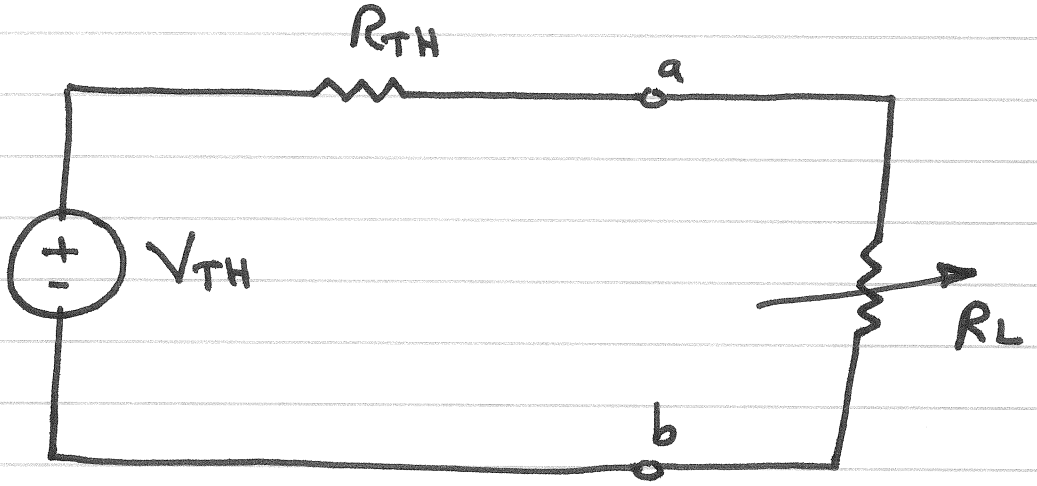
Maximum Power Transfer



A Load resistance will recieve maximum power from a Circuit when the resistance of the load is exactly the same as the thevenin's resistance looking back at the Circuit.

$$R_L = R_{TH}$$

$$P_L = \frac{V_L^2}{R_L}$$

$$V_L = \frac{R_L}{R_L + R_{TH}} \cdot V_{TH}$$

$$P_L = \frac{V_{TH}^2 R_L}{(R_L + R_{TH})^2}$$

$$\frac{dP_L}{dR_L} = \frac{V_{TH}^2 \left((R_L + R_{TH})^2 - 2R_L (R_{TH} + R_L) \right)}{(R_L + R_{TH})^4}$$

for $\frac{dP_L}{dR_L} = 0$

$$(R_L + R_{TH})^2 - 2R_L (R_{TH} + R_L) = 0$$

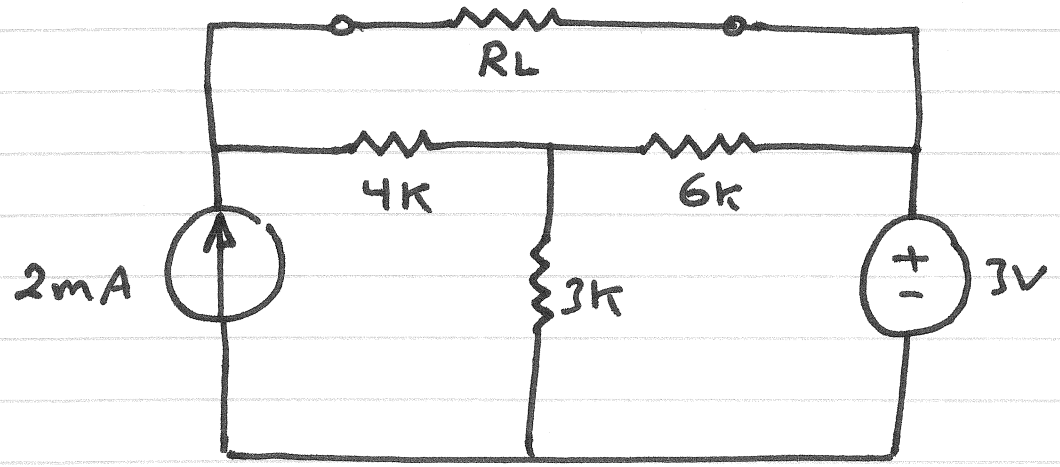
$$(R_L + R_{TH}) \left((R_{TH} + R_L) - 2R_L \right) = 0$$

$$\therefore \quad R_{TH} - R_L = 0$$

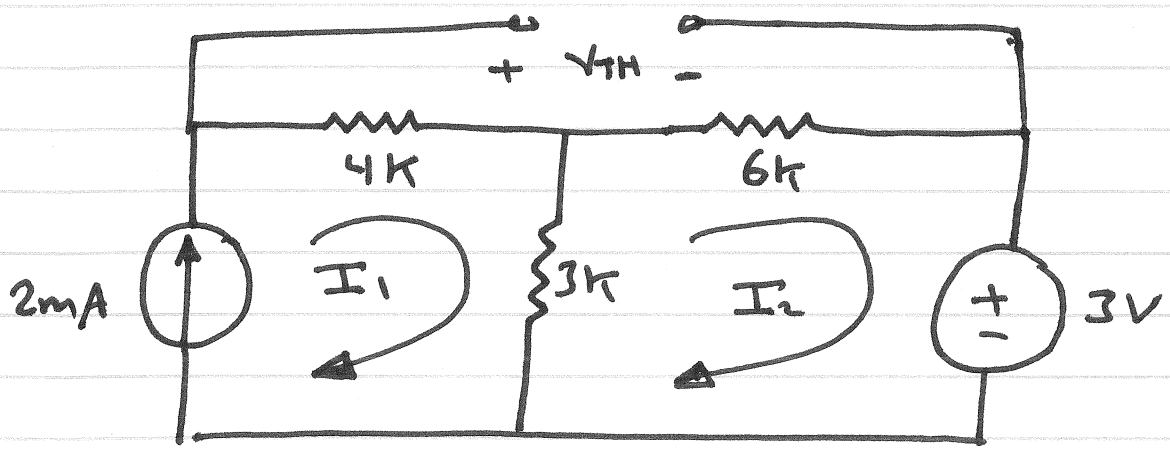
$$\therefore \quad R_L = R_{TH}$$

$$P_{L,max} = \frac{V_{TH}^2}{4R_L} = \frac{V_{TH}^2}{4R_{TH}}$$

- Find the value of R_L for maximum power transfer in the circuit shown.
- Find the maximum power



To find V_{TH}



$I_1 = 2mA$ Constrain equation

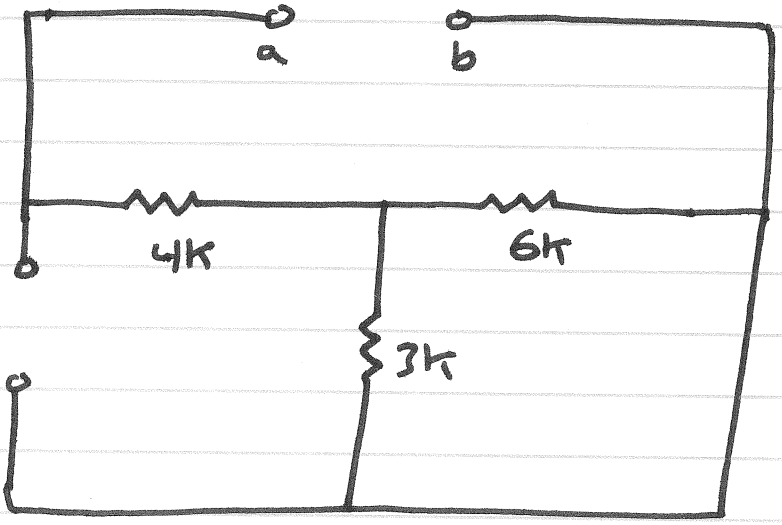
$-3 = 9K\,I_2 - 3K\,I_1$

$\therefore I_2 = \frac{1}{3}\,mA$

$$V_{TH} = 4k\,I_1 + 6k\,I_2$$

$$V_{TH} = 10V$$

To find R_{TH}



$$R_{TH} = 4k + 3k \| 6k$$

$$= 4k + 2k$$

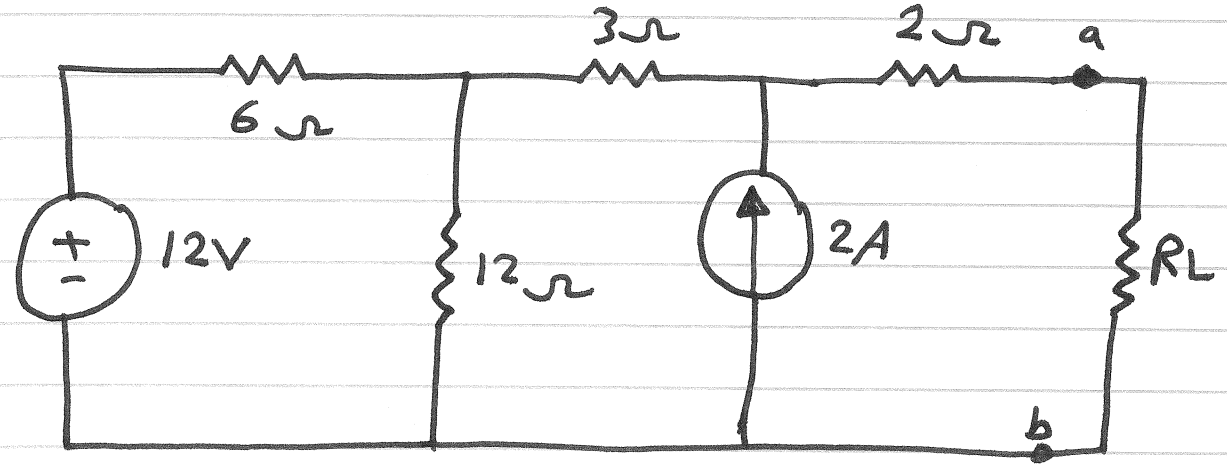
$$R_{TH} = 6k$$

$$\therefore R_L = R_{TH} = 6k$$

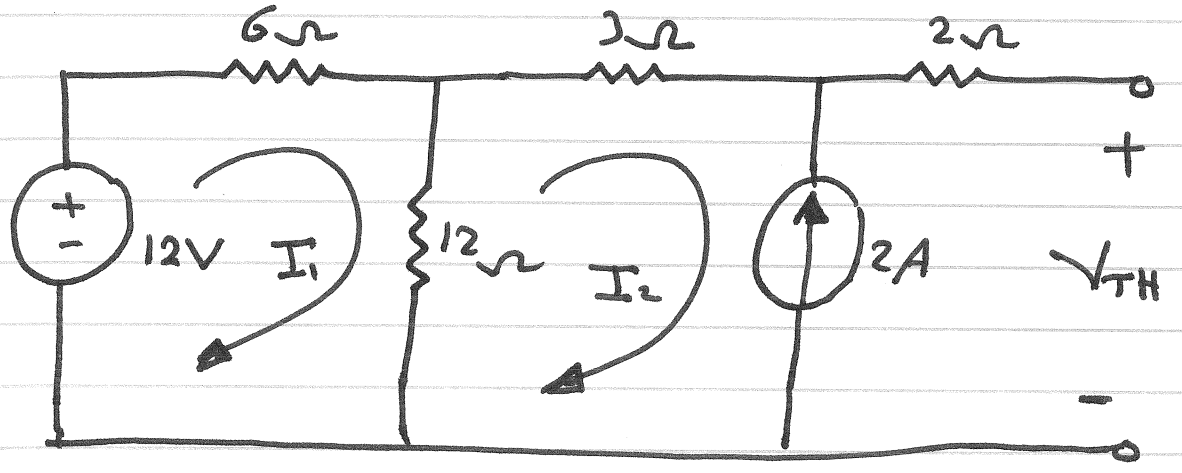
$$P_{L,max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{25}{6}\ mW$$

- Find the value of R_L for maximum power transfer in the circuit shown

- Find the maximum power



1) To find V_{TH}



$I_2 = -2A$ Constrain equation

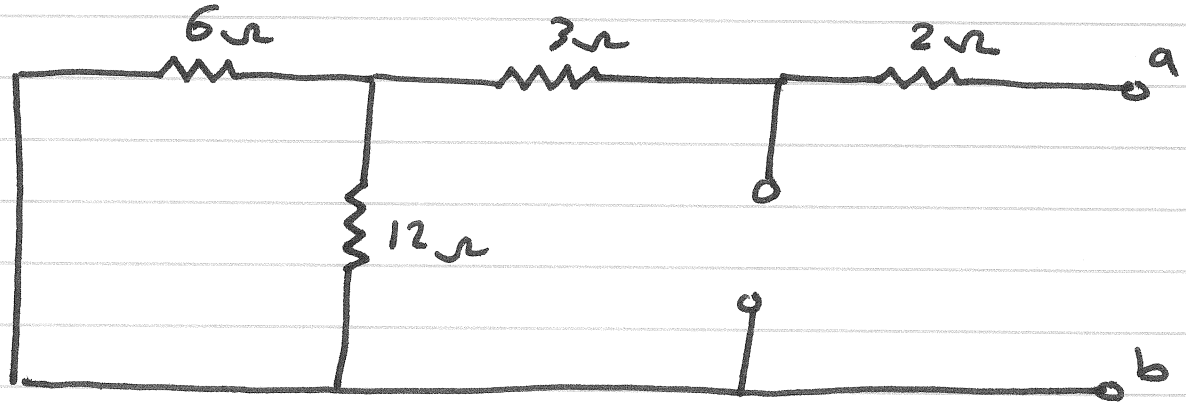
$12 = 18I_1 - 12I_2$

$\therefore I_1 = -\frac{2}{3} A$

$$V_{TH} = -3I_2 - 6I_1 + 12$$

$$\therefore V_{TH} = 22V$$

2) To find R_{TH}



$$R_{TH} = 2 + 3 + 6 \| 12$$

$$R_{TH} = 2 + 3 + 4 = 9\Omega$$

$$\therefore R_L = R_{TH} = 9\Omega$$

$$\therefore P_{L,max} = \frac{V_{TH}^2}{4R_{TH}} = 13.44W$$