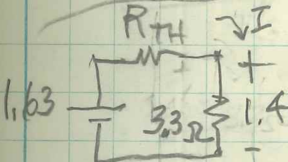
$\boxed{V_{oc}=1.63 \quad V_{oc}=1.62 \quad V_{oc}=1.6 \quad V_{oc}=1.57 \quad V_{oc}=9.56} \leftarrow V_{oc}=V_{TH}$

31

$V_{3.3}=1.46 \quad V_{3.3}=1.49 \quad V_{3.3}=1.46 \quad V_{3.3}=1.49 \quad V_{47}=8.3$

AAA	AA	C	D	9V
15Ω	22Ω	33Ω	47Ω	220Ω

HW #2 (See Bottom of Sheet)

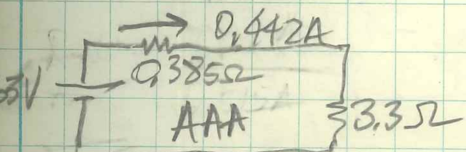


$I = \frac{1.46}{3.3\Omega} = 0.442A$

$I \times R = (1.63 - 1.46)V$
$= 0.17V$

0.442

$R = \frac{0.17V}{0.442A} = 0.385\Omega$



$-1.63 + (0.442)[0.385 + 3.3\Omega] = ?$

$-1.63 + 0.442(3.69) = 0$

For AA, $I = \frac{1.49V}{3.3} = 0.452A$

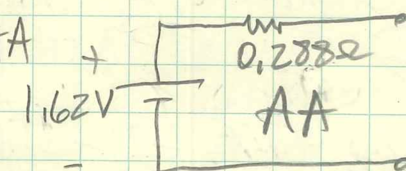
$-V_{oc} + IR_{TH} + V_{3.3} = 0, \quad IR_{TH} = V_{oc} - V_{3.3}$

0.452 1.49

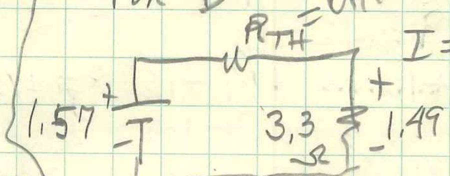
$R_{TH} = \frac{1.62 - 1.49}{0.452} = 0.288\Omega$

Check $-1.62 + (0.452)(0.288) + 1.49$
$= -1.62 + 0.1574 + 1.49 \approx 0$

AA



For D



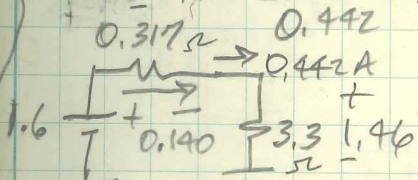
$I = \frac{1.49V}{3.3\Omega} = 0.452A$

$IR_{TH} = (1.57 - 1.49), \quad R_{TH} = \frac{0.08V}{0.452A}$

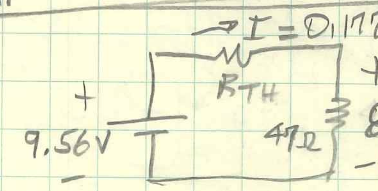
$R_{TH} = 0.177\Omega$

C Batt, $V_{oc} = 1.6 \quad I = \frac{1.46}{3.3\Omega} =$
$V_{3.3} = 1.46, \quad I = 0.442A$

$-V_{oc} + (0.442)R_{TH} + V_{3.3} = 0$
$-1.6 + 0.442R_{TH} + 1.46 = 0$
$R_{TH} = \frac{1.6 - 1.46}{0.442} = 0.317\Omega$



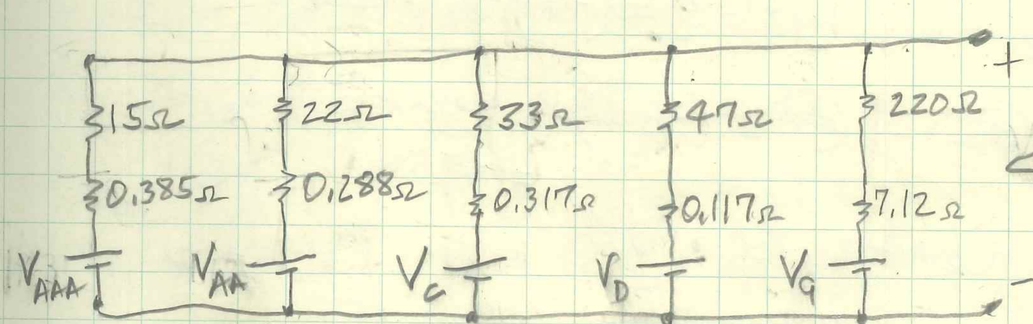
9V.



$I = \frac{8.3V}{47\Omega}$
$= 0.177A$

$-9.56 + 0.177R_{TH} + 8.3 = 0$

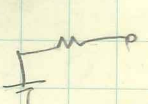
$R_{TH} = \frac{9.56 - 8.3}{0.177} = 7.12\Omega$



Find the Thev. Eq.

HW #2

Due Wed 09/22



HW #4 2021_0923a

The Procedure for Coding the Gaussian Elimination / Backward Substitution Method for Solving Large (1000's) of Nodal and other sets of equations

Gaussian Elimination Method for Solving a set of Equations. Consider two equations:

$$\#1 \quad Ax + By + C = 0$$

$$\#2 \quad Dx + Ey + F = 0$$

A, B, C, D, E, F are known.
$\boxed{x \text{ and } y \text{ are unknown}}$

Since both equations $= 0$, you can add or subtract the equations or multiples of the equations without affecting the final solutions for x and y.

Gaussian Elimination says to subtract a multiple of #1 from #2 so that the "modified" D becomes zero.

If we multiply #2 by $\frac{A}{D}$ we get

$$\left(\frac{A}{D}\right)\cdot Dx + \left(\frac{A}{D}\right)\cdot Ey + \left(\frac{A}{D}\right)\cdot F = 0$$

yielding mod. #2: $\left[Ax + \frac{AE}{D}y + \frac{AF}{D} = 0\right]$

The new pair of equations is

$$1 \quad Ax + By + C = 0$$

$$2''_{mod} \quad Ax + \frac{AE}{D}y + \frac{AF}{D} = 0$$

Now subtract 1 from 2'', yielding

$$1 \quad Ax + By + C = 0$$

$$2_{mod} \quad 0 + \left(\frac{AE}{D} - B\right)y + \left(\frac{AF}{D} - C\right) = 0$$

Thus, $\boxed{y = \dfrac{C - \frac{AF}{D}}{\frac{AE}{D} - B}}$

2021_0923b

For 3x3,

$$\begin{cases} Ax + By + Cz + J = 0 \\ Dx + Ey + Fz + K = 0 \leftarrow \text{mult. by } \frac{A}{D} \text{ to eliminate } D. \\ Gx + Hy + Iz + L = 0 \leftarrow \text{mult. by } \frac{A}{G} \text{ to eliminate } G. \end{cases}$$

Creating modified equations

$$\begin{array}{llllll} \#1 & \boxed{Ax + By + Cz + J = 0} \\ \#2' & 0 + \boxed{E'y + F'z + K' = 0} \\ \#3' & 0 \quad \boxed{H'y + I'z + L' = 0} \end{array}$$

Now, repeat the process for the two equations

$$\begin{array}{l} \#2' \\ \#3' \end{array} \begin{bmatrix} E'y + F'z + K' = 0 \\ H'y + I'z + L' = 0 \end{bmatrix}$$

And eliminate $H'y$, so

$$\begin{array}{l} \#2' \\ \#3'' \end{array} \left[\begin{array}{l} E'y + F'z + K' = 0 \\ 0 \qquad \boxed{I''z + L'' = 0} \end{array}\right]$$

Now, $I''z = -L''$

So, from #3'' $\boxed{z = \frac{-L''}{I''}}$!

Now, use backward substitution

Insert known z into #2' to compute y.

The insert known z and y into #1 to compute x.

2021_0923c

Your Problem

① $1x_1 - 2x_2 - 3x_3 - 4 = 0$

② $5x_1 + 6x_2 + 7x_3 - 8 = 0$

③ $9x_1 + 10x_2 + 11x_3 - 12 = 0$

② is now $\frac{1}{5}[5x_1 + 6x_2 + 7x_3 - 8] = 0$

$\hookrightarrow x_1 + \frac{6}{5}x_2 + \frac{7}{5}x_3 - \frac{8}{5} = 0$

③ is now $\frac{1}{9}[9x_1 + 10x_2 + 11x_3 - 12] = 0$

$\hookrightarrow x_1 + \frac{10}{9}x_2 + \frac{11}{9}x_3 - \frac{12}{9} = 0$

① $x_1 - 2x_2 - 3x_3 - 4 = 0$

② $x_1 + \frac{6}{5}x_2 + \frac{7}{5}x_3 - \frac{8}{5} = 0$

③ $x_1 + \frac{10}{9}x_2 + \frac{11}{9}x_3 - \frac{12}{9} = 0$

$2'' = ② - ① \Rightarrow 0x_1 + (\frac{6}{5}+2)x_2 + (\frac{7}{5}+3)x_3 - \frac{8}{5} + 4 = 0$

$3'' = ③ - ① \Rightarrow 0x_1 + (\frac{10}{9}+2)x_2 + (\frac{11}{9}+3)x_3 - \frac{12}{9} + 4 = 0$

Simplifying $2'' \Rightarrow (\frac{16}{5})x_2 + (\frac{22}{5})x_3 + (\frac{12}{5}) = 0$

$3'' \Rightarrow (\frac{28}{9})x_2 + (\frac{38}{9})x_3 + (\frac{24}{9}) = 0$

Multiply $2''$ by 5, Multiply $3''$ by 9, $\begin{bmatrix} 16x_2 + 22x_3 + 12 = 0 \\ 28x_2 + 38x_3 + 24 = 0 \end{bmatrix}$

Eliminate x_2 by Multiplying $3''$ by $\frac{16}{28}$

$2''$: $16x_2 + 22x_3 + 12 = 0$

$3''$: $\frac{16}{\cancel{28}}(\cancel{28})x_2 + \frac{16}{28}(38)x_3 + \frac{16}{28}(24) = 0$

$3''' = 3'' - 2'' \Rightarrow 0x_2 + (\frac{16}{28}(38) - 22)x_3 + \frac{16(24)}{28} - 12 = 0$

mult. by 28, $[(16)(38) - 616]x_3 + 384 - 336 = 0$

$-8x_3 = -48$

$\boxed{x_3 = 6}$

Sub into $2''$, $16x_2 + 22x_3 + 12 = 0$

$16x_2 + 22(6) + 12 = 0$

$\boxed{x_2 = -9}$

Last Step

$x_1 = 2x_2 + 3x_3 + 4$

$= 2(-9) + 3(6) + 4$

$= -18 + 18 + 4$, $\boxed{x_1 = 4}$

Check

② $5(4) + 6(-9) + 7(6) - 8 = 0$ Yeah!

Check ③

$9x_1 + 10x_2 + 11x_3 - 12$

$9(4) + 10(-9) + 11(6) - 12 = 0$

Yeah!!

Now

So, why do All this - so you can see that given the procedure, you could write the computer code to do it!