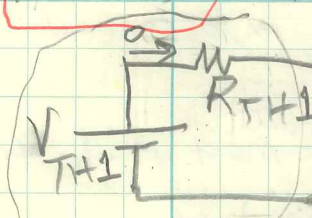
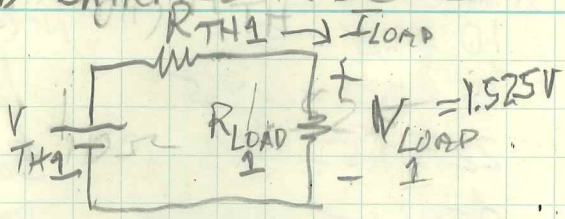
Thevenin Eq. of 8 D batteries in series



ON PAPER

Open ckt $V_{MEAS} = V_{OC} = V_{TH1}$

$= 1.575\ V$

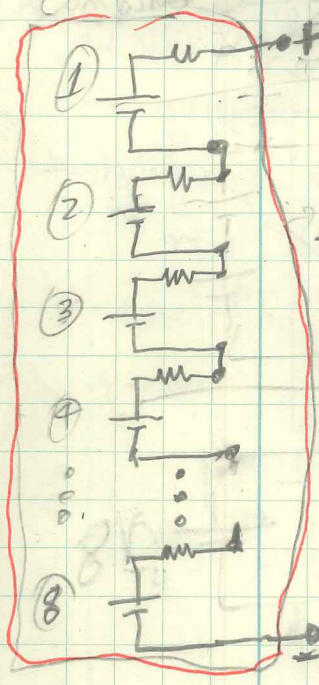


KVL

$-V_{TH_1} + I_{LOAD_1} R_{TH_1} + V_{LOAD_1} = 0$

HW#1 Due Wed (on paper)

Put 8 of the batteries shown here in series.

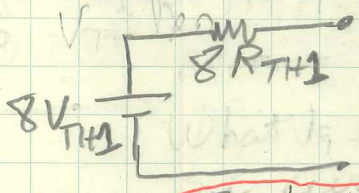


Solve for Thev Eq. of 8 identical batteries in series

V_{OC} (NO CURRENT) $= 8 \times 1.575\ V$ ← FOR 1

Turn off the sources (i.e, V=0)

$R_{TH} = 8 \times (0.328)$



Open ckt VOLTAGE INCREASES by 8. → CAN produce 8 times the power of 1

S.C. current is same as 1 batt

$R_{TH} = \frac{V_{TH} - V_{LOAD}}{I_{LOAD}}$

In this case we know

$R_{LOAD1} = 10\Omega$

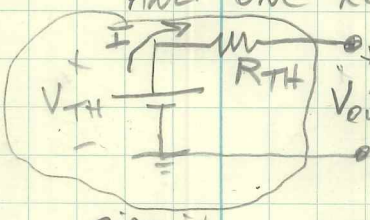
So $I_{LOAD_1} = \frac{V_{LOAD}}{R_{LOAD}} = 0.1525A$

So $R_{TH_1} = \frac{1.575 - 1.525}{0.1525}$

$R_{TH_1} = 0.328\Omega$

Find the R_{LOAD} that will consume 10 WATTS

Thevenin's Theorem says that AN two nodes of a linear circuit CAN be represented by one voltage source AND one resistor



← Thevin Ckt.

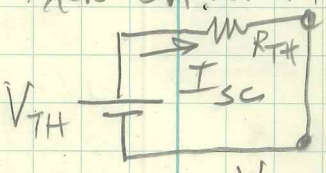
circuit

KVL, $-V_{TH} + I R_{TH} + V_{out} = 0$ ← 0 for open ckt

so $V_{TH} = V_{OUT}$ open ckt

We CAN also apply the theorem to a REASONABLY-LINEAR "CIRCUIT" such as a BATTERY. Ideally you CAN MEASURE the output voltage when open circuited, NO CURRENT flow in and out, so $V_{TH} = V_{OUT}$ @ open ckt

Then short it, Measure I_{SC}.



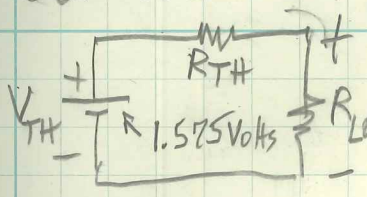
Our $V_{TH} = 1.5$ Volts

so $-V_{TH} + I_{SC} R_{TH} = 0$

$R_{TH} = V_{TH} / I_{SC}$

Shorting CAN cause damage, so connect a Resistor to the output that will have A REASONABLE CURRENT, AND test under load instead of short ckt (SO)

Our Case $V_{LOAD_{MEAS}} = 1.525^{V}$, $I_{LOAD} = \frac{1.525}{10\Omega} \approx 0.1525$ Amps

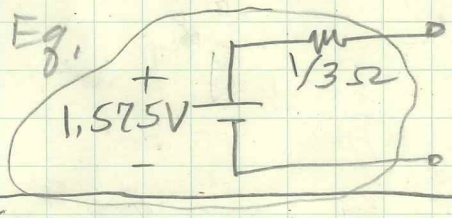


Matches the measured current 0.15 A

Now, use KVL, $-V_{TH} + IR_{TH} + V_{LOAD} = 0$, $R_{TH} = \frac{V_{TH} - V_{LOAD}}{0.15A}$

$R_{TH} = \frac{1.575 - 1.525 \text{ volts}}{0.15A} = \frac{0.05 \text{ volts}}{0.15A} = \frac{1}{3}\Omega$

Battery Thev Eq.



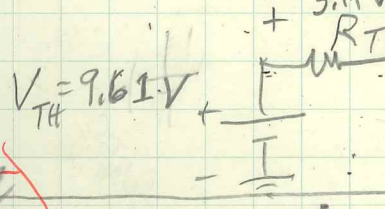
Class D $V_{oc} = 1.575$ V, 10Ω, V_{LOAD} 1.533, $I = \frac{1.533}{10} = 0.1533$A, $R_{TH} = \frac{1.575 - 1.533}{0.1533} = 0.274\Omega$

C $V_{oc} = 1.605$ V, 10Ω, V_{LOAD} 1.543, $I = \frac{1.543}{10} = 0.1543$A, $R_{TH} = 0.402\Omega$

AA $V_{oc} = 1.620$, 10Ω, V_{LOAD} 1.564, $I = \frac{1.564}{10} = 0.164$, $R_{TH} = 0.358\Omega$

AAA $V_{oc} = 1.620$, 10Ω, V_{LOAD} 1.555, $I = \frac{1.555}{10} = 0.1555$, $R_{TH} = 0.418\Omega$

9V $V_{oc} = 9.61$, 10Ω, V_{LOAD} 6.50, $I = \frac{6.5}{10} = 0.65$A, $R_{TH} = 4.78\Omega$

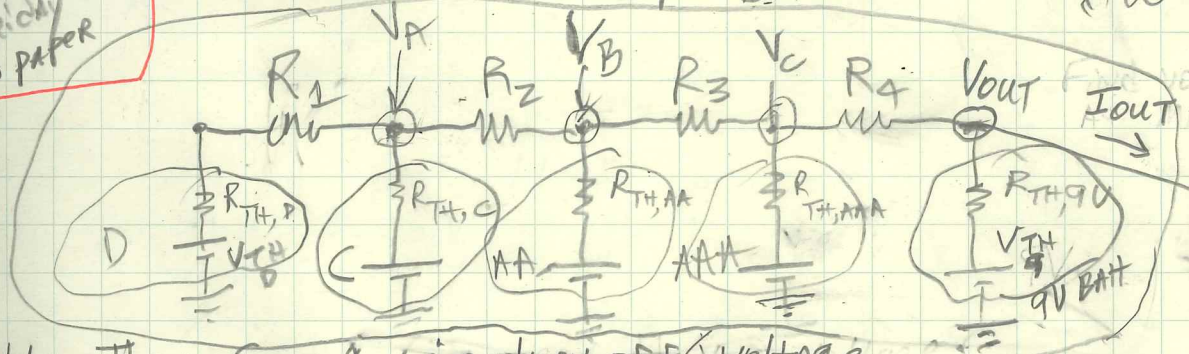


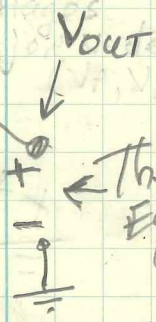
$R_{TH} = \frac{9.61 - 6.50}{0.65} = 4.78\Omega$

HW #2 Friday on paper

How to handle multiple batteries

HW #2 Friday





- Use Thev. Case 1 (i.e, turn off voltage sources) AND develop AN expression (VARIABLES only) to determine R_{TH} FOR the combined ckt. Work from left-to-right to get the expression FOR R_{TH} At the output.

Use the battery R_{TH} values, AND $R_1 = 15$, $R_2 = 22$, $R_3 = 33$, $R_4 = 48\Omega$ to solve for R_{TH} At the Output

- Use the Nodal method to form the matrix needed to solve FOR V_A, V_B, V_C, V_{OUT}. NO NUMBERS.