Problem 1) Implant P at a dose of $10^{12}$ atoms/cm² and an energy of 200 KeV. Assume that the dopant is activated by a RTA such that no further diffusion occurs.

   a) Sketch the dopant profile, calculating the conc. of at least four points.
   b) Drive-in the P at 1050 C for 8 hrs. and sketch the resulting profile, calculating the conc. of at least four points.

Problem 2) How much oxide is required to block 99.999% of a Sb implant with a dose of $10^{13}$ atoms/cm² and an energy of 120 KeV?

Problem 3) Using the Rp and the ΔRp table from the lecture notes, B is implanted at a dose of $Q=5\times10^{12}$ atoms/cm² and an energy of 500 KeV. Assume the dopant is activated by a RTA such that no further diffusion occurs. The background conc. is N-type at $5\times10^{15}$ atoms/cm³.

   a) What is the junction depth?
   b) Estimate the sheet resistance of the Boron layer.

Problem 4) For a single wafer implant tool the beam current for P is 20 mA. The implanter implants 300 mm wafers with a dose of $10^{13}$ atoms/cm². Assume that it takes 3 sec to switch wafers. Calculate the throughput in wafers/hr for this process step.

Problem 5) When implanting decaborane, B₁₀H₁₄, the energy of a Boron atom is 1/11 the energy of the molecule.

   a) For a 100 KeV implant find the oxide thickness required to block 99.999% of the implant when $Q=1\times10^{13}$ atoms/cm².
   b) What will the junction depth, $x_j$, be when the decaborane is implanted at 40 KeV into bare silicon with a N-type background of $2\times10^{15}$ atoms/cm³. The dose is $10^{13}$ atoms/cm². Assume RTA activation of dopant with no additional diffusion.

Problem 6) P++ is implanted at 80 KeV with a dose of $5\times10^{13}$ atoms/cm². Then the P is driven in at 1050 C for 8 hrs. and finally a second diffusion at 975 C for 20 hrs. Sketch the final dopant profile calculating at least four points.