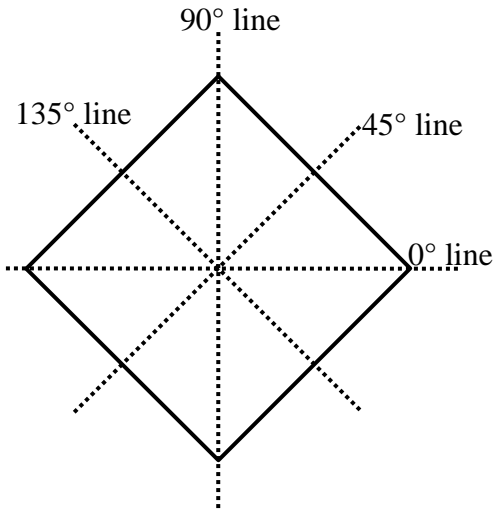


Geometry Group Work: Exploring the Symmetries of a Square

In this project, you will explore the *dihedral group with eight elements*, D_8 . This is the group of symmetries of a square. If we orient the square with its center at the origin, and one of the vertices lying on the positive x -axis, as shown in the figure below, then the elements of this group are as shown in the list to the right.



Elements of the group D_8

R_{0° = identity = id

R_{90° = counterclockwise rotation through 90°

R_{180° = counterclockwise rotation through 180°

R_{270° = counterclockwise rotation through 270°

M_1 = reflection in the 0° line

M_2 = reflection in the 45° line

M_3 = reflection in the 90° line

M_4 = reflection in the 135° line

(In the figure, you should think of the degree lines as being fixed to the table, while the square is the thing that gets rotated and flipped. For instance, the 0° line is always horizontal, and the 45° line always goes from lower left to upper right, as shown.)

Your tasks for the project are to

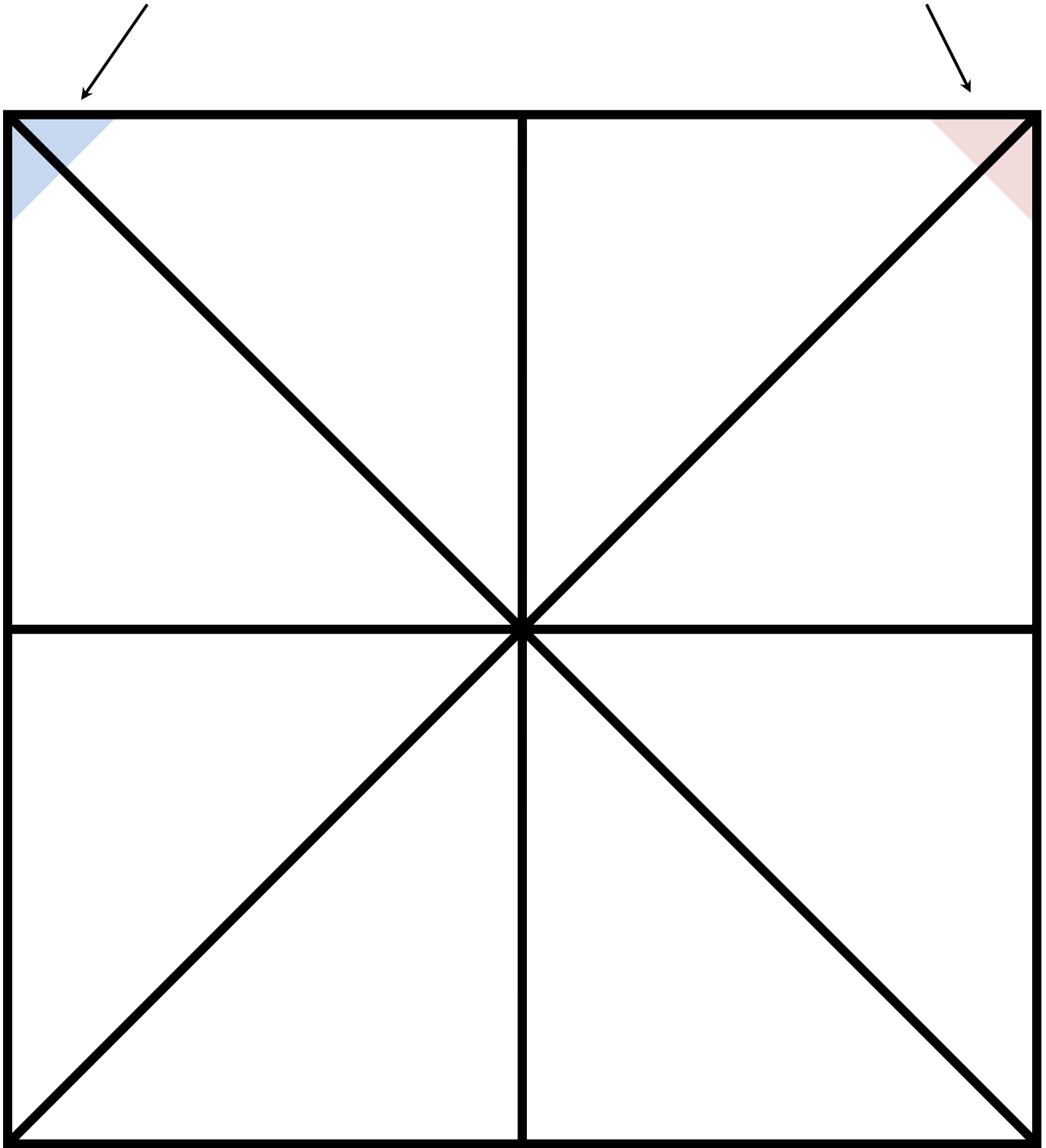
4. Color the vertices on the square on the following page, and then cut it out.
5. Fill out the group table below
6. Make a subgroup diagram for the group D_8 .

		transformation to the right of ◦ symbol							
		id	R_{90°	R_{180°	R_{270°	M_1	M_2	M_3	M_4
	\circ								
transformation to the left of ◦ symbol	id								
	R_{90°								
	R_{180°								
	R_{270°								
	M_1								
	M_2								
	M_3								
	M_4								

Color the vertices.

Color this vertex blue
(on front and back).

Color this vertex red
(on front and back).



Then cut out the square and color the back sides of the vertices if you have not already done so.