[pex6] Layer of bound charge of exponential profile and variable thickness

Consider a layer of bound charges (as realized in a poly-electrolyte gel) with exponential profile,

$$n_b(x) = \frac{n_l}{2a} e^{-|x|/a},$$

immersed in an ionic solvent. The width of the layer is controlled by the parameter a.

(a) Solve the linearized Poisson-Boltzmann equation via Fourier transform as described in [pln69]. (b) Show that in the limit $a \rightarrow 0$ the result of [pex9] emerges.

(c) Plot $n_b(x)$ and $\psi(x)$ versus x for the cases a = 1.5, 0.5, 0.1, 0.0001 (four curves each in two frames). Set $e_b, \epsilon, \kappa, n_l$ all equal to unity for the purpose of graphical representation.

Solution: