

1. Consider Heterostructure Bipolar transistor with the base made of GaAs ( $E_g \sim 1.5\text{eV}$ ) and emitter made of  $\text{Al}_{0.3}\text{Ga}_{0.7}\text{As}$  ( $E_g \sim 1.8\text{eV}$ ). Emitter is doped with  $N_{D,E} = 10^{18}\text{cm}^{-3}$ . The base is 200 nm wide. Assume that diffusion lengths for both carriers are  $5\mu\text{m}$ . How high can you dope the base and still have a decent  $\beta > 200$ .
2. How both speed and gain of transistor can be improved by using a graded base? Give an example with numbers.