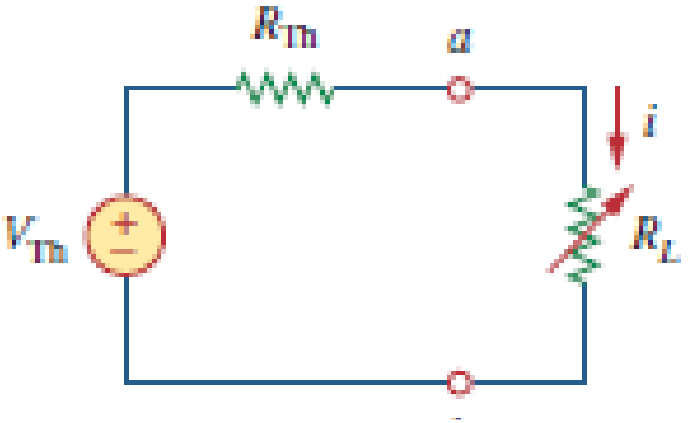
Electrical Circuits for Engineers (EC1000)

Lecture -4(C) Max. Power Transfer Theorem (Chapter 4)

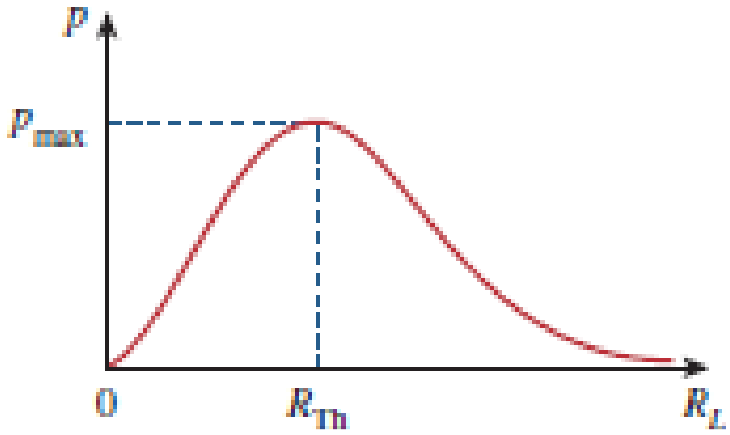
3. Maximum Power Transfer Theorem

Maximum Power Transfer Theorem

- In some applications it is required to transfer maximum power to the load.
- Maximum power is transferred to the load when the load resistance equals the Thevenin resistance $\boldsymbol{R_L = R_{Th}}$

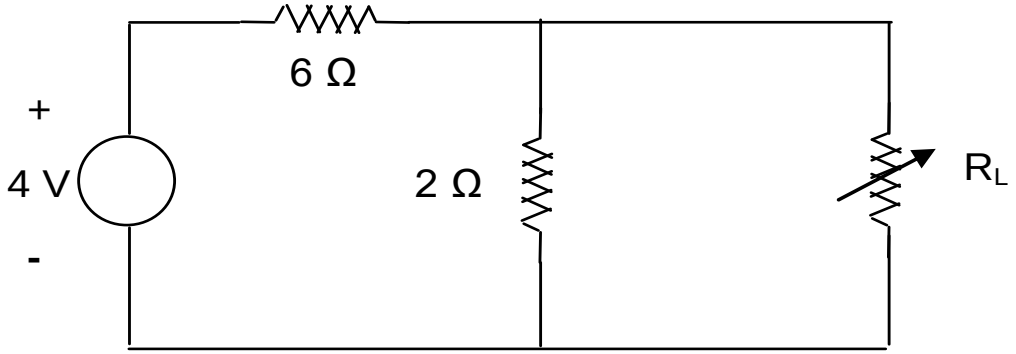


$$p = i^2 R_L = \left(\frac{V_{Th}}{R_{Th} + R_L}\right)^2 R_L$$



3. Maximum Power Transfer Theorem

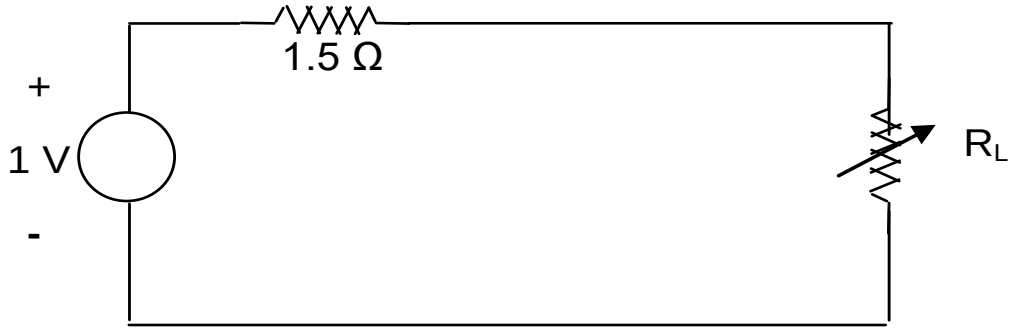
Example 1 Consider the circuit shown below. Determine the value of R_L when it is dissipating maximum power. Also find the value of maximum power dissipated.



Solution:

As a first step, Thevenin's equivalent across the load resistor is obtained.

$V_{Th} = \frac{2}{2+6} \times 4 = 1\,V$; $R_{Th} = 6 \,||\, 2 = 1.5\ \Omega$ Resulting circuit is shown.



For P_L to be maximum, $R_L = 1.5\ \Omega$; Then circuit current = 1/3 = 0.3333 A

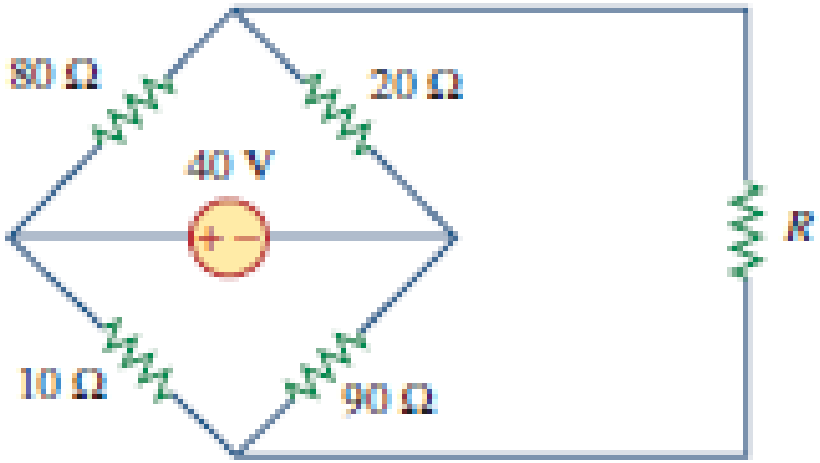
Maximum power dissipated $P_{max} = 0.3333^2 \times 1.5 = 0.16667$ W

Example Problems

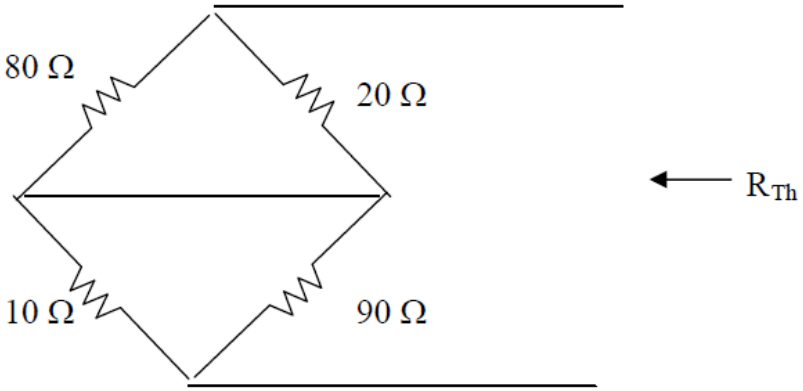
Examble:2: The variable resistor R_L in given figure is adjusted until it absorbs the maximum power from the circuit.

(a) Calculate the value of R for maximum power.

(b) Determine the maximum power absorbed by R.



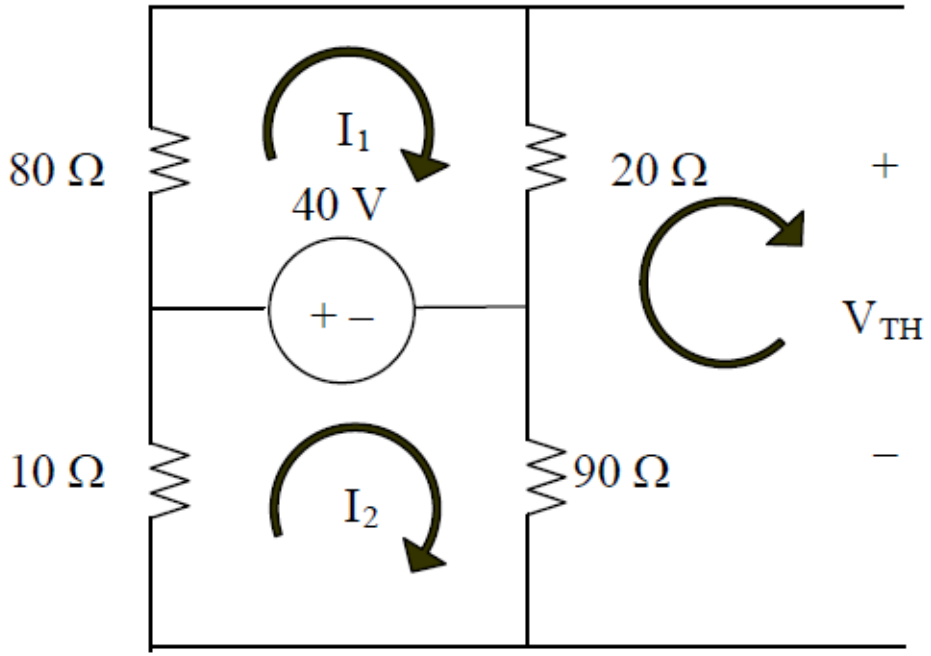
To find R_{th}



$$R_{Th} = 20//80 + 90//10 = 16 + 9 = 25\ \Omega$$

Contd.,

To find V_{th}



$$(80+20)i_1 - 40 = 0 \longrightarrow i_1 = 0.4$$

$$(10+90)i_2 + 40 = 0 \longrightarrow i_2 = -0.4$$

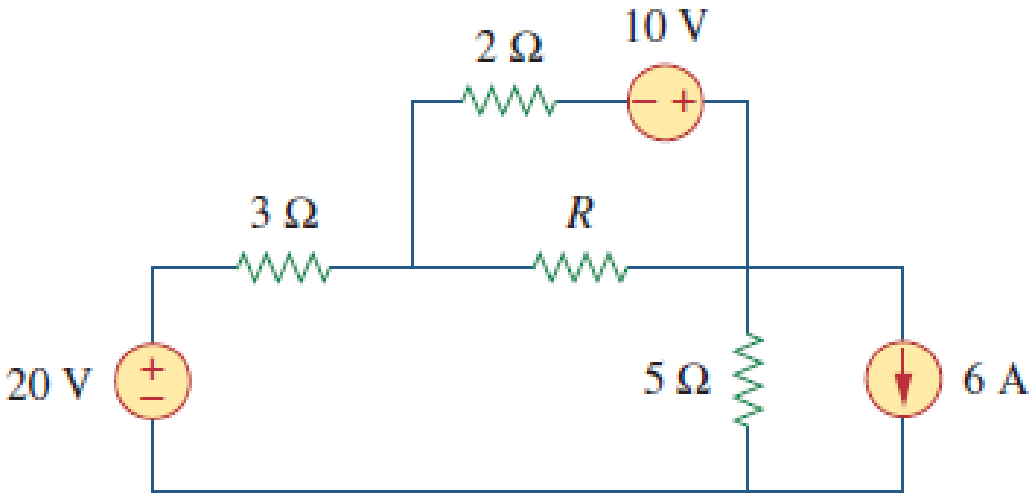
$$-90i_2 - 20i_1 + V_{Th} = 0 \longrightarrow V_{Th} = -28 \text{ V}$$

(a) $R = R_{Th} = \mathbf{25\ \Omega}$

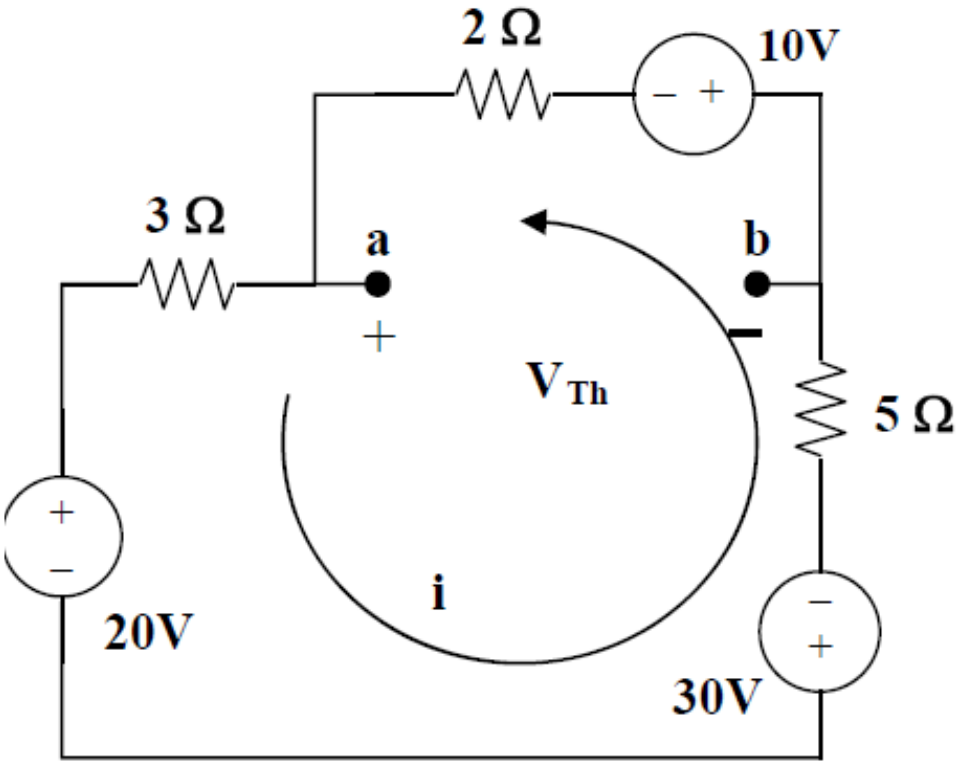
(b) $P_{max} = \dfrac{V_{Th}^2}{4R_{Th}} = \dfrac{(28)^2}{100} = \underline{7.84 \text{ W}}$

Example Problems

Examble:3: Find the maximum power that can be delivered to the resistor R in the circuit of Figure below.



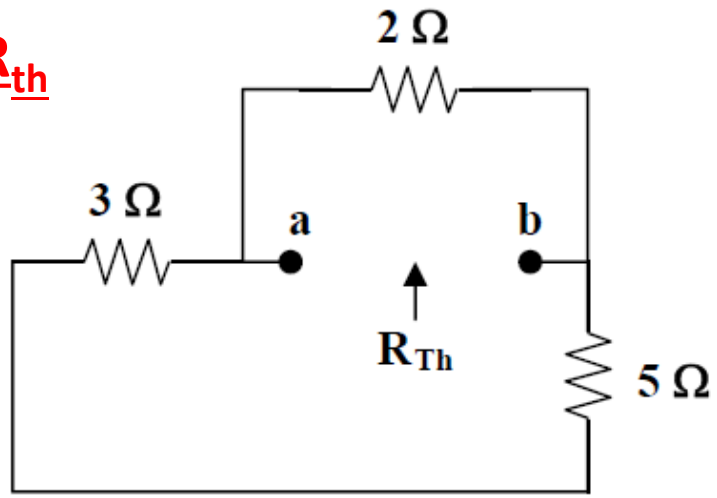
To find V_{th}



$10i + 30 + 20 + 10 = 0$, or $i = -6$

$V_{Th} + 10 + 2i = 0$, or $V_{Th} = 2\ V$

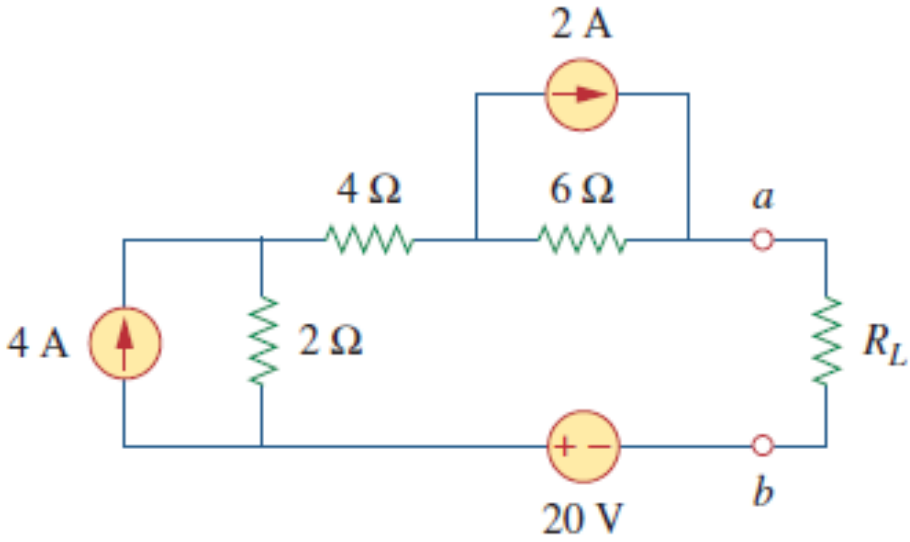
To find R_{th}



$R_{Th} = 2||(3+5) = 2||8 =$ **1.6 ohms** $\quad p = V_{Th}^2/(4R_{Th}) = (2)^2/[4(1.6)] =$ **625 m watts**

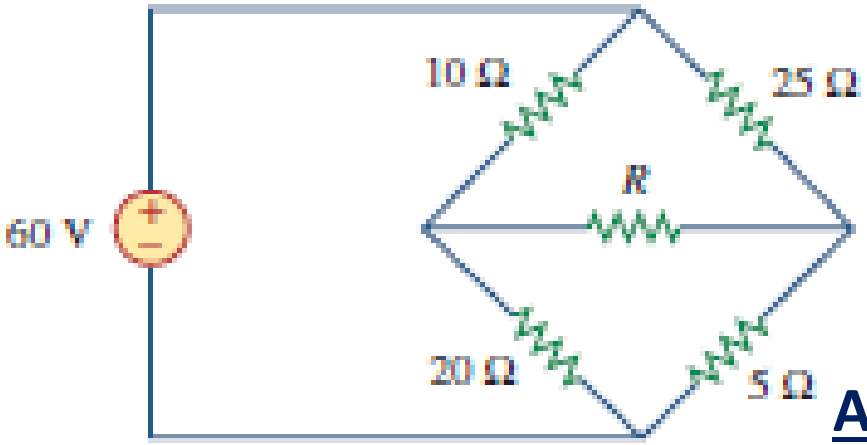
Practical Problems

1. (a) For the circuit in Figure, obtain the Thevenin equivalent at terminals a-b
(b) Calculate the current in R_L=10 Ohm
(c) Find R_L for maximum power deliverable.
(d) Determine that maximum power.



Ans: 12 Ohm, 40 V, 33.33 W

2. Determine the maximum power that can be delivered to the variable resistor R in the circuit.



Ans: 10.83 Ohm, 20.77 W