Let's assume a thick *n*-type semiconductor crystal occupies the half-space $x \geq 0$. It is illuminated from $x < 0$ with a constant, monochromatic photon flux density *I* (number of photons/time/area). Absorption of the photons in the semiconductor creates electron-hole pairs; this absorption is characterized by the absorption coefficient α. (Reflection from the semiconductor surface at $x = 0$ is negligible.)

We are interested in the steady-state minority carrier distribution. Minority carriers diffuse with diffusivity *D*, they recombine in the semiconductor with lifetime τ, and on the surface with recombination velocity v_s. (You may assume: $\alpha < 1/\sqrt{D\tau}$, and you should assume that surface electric fields are negligible, i.e. no majority carrier depletion or accumulation near the surface.)

a) (3.2 Pts.) Calculate the excess minority carrier density profile as a function of *x*.
b) (0.8 Pts.) Is there a charge current flowing anywhere in the semiconductor under the conditions described above? Explain in words. (English words, please.)