



## Grade 9/10 Math Circles

### An Introduction to Group Theory Part 2 - Problem Set

1. Compute the following compositions:

(a)  $\begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix} \circ \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$

(b)  $\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{pmatrix} \begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 3 & 2 & 1 \end{pmatrix}$

(c)  $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 5 & 2 & 1 & 6 & 4 \end{pmatrix} \circ \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 1 & 4 & 3 & 6 & 4 \end{pmatrix}$

2. Compute the inverses of the following permutations:

(a)  $\begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$

(b)  $\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{pmatrix}$

(c)  $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 5 & 2 & 1 & 6 & 4 \end{pmatrix}$

3. Let  $P_n$  be a regular polygon with  $n$  sides where  $n \geq 4$ . Convince yourself that the symmetry group of  $P_n$  is not the same as the symmetric group on  $\{1, \dots, n\}$ .

*Hint: how many elements are in  $\text{Sym}(P_n)$  and  $S_n$ ?*