[1] How many different necklaces can be made from 12 red or blue beads, if we consider rotations to be the same necklace?
[2] How many ways can 4 checkers be placed on a 4 by 4 checkerboard, if two arrangements are considered the same if they differ by a symmetry of the dihedral group $D_4$?
1. Find two groups of order 8 which have the cyclic group $C_4$ of order 4 as a normal subgroup.
2. Find two groups of order 18 which have the symmetric group $S_3$ of order 6 as a normal subgroup.
Let $A_4$ be the alternating group of order 12, of all even permutations of $\{1, 2, 3, 4\}$. Find a nontrivial normal subgroup $N$ of $A_4$. For your choice of $N$, what is the quotient group $A_4/N$?
Let $A_4$ be the alternating group of order 12, of all even permutations of $\{1, 2, 3, 4\}$. Let $H$ be the cyclic subgroup of order 3 generated by the permutation $(1\ 2\ 3)$.

1. Is $H$ a normal subgroup of $A_4$? Why or why not?

2. Let $X$ be the set of all 3-element subsets of $A_4$. Let $A_4$ act on $X$ by conjugation. $H$ is an element of $X$; what is the size of its orbit?

3. How many orbits are there, for this action of $A_4$ on $X$?