12

Definition: Let $K=\{1, 2, \dots, n\}$ be a finite subset of the natural numbers $\mathbb{N}$, a one-to-one, onto map from $K$ to itself is called a permutation may be written as:
$$\begin{pmatrix} 1 & 2 & \cdots & n \\ a_1 & a_2 & \cdots & a_n \end{pmatrix}$$

Def: Let $S_n$ be the set of all permutations on $K$ then $(S_n, \circ)$ form a group called the symmetric group of degree $n$, where $\circ$ is the usual composition of maps.

Theorem: $|S_n| = n!$

Theorem: $S_n$ is generated by the elements
$$(12), (13), \dots, (1n)$$

Any permutation can be written as a product of finite number of transpositions "cycles of length 2".

Example: the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 1 & 5 & 2 & 4 & 3 \end{pmatrix}$ in $S_5$ written as $(253) = (45)(35)(25)(34)$

also it can be written as $(253) = (25)(23)$