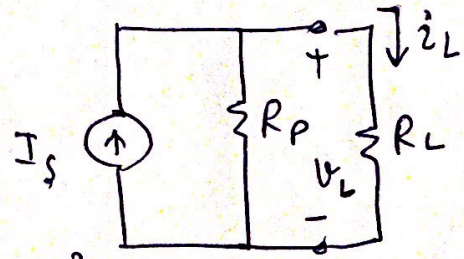
Maximum Power Transfer Theorem

A practical current source provides 10W to a 250Ω load. It provides 20W when connected to an 80Ω load. Find the value of R_L to which maximum power is delivered by this practical current source.

Solution: The circuit is :-



Now $P_L = I_L^2 R_L$ so we know $10 = I_1^2 \times 250$

and $20 = I_2^2 \times 80$

Also $P_{L_1} = \left(\frac{I_s R_p}{R_p + R_{L_1}}\right)^2 R_{L_1}$

So $10 = \left(\frac{I_s R_p}{R_p + 250}\right)^2 \times 250$ ① and $20 = \left(\frac{I_s R_p}{R_p + 80}\right)^2 \times 80$ ②

Dividing $\frac{2\phi}{1\phi} = \frac{80}{250}\left(\frac{R_p + 250}{R_p + 80}\right)^2$

$$\sqrt{\frac{50}{8}} = \frac{R_p + 250}{R_p + 80} \quad \text{or} \quad \frac{5}{2} = \frac{R_p + 250}{R_p + 80}$$

So $5R_p + 400 = 2R_p + 500 \Rightarrow R_p = \frac{100}{3}\ \Omega$

For max power transfer

$$R_L = R_p = \frac{100}{3}\ \Omega$$