The Junction Diode Equation

The relationship between the **current** through a **junction diode** (i_D) and the **voltage** across it (v_D) is:

$$i_D = I_s\left(e^{v_D / nV_T} - 1\right) \quad \text{for} \quad v_D > -V_{ZK}$$

Note: this equation describes diode behavior in the forward **and** reverse biased region **only** (i.e., **not** valid for **breakdown**).

Q: *Good **golly**! Just what do those **dog-gone** parameters n, I_s and V_T mean?*

A: Similar to the resistance value R of a resistor, or the capacitance C of a capacitor, these **three** parameters specify the performance of a **junction diode**. Specifically, they are:

1. I_s = **Saturation** (or scale) **Current**. Depends on diode material, size, and **temperature**.

➡ Typical values range from 10^{-8} to 10^{-15} A (i.e., **tiny**)!

2. V_T = **Thermal Voltage** = $\frac{kT}{q}$

Where:

k = Boltzman's Constant

T = Diode Temperature ($^\circ$K)

q = Charge on an electron (coulombs)

$$\text{At } 20\ ^\circ C,\ V_T \approx 25\ mV$$

IMPORTANT NOTE!: Unless **otherwise** stated, we will **assume** that each and every junction diode is at **room temperature** (i.e., $T = 20^\circ\ C$). Thus, we will **always** assume that the **thermal voltage** V_T of **all** junction diodes is **25 mV** (i.e., $V_T = 25$ mV)!

3. n = a constant called the **ideality factor** (i.e. a "fudge factor").

Typically, $1 \leq n \leq 2$