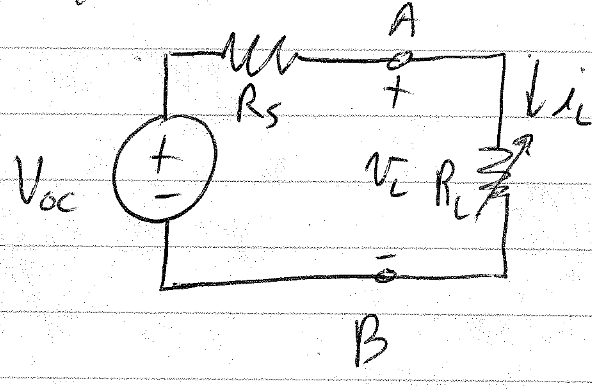
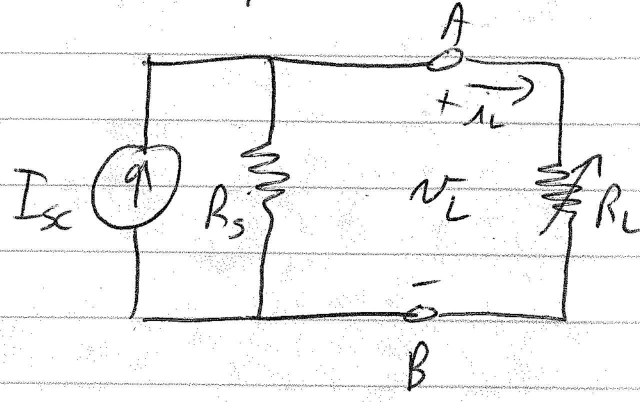
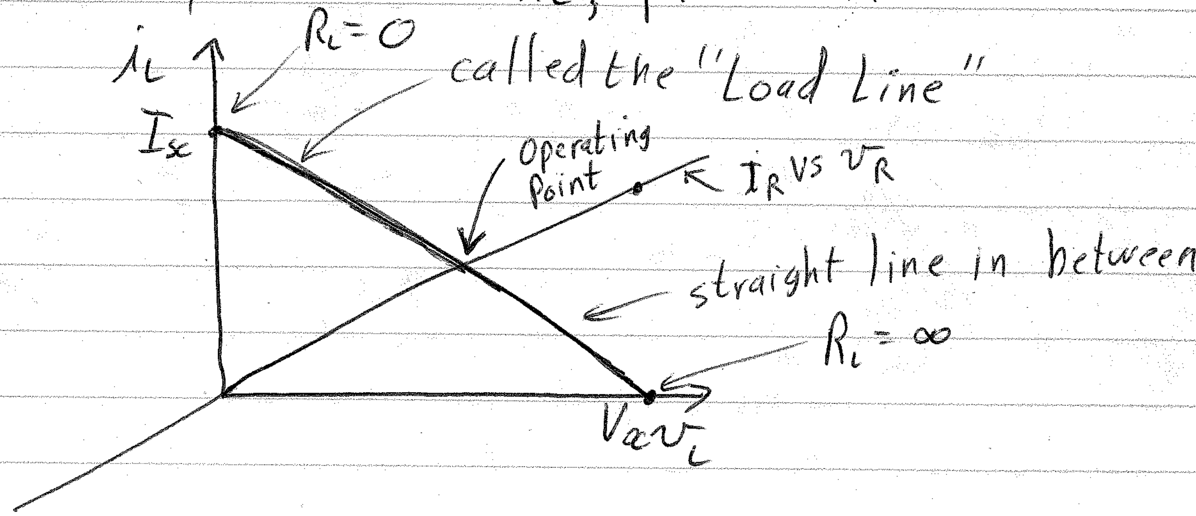
Another way to use Thevenin + Norton Equivalents: Load Line Analysis





Put on an external $\underbrace{}_{}$variable resistor and measure $v_L + i_L$ for many values of R_L, plot them:



What if I put a fixed resistor R_1 in place of the load, what would $v_L + i_L$ be?

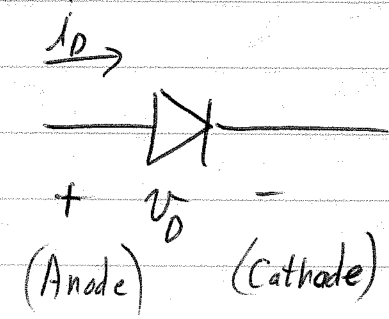
On same plot, put i_R vs v_R: $v_R = R_1 i_R$

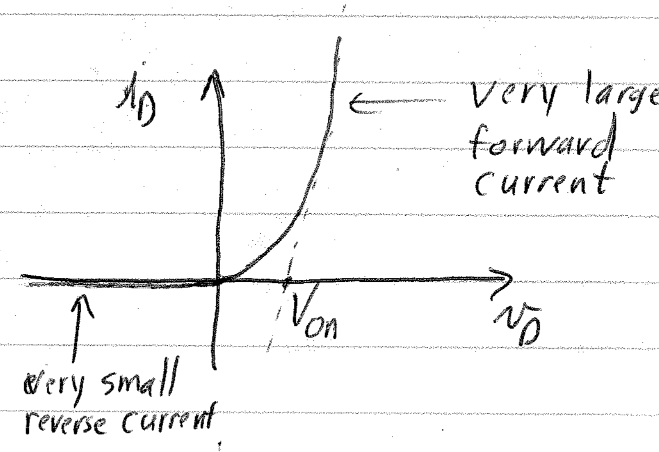
or $i_R = \frac{1}{R_1} v_R$ (slope $= \frac{1}{R}$)

Maximum power is dissipated in R_L when these two lines ~~are perpendicular, or when $R_L = R_S$. (Point of closest approach to the origin)~~ intersect at $\left(\frac{V_{oc}}{2}, \frac{I_{sc}}{2}\right)$ or a slope of

$$\frac{\frac{1}{2} I_{sc} - 0}{\frac{1}{2} V_{oc} - 0} = \frac{I_{sc}}{V_{oc}} = \frac{1}{R_S}$$

This is even more useful when the load is non-linear, $i_L \neq K v_L$ but is instead a different function like an exponential. A good example is a diode:



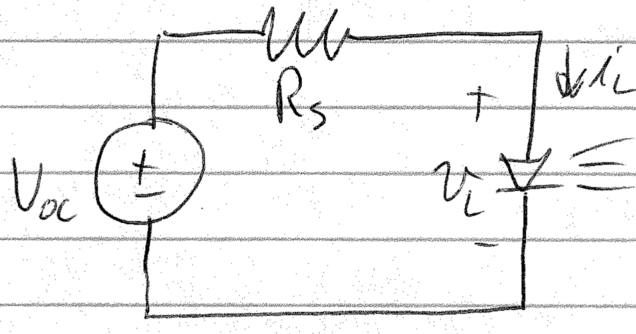


Limited by <u>forward current</u> and <u>reverse voltage</u>

Reverse Biased | Forward Biased

You can write various formulas to describe this curve, but all are nonlinear.

If you put this in a simple ckt:

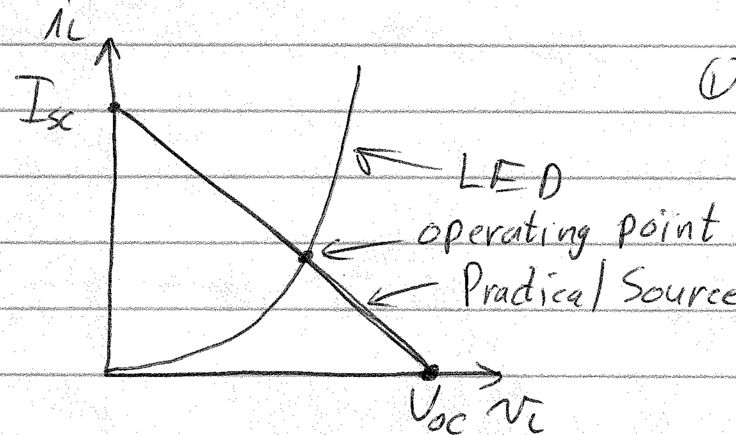


Light
Emitting
Diode
or
LED

Max Current: 40 mA
Optimum Current: 20 mA

Cannot solve this analytically, can do it graphically

① Remove LED, plot I_L vs R_L



More probably: