Dr. Neil Manibo

Fakultät für Mathematik,
Universität Bielefeld

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Symmetries in Physics

Seatwork 3

(1) Terms of the day: conjugacy class, class equation

(2) Consider the symmetric group $G_1 = S_4$ on four elements, and the following subgroups

- $G_2 = \{(1), (13)\} \simeq S_2$
- $G_3 = \{\sigma \in S_4 : \sigma(4) = 4\} \simeq S_3$
- $G_4 = \{\sigma \in S_4 : \sigma \text{ is an even permutation}\} = A_4$.

Here, a permutation σ is called even if it can be expressed as a product of an even number of two cycles. A_n is called the **alternating group** on n elements.

(a) Which among them are normal subgroups of S_4?

(b) Consider G_3. How many cosets $g \cdot G_3$ are there? Give at least one non-trivial coset of G_3 in S_4. Is S_4/G_3 a group?

(c) Is G_4 Abelian? How many elements does G_4 have? Determine the coset $(12) \cdot G_4$.

*If you need extra paper, please ask the tutor.