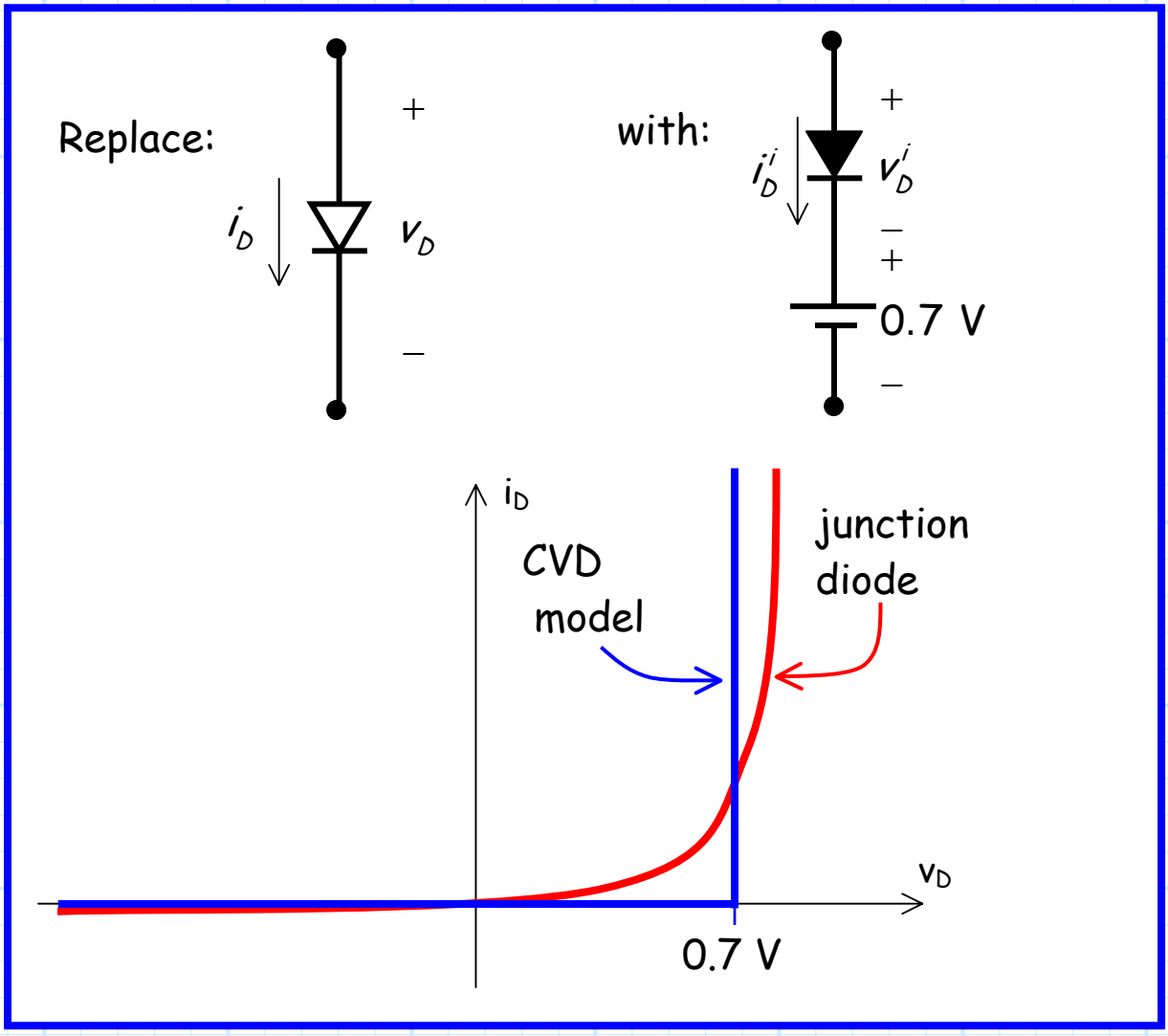
The Constant Voltage Drop (CVD) Model

Q: *We know if **significant** positive current flows through a junction diode, the diode voltage will be some value near 0.7 V. Yet, the ideal diode model provides an approximate answer of v_D=0 V. Isn't there a more **accurate** model?*

A: Yes! Consider the **Constant Voltage Drop** (CVD) model.



In other words, replace the junction diode with **two** devices—an **ideal diode** in series with a **0.7 V voltage source**.

To find **approximate** current and voltage values of a junction diode circuit, follow these steps:

Step 1 - **Replace** each junction diode with the **two** devices of the **CVD model**.

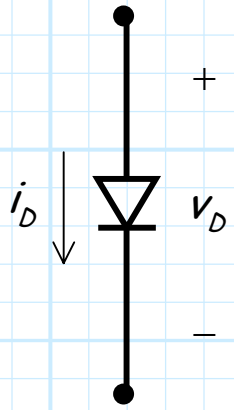
Note you now a have an **IDEAL** diode circuit! There are **no junction diodes** in the circuit, and therefore **no junction diode** knowledge need be (or should be) used to analyze it.

Step 2 - **Analyze** the **IDEAL** diode circuit. Determine i_D^i and v_D^i for **each ideal** diode.

IMPORTANT NOTE!!! PLEASE READ THIS CAREFULLY:

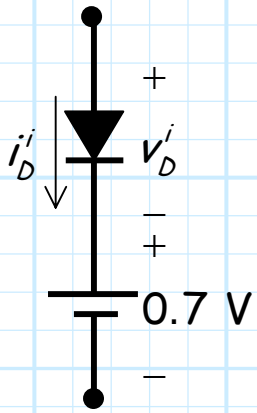
Make sure you analyze the resulting circuit **precisely** as we did in section 3.1. You **assume** the same **IDEAL** diode modes, you **enforce** the same **IDEAL** diode values, and you **check** the same **IDEAL** diode results, **precisely** as before. Once we replace the junction diodes with the CVD model, we have an **IDEAL** diode circuit—**no junction diodes** are involved!

Step 3 – Determine the **approximate** values i_D and v_D of the **junction** diode from the **ideal** diode values i_D^i and v_D^i:



$$i_D \approx i_D^i$$

$$v_D \approx v_D^i + 0.7$$



Note therefore, **if** the **IDEAL** diode (note here I said **IDEAL** diode) is **forward** biased ($i_D^i > 0$), then the **approximation** of the **junction** diode current will likewise be positive ($i_D > 0$), and the **approximation** of the **junction** diode voltage (unlike the **ideal** diode voltage of $v_D^i = 0$) will be:

$$\begin{aligned} v_D &= v_D^i + 0.7 \\ &= 0.0 + 0.7 \\ &= 0.7 \text{ V} \end{aligned}$$

However, **if** the **IDEAL** diode is **reversed** biased ($i_D^i = 0$), then the **approximation** of the **junction** diode current will likewise be zero ($i_D = 0$), and the approximation of the junction diode voltage (unlike the **ideal** diode voltage of $v_D^i < 0$) will be:

$$\begin{aligned} v_D &= v_D^i + 0.7 \\ &< 0.7 \text{ V} \end{aligned}$$

NOTE: Do **not** check the resulting **junction** diode approximations. You do not **assume** anything about the **junction** diode, so there is **nothing to check** regarding the junction diode answers.