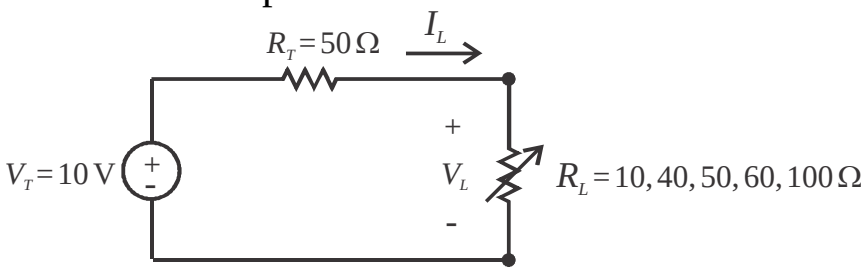
Example- Look at maximum power transfer for the circuit below.



$\underline{R_L = 10\,\Omega}$

$$I_L = \frac{V_T}{R_T + R_L} = \frac{10\,\text{V}}{50\,\Omega + 10\,\Omega} = 166.\overline{6}\ \text{mA},$$

$$V_L = V_T \frac{R_L}{R_T + R_L} = I_L R_L = 10\,\text{V}\left(\frac{10\,\Omega}{50\,\Omega + 10\,\Omega}\right) = 1.\overline{6}\ \text{V}$$

$$P_L = V_L I_L = (1.\overline{6}\ \text{V})(166.\overline{6}\ \text{mA}) = \underline{277.\overline{7}\ \text{mW}}$$

$$P_{RT} = I_L^2 R_T = (0.166\overline{6}\ \text{A})^2 50 = \underline{1388.\overline{8}\ \text{mW}}$$

$\underline{R_L = 40\,\Omega}$

$$I_L = \frac{V_T}{R_T + R_L} = \frac{10\,\text{V}}{50\,\Omega + 40\,\Omega} = 111.\overline{1}\ \text{mA},$$

$$V_L = I_L R_L = (0.\overline{1}\ \text{A})(40\,\Omega) = 4.\overline{4}\ \text{V}$$

$$P_L = V_L I_L = (4.\overline{4}\ \text{V})(111.\overline{1}\ \text{mA}) = \underline{493.83\ \text{mW}}$$

$$P_{RT} = I_L^2 R_T = (0.\overline{1}\ \text{A})^2 50 = \underline{617.284\ \text{mW}}$$

$\underline{R_{L,\max} = R_T = 50\,\Omega}$

$$I_L = \frac{V_T}{R_T + R_L} = \frac{10\,\text{V}}{50\,\Omega + 50\,\Omega} = 100\ \text{mA},$$

$$V_L = I_L R_L = (0.1\ \text{A})(50\,\Omega) = 5\ \text{V}$$

$$P_{L,\max} = V_L I_L = (5\text{V})(100\ \text{mA}) = \underline{500\ \text{mW}}$$

$$P_{RT} = I_L^2 R_T = (0.1\ \text{A})^2 50 = \underline{500\ \text{mW}}$$

$\underline{R_L = 60\,\Omega}$

$$I_L = \frac{V_T}{R_T + R_L} = \frac{10\,\text{V}}{50\,\Omega + 60\,\Omega} = 90.\overline{90}\ \text{mA},$$

$$V_L = I_L R_L = (0.0\overline{90}\ \text{A})(50\,\Omega) = 5.\overline{45}\ \text{V}$$

$$P_L = V_L I_L = (5.\overline{45}\ \text{V})(90.\overline{90}\ \text{mA}) = \underline{495.87\ \text{mW}}$$

$$P_{RT} = I_L^2 R_T = (0.0\overline{90}\ \text{A})^2 50 = \underline{413.22\ \text{mW}}$$

$$\underline{R_L = 100\,\Omega}$$

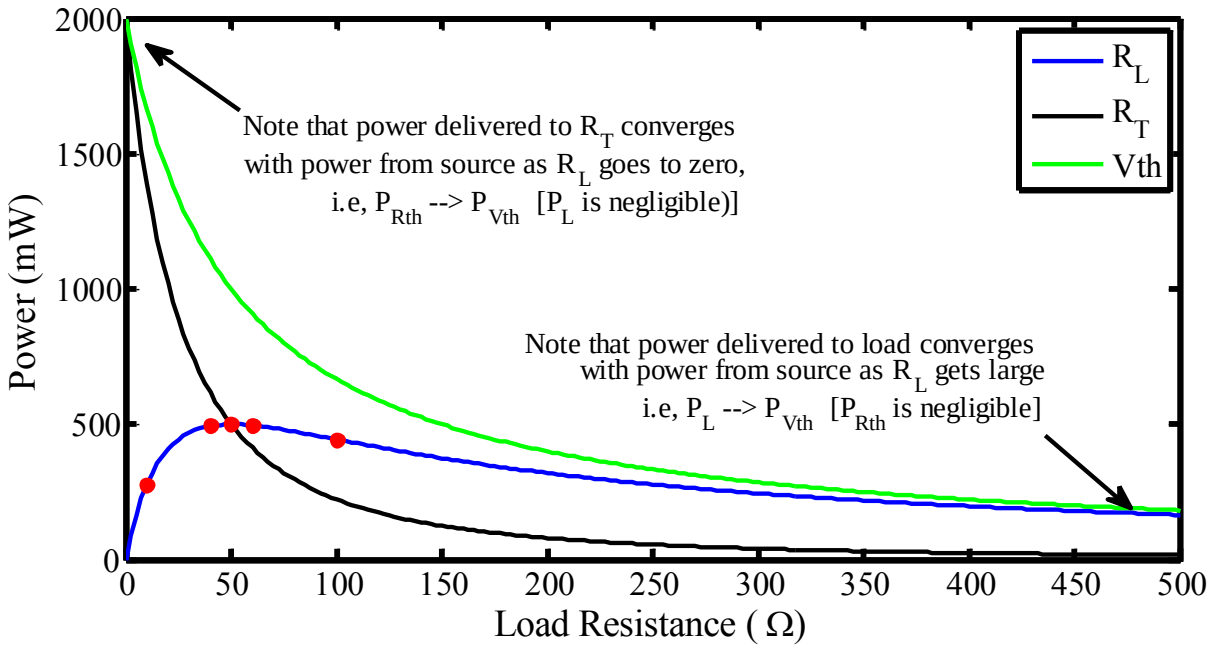
$$I_L = \frac{V_T}{R_T + R_L} = \frac{10\,\text{V}}{50\,\Omega + 100\,\Omega} = 66.\overline{6}\ \text{mA},$$

$$V_L = I_L R_L = (0.0\overline{6}\ \text{A})(100\,\Omega) = 6.\overline{6}\ \text{V}$$

$$P_L = V_L I_L = (6.\overline{6}\ \text{V})(66.\overline{6}\ \text{mA}) = \underline{444.\overline{4}\ \text{mW}}$$

$$P_{RT} = I_L^2 R_T = (0.0\overline{6}\ \text{A})^2 50 = \underline{222.\overline{2}\ \text{mW}}$$

Note: As R_L increased, I_L decreased, and V_L increased.




```
% max_power_transfer.m
% EE 220L
% Dr. Thomas P. Montoya
% Generate plot of load power vs. load resistance
%
clear;clc;close all;
Rth = 50; % Thevenin equivalent resistance
Vth = 10; % Thevenin equivalent voltage
RLex = [10,40,50,60,100]; % example resistance
PLex = [277.78,493.83,500,495.87,444.44];% example power
RL = 0:2.5:500;
IL = Vth./(Rth + RL);
PL1 = 1000*IL.*IL.*RL;
PRth = 1000*IL.*IL.*Rth;
PVth = Vth.*IL*1000;
Perc_pwr_del = 100*PL./PVth;
plot(RL,PL1,'b-',RL,PRth,'k-',RL,PVth,'g-',RLex,PLex,'r.');
legend('R_L','R_T','Vth' );
ylabel('Power (mW)','fontsize',16,'fontname','times')
xlabel('Load Resistance (\Omega)','fontsize',16,'fontname','times')
set(findobj('type','axes'),'fontname','times','fontsize',14)
set(findobj('type','line'),'linewidth',2)
set(findobj('type','line'),'markersize',20)
set(findobj('type','axes'),'linewidth',2.5)
```