Some useful equations for pn junctions at zero bias:

Potentials:

$$\phi_p = \frac{kT}{q}\ln\left(\frac{N_a}{n_i}\right) \approx 60mV\log_{10}\left(\frac{N_a}{n_i}\right)$$

$$\phi_n = \frac{kT}{q}\ln\left(\frac{N_d}{n_i}\right) \approx 60mV\log_{10}\left(\frac{N_d}{n_i}\right)$$

$$V_{bi} = \phi_o = \phi_p + \phi_n = \frac{kT}{q}\ln\left(\frac{N_a N_d}{n_i^{\,2}}\right)$$

Depletion region widths:

$$x_{no} = \sqrt{\frac{2\varepsilon\phi_o}{qN_d}\left(\frac{N_a}{N_d + N_a}\right)}$$

$$x_{po} = \sqrt{\frac{2\varepsilon\phi_o}{qN_a}\left(\frac{N_d}{N_d + N_a}\right)}$$

$$W_j = x_{no} + x_{po} = \sqrt{\frac{2\varepsilon\phi_o}{q}\left(\frac{N_d + N_a}{N_d N_a}\right)}$$