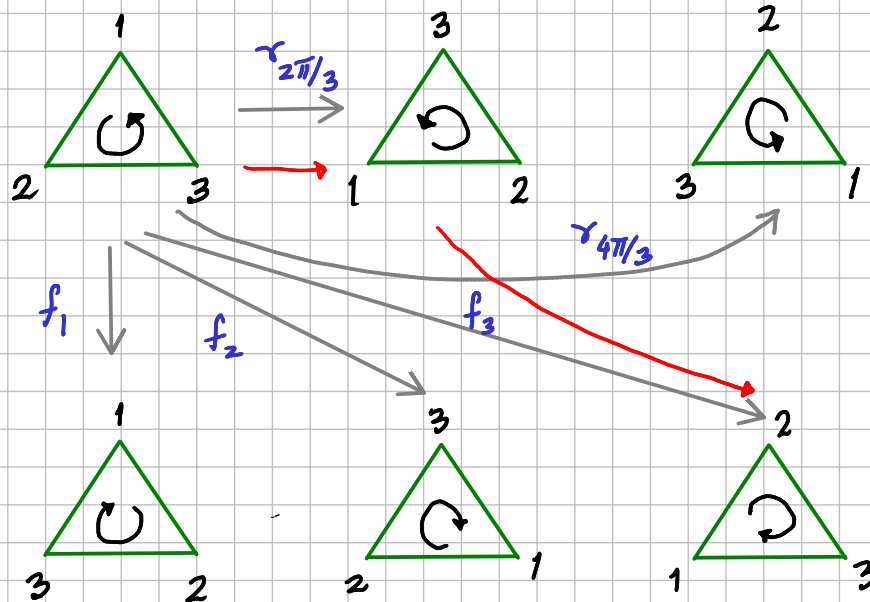1. Determine symmetries of the following shapes. Write their composition tables.

    (a) Equilateral triangle.

    (b) Square.

(a).

Then

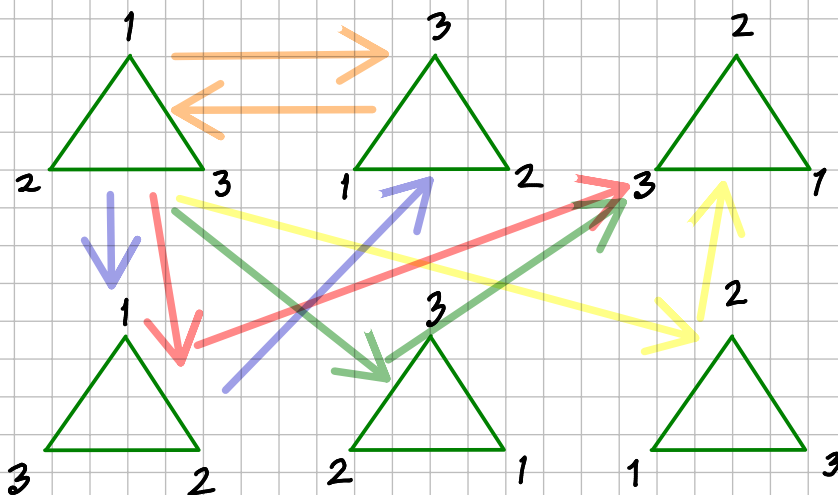| First / Then	1	$r_{2\pi/3}$	$r_{4\pi/3}$	f_1	f_2	f_3
1	1	$r_{2\pi/3}$	$r_{4\pi/3}$	f_1	f_2	f_3
$r_{2\pi/3}$	$r_{2\pi/3}$	$r_{4\pi/3}$	1	f_3	f_1	f_2
$r_{4\pi/3}$	$r_{4\pi/3}$	1	$r_{2\pi/3}$	f_2	f_3	f_1
f_1	f_1	f_2	f_3	1	$r_{2\pi/3}$	$r_{2\pi/3}$
f_2	f_2	f_3	f_1	$r_{4\pi/3}$	1	$r_{2\pi/3}$
f_3	f_3	f_1	f_2	$r_{2\pi/3}$	$r_{4\pi/3}$	1

First

2. Using the symmetries of an equilateral triangle, obtain the following composition rules for permutations.

    (a) $(1\ 3)(1\ 2) = (1\ 2\ 3)$

    (b) $(1\ 3)(2\ 3) = (1\ 3\ 2)$
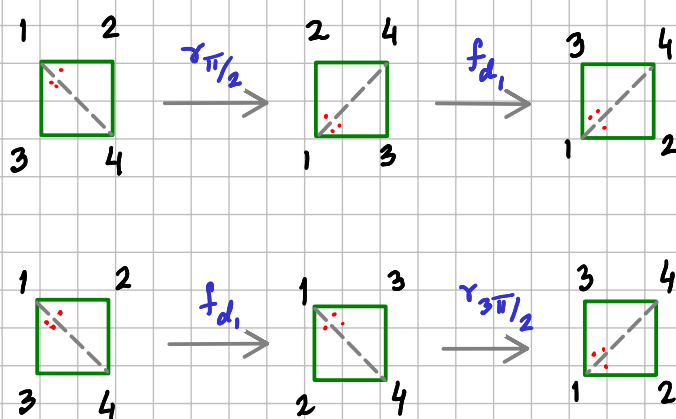
    (c) $(1\ 2)(2\ 3) = (2\ 3)(3\ 1)$

    (d) $(1\ 2\ 3)(1\ 3\ 2) =$ original configuration.

1(b)   Square $\square$

- Symmetries are $\{1, r_{\pi/2}, r_{\pi}, r_{3\pi/2}, f_x, f_y, f_{d_1}, f_{d_2}\}$

- An instance of composition of symmetries of a square.
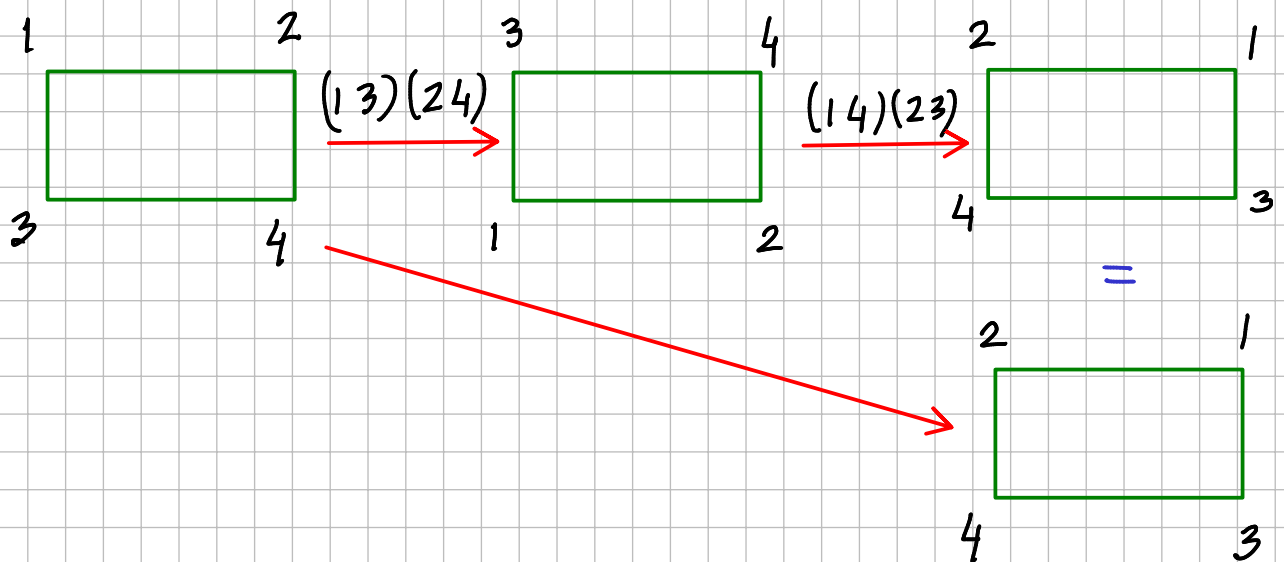

Both result into f_x.

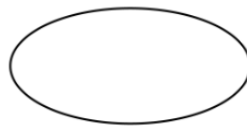In terms of permutations

$$(2\ 3)(1\ 2\ 4\ 3) = (1\ 3)(2\ 4)$$

$$(1\ 3\ 4\ 2)(2\ 3) = (1\ 3)(2\ 4)$$

3. Write the composition table of symmetries of a rectangle in permutation notation.

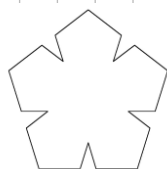|	1	(1 2)(3 4)	(1 3)(2 4)	(1 4)(2 3)
1	1	(1 2)(3 4)	(1 3)(2 4)	(1 4)(2 3)
(1 2)(3 4)	(1 2)(34)	1	(1 4)(2 3)	(1 2)(34)
(1 3)(2 4)	(1 3)(2 4)	(1 4)(2 3)	1	**(1 2)(3 4)**
(1 4)(2 3)	(1 4)(2 3)	(1 3)(2 4)	(1 2)(34)	1

(d) Ellipse. (This should be easier!)

Symmetries are same as that of a rectangle.

1(c)

Thinking is encouraged. This would appear as a graded assignment!