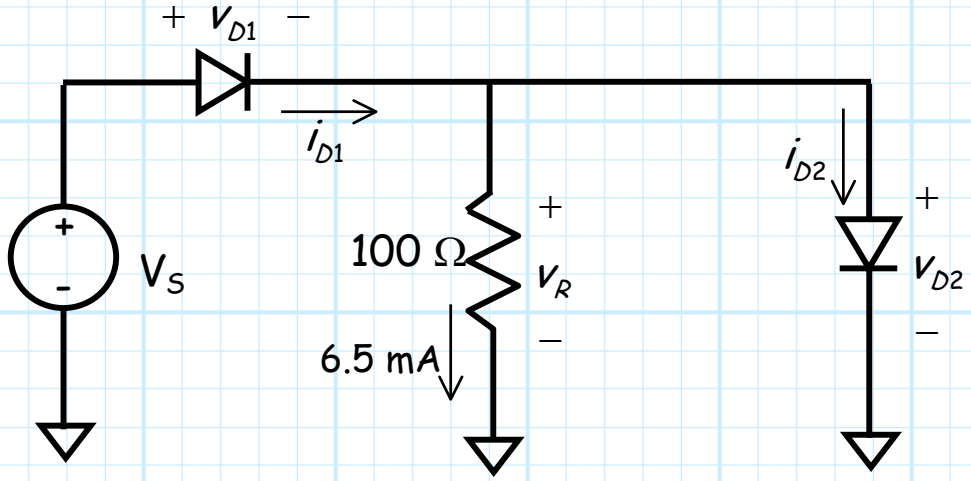
# Example: A Junction Diode Circuit

Consider the following circuit with two junction diodes:



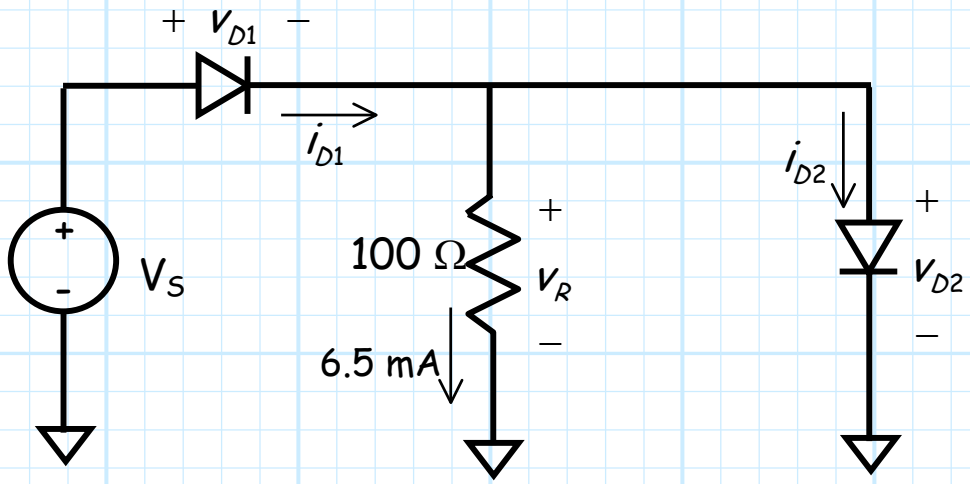

The diodes are identical, with n = 1 and $I_S = 10^{-14}$ A.

**Q:** *If the current through the resistor is 6.5 mA, what is the voltage of source $V_S$ ??*

**A:** This is a **difficult** problem to solve ! Certainly, we cannot just write:

$$V_S =$$

and then the answer. Instead, let's just determine **what we can**, and see what happens !




1) If 6.5 mA flows through a 0.1 K resistor, the voltage across that resistor is:

$$v_R = 0.1(6.5) = 0.65\,V$$

2) If the voltage across the resistor is 0.65 V, then the voltage across the diode $D_2$ , which is **parallel** to the resistor, is the **same** value:

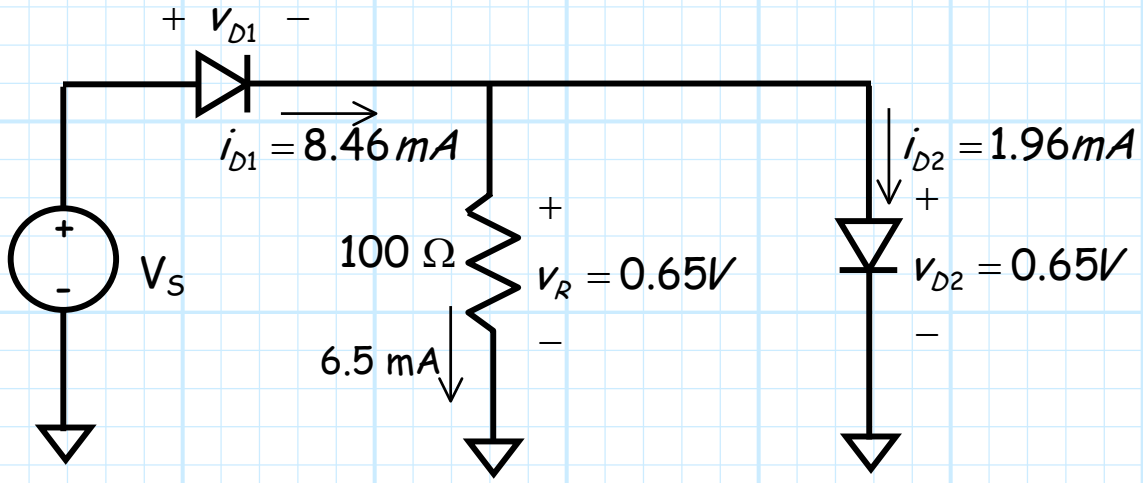
$$v_{D2} = v_R = 0.65\,V$$

3) If we know the **voltage** across a p-n junction diode, then we also know its **current** !

$$i_{D2} = I_S\, exp\left[\frac{v_{D2}}{nV_T}\right] = 10^{-14}\, exp\left[\frac{0.650}{0.025}\right] = 1.96\ mA$$

4) If we know $i_{D2}$ and the current through the resistor, we know (using KCL) the current through $D_1$ :

$$\begin{aligned} i_{D1} &= 6.5 + i_{D2} \\ &= 6.5 + 1.96 \\ &= 8.46 mA \end{aligned}$$




5) If we know the **current** through a junction diode, then we can find the **voltage** across it:

$$v_{D1} = nV_T \ln\left(\frac{i_{D1}}{I_S}\right) = 0.025 \ln\left(\frac{0.00846}{10^{-14}}\right) = 0.69V$$

6) Finally, if we know $v_{D1}$ and $v_{D2}$, we can find $V_S$ using KVL:

$$V_S = v_{D1} + v_{D2} = 0.69 + 0.65 = 1.34\,V$$