

Please complete the following homework assignment on a separate piece of paper. It is due on November 29<sup>th</sup> at 9:30 am.

1. Describe all the symmetries of the following border patterns. Mark roto-centers or lines of reflection on the border pattern when appropriate. Finally, label them according to the crystallography classification.

(a) **NNNNNNNNNNNN**

The symmetries are  $t$  and  $r$  with roto-centers between two N's and along the diagonal of the N's. The classification is p112.

(b) **pqpqpqpqpqpq**

The symmetries are  $t$  and  $y$  with vertical line of reflection between each p and q. The classification is pm11.

(c) **dpdpdpdpdpd**

The symmetries are  $t$  and  $r$  with roto-centers between each d and p. The classification is p112.

(d) **qdqdqdqdqd**

The symmetries are  $t$  and  $g$  so the classification is p1g1.

(e) **DDDDDDDDDDDD**

The symmetries are  $t$  and  $x$  (and so also  $g$ ) so the classification is p1m1.

2. Describe all the symmetries of the following border patterns. Mark roto-centers or lines of reflection on the border pattern when appropriate. Finally, label them according to the crystallography classification.

(a) The symmetries are  $t$  and  $g$ .

(b) The symmetry is  $t$  only.

(c) The symmetries are  $t$  and  $r$ .

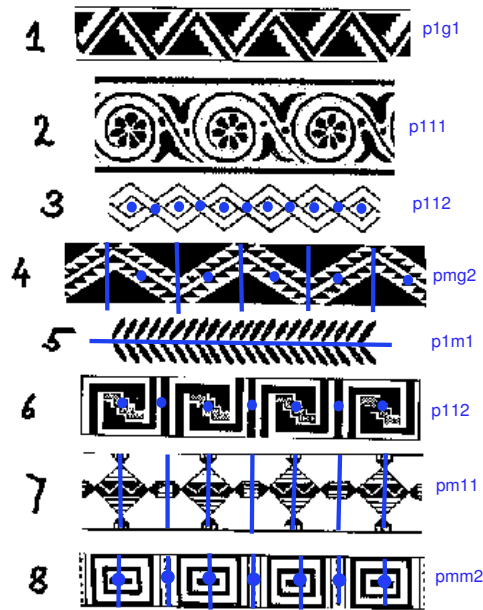
(d) The symmetries are  $t$ ,  $y$ ,  $r$  (and hence  $g$ ).

(e) The symmetries are  $t$  and  $x$ .

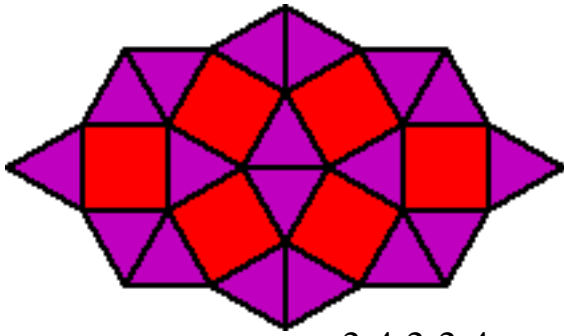
(f) The symmetries are  $t$  and  $r$ .

(g) The symmetries are  $t$  and  $y$ .

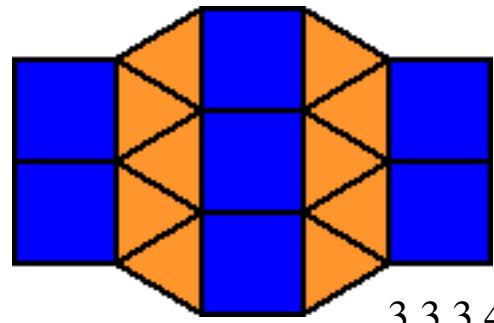
(h) The symmetries are  $t$ ,  $x$ ,  $y$  and  $r$ .



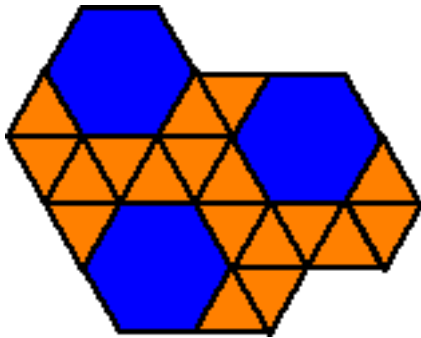
3. Draw examples of each of the seven possible border patterns and label them. Use a motif of your choice. Be creative.
4. Based on your results from Tuesday's workshop on semi-regular tilings, draw sections of each of the possible semi-regular tilings of the plane. Be careful. For the cases where five polygons fit around a vertex there may be more than one way to arrange the polygons to make a tiling. You should end up with drawings of three regular tilings and eight semi-regular tilings.



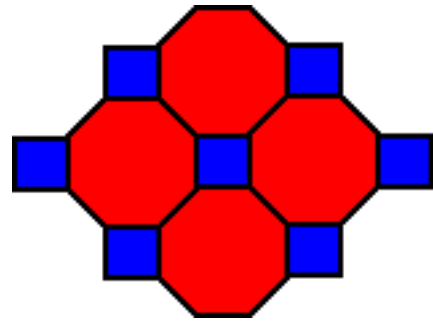
3.4.3.3.4



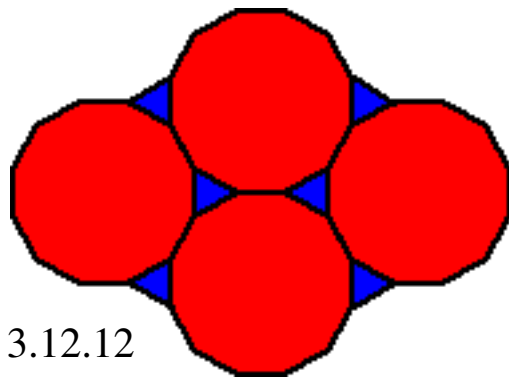
3.3.3.4.4



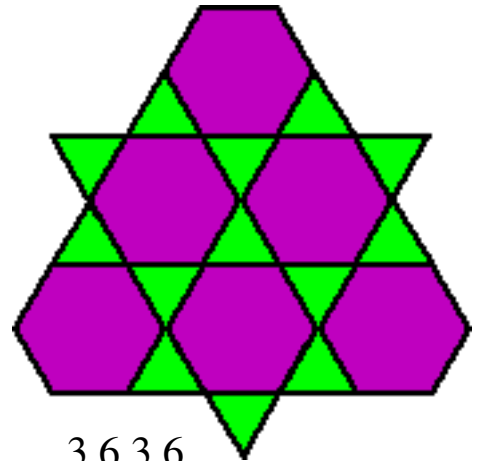
3.3.3.3.6



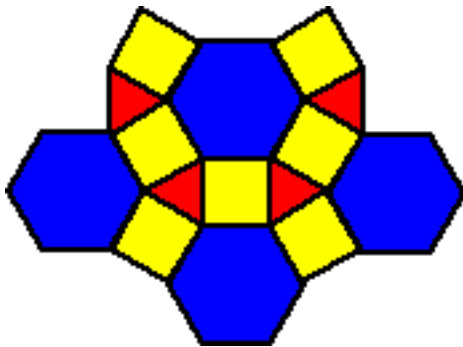
4.8.8



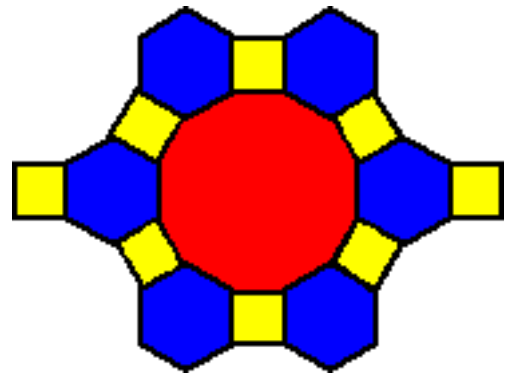
3.12.12



3.6.3.6



3.4.6.4



4.6.12