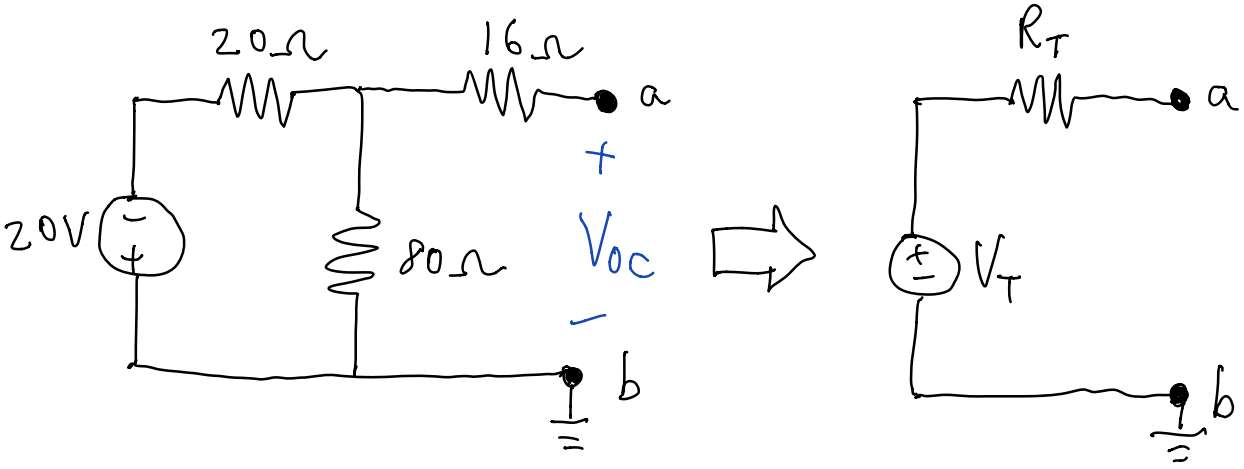
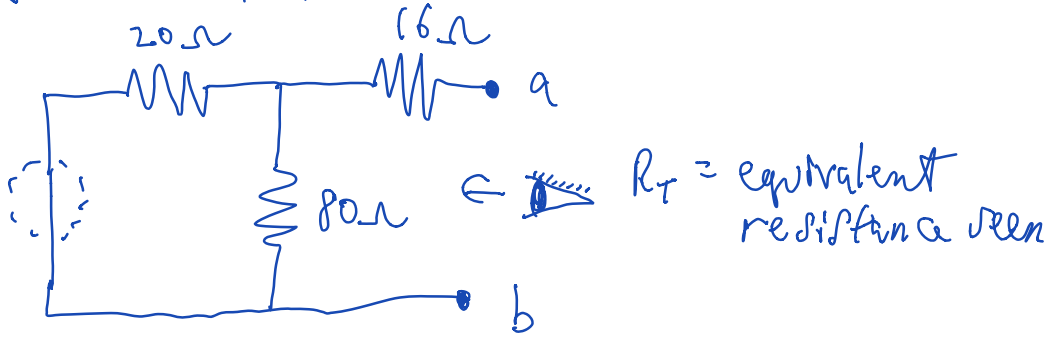
Additional Practice Questions for Thevenin Equivalent Circuits

① Find the Thevenin equivalent circuit across a & b:



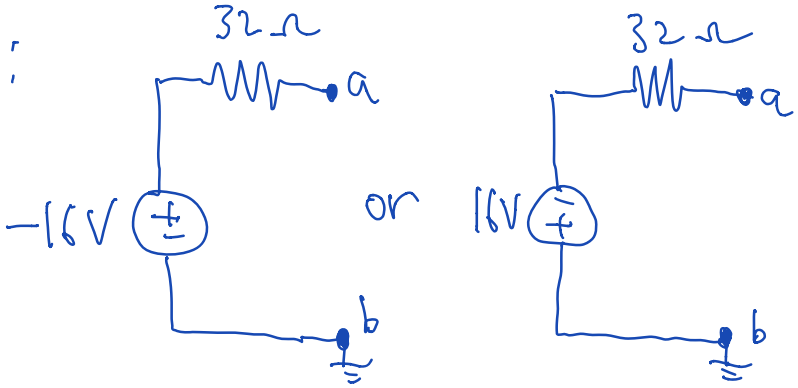
$$V_T = V_{OC} = \frac{80}{20+80} \times (-20) = -16\,V$$

To find R_T, put source to 0:

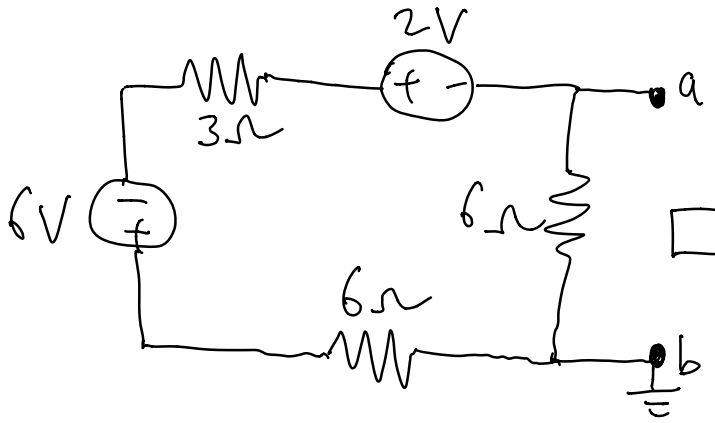


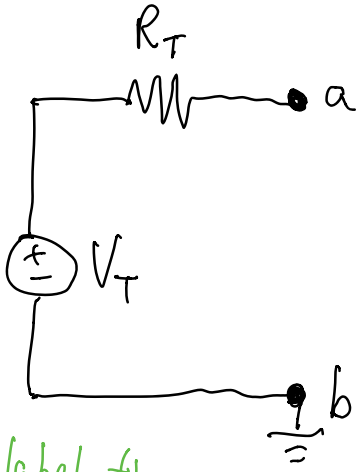
$$\therefore R_T = (20 // 80) + 16 = 32\,\Omega$$

Thevenin circuit:

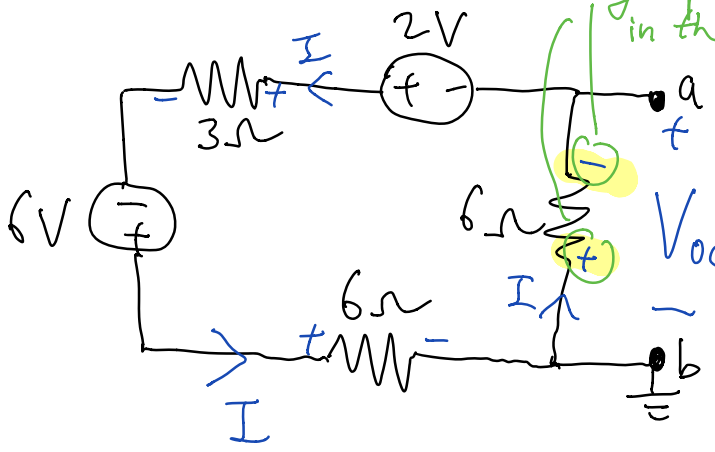


(2) Find the Thevenin equivalent circuit across a & b:





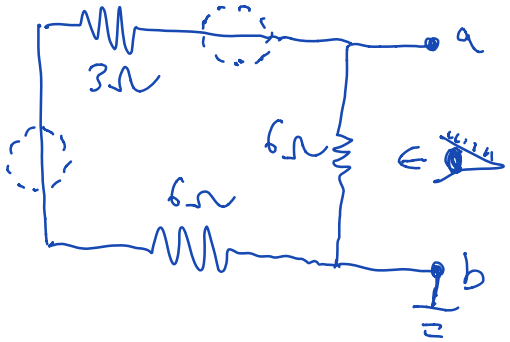
Notice that we label the voltage polarity s.t. voltage decreases in the direction of I



$$I = \frac{(6V + 2V)}{(3+6+6)\Omega} = \frac{8}{15}\,A$$

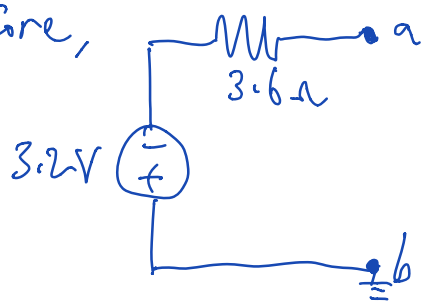
$$\therefore V_T = V_{OC} = -6 \times \frac{8}{15} = -3.2V$$

To find R_T:

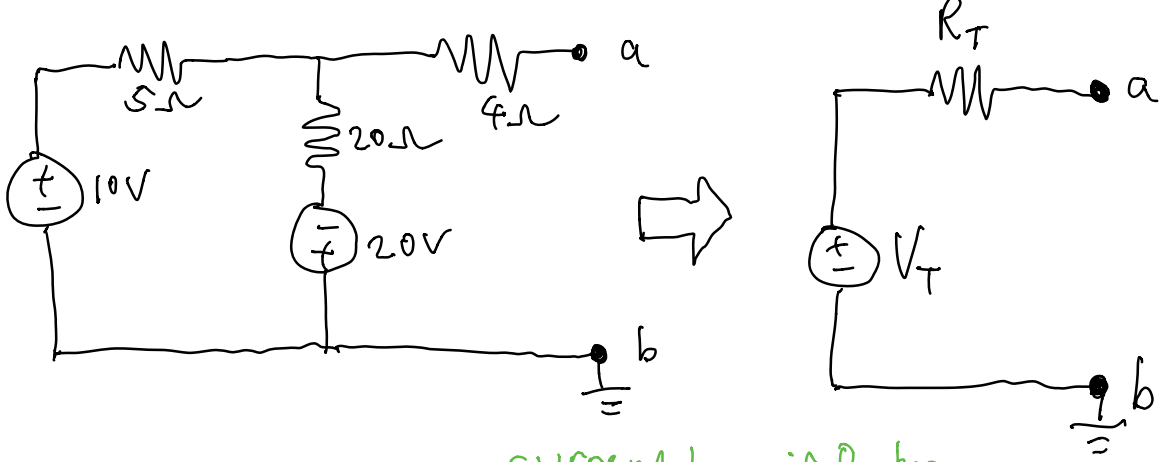


$$R_T = (3+6)\,//\,6 = 3.6\Omega$$

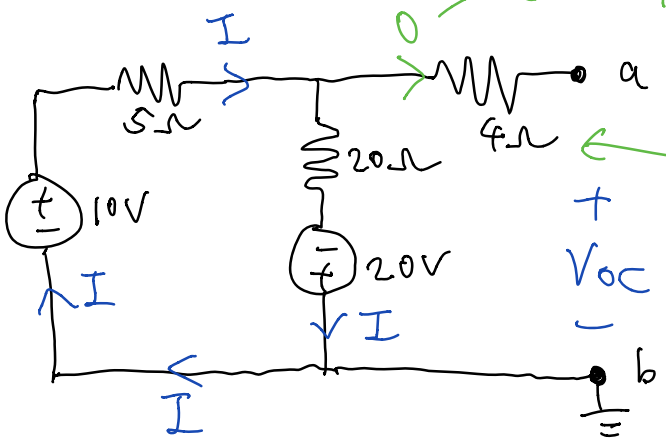
Therefore,



(3) Find the Thevenin equivalent circuit across a & b:



current here is 0 because a & b is open

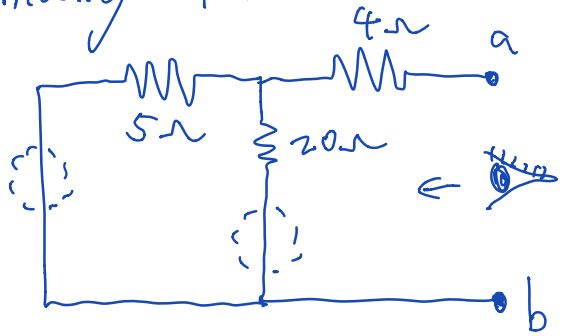


No voltage drop across 4Ω because no current (from ohm's Law!)

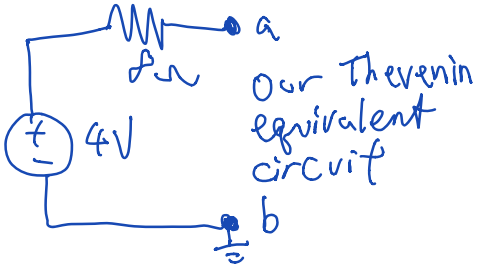
$$I = \frac{(10+20)V}{(5+20)\Omega} = \frac{6}{5}A$$

$$\therefore V_T = V_{OC} = \left(20 \times \frac{6}{5}\right) - 20 = 4V$$

Finding R_T:

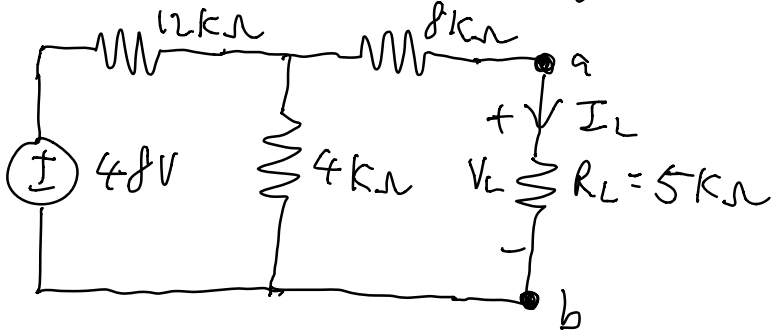


$$R_T = 5 // 20 + 4 = 8\Omega$$

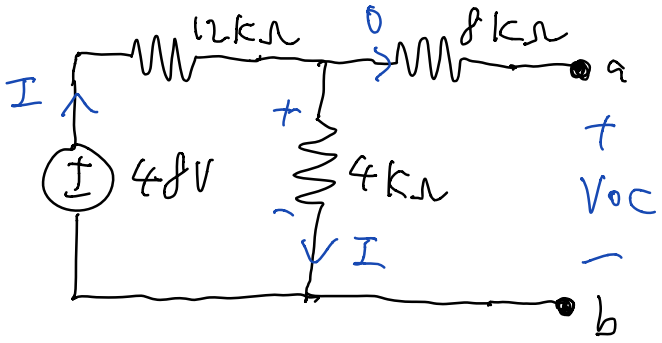


Our Thevenin equivalent circuit

(4) In the following circuit, R_L is the load.
Find the Thevenin equivalent circuit as seen by R_L, and also the load voltage V_L and load current I_L.



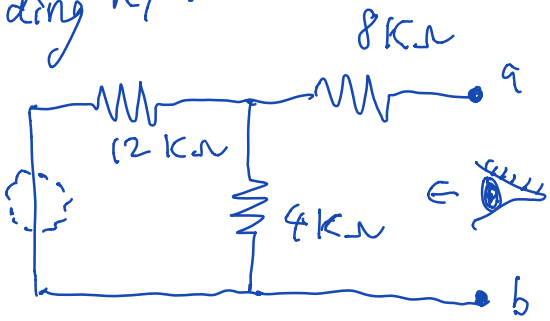
To find the Thevenin equivalent circuit seen by the load, we must first remove the load.



$$I = \frac{48V}{(12K + 4K)\Omega} = 3mA$$

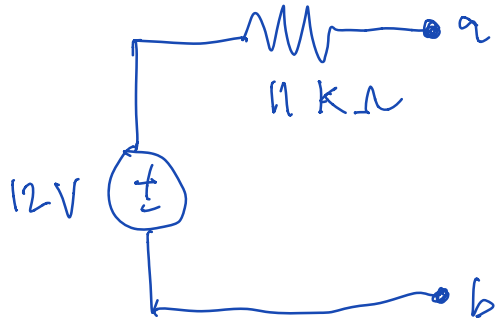
$$\therefore V_T = V_{OC}$$
$$= 4K\Omega \times 3mA$$
$$= 12V$$

Finding R_T:

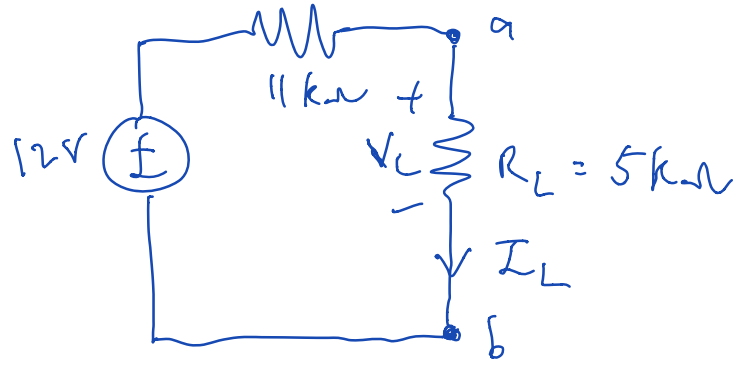


$$R_T = (12K // 4K) + 8k$$
$$= 11\ K\Omega$$

∴ The Thevenin equivalent circuit seen by the load is:



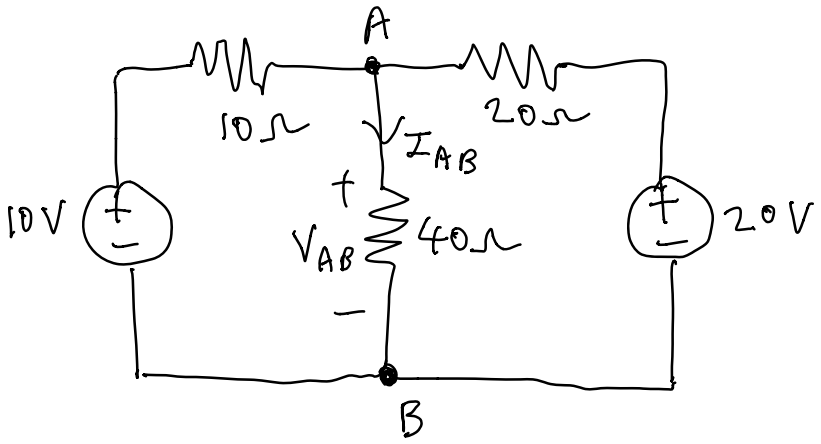
The circuit with the load is thus:



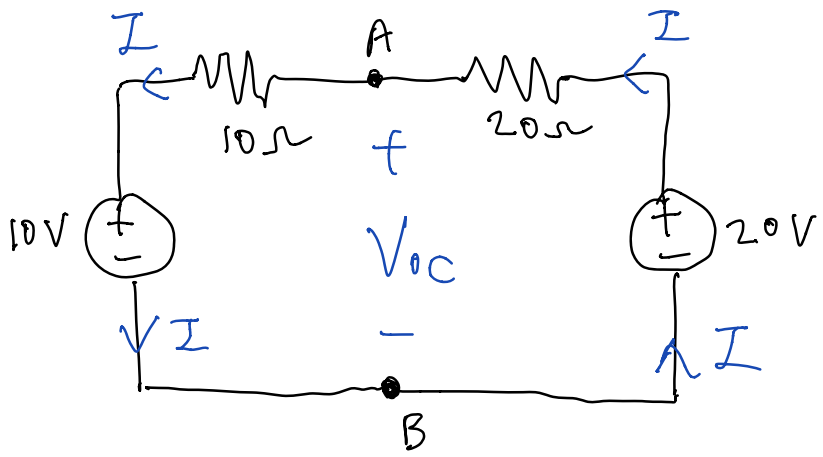
$$\therefore I_L = \frac{12\,V}{(11k+5k)\Omega} = 0.75\ mA$$

$$\therefore V_L = \frac{5K}{11k+5k} \times 12V = 3.75V$$

(5) In the following circuit, the 40Ω is the load. Use Thevenin equivalent circuit to solve for V_{AB} & I_{AB}.



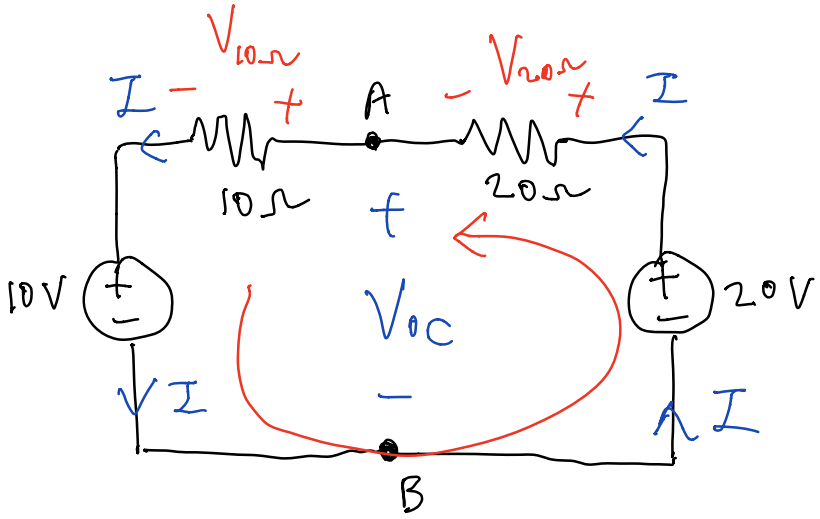
To find Thevenin equivalent circuit as seen by the load, we must first remove the load.



If you can see it directly by inspection,

$$I = \frac{(20-10)V}{10\Omega + 20\Omega} = \frac{1}{3}A$$

If you cannot see it by inspection, you can always go to the basics by applying KVL & Ohm's Law:



Sum of voltage rise = Sum of voltage fall

$$20\,V = V_{10\Omega} + V_{20\Omega} + 10\,V$$

$$(20-10) = 10I + 20I$$

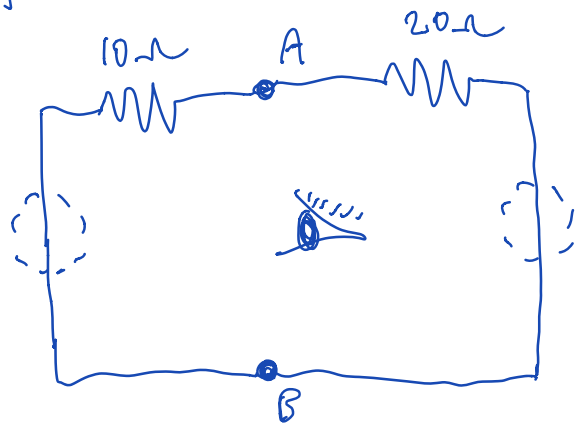
$$\therefore I = \frac{20-10}{(10+20)} = \frac{1}{3}\,A$$

$$\therefore V_T = V_{OC} = 20 - V_{20\Omega}$$

$$= 20 - 20 \times I$$

$$= 13\tfrac{1}{3}\,V$$

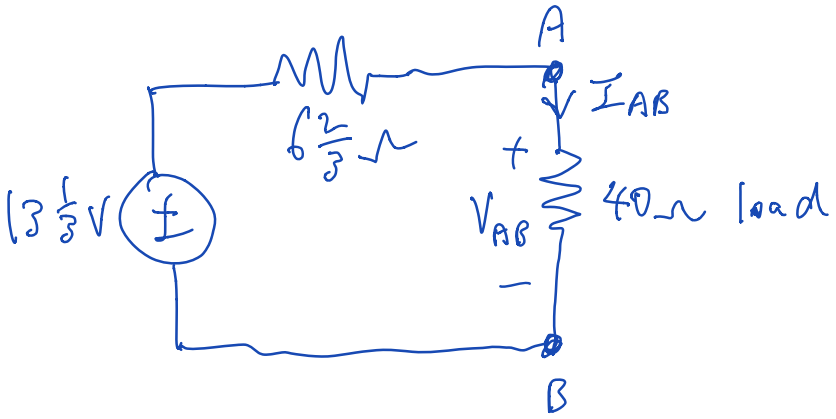
To find R_T:



R_T = Equivalent resistance seen across A & B

$= 10 // 20 = 6\frac{2}{3}\Omega$

∴ Our Thevenin equivalent circuit + load is as follows:



$$\therefore V_{AB} = \frac{40}{40 + 6\frac{2}{3}} \times 13\tfrac{1}{3} = 11.4 \text{ V}$$

$$I_{AB} = \frac{13\frac{1}{3}}{40 + 6\frac{2}{3}} = 0.286 \text{ A}$$