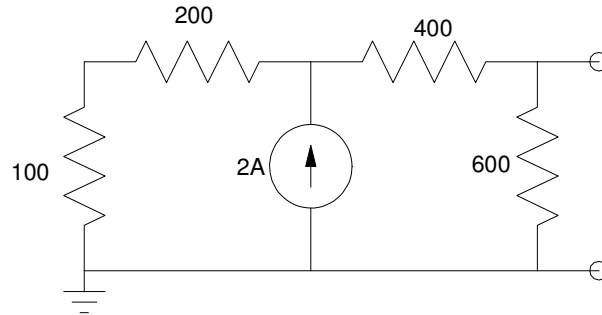


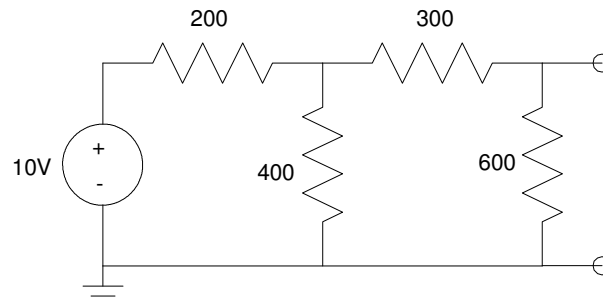
Thevenin Equivalents

EE 206 Practice Problems

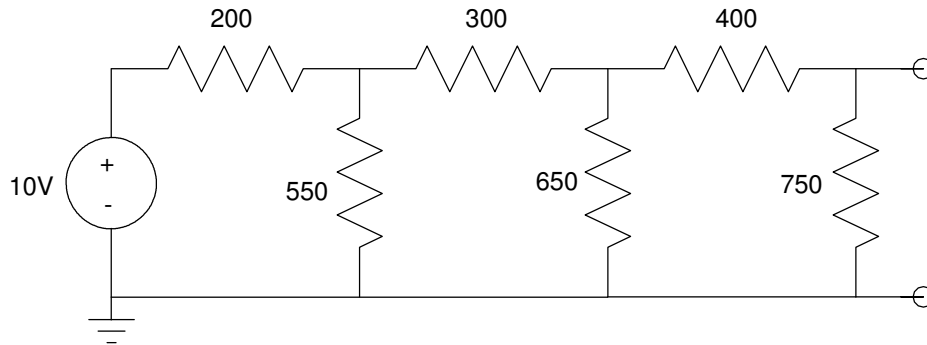
Find the Thevenin equivalent for the following circuits by transforming between Thevenin and Norton equivalents



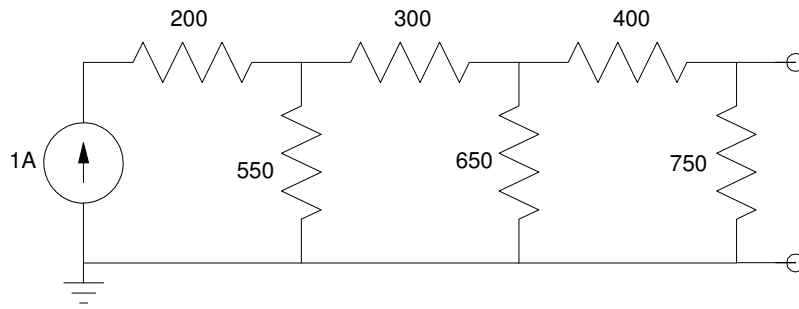
Problem 1



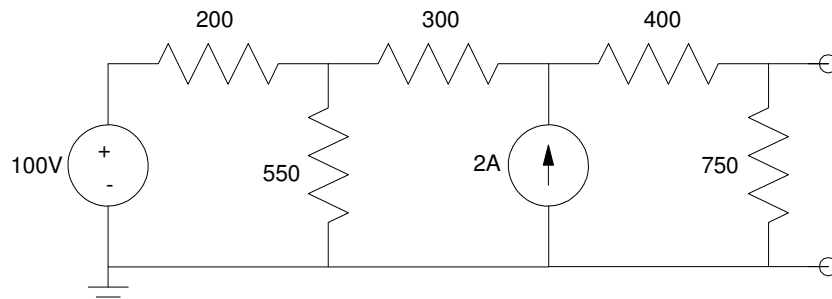
Problem 2



Problem 3



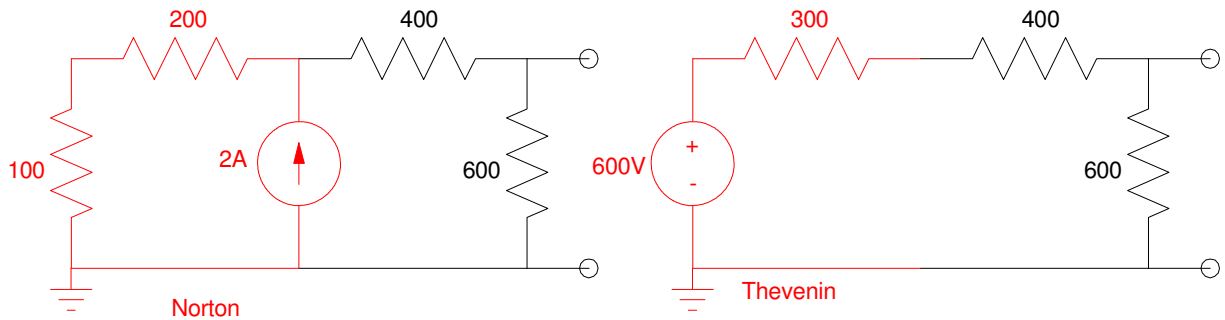
Problem 4



Problem 5

Solutions

Problem 1) Swapping from Norton to Thevenin



$$R_{th} = R_N = 100 + 200$$

$$V_{th} = I_N R_N = 600V$$

V_{th}: Now use voltage division to find the open-circuit voltage:

$$V_{open} = \left(\frac{600}{600+400+300} \right) 600V$$

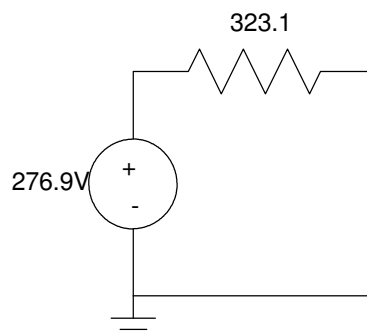
$$V_{open} = 276.92V$$

R_{th}: Turn off the source and measure the resistance looking in:

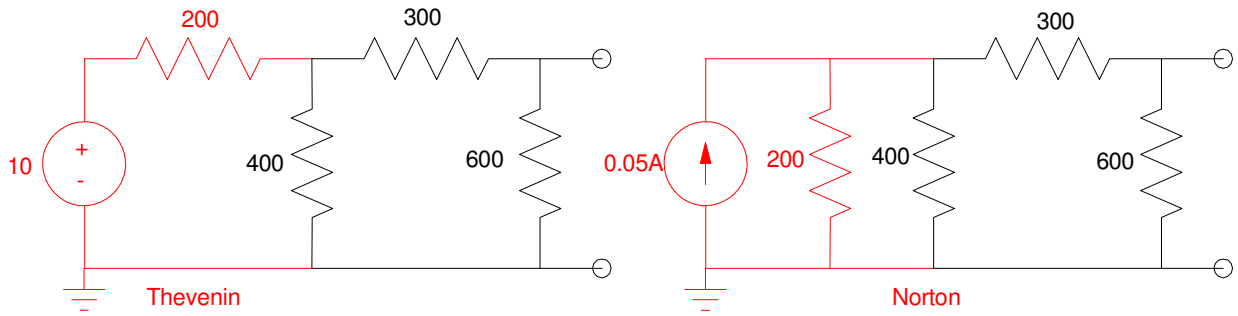
$$R_{th} = 600 || 700$$

$$R_{th} = 323.1\Omega$$

answer:



Problem 2) Convert from Thevenin to Norton



$$I_N = \frac{V_{th}}{R_{th}} = \frac{10V}{200\Omega} = 0.05A$$

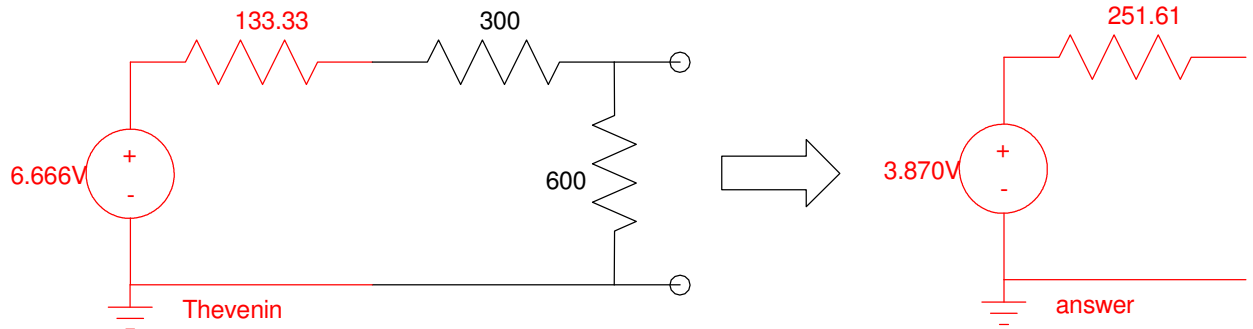
$$R_{th} = R_N = 200$$

Combine the 200 Ohms and 400 Ohm resistors in parallel

$$200 \parallel 400 = 133.333\Omega$$

Convert back to Thevenin

$$V_{th} = I_N R_N = 0.05A \cdot 133.333\Omega = 6.6666V$$

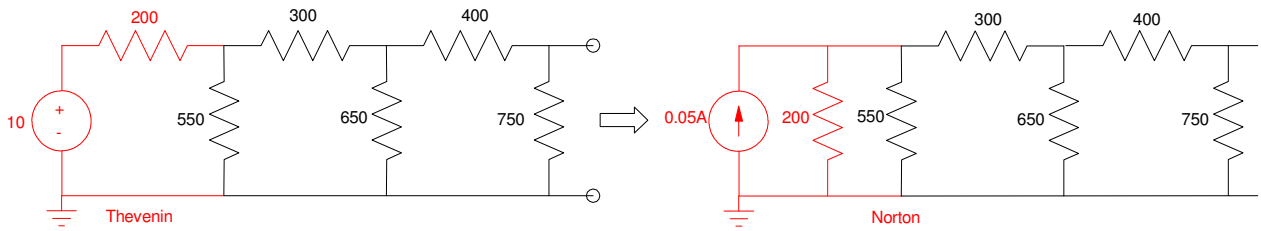


Now you can find the Thevenin voltage and resistance

$$V_{th} = V_{open} = \left(\frac{600}{600+300+133.333} \right) 6.666V = 3.870V$$

$$R_{th} = 600 \parallel 433.333 = 251.61\Omega$$

Problem 3) Convert from Thevenin to Norton

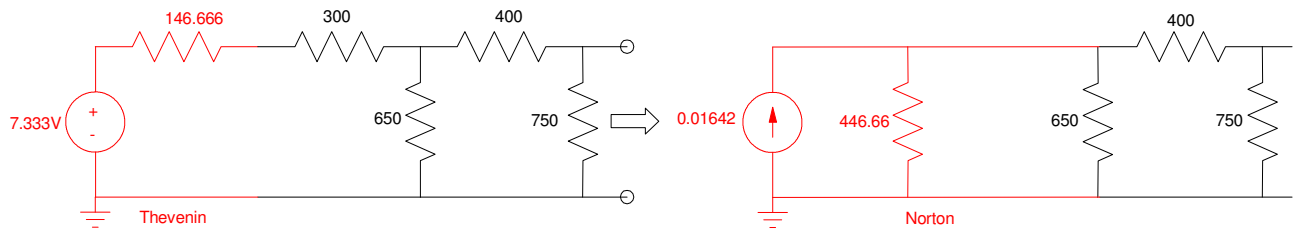


Combine resistors

$$200 \parallel 550 = 146.666$$

Convert back to Thevenin

$$V_{th} = I_N R_N = 0.05A \cdot 146.666\Omega = 7.333V$$



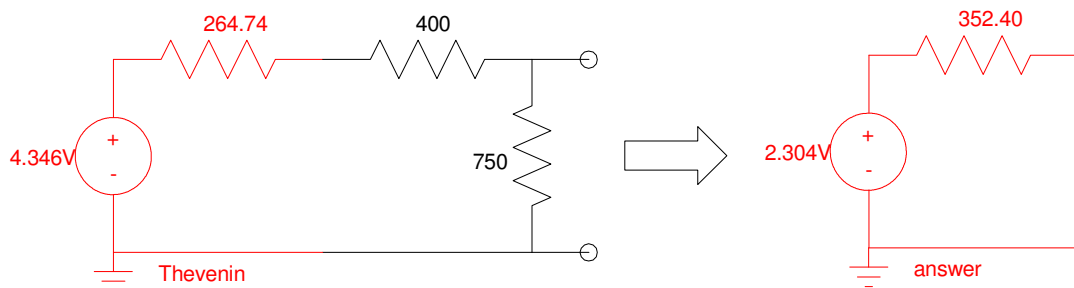
Combine the 146.66 and 300 Ohm resistor in series. Convert to Norton

$$I_N = \frac{V_{th}}{R_{th}} = \frac{7.3333V}{446.666\Omega} = 0.01642A$$

Add the 446 and 650 Ohm resistor in parallel

$$R_{th} = 446 \parallel 650 = 264.74\Omega$$

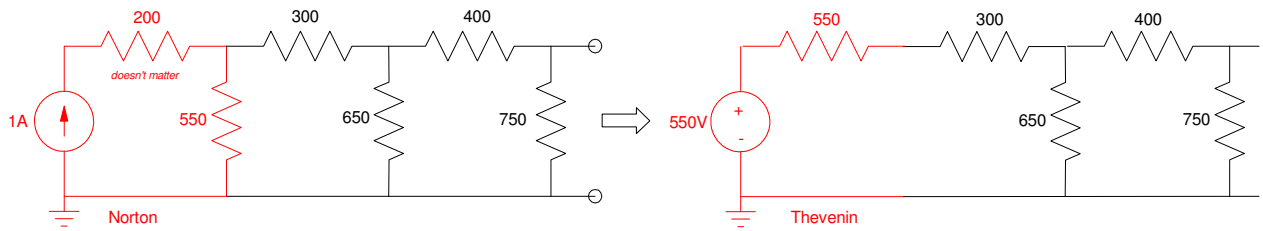
$$V_{th} = I_N R_N = 0.01642A \cdot 264.74\Omega = 4.346V$$



$$V_{th} = \left(\frac{750}{650+400+264.74} \right) 4.346V = 2.304V$$

$$R_{th} = 750 \parallel 664.74 = 352.40$$

Problem 4) The 200 Ohm resistor has no effect on the circuit. Take the Thevenin of the 1A source and 550 Ohm resistor:



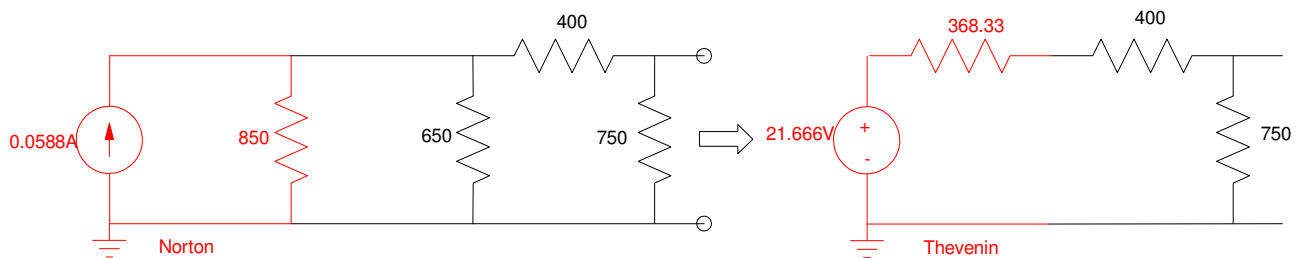
$$V_{th} = I_N R_N = 1A \cdot 550\Omega = 550V$$

$$R_{th} = R_N = 550\Omega$$

Combine the 550 and 300 Ohm resistor (result 830 Ohms.) Take the Norton Equivalent

$$R_N = R_{th} = 850\Omega$$

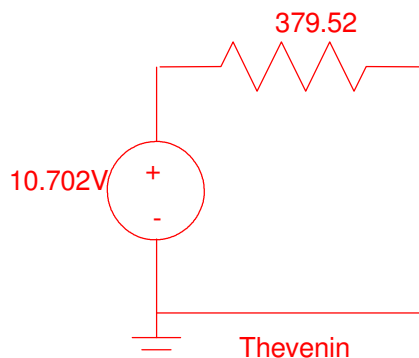
$$I_N = \frac{V_{th}}{R_{th}} = \frac{550V}{850\Omega} = 0.0588A$$



Now find V_{th} and R_{th}

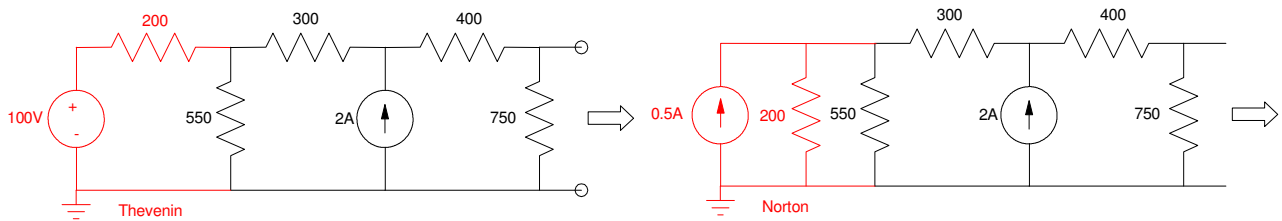
$$V_{open} = V_{th} = \left(\frac{750}{750+400+368.333} \right) 21.666V = 10.702V$$

$$R_{th} = 750 \parallel (400 + 368.33) = 379.52\Omega$$



Problem 5) Convert the 100V source to a Norton equivalent

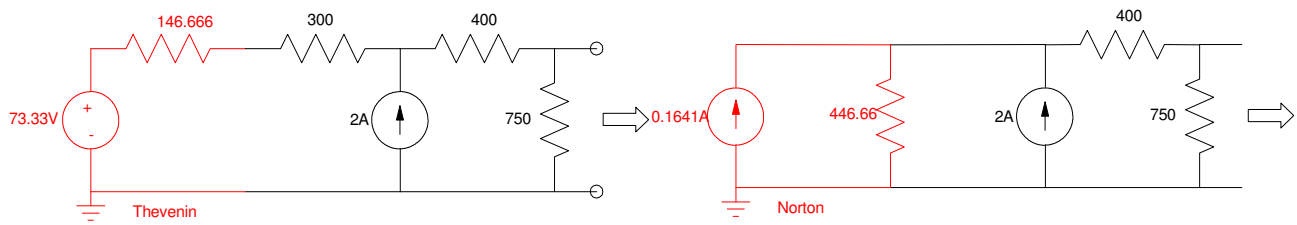
$$I_N = \frac{V_{th}}{R_{th}} = \frac{100V}{200\Omega} = 0.5A$$



Combine the 200 and 550 Ohm resistor in parallel. Take the Thevenin equivalent

$$R_{th} = 200 || 550 = 146.666\Omega$$

$$V_{th} = I_N R_{th} = 0.5A \cdot 146.666\Omega = 73.333V$$



The current sources add

$$I_N = 0.1641A + 2A = 2.1641A$$

Convert to a Thevenin

$$V_{th} = I_N R_N = 2.1641A \cdot 446.66\Omega = 966.66V$$

$$R_{th} = R_N = 446.66\Omega$$

