Wallpaper Patterns

Attached are samples of all 17 wallpaper types. (Singularities are not shown.) In teams of two, do the following for each wallpaper sample.

1. Draw the mirror lines and the lines of glide reflection, and mark the centers of rotation.

2. Draw a basic cell with centers of highest rotation order (if any) at its vertices. 
   **Note:** Make your basic cell as small as possible.

3. Determine the type of your cell.
   **Recall:** The five cell types are parallelogram, rectangle, rhombus, square, and hexagonal parallelogram. Every hexagonal parallelogram is a rhombus; every rhombus is a parallelogram; every square is both a rhombus and a rectangle; every rhombus and every rectangle is a parallelogram. The type of your cell is determined by the *most general* shape possible for this pattern.

4. Rotate your paper, as necessary, to make sure that your cell has one horizontal diagonal if it is a rhombic cell, or one horizontal side if it is any other cell. If, after all that, you have a choice between having vertical mirrors or having horizontal mirrors, make them vertical. Draw an $x$-axis to indicate the direction of your horizontal if it is not the natural horizontal of the paper.

5. Determine whether there is a vertical mirror or, if not, a vertical glide reflection.

6. Determine the angle $\alpha$ between the slant direction and the horizontal.
   **Recall:** Suppose $n$ denotes the highest $n$-fold rotation order. Then $\alpha = 0^\circ$ if $n = 1, 2$; $\alpha = 60^\circ$ if $n = 3, 6$; and $\alpha = 45^\circ$ if $n = 4$.

7. Determine whether the slant direction is a mirror line or, if not, a line of glide reflection.

8. Find the international crystallographic name for the wallpaper.

9. Check your answer to Problem 8 with the flow chart on page 163 of your textbook.