1.) Prove the Jacobi identity for operators
\[
[[X_1, X_2], X_3] + [[X_2, X_3], X_1] + [[X_3, X_1], X_2] = 0
\]

2.) Compute the irreducible representations of $Z_4$.

3.) Compute the characters of $Z_4$ and show that they are orthogonal.

4.) Find the conjugacy classes of $S_4$.

5.) Show that
\[
e^x = \lim_{n \to \infty} (1 + x/n)^n
\]

6.) Find a non-trivial subgroup of $S_4$. Compute the left and right cosets of the subgroup. Determine if your chosen subgroup is normal or not.