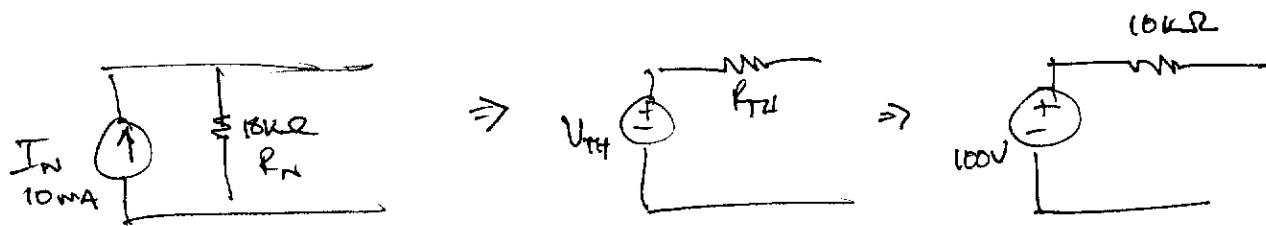


hw#2

①

#1 (1-17)



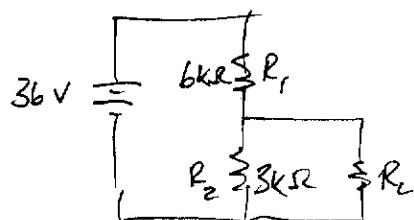
From pg 19, $V_{TH} = I_N R_N$ and $R_{TH} = R_N$

$$V_{TH} = I_N R_N = 10\text{mA} \cdot 10\text{k} \boxed{= 100\text{V}}$$

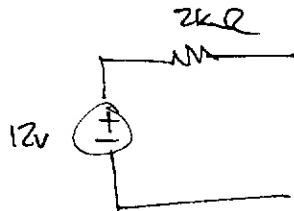
$$R_{TH} = R_N = \boxed{10\text{k}\Omega}$$

#2. (1-27)

FIND THEVENIN:



From last hw
⇒



NOW FIND LOAD CURRENT:

$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$

$$V_{TH} = V_2 \frac{R_2}{R_1 + R_2} = 12\text{V}$$

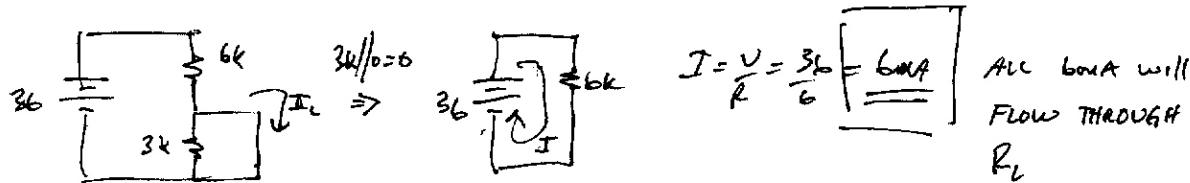
$$R_{TH} = R_1 \parallel R_2 > \frac{R_1 R_2}{R_1 + R_2} = 2\text{k}\Omega$$

R_L	I_L
0	6mA
1k	4mA
2k	3mA
3k	2.4mA
4k	2mA
5k	1.7mA
6k	1.5mA

#2 continued...

(2)

$$R_L = 0 \Omega$$



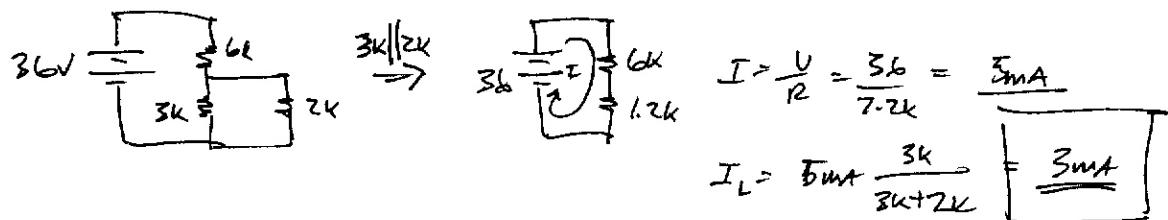
$$R_L = 1k \Omega$$



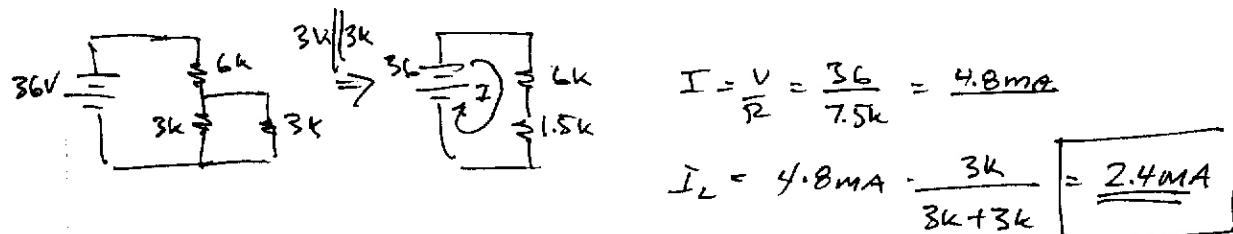
NOW NO CURRENT DIVIDER FOR I_L :

$$I_L = I \cdot \frac{3k}{3k+1k} = 4 \text{ mA}$$

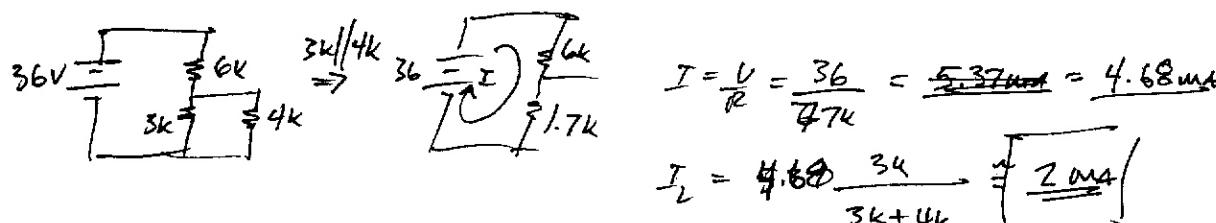
$$R_L = 2k \Omega$$



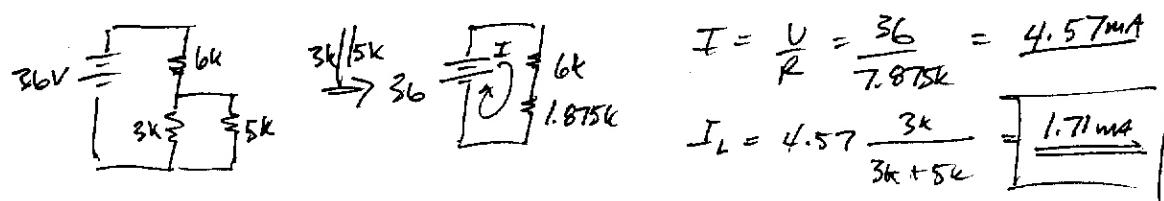
$$R_L = 3k \Omega$$



$$R_L = 4k \Omega$$



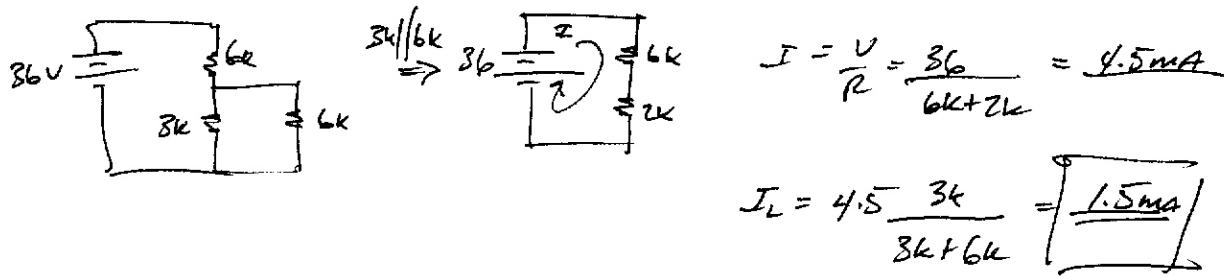
$$R_L = 5k \Omega$$



#2 continued...

(3)

$$R_L = 2k\Omega$$



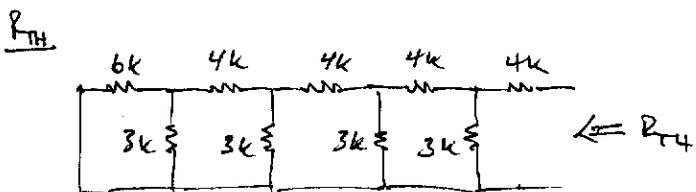
THEVENIN EQUIV. CIRCUITS MAKE FINDING THE SOLUTIONS MUCH EASIER AND SAVES PAPER :)

#3 (1-22)

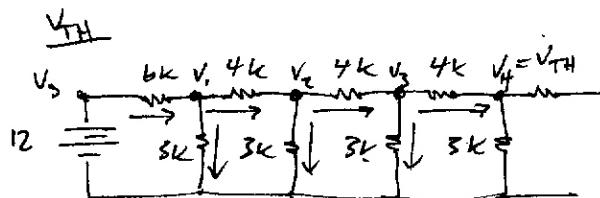
From first law: R_L is open circuited by 12 Volts is V_{TH} (which is the open circuit voltage); when R_L is added, some different current is drawn from the voltage source, changing the output voltage.

#4 (1-34)

FIND THEV. EQUIV.



$$\left(\left[\left(6k \parallel 3k+4k \right) \parallel 3k \right] + 4k \right) \parallel 3k+4k = 6k$$



4 EQUATIONS, 4 UNKNOWNNS. USING KCL

$$\textcircled{1} \frac{V_2 - V_1}{6k} = \frac{V_1}{3k} + \frac{V_1 - V_2}{4k} \quad \textcircled{2} \frac{V_1 - V_2}{4k} = \frac{V_2}{3k} + \frac{V_2 - V_3}{4k}$$

$$\textcircled{3} \frac{V_2 - V_3}{4k} = \frac{V_3}{3k} + \frac{V_3 - V_4}{4k} \quad \textcircled{4} \frac{V_3 - V_4}{4k} = \frac{V_4}{3k}$$

Fwd, solve, for V_4

(4)

#4 continued ...

REDUCE EQUATIONS:

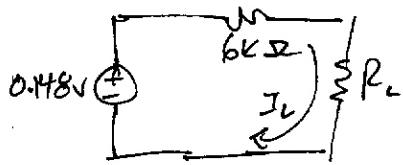
$$\textcircled{1} \quad 9V_1 - 3V_2 = 2V_8 = 24 \quad \textcircled{3} \quad -3V_1 + 10V_2 - 3V_3 = 0$$

$$\textcircled{2} \quad -3V_2 + 10V_3 - 3V_4 = 0 \quad \textcircled{4} \quad 3V_3 - 7V_4 = 0$$

SOLVE USING MATRIX:

$$\left[\begin{array}{cccc|c} 9 & -3 & 0 & 0 & 24 \\ -3 & 10 & -3 & 0 & 0 \\ 0 & -3 & 10 & -3 & 0 \\ 0 & 0 & 3 & -7 & 0 \end{array} \right] \xrightarrow{\text{RREF}} \left[\begin{array}{cccc|c} 1 & 0 & 0 & 0 & 3 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0.346 \\ 0 & 0 & 0 & 1 & 0.148 \end{array} \right] \Rightarrow V_4 = \underline{\underline{0.148V}}$$

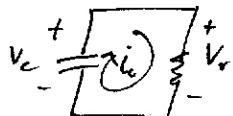
THEV. EQUIV:



$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$

R_L	I_L
0	24 μA
1k	21 μA
2k	18.5 μA
3k	16.4 μA
4k	14.8 μA
5k	13.5 μA
6k	12.3 μA

#5



$$V_{CO} = 20V$$

$$i_c = C \frac{dV_c}{dt}$$

$$\begin{aligned} V_r + V_c &= 0 \\ i_c \cdot R + V_c &= 0 \\ C \frac{dV_c}{dt} \cdot R + V_c &= 0 \end{aligned}$$

$$RC \frac{dV_c}{dt} = -V_c$$

$$\frac{dV_c}{V_c} = -\frac{1}{RC} dt$$

$$0 \int \frac{dV_c}{V_c} = -\frac{1}{RC} \int_0^t dt$$

$$\ln V_c = -\frac{t}{RC}$$

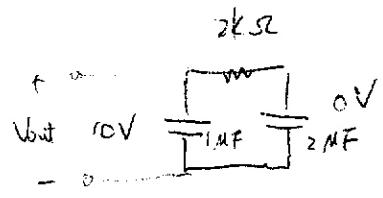
$$T = RC$$

$$\ln V_c = -\frac{t}{T}$$

$$V_c = V_{CO} e^{-\frac{t}{T}}$$

$$T = RC = 1\mu F \cdot 1k\Omega = 0.001$$

t	V_c
0	20
10ns	$20e^{-10ns/0.001} = 19.8V$
100ns	18.1V
1μs	7.36V
5ms	0.135V



$$Q = CV$$

$$Q = 1\mu F \times 10V$$

At steady state, $C_{eq} = C_1 + C_2 = 3\mu F$

$$Q = C_{eq} \times V_{out}$$

$$V_{out} = \frac{1\mu F \times 10V}{3\mu F} = \frac{10}{3} V$$