Further to the example*

$$(123)(231) = (132) \ \mathit{order}\ 3$$

$(123456) * (123) = (231456)$ and $(123456) * (231) = (231456)$! It looks like $(123) = (231)$. Yes, they are cycles and therefore $(123) = (231) = (312)$.

Order! $(123456) * (123) = (231456)$ and $(231456) * (123) = (312456)$; now the third application of the permutation (123) gives $(312456) * (123) = (123456)$, back to the initial, standard, permutation. Three applications of (123) return to the initial state. The *order* of (123) is 3.

$$\begin{pmatrix} 123456 \\ 231456 \end{pmatrix}, \begin{pmatrix} 231456 \\ 312456 \end{pmatrix}, \begin{pmatrix} 312456 \\ 123456 \end{pmatrix}.$$

Going backwards! (123) the other way around is (321). A canonical cycle would have the smallest element first, and (321) written in its cononical form is (132).

Parity! The permutation 3-cycle (123) can also be written as a two 2-cycle permutation $(12)(13)$, which shows that the *parity* of (123) is *even*.

$$(123456) * (123) = (231456);$$

$$(123456) * (12) = (213456),$$

$$(213456) * (13) = (231456).$$

* http://web.mit.edu/sp.268/www/rubik.pdf