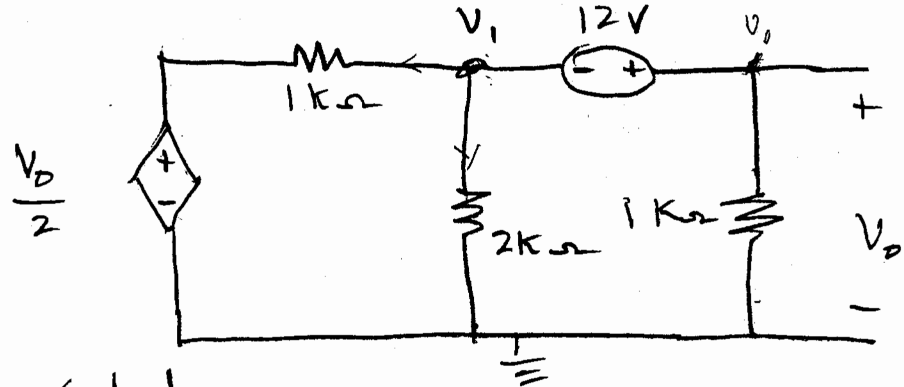
$$2V_o + 2V_o + 12 + V_o + 18 + 2V_o + 24 = 0$$

$$7V_o = -54$$

$$V_o = -7.71 \text{ V}$$

3.31 wlg

Find V_o using nodal analysis



Solution:

Assign V_1 as shown. Write KCL at V_1.

$$\frac{(V_1 - 0.5V_o)}{1K} + \frac{V_1}{2K} + \frac{V_1+12}{1K} = 0$$

$$2V_1 - V_o + V_1 + 2V_1 + 24 = 0$$

$$5V_1 - V_o = -24 \qquad (1)$$

but

$$V_1 + 12 - V_o = 0$$

$$V_o = V_1 + 12 \qquad (2)$$

substitute (2) into (1)

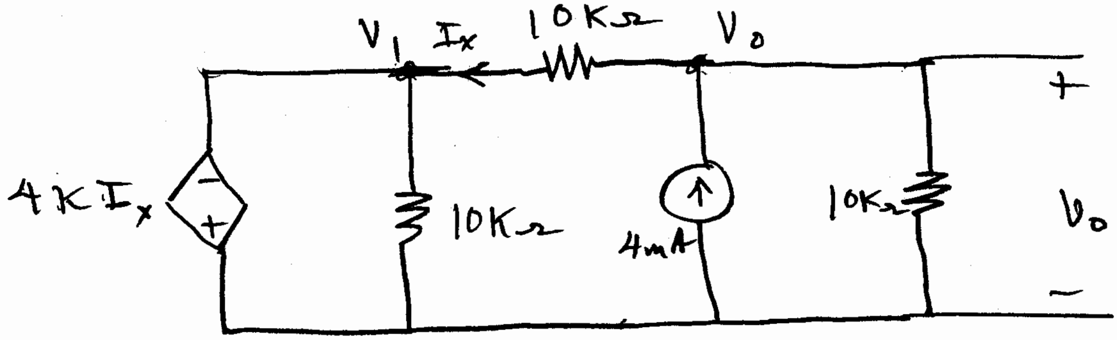
$$5V_1 - (V_1 + 12) = -24$$

$$4V_1 = -12$$

$$V_1 = -3V$$

then $\boxed{V_o = 9\text{ V}}$

3.37 wlz



FIND V_0 using nodal analysis:

@ V_1

$$V_1 = -4K\,I_x \qquad (1)$$

@ V_0

$$\frac{V_0 - V_1}{10K} - \frac{4A}{1K} + \frac{V_0}{10K} = 0$$

so,

$$V_0 - V_1 - 40 + V_0 = 0$$

$$2V_0 = 40 + V_1 \qquad (2)$$

Now

$$I_x = \frac{V_0 + 4K I_x}{10K} \qquad (3)$$

and from (3)

$$I_x = \frac{V_0}{6K}$$

From (1)

$$V_1 = -4K\left(\frac{V_0}{6K}\right) = -\frac{2}{3}V_0$$

Into (2)

$$2V_0 = 40 - \frac{2}{3}V_0$$

Giving

$$\boxed{V_0 = 15V}$$

3.37 wlg

Another way of working

$$V_1 + 4K\, I_x = 0 \qquad (1)$$

$$V_1 - 2V_o = -40 \qquad (2)$$

$$V_o - 6K I_x = 0 \qquad (3)$$

From (1), (2), and (3)

$$\begin{array}{ccc} V_1 & V_o & I_x \end{array}$$

$$\begin{bmatrix} 1 & 0 & 4K \\ 1 & -2 & 0 \\ 0 & 1 & -6K \end{bmatrix} \begin{bmatrix} V_1 \\ V_o \\ I_x \end{bmatrix} = \begin{bmatrix} 0 \\ -40 \\ 0 \end{bmatrix}$$

$V_1 = -10$, $V_o = 15$, $I_x = 0.0025\,A$