Let denote the group of symmetries of the square. Denote by a rotation anticlockwise by about the centre of the square, and by a reflection through the midpoints of an opposite pair of edges.

1. Verify that each rotation in can be expressed as and each reflection can be expressed as, for.
2. Verify the relations and. Explain how these relations may be used to write any product of elements in in the form given in (i) above. Illustrate this with the example.
3. Find the conjugacy classes of.
4. Show that the rotations in form a normal subgroup, . Write down the distinct cosets. Compute the multiplication table of the quotient group. To which well-known group is isomorphic? Is the subgroup generated by normal in?
5. Viewing the square in the real plane, centred at the origin, write down the matrix which represents the rotation and the matrix which represents the reflection. Check that

(This shows that you can define a homomorphism by letting.)

1. By labelling the corners of the square or otherwise, write down the homomorphism , verifying that