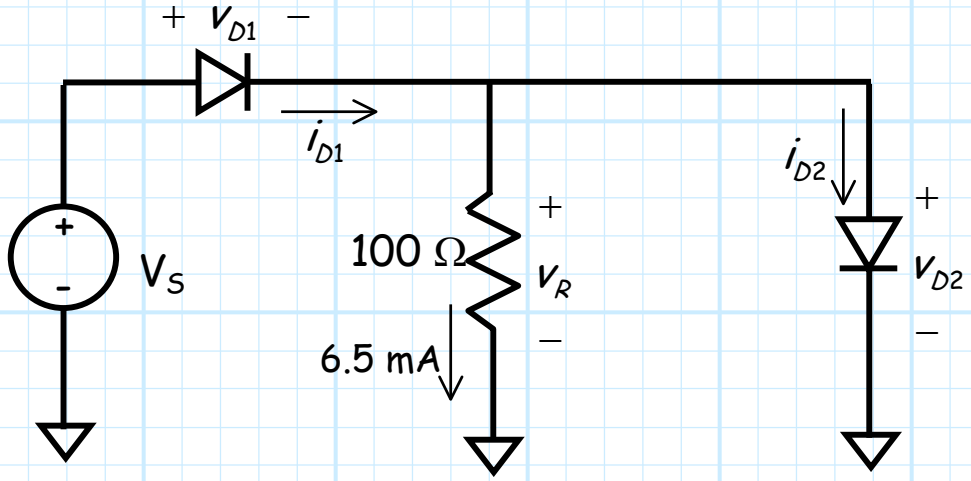
Example: A Junction Diode Circuit

Consider the following circuit with two junction diodes:



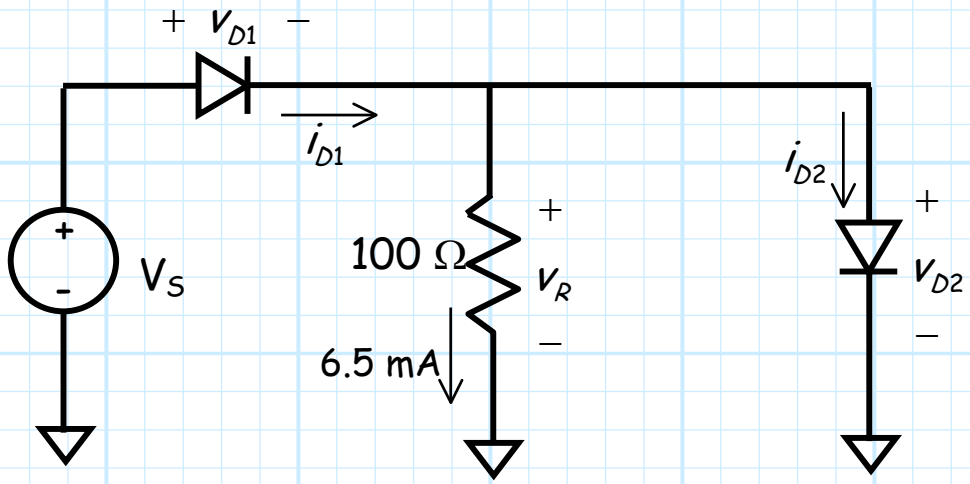
The diodes are identical, with n = 1 and $I_S = 10^{-14}$ A.

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:

$$v_R =$$

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:

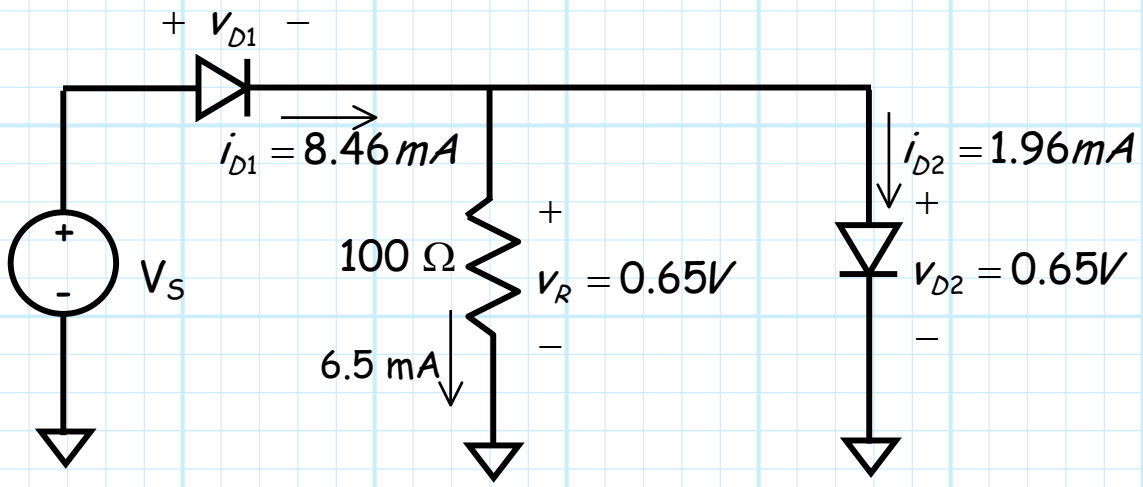
$$v_{D2} =$$

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 :

$$i_{D1} =$$



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:

$$V_S =$$