Q9. Window layers

A $CuInSe_2$ n–p junction solar cell has a 0.1 μm heavily doped n-type emitter layer and a 4 μm lightly doped p-type base. Use the information below to estimate the relative increase in quantum efficiency at 600 nm when the $CuInSe_2$ emitter layer is replaced with CdS. Explain your reasoning and state clearly any assumptions which you make.

Absorption coefficient of $CuInSe_2$ at 600 nm (α)	1.5×10^7 m^{-1}
Band gap of CdS	2.4 eV
Diffusion length of holes in n^+-type $CuInSe_2$ (L_p)	0.01 μm
Diffusion length of electrons in p-type $CuInSe_2$ (L_n)	2.0 μm

Q10. Electric field in an a-Si p–i–n cell

(a) An amorphous silicon p–i–n solar cell has a p type background doping of 2.0×10^{21} m^{-3} in the intrinsic region and dielectric constant of $\varepsilon = 1.0 \times 10^{-10}$ F m^{-1}. If the cell has a built in bias V_{bi} of 0.9 V, calculate the thickness of the depletion layer in the intrinsic material at zero applied bias, treating the intrinsic region as the p side of a p–n junction. State any approximations which you make.

(b) Would your answer to (a) be a suitable value for the width of the i-region of the solar cell? Give a reason for your answer. Estimate a better value for the i region thickness, stating any assumptions made.