



# MATH337

## Algebra IIIA

S1 Day 2017

*Dept of Mathematics*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Unit Convenor

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By appointment

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most days

Credit points

3

Prerequisites

(39cp at 100 level or above) including MATH235

Corequisites

MATH300 or MATH331 or MATH335

Co-badged status

Unit description

This unit develops the basic ideas of modern abstract algebra by concentrating on the many facets of group theory. As well as the standard material leading to the isomorphism theorems, we cover combinational aspects such as presentations of groups, the Todd-Coxeter algorithm, and subgroups of free groups via groupoids. Also studied are permutation groups, finitely generated abelian groups, soluble groups and group representations. The unit is especially suitable for students majoring in the theoretical aspects of physics or computing science.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

On successful completion of this unit, you will be able to:

demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.

demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.

present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience

engage in mathematical work in a manner consistent with professional and ethical standards.

## General Assessment Information

**HURDLES:** This unit has no hurdle requirements. This means that there are no second chance examinations and assessments if you happen to fail at your first attempt. Students should aim to get at least 60% for the course work in order to be reasonably confident of passing the unit.

**IMPORTANT:** If you apply for Disruption to Study for your final examination, you must make yourself available for the week of 24–28 July 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignments</u>	24%	No	see iLearn
<u>Projects</u>	16%	No	see iLearn
<u>Final examination</u>	60%	No	University examination period

## Assignments

Due: **see iLearn**

Weighting: **24%**

3 regular homework assignments

On successful completion you will be able to:

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.

- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience
- engage in mathematical work in a manner consistent with professional and ethical standards.

## Projects

Due: **see iLearn**

Weighting: **16%**

Two substantial pieces of individual work, requiring the integration of a broad range of mathematical ideas developed in this and preceding units.

A key component of this task is the demonstration of the skills developed to communicate mathematical ideas in a manner appropriate to the intended audience.

On successful completion you will be able to:

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience
- engage in mathematical work in a manner consistent with professional and ethical standards.

## Final examination

Due: **University examination period**

Weighting: **60%**

Examination

On successful completion you will be able to:

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience

## Delivery and Resources

### Text:

CDHC Cooper: Groups, presentations and representations

Available at <http://maths.science.mq.edu.au/ccoooper/Groups/>

## Unit Schedule

27/02/2017	<a href="#">Introduction</a>	<a href="#">Permutations</a>	
06/03/2017	<a href="#">Examples</a>		
13/03/2017	<a href="#">Theory, 1</a>	<a href="#">The Todd-Coxeter algorithm</a>	
20/03/2017	<a href="#">Theory, 2</a>		
27/03/2017		<a href="#">Groups acting on sets: Sylow subgroups</a>	
03/04/2017	<a href="#">Representations</a>		
10/04/2017	<a href="#">Representations, continued</a>	<a href="#">Free groups</a>	P1
01/05/2017			
08/05/2017			
15/05/2017		<a href="#">Finitely generated abelian groups</a>	
22/05/2017	<a href="#">Solvable groups</a>		
29/05/2017		<a href="#">Infinite abelian groups</a>	P2
05/06/2017	<b>Revision</b>		

## Learning and Teaching Activities

### Hands-on “symmetrical solids”

This task should be completed prior to attendance at the first Monday lecture, so that you will have a set of (at least) 5 Platonic solids that you can bring to lectures, for “hands-on” reference as aspects of their symmetry are discussed. The task is to build for yourself at least one set of Platonic solids; e.g. using cardboard templates, glued appropriately, or any other suitable medium. It is suggested that you make at least 2 complete sets, as it will be desirable to add

markings to some of these objects. It may be desired to keep one set completely clean. Templates for the Platonic solids can be easily found with a Google search; e.g., • [https://www.mathsisfun.com/platonic\\_solids.html](https://www.mathsisfun.com/platonic_solids.html) • <http://www.korthalsaltes.com/cuadros.php?type=p> • <https://isotropic.org/polyhedra/> ... and many more sites. Read the website taking note of interesting facts. Download and print out each template onto thin stiff cardboard. Cut out the shape (with tabs), then bend and staple or glue it together (using the tabs) to create a well-formed symmetrical solid.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html)

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy (in effect until Dec 4th, 2017): [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html)

Special Consideration Policy (in effect from Dec 4th, 2017): <https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration>

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: [https://students.mq.edu.au/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)

- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

## Student Enquiries

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

## Graduate Capabilities

### Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcomes

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience

### Assessment task

- Projects

### Learning and teaching activity

- This task should be completed prior to attendance at the first Monday lecture, so that you

will have a set of (at least) 5 Platonic solids that you can bring to lectures, for “hands-on” reference as aspects of their symmetry are discussed. The task is to build for yourself at least one set of Platonic solids; e.g. using cardboard templates, glued appropriately, or any other suitable medium. It is suggested that you make at least 2 complete sets, as it will be desirable to add markings to some of these objects. It may be desired to keep one set completely clean. Templates for the Platonic solids can be easily found with a Google search; e.g., • [https://www.mathsisfun.com/platonic\\_solids.html](https://www.mathsisfun.com/platonic_solids.html) • <http://www.korthalsaltes.com/cuadros.php?type=p> • <https://isotropic.org/polyhedra/> ... and many more sites. Read the website taking note of interesting facts. Download and print out each template onto thin stiff cardboard. Cut out the shape (with tabs), then bend and staple or glue it together (using the tabs) to create a well-formed symmetrical solid.

## Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

### Learning outcomes

- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience
- engage in mathematical work in a manner consistent with professional and ethical standards.

### Assessment tasks

- Assignments
- Projects

### Learning and teaching activities

- This task should be completed prior to attendance at the first Monday lecture, so that you will have a set of (at least) 5 Platonic solids that you can bring to lectures, for “hands-on” reference as aspects of their symmetry are discussed. The task is to build for yourself at least one set of Platonic solids; e.g. using cardboard templates, glued appropriately, or



any other suitable medium. It is suggested that you make at least 2 complete sets, as it will be desirable to add markings to some of these objects. It may be desired to keep one set completely clean. Templates for the Platonic solids can be easily found with a Google search; e.g., • [https://www.mathsisfun.com/platonic\\_solids.html](https://www.mathsisfun.com/platonic_solids.html) • <http://www.korthalsaltes.com/cuadros.php?type=p> • <https://isotropic.org/polyhedra/> ... and many more sites. Read the website taking note of interesting facts. Download and print out each template onto thin stiff cardboard. Cut out the shape (with tabs), then bend and staple or glue it together (using the tabs) to create a well-formed symmetrical solid.

## Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

### Learning outcome

- engage in mathematical work in a manner consistent with professional and ethical standards.

## Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

### Learning outcomes

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience

### Assessment tasks

- Assignments

- Projects
- Final examination

## Learning and teaching activities

- This task should be completed prior to attendance at the first Monday lecture, so that you will have a set of (at least) 5 Platonic solids that you can bring to lectures, for “hands-on” reference as aspects of their symmetry are discussed. The task is to build for yourself at least one set of Platonic solids; e.g. using cardboard templates, glued appropriately, or any other suitable medium. It is suggested that you make at least 2 complete sets, as it will be desirable to add markings to some of these objects. It may be desired to keep one set completely clean. Templates for the Platonic solids can be easily found with a Google search; e.g., • [https://www.mathsisfun.com/platonic\\_solids.html](https://www.mathsisfun.com/platonic_solids.html) • <http://www.korthalsaltes.com/cuadros.php?type=p> • <https://isotropic.org/polyhedra/> ... and many more sites. Read the website taking note of interesting facts. Download and print out each template onto thin stiff cardboard. Cut out the shape (with tabs), then bend and staple or glue it together (using the tabs) to create a well-formed symmetrical solid.

## Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## Learning outcomes

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.

## Assessment tasks

- Assignments
- Projects
- Final examination

## Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

### Learning outcomes

- demonstrate a well developed knowledge of algebraic principles, concepts and techniques. Integrate and synthesise knowledge from multiple and diverse mathematical areas to develop a sophisticated understanding of group theory.
- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.

### Assessment tasks

- Assignments
- Projects
- Final examination

## Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

### Learning outcomes

- demonstrate a capacity to apply knowledge to an unstructured, authentic problem in group theory; with evidence of sustained logical, clearly presented and justified mathematical arguments.
- present mathematical ideas, arguments and findings in a professional manner appropriate to the intended audience

### Assessment tasks

- Assignments
- Projects

- Final examination

## Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

### Learning outcome

- engage in mathematical work in a manner consistent with professional and ethical standards.

### Assessment task

- Projects

## Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

### Learning outcome

- engage in mathematical work in a manner consistent with professional and ethical standards.

## Changes from Previous Offering

Added the initial hands-on task, of constructing a set of Platonic solid models.