

## Structure of finite groups with restrictions on the set of conjugacy classes sizes

Ilya Gorshkov

**Abstract.** Let  $N(G)$  be the set of conjugacy classes sizes of  $G$ . We prove that if  $N(G) = \Omega \times \{1, n\}$  for specific set  $\Omega$  of integers, then  $G \simeq A \times B$  where  $N(A) = \Omega$ ,  $N(B) = \{1, n\}$ , and  $n$  is a power of prime.

### Introduction

Let  $A, B$  be finite groups and  $G := A \times B$ . It is easy to check that  $N(G) = N(A) \times N(B)$ . We are interested in the converse of this assertion.

**Question 0.1.** *Let  $G$  be a group such that  $N(G) = \Omega \times \Delta$ . Which  $\Delta$  and  $\Omega$  guarantee that  $G \simeq A \times B$ , where  $A$  and  $B$  are subgroups such that  $N(A) = \Omega$  and  $N(B) = \Delta$ ?*

A. Camina proved in [4] that, if  $N(G) = \{1, p^m\} \times \{1, q^n\}$ , where  $p$  and  $q$  are distinct primes, then  $G$  is nilpotent. In particular,  $G = P \times Q$  for a Sylow  $p$ -subgroup  $P$  and a Sylow  $q$ -subgroup  $Q$ . Later A. Beltran and M. J. Felipe (see [1] and [2]) proved a more general result asserting that, if  $N(G) = \{1, m\} \times \{1, n\}$ , where  $m$  and  $n$  are positive coprime integers, then  $G$  is nilpotent,  $n = p^k$  and  $m = q^l$  for some distinct primes  $p$  and  $q$ .

In [13], C. Shao and Q. Jiang showed that if  $N(G) = \{1, m_1, m_2\} \times \{1, m_3\}$ , where  $m_1, m_2, m_3$  are positive integers such that  $m_1$  and  $m_2$  do not divide each other and  $m_1 m_2$  is coprime to  $m_3$ , then  $G \simeq A \times B$ , where  $A$  and  $B$  are such that  $N(A) = \{1, m_1, m_2\}$  and  $N(B) = \{1, m_3\}$ . In all these cases, the sets of prime divisors of the orders of  $A$  and  $B$  do not intersect. It was proved in [11] that if  $N(G) = N(\text{Alt}_5) \times N(\text{Alt}_5)$  and  $Z(G) = 1$  then  $G \simeq \text{Alt}_5 \times \text{Alt}_5$ .

In [7] a directed graph was introduced on the set  $N(G) \setminus \{1\}$ . Given  $\Theta \subseteq \mathbb{N}$ , with  $|\Theta| < \infty$ , define the directed graph  $\Gamma(\Theta)$ , with the vertex set  $\Theta$  and edges  $\overrightarrow{ab}$  whenever  $a$  divides  $b$ . Set  $\Gamma(G) = \Gamma(N(G) \setminus \{1\})$ .

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*Affiliation:*

Sobolev Institute of Mathematics,

*E-mail:* [ilygor8@gmail.com](mailto:ilygor8@gmail.com)

# Apps Of Finite Groups

**James Lepowsky, John McKay, Michael  
P. Tuite**

## **Apps Of Finite Groups:**

Representing Finite Groups Ambar N. Sengupta, 2011-12-08 This graduate textbook presents the basics of representation theory for finite groups from the point of view of semisimple algebras and modules over them The presentation interweaves insights from specific examples with development of general and powerful tools based on the notion of semisimplicity The elegant ideas of commutant duality are introduced along with an introduction to representations of unitary groups The text progresses systematically and the presentation is friendly and inviting Central concepts are revisited and explored from multiple viewpoints Exercises at the end of the chapter help reinforce the material Representing Finite Groups A Semisimple Introduction would serve as a textbook for graduate and some advanced undergraduate courses in mathematics Prerequisites include acquaintance with elementary group theory and some familiarity with rings and modules A final chapter presents a self contained account of notions and results in algebra that are used Researchers in mathematics and mathematical physics will also find this book useful A separate solutions manual is available for instructors *Groups--St. Andrews 1981* C. M. Campbell, E. F. Robertson, 1982 This book contains selected papers from the international conference Groups St Andrews 1981 which was held at the University of St Andrews in July August 1981 Its contents reflect the main topics of the conference combinatorial group theory infinite groups general groups finite or infinite computational group theory Four courses each providing a five lecture survey given by J Neubuser Aachen D J S Robinson Illinois S J Tobin Galway and J Wiengold Cardiff have been expanded into articles forming the first part of the book The second part consists of surveys and research articles written by other conference participants More than two thirds of the book is composed of survey articles providing a remarkably clear and up to date picture of those areas of group theory The articles which comprise this book together with their extensive bibliographies will prove an invaluable tool to researchers in group theory and in addition their detailed expositions make them very suitable for relevant postgraduate courses publisher description **Representations of Finite Groups of Lie Type** François Digne, Jean Michel, 2020-03-05 An up to date and self contained introduction based on a graduate course taught at the University of Paris *Profinite Groups, Arithmetic, and Geometry* Stephen S. Shatz, 1972-03-21 This volume reproduces in the first five chapters the content of a one semester course given at the University of Pennsylvania in the spring of 1968 The final chapter was material that was not presented during the course due to lack of time The aim of the course was to acquaint students with a body of material upon which some of the modern research in Diophantine geometry and higher arithmetic is based and in a way which emphasized the many interesting roads out of these elementary foundations Applications of Finite Groups J. S. Lomont, 2014-05-12 Applications of Finite Groups focuses on the applications of finite groups to problems of physics including representation theory crystals wave equations and nuclear and molecular structures The book first elaborates on matrices groups and representations Topics include abstract properties applications matrix groups key theorem of representation theory properties of character tables simply

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*Asian Mathematical Conference, 1990 - Proceedings Of The Conference*  
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problems about quadratic forms On the basis of their work Minkowski Siegel Hasse Eichler and many others created the impressive arithmetic theory of quadratic forms which has been the object of the well known books by Bachmann 1898 1923 Eichler 1952 and O Meara 1963 Parallel to this development the ideas of abstract algebra and abstract linear algebra introduced by Dedekind Frobenius E Noether and Artin led to today's structural mathematics with its emphasis on classification problems and general structure theorems On the basis of both the number theory of quadratic forms and the ideas of modern algebra Witt opened in 1937 a new chapter in the theory of quadratic forms His most fruitful idea was to consider not single individual quadratic forms but rather the entity of all forms over a fixed ground field and to construct from this an algebraic object This object the Witt ring then became the principal object of the entire theory Thirty years later Pfister demonstrated the significance of this approach by his celebrated structure theorems

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