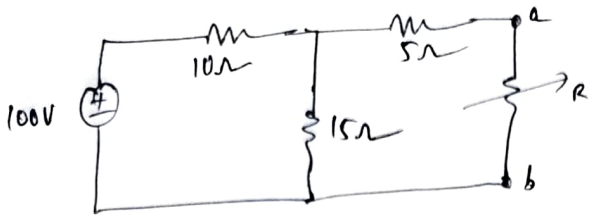
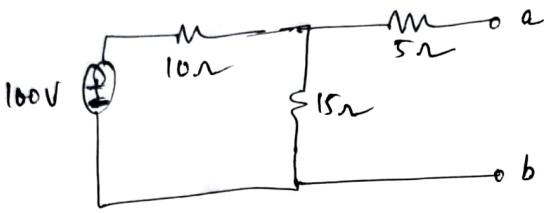
Maximum power transfer theorem

(1)



R_{ab} for Max power

Firstly find thevinens eq circuit:

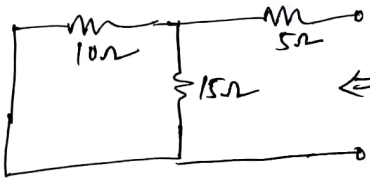


$V_{ab} = V_{15\Omega} = ?$

$$I = \frac{100}{10+15} = \frac{100}{25} = 4A.$$

$$V_{15\Omega} = 4(15) = 60V. = V_{th}.$$

Finding R_{th}:

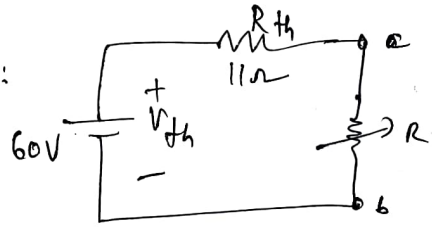


$10 \| 15 = \frac{150}{25} = 6$

$6+5 = 11\Omega$

$R_{th} = 11\Omega$

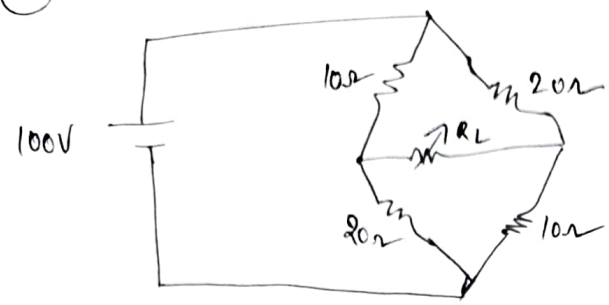
Thevinens eq circuit:



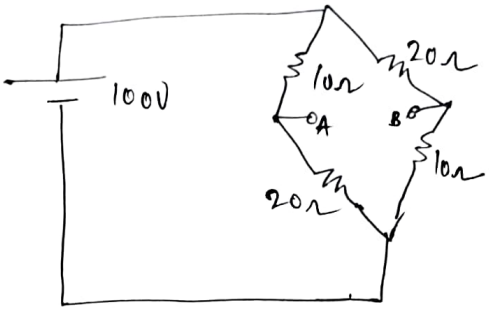
If $R = 11\Omega$; max power transfer transfer will occur.

$$\text{Max power} = \frac{V_{th}^2}{4R_{th}} = \frac{60^2}{4(11)} = \frac{3600}{44} = 81.8\ w.$$

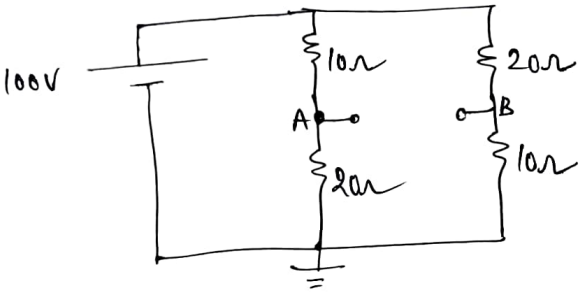
(2)



open $R_L \Rightarrow$ find V_{th}.



Redraw.



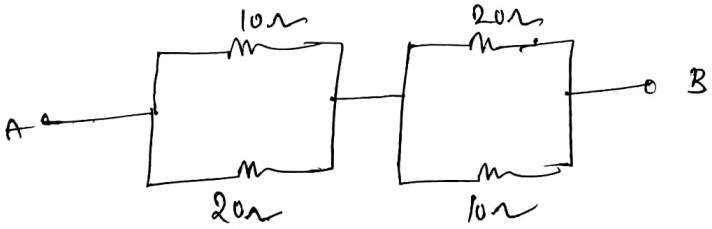
$V_{AB} = V_A - V_B$.

$V_A = 100 \times \frac{20}{30} = \frac{2000}{30} = 66.7$ V.

$V_B = 100 \times \frac{10}{30} = \frac{1000}{3} = 33.3$ V

$V_{th} = V_{AB} = 33.4$ V.

Find R_{th}:

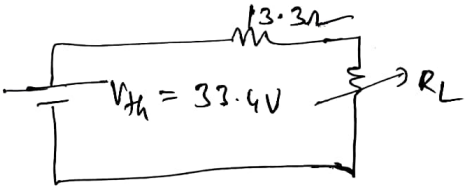


$10 \| 20 = \frac{200}{30} = 6.67$

$20 \| 10 = \frac{200}{30} = 6.67$

$R_{th} = R_{AB} = 13.3\ \Omega$

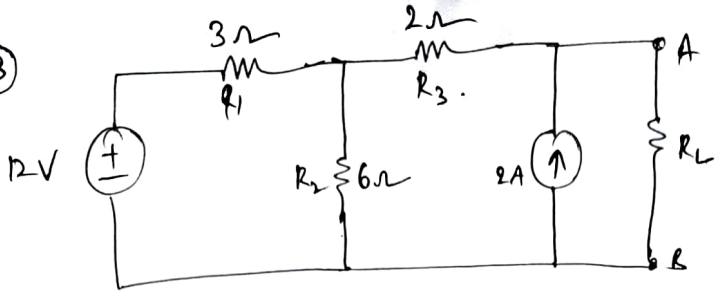
Thevenin eq circuit:



If $R_L = 13.3\ \Omega$ max power will deliver

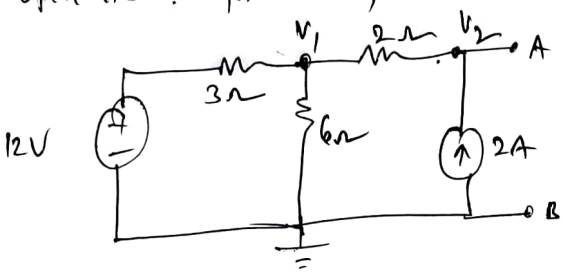
$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{33.4^2}{4(13.3)} = \frac{1115.56}{53.2} = 20.96$ W.

(3)



Max power

Open AB : find V_{th}



We need to find V_2,

nodal analysis at V_1: $\frac{V_1 - 12}{3} + \frac{V_1 - 0}{6} = 2$

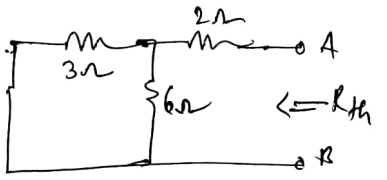
$$\frac{2V_1 - 24 + V_1}{6} = 2$$

$$3V_1 - 24 = 12$$

$$3V_1 = 36 \Rightarrow V_1 = \frac{36}{3} = 12\,V.$$

$$V_2 = V_1 + IR_{2\Omega} = 12 + 2(2) = 12 + 4 = 16V$$

Finding R_{th}:



$3 \| 6 = \frac{3(6)}{9} = 2$

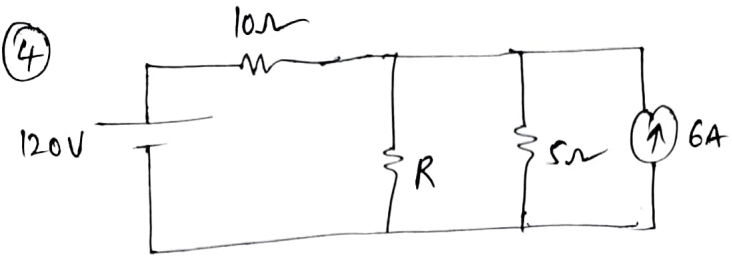
$2 + 2 = 4\Omega$

Thevenin eq circuit:

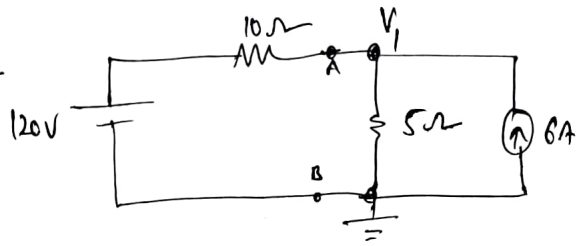
If $R_L = 4\Omega$ max power occurs.

$$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{16^2}{4(4)} = 16\,W.$$

(4)



To find V_{th}:



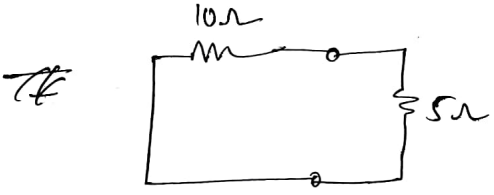
$$\frac{V_1 - 120}{10} + \frac{V_1 - 0}{5} = 6$$

$$\frac{V_1 - 120 + 2V_1}{10} = 6 \Rightarrow 3V_1 - 120 = 60$$

$$3V_1 = 180$$

$$V_1 = \frac{180}{3} = 60\,V.$$

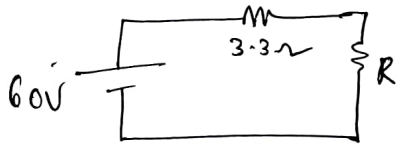
R_{th}:



$$10\Omega \| 5\Omega = \frac{50}{15}$$

$$= 3.3\,\Omega$$

Thevinens ed circuit:



If $R = 3.3\,\Omega$ max power transfer occurs

$$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{60^2}{4(3.3)} = 272.7\,W$$