Problem 1 (Diffusion)
A phosphorus diffusion has a surface concentration of \(5 \times 10^{18}/\text{cm}^3\), and the background concentration of the p-type wafer is \(1 \times 10^{15}/\text{cm}^3\). The \(D_t\) product of the diffusion is \(10^{-8} \text{ cm}^2\).
(a) Find the junction depth of a Gaussian distribution
(b) Find the junction depth of an \(\text{erfc}\) profile
(c) What is the sheet resistance of the two diffusions, respectively?

Problem 2 (Diffusion)
(a) What is the total number of squares in the resistor shown, assuming that its geometry is specified precisely by the mask dimensions?
(b) The resistor is actually formed from a p-type base diffusion with a 6-\(\mu\)m junction depth. What is the actual number of squares in this resistor, assuming that the lateral diffusion under the edge is 5\(\mu\)m?
(c) What would be the resistance of the resistor in parts (a) and (b) if the surface concentration of the base diffusion was \(5 \times 10^{18}\) boron atoms/cm\(^3\), the bulk concentration \(10^{15}/\text{cm}^3\) and the junction depth 6\(\mu\)m. (hint: you will need to use Fig. 4.15 & Fig. 4.16d)

Problem 3 (MEMS)
Please calculate the end deflections of the following MEMS devices under the influence of gravity. The device is fabricated by the MUMPs process and the material is polysilicon. Assuming \(E = 150\) GPa,
(a) A cantilever beam with width of 2 \(\mu\)m, length of 400 \(\mu\)m and thickness of 2 \(\mu\)m. (you don’t need to derive the formula, cite the right formula in any book is fine)
(b) The same cantilever beam (assume it is massless) which is to support a 100X100 \(\mu\)m\(^2\) plate at the end. (you can assume all the weight of the plate is put on the end of the cantilever beam)