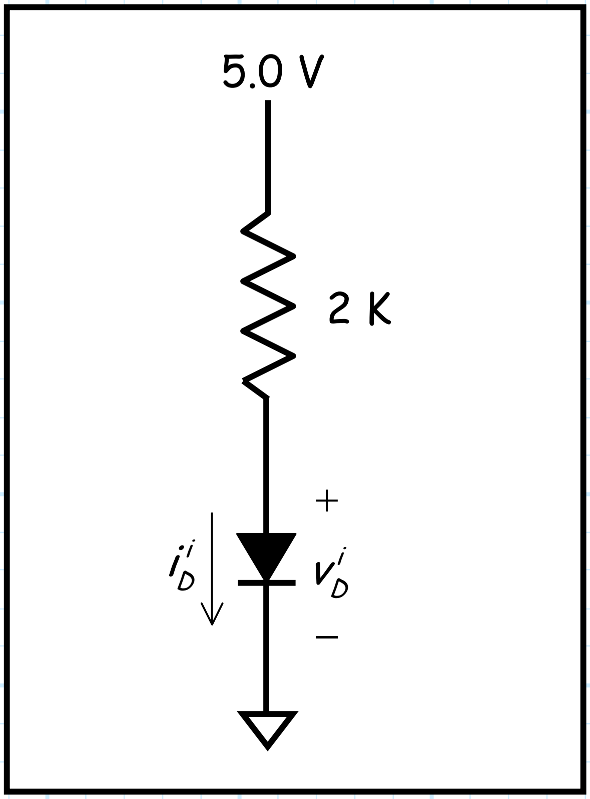
Example: A Simple Ideal Diode Circuit

Consider this simple circuit that includes an **ideal** diode:



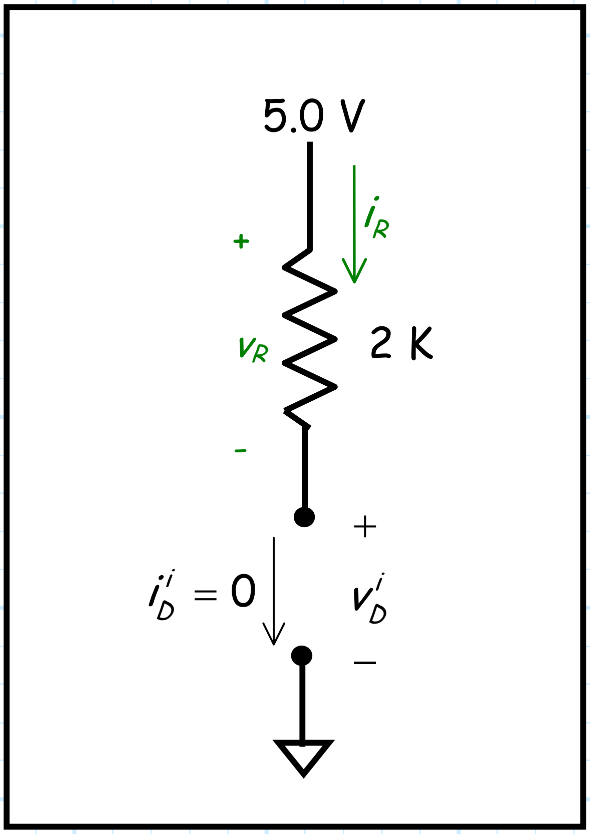
Q: *What are i_D^i and v_D^i?*

A: Follow the five easy analysis steps !

Step 1: Let's *ASSUME* the ideal diode is **reverse biased** (we're just guessing!).

Step 2: We therefore *ENFORCE* $i_D^i = 0$ by replacing the ideal diode with an **open** circuit.

Step 3: Now we *ANALYZE* the circuit; finding the value of v_D^i.



$$5.0 - v_R - v_D^i = 0 \quad \text{(KVL)}$$

$$\therefore \; v_D^i = 5.0 - v_R$$

$$i_R = i_D^i \quad \text{(KCL)}$$

$$v_R = 2\, i_R \quad \text{(Ohm's)}$$

$$i_D^i = 0 \quad \text{(enforced)}$$

$$\therefore \; i_R = 0$$

$$\therefore \; v_R = 2(0) = 0$$

$$\therefore \; v_D^i = 5.0 - 0 = 5.0\, V$$

Step 4: Now let's CHECK our result. ⇨ **Is** $v_D^i < 0$??

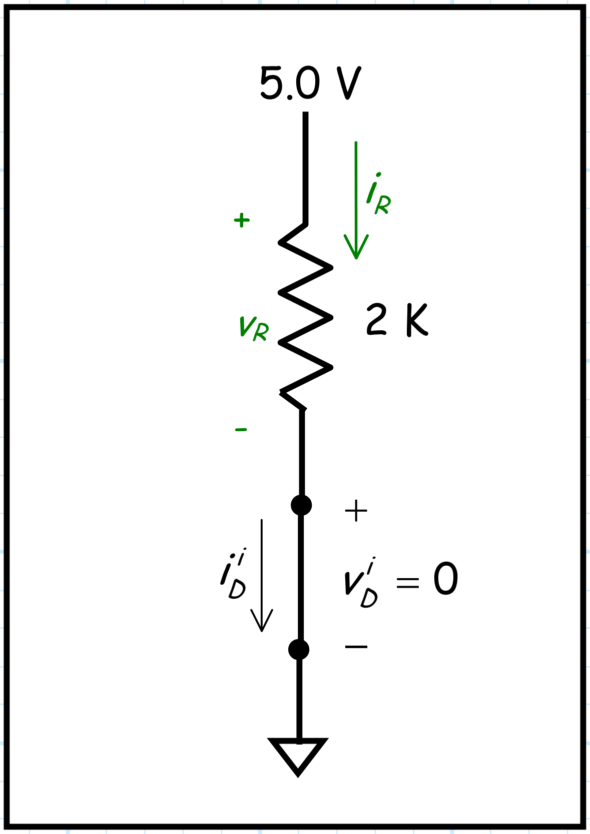
$v_D^i = 5.0 > 0$ ✗

We must change our assumption, and then **start over** (Doh!).

1) Now *ASSUME* the ideal diode is **forward biased** (what's left?).

2) We therefore *ENFORCE* $v_D^i = 0$ by replacing the ideal diode with an **short** circuit.

3) Now we *ANALYZE* the circuit; finding the value of i_D^i.



$$5.0 - v_R - v_D^i = 0 \quad \text{(KVL)}$$

$$\therefore \; v_R = 5.0 - v_D^i$$

$$i_D^i = i_R \quad \text{(KCL)}$$

$$i_R = v_R / 2 \quad \text{(Ohm's)}$$

$$v_D^i = 0 \quad \text{(enforced)}$$

$$\therefore v_R = 5.0 - 0 = 5.0 \, V$$

$$\therefore \; i_R = 5.0/2 = 2.5 \, mA$$

$$\therefore \; i_D^i = 2.5 \, mA$$

4) Now, let's *CHECK* our result. ⇨ **Is** $i_D^i > 0$??

$$i_D^i = 2.5 \, mA \quad > \quad 0 \; ✓$$

Our assumption is correct !

Therefore, in this circuit, we now **know** that:

$$v_D^i = 0 \text{ and } i_D^i = 2.5 \, mA$$