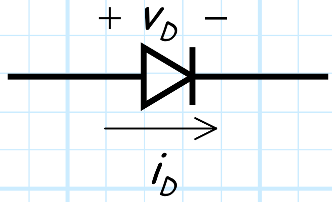
3.2 Terminal Characteristics of Junction Diodes (pp.147-153)

A Junction Diode –

I.E., A "real" diode!

Similar to an **ideal** diode, its circuit symbol is:



HO: The Junction Diode Curve

HO: The Junction Diode Equation

A. The Forward Bias Region

Consider when $v_D \gg nV_T$ (i.e, when $v_D \gg \approx 25mV$).

→

Note then (when $v_D \gg \approx 25mV$) that $e^{v_D/nV_T} \gg 1$, so that a **forward biased** junction diode **approximation** is:

$$i_D = I_s\left(e^{v_D/nV_T} - 1\right)$$

$$\approx I_s\, e^{v_D/nV_T} \qquad \text{for} \quad v_D \gg nV_T$$

An **exponential** curve !

→

Example: $I_s = 10^{-12}$, n=1

v_D (V)	i_D
0.4	
0.5	
0.6	
0.7	
0.8	
0.9	

∴ A junction diode in forward bias with **significant** but **plausible** current always has a voltage v_D between approximately 0.5V and 0.8 V!

I.E., $0.5 < v_D < 0.8$ (aprox.) when in f.b.

Therfore, we often **APPROXIMATE** the **forward biased** junction diode voltage as simply:

Note that this approximation:

a)

b)

HO: The Junction Diode Forward Bias Equation

HO: Example: A Junction Diode Circuit

B. The Reverse Bias Region

Now consider when $v_D \ll -nV_T$ (i.e, when $v_D \ll \approx -25mV$).

→

Note then that now $e^{v_D/nV_T} \ll 1$, so that a **reverse biased** junction diode **approximation** is:

$$
\begin{aligned}
i_D &= I_s\left(e^{v_D/nV_T} - 1\right) \\
&\approx -I_s \qquad\qquad for \quad v_D \ll -nV_T
\end{aligned}
$$

Therefore, a reverse biased junction diode has a **tiny, negative** current.

→

HO: Forward and Reverse Bias Approximations

C. The Breakdown Region

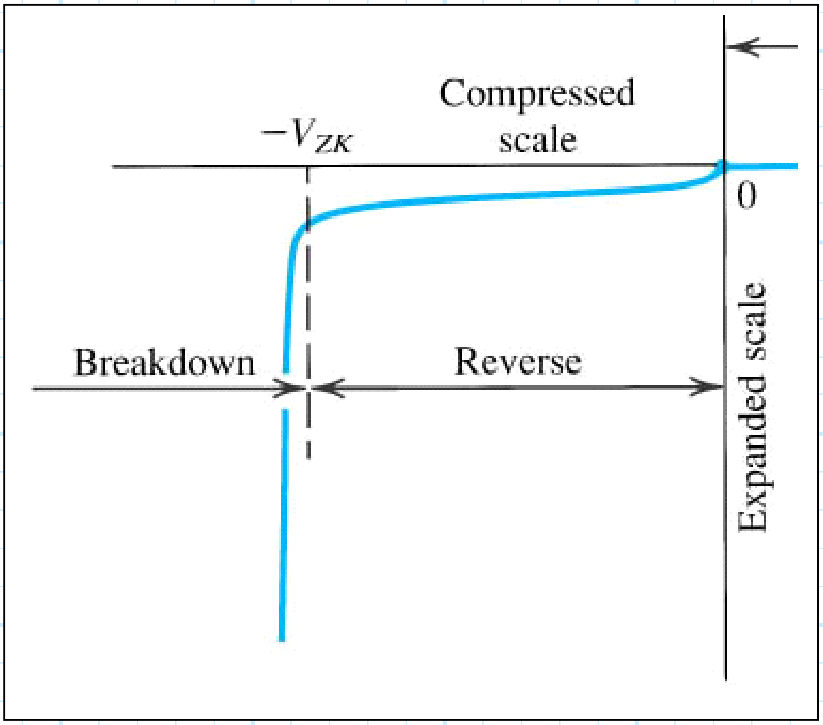
If v_D becomes too **negative**, then diode will **breakdown** (b.d.)!

* I.E., **significant** current **will** flow from cathode to anode (i_D < 0 !).

* v_D will remain at approximately $-V_{ZK}$, **regardless** of i_D.

Therefore, **breakdown** is describe mathematically as:

Note that V_{ZK} is a "knee" voltage (i.e., value is **subjective**).



D. Power Dissipation in Junction Diodes

Consider the **power** dissipated by a junction diode (i.e., $P = V I$)

f.b. →

r.b →

b.d →

Thus, we typically try to **avoid** breakdown. In other words, we desire V_{ZK} to be as **big** as possible!