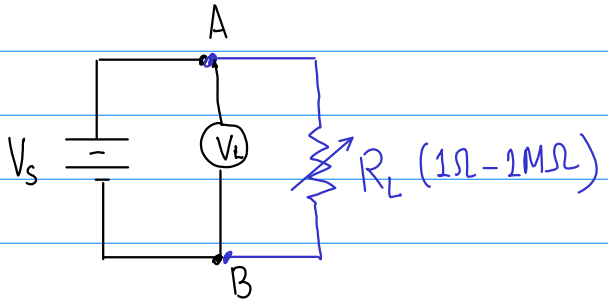
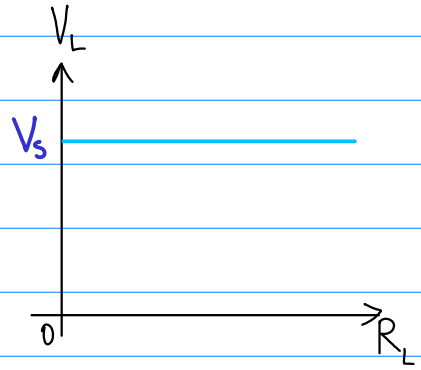
27.12.2021

Sources & Circuit Theorems

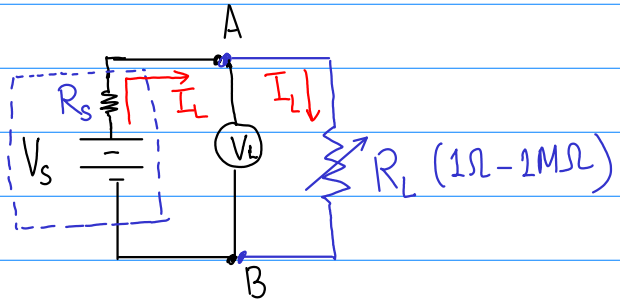
① Voltage Sources :

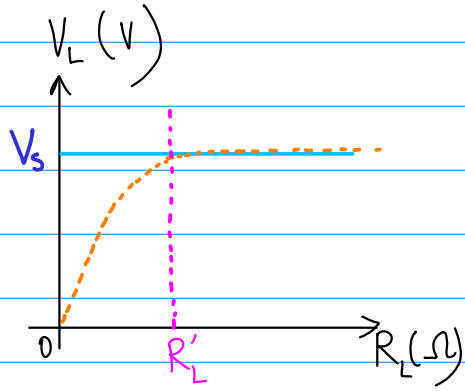




Ideal Voltage source

Real Voltage Source :





Real Voltage source

$$\text{Load Current, } I_L = \frac{V_s}{R_s + R_L}$$

$$V_L = I_L R_L = \left(\frac{R_L}{R_s + R_L}\right) V_s$$

$$\boxed{V_L = \left(\frac{R_L}{R_s + R_L}\right) V_s}$$

Load voltage we will measure across the load resistance R_L.

Special Case:

(i) $R_s = 0\ \Omega \Rightarrow V_L = V_s \Rightarrow$ Ideal Voltage Source

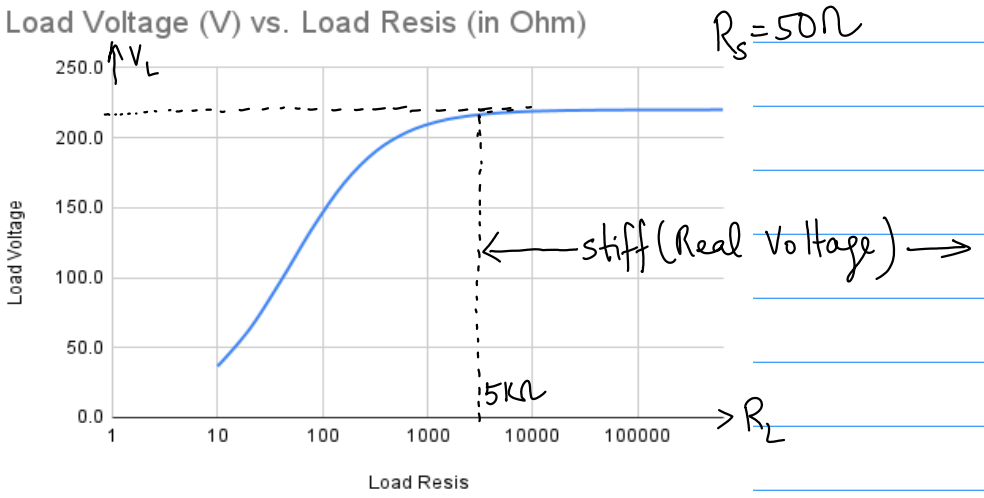
(ii) $R_s \neq 0$ (finite value) for example $R_s = 100\,\Omega$

$$V_L = \left(\frac{R_L}{100\,\Omega + R_L}\right) V_s$$

$R_L = 10\,\Omega \Rightarrow V_L = \frac{10}{110} \times V_s$

$\vdots$

$R_L = 500\,\Omega \Rightarrow V_L = \frac{500\,\Omega}{100\,\Omega + 500\,\Omega} \cdot V_s$

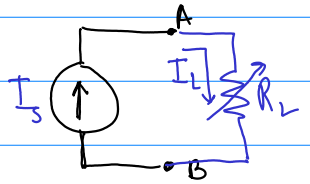


For real (stiff) voltage source,

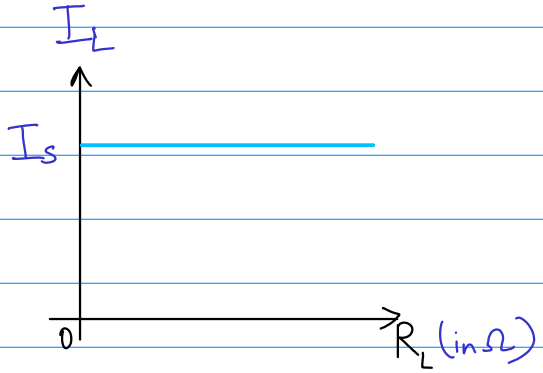
$$\boxed{R_L \geq 100\, R_s}$$

Current Sources :

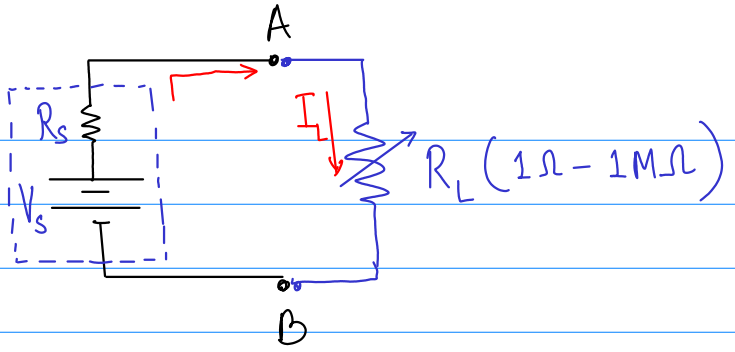
Ideal Current Source



$I_L = I_s$



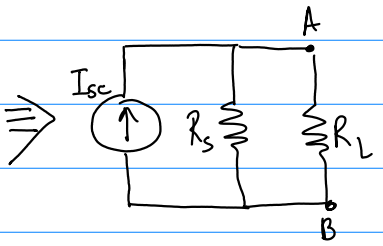
Real Voltage Source



$$I_L = \frac{V_s}{R_s + R_L}$$

$$\Rightarrow I_L = \frac{V_s/R_s}{(R_s+R_L)/R_s}$$

$$I_L = \left(\frac{R_s}{R_s+R_L}\right) I_{sc}$$



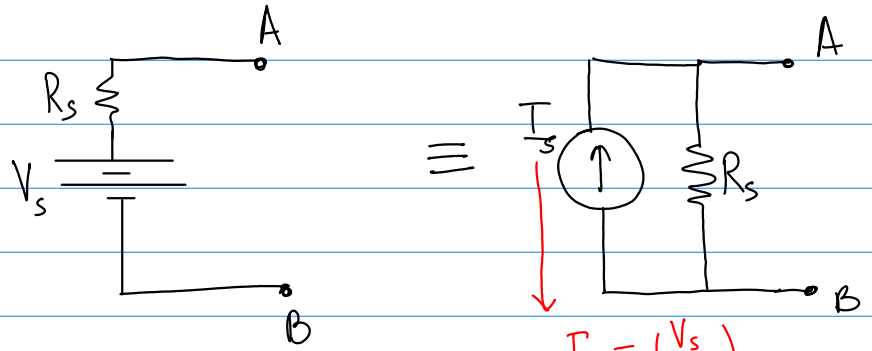
Recall; (School level concept)

KCL

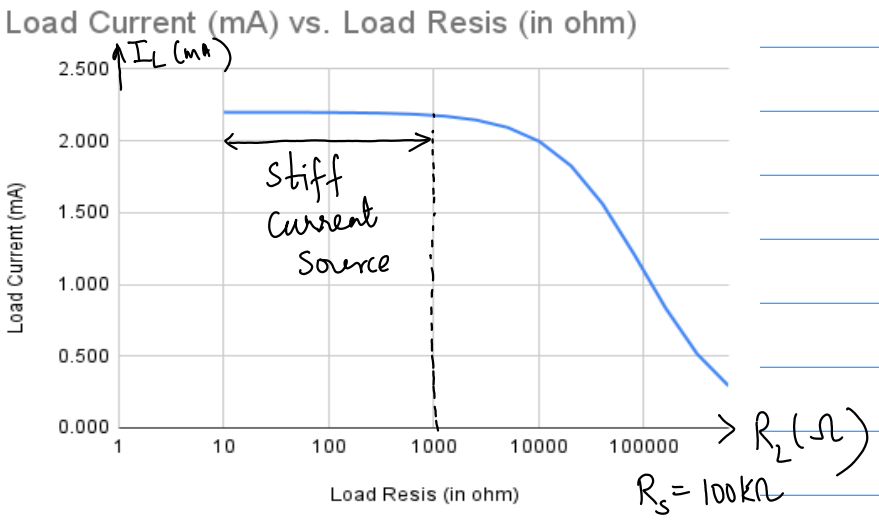
$I = I_1 + I_2$

$$I_2 = \left(\frac{R_1}{R_1+R_2}\right) I$$

$$I_1 = \left(\frac{R_2}{R_1+R_2}\right) I$$



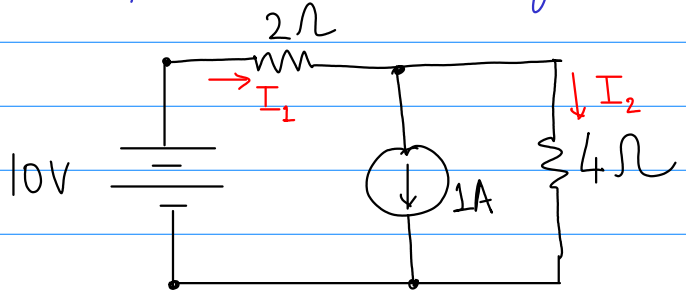
$$I_s = \left(\frac{V_s}{R_s}\right)$$



For a real (stiff) current source:

$$R_L \leq \frac{1}{100} R_s$$

Simple example with voltage & current sources:



Use: KCL, KVL to determine I_1 & I_2

Reference: Chapter 1, Malvino & Bates.