Ans 5. In electrical engineering, the maximum power transfer theorem states that, to obtain maximum external power from a source with a finite internal resistance, the resistance of the load must equal the resistance of the sources as viewed from its output terminals.

Prove that $P = E^2/4R$:-

The maximum power transfer theorem ensure the values of the load resistance, at which the maximum power transfered to the load.

The current through the load for any value of load resistance is.

$$I_L = \frac{E_{th}}{R_{th} + R_L}$$

The power absorbed by the load is

$$P_L = I_L^2 \times R_2$$

$$= \left[\frac{E_{th}}{R_{th} + R_L}\right]^R \times R_1$$

$$\frac{dP(R_2)}{dR_2} = V_{th}^2 \left[\frac{(R_{th}+R_L)^2 - 2R_L \times (R_{th} + R_L)}{(R_{th} + R_L)^2}\right]$$

$$\Rightarrow (R_{Th} + R_L) \cdot 2R_L = 0$$

$$\Rightarrow R_L = R_{TH}$$

The maximum power delivered to the is,

$$P_{max} = \left[\frac{E_{th}}{R_{th} + R_L}\right]^R \times R_L \Big[R_L = R_{TH}$$

$$P = \frac{E_{TH}^2}{4R_{TH}}$$

(2) According to this theorem, a given network when viewed from its any two terminal points can be replaced by a single voltage source in series with a single resistance.

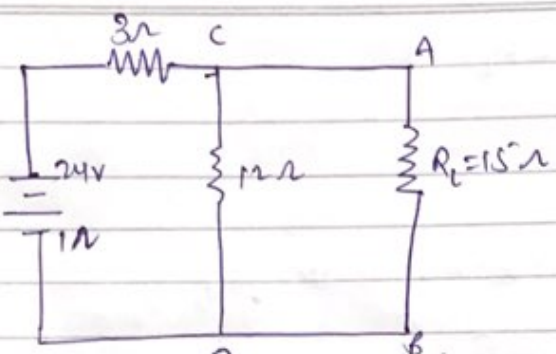
Now R_L is connected back across terminals A and B from ~~to~~ where it is removed. Then current through R_L is

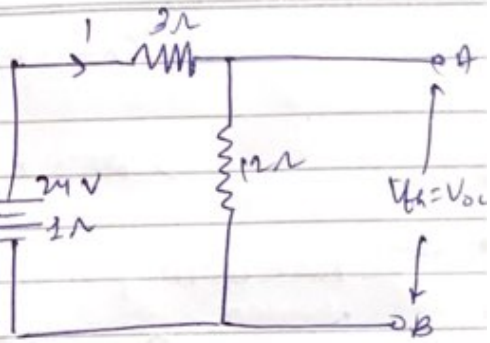
$$I = \frac{V_{th}}{R_{th} + R_L}$$

on removing load resistance;

Eg:- Apply thevenin's theorem and find the following.
(i) Equivalent e.m.f when viewed from terminals A & B.
(ii) The equivalent resistance of the network when viewed from A & B.
(iii) Current in load resistance R_L of 15 Ω.

Sol.n



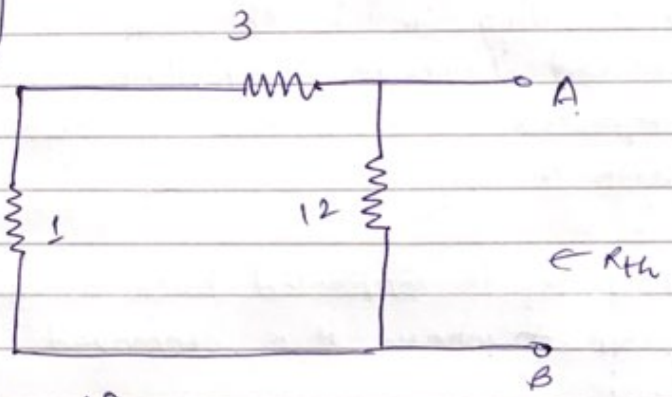


(i) Current in circuit after removing load Resistance

$$\# \quad I = \frac{24}{12+3+1} = 1.5A$$

Voltage $V_{th} = 12 \times 1.15 = 18V$.

$$\# \quad R_{th} = \frac{12 \times 4}{12+4} = 3\Omega.$$



$$\# \quad I = \frac{18}{15+3} = 1A$$