6.781
Submicrometer and Nanometer Technology
Homework Set #13

13-1.  Fig. 14.1 assumes a minimum of 100 electrons per pixel. This is a minimum of the **mean value**.  That is, in writing a pattern the number of electrons delivered to any individual pixel will vary from the mean in accordance with Poisson statistics (see Lecture 7).  Assume that if the number of electrons delivered to a pixel falls below 70 that pixel remains unexposed.  For a pixel size of 10nm (pixel size equal to the address grid period) how many pixels will be left unexposed if one writes an area of 1 $cm^2$.

13-2.  A vector-scan electron-beam-lithography system is operated with a focal length of 1cm, a source brightness of $B = 10^6$ A/$cm^2$ steradian (i.e., LaB6), and a beam current of 1 nanoamp.  The convergence angle at the substrate surface is 5 milliradians. What is the beam diameter at best focus.

13-3.  The attached graphics are provided by Leica Corp., a leading manufacturer of research scanning-electron-beam lithography systems.  Write a short paragraph or make up a  chart comparing the performance of such a system with what one would likely be able to achieve with a SEM based system, taking into account the following items:

   resolution
   writing speed
   intrafield pattern fidelity
   interfield stitching precision
   size of scan field

Graphics removed due to copyright restrictions.

Visit http://www.semiconation.com/ for corporate information about electronbeam lithography and Vistec Semiconductor Systems (formerly Leica). For information about the Leica VB6 HR, visit http://www.cnf.cornell.edu/cnf_process_ebl_equipment.html. For backgroundinformation on microlithography, visit http://www.cnf.cornell.edu/cnf_spietoc.html.