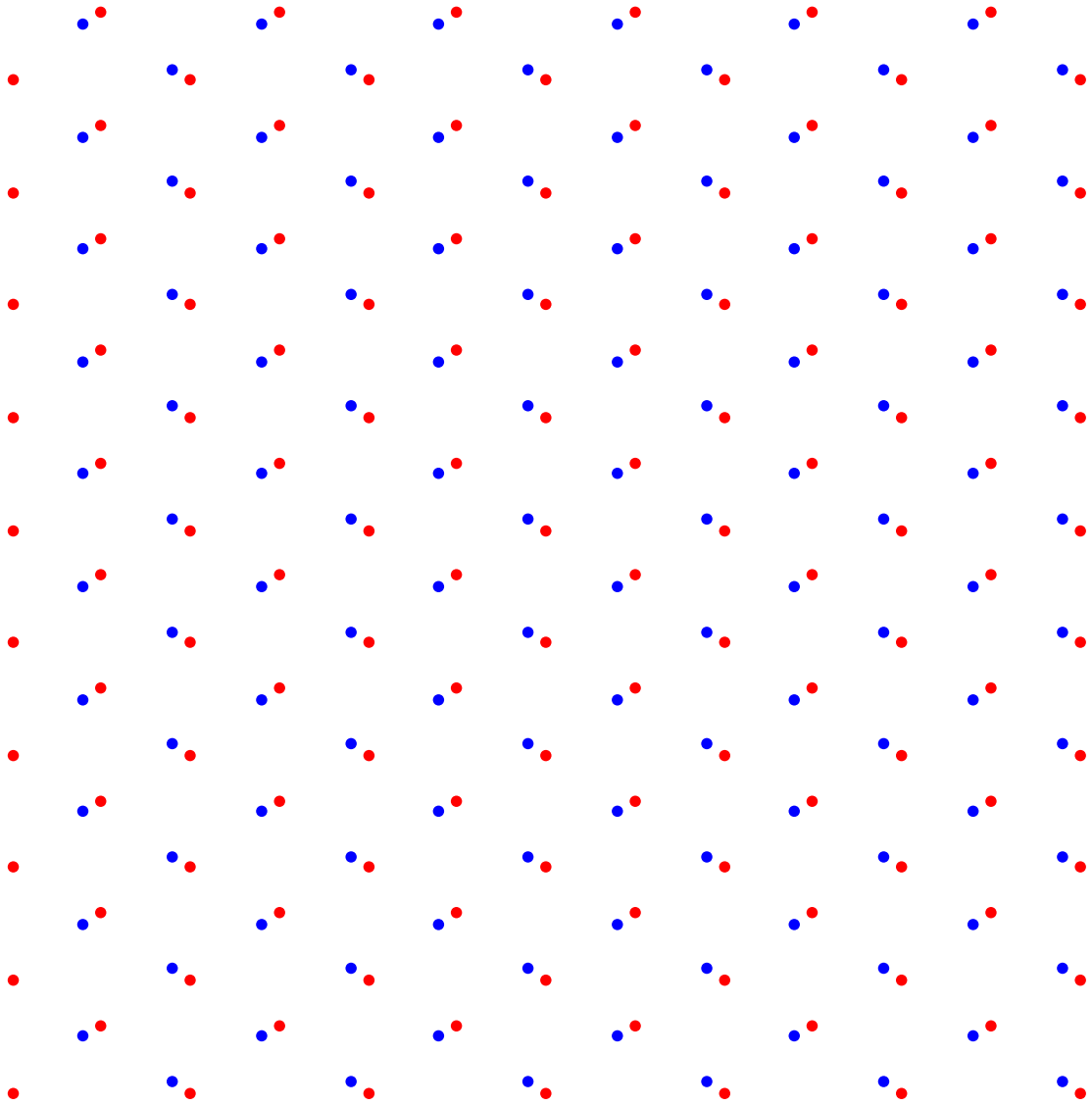
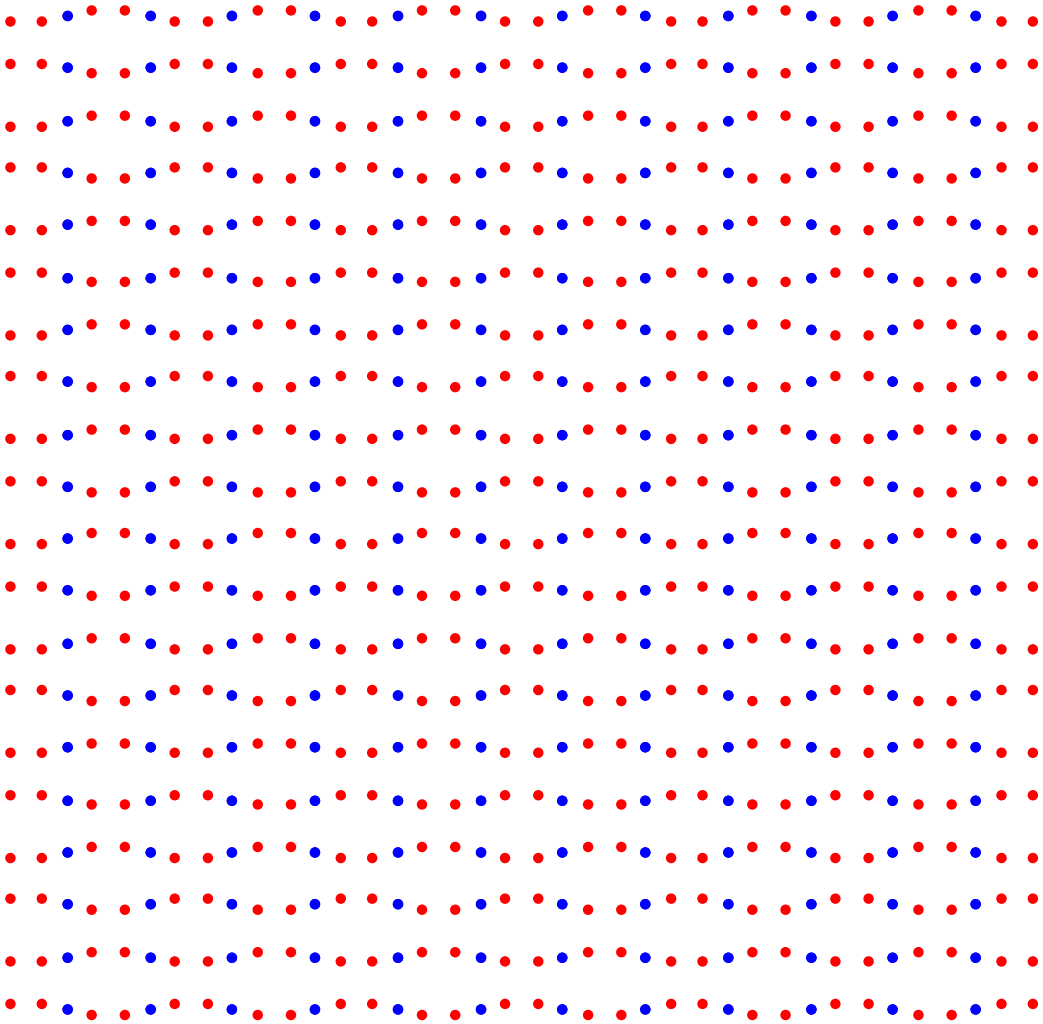
MSE 102, Fall 2018 Problem Set #3
Prof. D. C. Chrzan

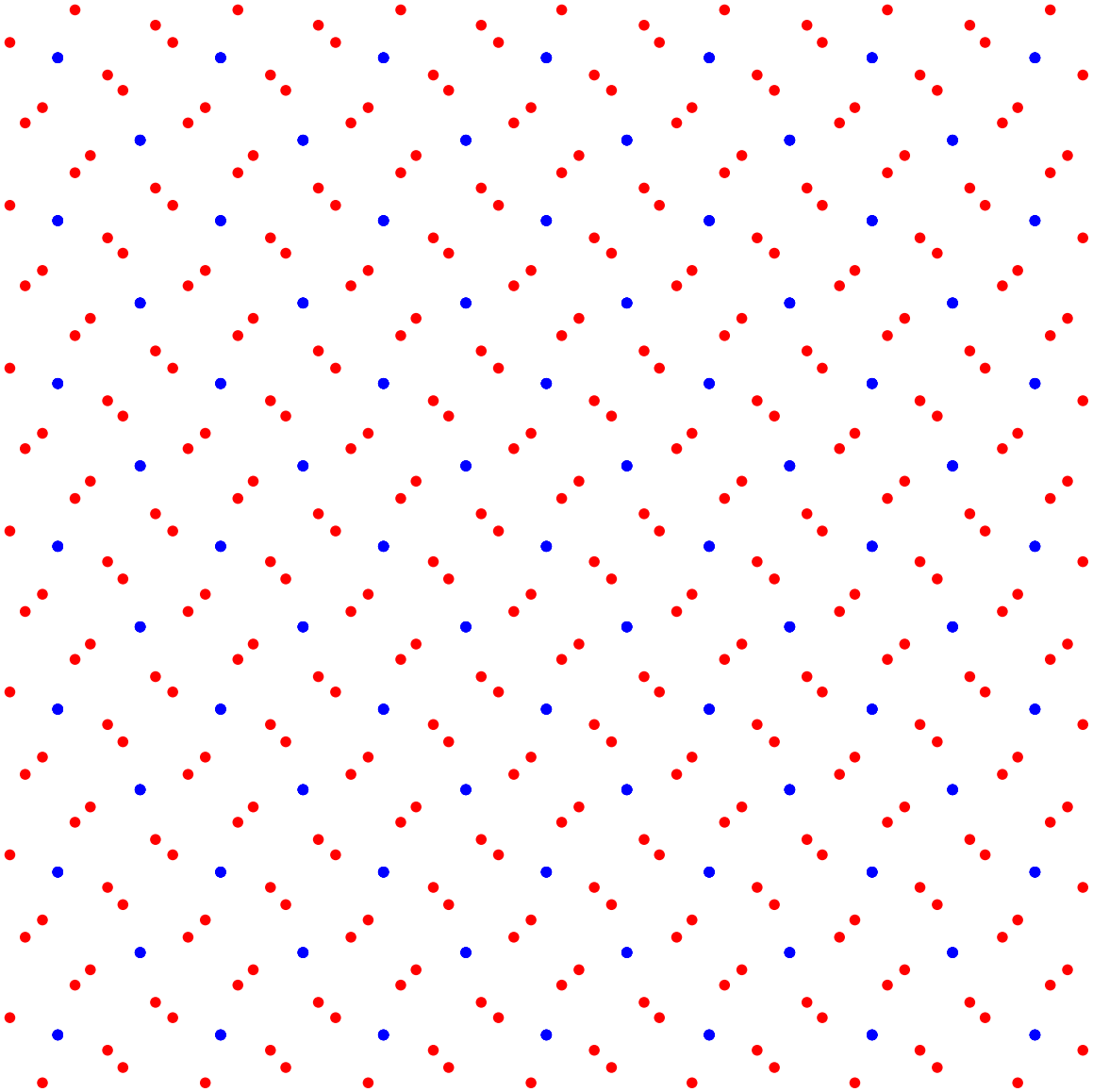
- The following structure is a binary alloy composed of blue and red atoms. Identify the plane group describing this structure.
    - (7 points) Begin by marking a set of points that are identical by symmetry. These are the lattice points of the structure. Indicate whether or not the lattice that you found is oblique, rectangular, square or hexagonal, and whether or not the lattice is centered.
    - (7 points) Identify the plane group that describes the symmetry of the crystal, and sketch the unit cell, with all of its symmetry elements, on the crystal.
    - (6 points) Identify the Wyckoff letter describing the positions of each color of atom.



- The following structure is a binary alloy composed of blue and red atoms. Identify the plane group describing this structure.
    - (7 points) Begin by marking a set of points that are identical by symmetry. These are the lattice points of the structure. Indicate whether or not the lattice that you found is oblique, rectangular, square or hexagonal, and whether or not the lattice is centered.
    - (7 points) Identify the plane group that describes the symmetry of the crystal, and sketch the unit cell, with all of its symmetry elements, on the crystal.
    - (6 points) Identify the Wyckoff letter describing the positions of each color of atom.



- The following structure is a binary alloy composed of blue and red atoms. Identify the plane group describing this structure.
    - (7 points) Begin by marking a set of points that are identical by symmetry. These are the lattice points of the structure. Indicate whether or not the lattice that you found is oblique, rectangular, square or hexagonal, and whether or not the lattice is centered.
    - (7 points) Identify the plane group that describes the symmetry of the crystal, and sketch the unit cell, with all of its symmetry elements, on the crystal.
    - (6 points) Identify the Wyckoff letter describing the positions of each color of atom.



4. (20 points) A 2D crystal is known to have the symmetry *p*3*m*1. The lattice parameter (that is, the length of the vector **a)**, is 2.42 Angstroms. There are boron (B) atoms at Wyckoff position b, and nitrogen (N) atoms at Wyckoff position c. Construct a figure displaying the crystal structure by plotting the positions of the B atoms and the N atoms using different symbols. Plot at least six unit cells of the crystal, and sketch the unit cell, with symmetry elements, on the crystal that you have plotted.

5. (20 points) A 2D crystal is known to have the symmetry *p*4*mm*. The lattice parameter (that is, the length of the vector **a)**, is 5 Angstroms. There are silicon (Si) atoms at Wyckoff position g, with x= 0.2 and y=0.1. Construct a figure displaying the crystal structure by plotting the positions of the Si atoms. Plot at least six unit cells of the crystal, and sketch the unit cell, with symmetry elements, on the crystal that you have plotted.