

## MATRL 218 : Assignment 2

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1. You have seen the glide  $g$  in 1D and 2D. Look up  $a, b, c, n$  and  $d$  glides in 3D crystals and depict them with appropriate sketches.
2. Cubic cells always have a  $\bar{3}$  or  $3$  in the space group label. What is the  $\bar{3}$  symmetry element in a cube?
3. What is the difference between the  $6_1$  and  $6_5$  symmetry operations? Distinguish with a sketch. It is helpful to use a low-symmetry motif such as the letter “R” for your illustration.
4. Sketch the  $4_2$ ,  $6_2$ , and  $6_4$  symmetry operations.
5. Using a right triangle as a motif, sketch 2D objects (if you can), with the following symmetries: (i)  $2m'm'$ ; (ii)  $3'$ . i)  $4mm$  (ii)  $4'mm'$ . [Hint for (ii): This is a case of “frustration”. What does this say about spins (as in magnetism) at the corners of a triangle?]
6. The plane groups  $p31m$  and  $p3m1$  differ in that, in one of them but not the other, all rotation axes are on mirrors. Sketch examples of the two plane groups, indicating rotation axes and mirrors.
7. I purchased some interesting postage stamps last week (see below). (i) Identify the outline of the unit cell. (ii) Identify the plane group. (iii) Can you identify a feature of the plane group that reminds you of screw axes such as  $3_1$  or  $6_1$ ?



8. Use VESTA to sketch the structures of (i)  $\alpha$ -Po, (ii)  $\alpha$ -Fe, and (iii) Cu whose structures are given in your notes and determine the coordination number (number of nearest neighbors) and distances of shortest contact for each. Ensure that the structural images you submit *look good*, like structures that you will find in the PDF file on Oxide Structures on the website.