

## DIHEDRAL GROUP $D_3$

### LECTURE 1, EXERCISE SET 2

**Definition.** The dihedral group  $D_n$  ( $n \geq 3$ ) is the group of symmetries of a regular  $n$ -sided polygon.

**Exercise 1.** In this exercise we shall study the group  $D_3$ .

- (1) List all symmetries of an equilateral triangle, giving them “letter” names. Count the number of symmetries. Classify which symmetries are orientation-preserving, and which are orientation-reversing.
- (2) Compute the multiplication table for the group  $D_3$ .

Look at your multiplication table and convince yourself that  $D_3$  is a NON-ABELIAN group. This is the smallest non-abelian group, which also goes by the name  $S_3$ .

**Definition.** A group is called *finite* if it has a finite number of elements. The order of a finite group is the number of elements in the group.

**Definition.** (Informal) We say that a group is generated by two elements  $x, y$  if any element of the group can be written as a product of  $x$ 's and  $y$ 's.

**Exercise 2.** Show that  $D_3$  is generated by 2 elements:  $x$ , the rotation by  $2\pi/3$  and  $y$ , the reflection through the median.