Name: ______________________________

CHE323/384 Chemical Engineering for Micro- and Nanofabrication
Fall, 2013, Chris A. Mack

Practice Exam #1

closed book, closed notes, one formula sheet, calculators allowed

Definitions: Please provide short (one to two sentence) definitions of the following terms. DO NOT use any equations. Make all definitions in words. (2 pt each)

1) p-channel transistor

2) Space-charge region

3) Substitutional impurity

4) Transverse straggle

Questions: Please provide short (one to two sentence) answers to the following questions. DO NOT use any equations. Make all answers in words. (6 pts each)

1) Why is a vertical furnace preferred over a horizontal furnace?

2) Why do (111) silicon wafers thermally oxidize faster than (100) wafers?

Problems: Show all work. State all assumptions clearly.

1. (25 pts) A 600 nm oxide is required on a (100) silicon wafer, and it has been decided that thermal oxidation in wet (640 torr) oxygen at 1100 ºC is the best approach. With an initial oxide of 80 nm already on the wafer, how long should the oxidation be done?

2. (35 points) We use a thick oxide as an implant mask for a 120 keV implant of phosphorous using a dose of 1×10^{13} cm^{-2}. If the allowed dopant concentration at the bottom of the oxide is 2×10^{15} cm^{-3}, how thick must the oxide mask be? Assume the implant properties of SiO_2 are the same as silicon.

3. (20 points) We wish to make a 500 Ω resistor in silicon by making a bar at the top surface of the wafer that is 2 μm long, 0.5 μm wide, and penetrates 0.2 μm into the wafer. The wafer is p-type, with a background doping of 1×10^{17} cm^{-3}. How must this bar region be doped in order to achieve the desired resistance?