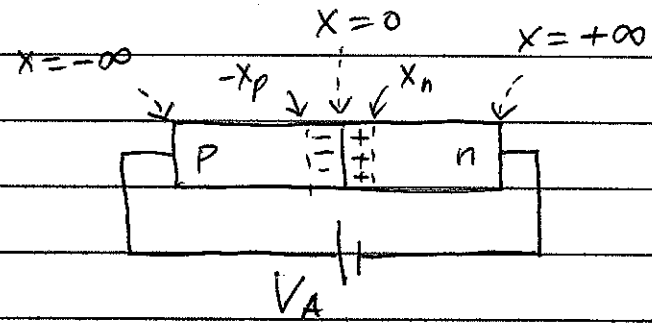
Mystery . . . ?!

Need some good detective work!!

Consider



(#) We know from the last class that the electrostatic problem for $V_A = 0$ gives

① --- $V_{bi} = \frac{k_B T}{e} \ln \frac{p(-\infty)}{p(\infty)} = \frac{k_B T}{e} \ln \frac{n(\infty)}{n(-\infty)}$

and

② --- $V_{bi} = \frac{k_B T}{e} \ln \frac{p(-x_p)}{p(x_n)} = \frac{k_B T}{e} \ln \frac{n(x_n)}{n(-x_p)}$

(##) We also know that the electrostatic problem for $V_A \neq 0$ is "just" the same problem as the unbiased one, as long as we make the following substitution $V_{bi} \rightarrow V_{bi} - V_A$.

And, yet, only one of ①, ② must be modified with that substitution, and the other remains valid as is even when $V_A \neq 0$!

Which one needs to be modified?
Which one need not be modified?

What is the missing physics?

See page 5 of LN 15, for answers.