University of Oxford: Department of Mathematics

GUIDANCE NOTES: PART B EXTENDED ESSAYS AND PART C DISSERTATIONS IN MATHEMATICS

Version 2017/18

Contents

1 Introduction and Key Points 3

2 Why choose to offer a project? 4

3 The amount of work involved 4

4 The formalities 5

4.1 Proposing your own topic . . . . . . . . . . . . . . . . . . . 5

4.1.1 The project proposal . . . . . . . . . . . . . . . . . . . 6

4.1.2 Choice of subject . . . . . . . . . . . . . . . . . . . . . 8

4.1.3 Supervisors . . . . . . . . . . . . . . . . . . . . . . . . . 9

4.2 Choosing a pre-approved topic (Part C only) . . . . . . . . 9

5 Written presentation of the project 9

6 Oral presentations 10

7 Regulations and marking 10

7.1 General Information on Assessment and Marking . . . . . . 12

7.2 Class Descriptors . . . . . . . . . . . . . . . . . . . . . . . 13

7.3 Prizes . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15
7.4 Late Submission of or Failure to Submit Coursework . . . . . 15

8 Plagiarism ........................................... 16
1 Introduction and Key Points

The Projects Committee for the Final Honour School of Mathematics offers the following notes as guidance to tutors and undergraduates. It should be observed in particular that these notes relate to Mathematics only. In the case of those doing one of the joint schools the notes may provide helpful advice, but they are not intended to be definitive.

A project may take the form of:

- an H-level 7500-word double unit Extended Essay in Mathematics (option BEE) in Part B;
- an H-level 7500-word double unit Extended Essay in a topic closely related to Mathematics (‘other mathematical’ option BOE);
- an M-level 10,000-word double unit Dissertation in Part C of the four-year course (option CCD);
- an M-level 10,000-word double unit Dissertation in a topic closely related to Mathematics (‘other mathematical’ option COD):

While ‘other mathematical’ options might, for example, treat relationships between mathematics and music, or topics in the history of mathematics, mathematical extended essays and dissertations must have substantial mathematical content. Students in their third or fourth year may offer one but not both of the mathematical and other mathematical options. Students may offer both an extended essay option in their third year and a dissertation option in their fourth year, if they so wish.

Note these Key Points:

- an extended essay or dissertation will not be accepted for examination unless the project has been approved in advance by the Projects Committee of the Department of Mathematics. For Part C dissertations, a booklet of pre-approved topics will be published in the preceding Trinity term;
- students wishing to offer a Part B extended essays and Part C students wishing to propose their own dissertation topic should submit an application for prior approval of a project no later than noon on Friday of Week 0 of Michaelmas Full Term (but may be submitted at any time from the beginning of the preceding Trinity Term);
  - applications must contain the title and a brief but clear description of the project;
  - the description of the project should be such as to convince the Projects Committee that it is appropriate to be offered as an H-level extended essay, or an M-level dissertation, respectively. In
particular those offering M-level ‘other mathematical’ dissertations should note that the level of sophistication expected will be appropriately higher than that required for H-level ‘other mathematical’ essays.

- Part C students wishing to offer one of the pre-approved dissertation topics should first obtain the agreement of the supervisor associated with that dissertation and then notify the Project Committee by noon on Friday of Week 0 of Michaelmas Full Term.

2 Why choose to offer a project?

There are two reasons why project options are offered by the Department. The first is educational. Most mathematics graduates have to write reports of one kind or another. The necessary skills—of collecting material, organising it, expounding it clearly and persuasively—are better learned sooner than later. The second is also educational. The Department recognises that some students might prefer to show their mathematical understanding better and progress via a sustained piece of exposition rather than in a time examination.

3 The amount of work involved

A project is of double unit weight, and should therefore be equivalent to two sixteen-hour lecture courses. Accordingly you might think of the project as being the equivalent of half a term’s work. If some preparation has been done in the Summer Vacation, it should occupy approximately a quarter of your working time during Michaelmas Term, the Christmas Vacation and Hilary Term.

You will receive 6 hours of tutorials from your supervisor as you work on your project. You and your supervisor can agree how best to arrange the six hours. Your supervisor will also read and comment on a draft of your project.

There is always a risk that a project might not succeed, especially if the original plan had involved some original research. Although this is a rare occurrence, examiners are aware of the possibility. They accept that a well-written account of the work done, with an explanation of why the original aims were not met, can nevertheless be worthy of high credit.
4 The formalities

4.1 Proposing your own topic

If you have ideas about a project you would like to do, you should first seek guidance on content and possible supervisors from your tutors. Members of the Projects Committee will also be happy to help focus a project and find a supervisor. The present committee is:

- Dr Richard Earl, Director of Undergraduate Studies (Chairman)
- Dr Cath Wilkins, BSP Course Organiser
- Prof. Fernando Alday
- Dr David Allwright
- Prof. Victor Flynn
- Prof. Ian Hewitt
- Prof. Kevin McGerty
- Prof. Alex Scott
- Prof. Dominic Vella

You should make initial contact with your proposed supervisor by **15th September**; do not wait until the beginning of Michaelmas Term. You should be aware that your tutors and potential supervisors may be hard to contact during the long vacation, and so you are advised to sort out a supervisor at the end of the preceding Trinity Term.

Once you have found a supervisor, you should prepare an abstract for your project (your supervisor will assist you with this). The abstract together with the project application form need to be submitted to the Projects Committee via Deputy Academic Administrator, Mathematical Institute. Your application must be received before 12 noon on Friday of Week 0 of Michaelmas Full Term. The application form is available on the Projects page:

http://www.maths.ox.ac.uk/members/students/undergraduate-courses/teaching-and-learning/projects/essays-and-dissertations

The Committee gives its approval if it estimates that the project is appropriate and viable and that suitable assessors are available. If the committee judges that the project is not on an appropriate subject it will reject the proposal. Similarly, if the proposal does not provide enough information for an assessment to be made it will also be rejected.

The committee will decide during the first week of Michaelmas Term which proposals are acceptable. Where a proposal is deemed unacceptable,
the student will be allowed to submit a version revised along the lines sug-
gested by the committee. If the revised version is unsuccessful, no further
resubmission will be allowed. The decisions of the committee will be com-
mu nicated by email.

This timetable gives the latest dates for applications. However the com-
mittee is very happy to receive submissions from Trinity Term onwards, and
will endeavour to process them as soon as it can. In particular, if you plan
to work on your project over the long vacation, you should seek approval for
your project before beginning work.

If, after your project has been approved, you wish to make minor changes
to the title or description of your project, then you may apply to the Chair-
man of the Projects Committee for the appropriate permission.

4.1.1 The project proposal

The proposal should be at least 150 words, and at most one A4 side. It
must be typed, and should be sufficiently detailed for the members of the
committee to judge whether the project is of appropriate depth and content
and whether it will be possible to find a suitable assessor in the University.
You should include details of the main references—books, papers, etc—with
full bibliographic details.

A common turn of phrase at the annual meeting where Projects Com-
mittee considers the proposals is “original contribution to the literature”.
Few projects will produce original research, but there should be a flavour,
topics, mindset or aim to the project that makes it distinct from anything in
the literature. It should not be possible for a committee member to reference
one or two chapters of a text or an article that essentially cover the same
material as a proposal and in much the same style. However it would be
reasonable to take material that only exists in sources, written in a technical
and abstract style for professional mathematicians, and explain this mate-
rial at a more undergraduate level, possibly illuminating the discussion by
focusing on one or two examples. It would precisely be this exposition, and
collation of the material from several sources, that made the piece original.

To ensure that you have included all the information required
by the examiners and the committee the appropriate sections of
the form should be checked and signed. Here is an example proposal,
with some comments:-

Approximation of Irrational numbers by Rationals
BEE Extended Essay
C.F. Gauss (Worcester)
If \( \alpha \) is a real irrational number then one can prove that there are infinitely many rational numbers \( a/q \) such that
\[
\left| \alpha - \frac{a}{q} \right| \leq \frac{3}{q^2}.
\]
A number of questions naturally arise. Can one replace the constant 3 by anything smaller? Can one replace \( q^2 \) by \( q^3 \)? What happens for specific irrationals like \( \sqrt{2} \) or \( \pi \)?

The essay will discuss such issues. It will give an exposition of the theorems of Liouville, Thue, and Apéry, and describe applications to transcendence problems and Diophantine equations. If time permits a complete proof of the finiteness of integer solutions of the Mordell equation \( y^3 = x^2 + k \) will be given. The latter will use results form the section B ‘Algebraic Number Theory course’.

References


Comments: This is neatly typed, in Latex in fact. However the proposal is rather short, at around 100 words rather than the expected 150. The first paragraph introduces the problem to be discussed, and the second paragraph says more of what the essay would include. There isn’t much sense of why the problem is historically interesting or what the answers are to these further questions. The final sentence tries to set out the relationship to courses on the syllabus and this is useful. It would also have been useful to cite the references during the proposal.

Further details of the specific results of Liouville, Thue and Apéry would be helpful (again with references). Reference to specific theorems of Liouville etc. would allow the committee to pinpoint the level of difficulty for the project.

The three references are not presented in quite the correct style – the essay itself will have to do better! However they do contain the key information. In particular it is good to see that the latest edition of Hardy & Wright will be used, since the previous edition is rather out of date now. Two of the sources cited are text books, but one is a (rather easy) research article.
The proposal however is weak in making clear its individuality. What is being discussed that isn’t found in standard text books? It would be helpful to make clear the purpose of the cited research article. Some specific investigation relating to a specific irrational (as mentioned in the second paragraph) or some bringing up to date of where current knowledge stands, a review of recent papers or similar, would help extend the scope of the essay outside the canonical material of a standard text.

So the proposal is most of the way there to being adequate and agreeable, but most likely Projects Committee would in the first instance refer the proposal back asking for some of the above points to be addressed, seeking more detail, and seeking a clear sense of the individual aims of the project. This would not involve much delay (a few days) and would be intended as constructive criticism, on the basis of which the student can start the project with clearer aims in mind.

4.1.2 Choice of subject

Any mathematical subject (or—in the case of options BOE, COD—any subject related to mathematics) is appropriate as long as it gives the student an opportunity to present his or her own work. It is understood that only in exceptional cases will this include original mathematical research. Often it will be a matter of organising, presenting, or completing material culled (and understood) from advanced textbooks, monographs or journals. There have in the past been projects on philosophy of mathematics, on history of mathematics, on algebra, on number theory, on geometry, on topology, on analysis, on numerical analysis, on mechanics, on mathematical biology, on finance, on theoretical physics, on mathematics and music, and on other subjects in, or closely related to, mathematics.

The choice of topic is very wide. However, students should note that certain projects, such as those on historical matters, will only be acceptable under the other mathematical options BOE and COD. For the approved mathematical options BEE and CCD students should take particular care to remember that the project must be a mathematical one and will be judged accordingly. The Projects Committee will give advice as to whether a proposed topic is suitable to be considered for a particular option.

It may happen that a student does an extended essay one year, and wishes to develop the theme further the following year as a dissertation. This is permissible, and the extended essay should be referenced in the dissertation in exactly the same way as any other source. Due care is needed here, see the discussion of ‘Autoplagiarism’ in the University’s guidance on plagiarism at [http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism](http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism).

Similarly a student may wish to base their project on work done during
a summer-studentship. Again this is permissible, providing that the rules of the studentship’s funding body are followed.

In deciding when to approve project proposals the committee will consider how closely the work will relate to existing courses available to the student in the Oxford Mathematics syllabus. Following the principle that a student may not gain credit twice for the same material, projects which relate too closely to courses the student has already taken, or is eligible to take in the future, will not be allowed. For this reason you must declare, on your project application, which courses you have previously taken.

4.1.3 Supervisors

Members of the Committee are willing to try to help you find a supervisor. Any member of the mathematical faculty may act as supervisor. If it is proposed that any other person should supervise, then prior approval should be obtained from the chairman of the Projects Committee (currently Dr Earl).

4.2 Choosing a pre-approved topic (Part C only)

The Projects Committee will publish a list of pre-approved Part C dissertation topics during the Trinity term preceding your final year. If you would like to undertake one of these dissertations you should make contact with the named supervisor, to give you and the supervisor an opportunity to think further about what the project might involve, and whether you are the right student to do it. You are advised to do this before the end of Trinity term as most projects will have a limit on the number of students who can do it.

Once you have chosen a topic and obtained the agreement of the supervisor, you should notify the Projects Committee that you are intending to offer a dissertation by completing the form available at https://www.maths.ox.ac.uk/members/students/undergraduate-courses/teaching-and-learning/projects/essays-and-dissertations.

5 Written presentation of the project

The examiners give credit for qualities such as content, accuracy, organisation, clarity and style. An extended essay or dissertation should be self-contained except insofar as it cites material from Prelims, Part A, Part B, and standard works or journals. Proper credit must be given to sources.

Projects must be word-processed. For BEE and CCD they must be prepared using \LaTeX, or some other dialect of \TeX. For BOE and COD other
appropriate packages may be used. **A short course on the use of \TeX\ will be offered in Michaelmas Term** (see the lecture list on Mathematical Institute website for the time). Further information is available on the Institute website.

http://www.maths.ox.ac.uk/members/it/faqs/latex

Facilities for \TeX\ processing are available with a Mathematical Institute Computer account. **Students are advised that they are entitled to apply for such an account, and that they are particularly welcome to use this facility for extended essays and dissertations.** Students who do not already have such an account should submit a computer account application form which is available online [http://www.maths.ox.ac.uk/members/it/it-facilities-access](http://www.maths.ox.ac.uk/members/it/it-facilities-access).

Students will need to self-certify the word length of their project, and must specify how the word-count was produced. Various internet applications are available for this, and can be found by a search on ‘Latex word count’.

### 6 Oral presentations

Each student offering a project is required to give an oral presentation to their supervisor and at least one other person with some knowledge of the field of the project. This presentation forms no part of the final assessment of the project. It is intended to give you an opportunity to practise your presentation skills and for your supervisor to test, through questioning, your understanding of the material included in the project. It is recommended that this presentation be delivered near the end of Hilary Term and after a first draft has been completed.

### 7 Regulations and marking

Dissertations and essays will be assigned USMs according to the same principles as Mathematics papers. In arriving at these marks, the relative weights (for BEE and CCD) given to content, mathematics, and presentation will be 25%, 50% and 25%, respectively. For the BOE and COD options on historical or similar topics the examiners will assign 75% for content and 25% for style and presentation. However, the content should have substantial connections with mathematics.

The Regulations governing essays and dissertations follow.

(1) **Subject, authorship, and format**
The subject of the essay or dissertation shall be a project either in mathematics or in the applications of mathematics in another field, which shall be supervised by a member of the Faculty of Mathematical Sciences or, in exceptional circumstances, by some other person of equivalent seniority approved by the Chairman of the Projects Committee of the Department of Mathematics.

The essay or dissertation shall be the candidate’s own work; it may, for example, be a computation based on known results or a critical review of published mathematics. The supervisor may discuss with the candidate the field of study, recommend references, and discuss what methods are appropriate; the supervisor may also read and comment on a first draft. Every candidate shall sign a certificate to the effect that the essay or dissertation is their own work, except as permitted by this regulation or where acknowledgement is made, and this certificate shall be placed in a sealed envelope bearing the candidate’s examination number and presented together with the essay or dissertation.

The presentation of the submitted essay or dissertation should conform to the following points.

- The essay or dissertation must be word-processed and have a font size of 12pt.
- The text may be single spaced and the essay or dissertation printed double-sided.
- The essay or dissertation should be spiral-bound or soft-bound.
- The essay or dissertation should have a title page which includes the following:
  - the approved title of the essay or dissertation,
  - the candidate’s examination number,
  - the title of the candidate’s degree course,
  - the term and year of submission.
- Its length should not exceed the equivalent of 7,500 words (BEE or BOE), or 10,000 words (CCD or COD). The word count may exclude any table of contents, all mathematical equations and symbols, diagrams, tables, bibliography and the texts of computer programs. However any preface, footnotes, and appendices must be included. The certificate of authorship must also include a statement as to the word length, and of the method by which the figure was reached. Project assessors may deduct marks for any failure to meet these conditions.
(2) Submission

Essays and Dissertations (two copies), identified by the candidate’s examination number only, must be sent to The Chairman of the Examiners, Honour School of Mathematics (Part B), Examination Schools, Oxford, or The Chairman of the Examiners, Honour School of Mathematics (Part C), Examination Schools, Oxford, as appropriate. They must arrive not later than noon on the Monday of the second week following the end of the Hilary Full Term preceding the examination. In addition they must submit an electronic version. The procedure for this will be announced in due course. At the same time, the supervisor shall submit to the Chairman of the Examiners a confidential report, which includes a record of meetings with the candidate, the purpose of which is to help the examiners to determine how much assistance the candidate has received in the preparation of the essay or dissertation; this report will be on a form supplied for the purpose by the Chairman of the Examiners. A candidate may withdraw notice of submission of an essay or a dissertation at any point prior to the submission deadline.

The examiners will give Extended Essays BEE and BOE, and Dissertation CCD and COD the weight of two units.

7.1 General Information on Assessment and Marking

When writing your essay or dissertation, you should be aware of how the examiners will assess it and mark it. The most important point is that for approved mathematical topics the project should be in mathematics. Do not forfeit marks by making your project inadequately mathematical. In fact, marks are awarded in the following proportions:

Mathematics 50%; Content 25%; Presentation 25%.

For other mathematical options marks are awarded in the following proportions:

Content 75%; Presentation 25%.

However it must be stressed that these will be judged bearing in mind the level, H or M, of the project.

Here is a brief explanation of these terms:

Mathematics: proofs and assertions should be correct, and the mathematics should be appropriate for the level of study. In applied topics, the derivation of the model should be properly justified.

Content: the examiners are looking for some of your own thoughts and contributions: you must do more than rehash text books and lecture notes; you should use original sources; you must not plagiarise [see §8 below].

12
**Presentation:** the mathematics must be clear and well laid out; the English should be clear and grammatically correct; sources should be properly acknowledged, references should be properly cited. Give some thought to notation, choice of typeface, and numbering of equations and sections. Do not fail to number the pages. Be sure to supply complete and accurate references for all the sources used in completing the project, and be sure to cite them properly in the text.

Excellent brief advice on mathematical writing is to be found on the London Mathematical Society website:

[http://www.lms.ac.uk/sites/lms.ac.uk/files/Publications/LMSHouseStyle.pdf](http://www.lms.ac.uk/sites/lms.ac.uk/files/Publications/LMSHouseStyle.pdf)

Although there are some small differences between American and British styles, the book *A Primer of Mathematical Writing* by Steven G. Krantz, published by the American Mathematical Society (1991) is also recommended, as is the older *How to write Mathematics* by N. E. Steenrod, P. R. Halmos, M. M. Schiffer and J. Dieudonné, American Mathematical Society (1973). Supervisors may recommend papers which illustrate good practice in writing mathematics and in citing sources.

For referencing several conventional systems are in use. Under most conventions the bibliography is listed in alphabetical order of surname of the first author. One convention labels items serially by number; another uses some form of abbreviation of authors’ names for labels; in another an item would be referred to by the author’s name and the year of publication (Gauss [1801], for example). The London Mathematical Society’s advice to its authors at

[http://www.lms.ac.uk/sites/lms.ac.uk/files/Publications/lms2eau1.pdf](http://www.lms.ac.uk/sites/lms.ac.uk/files/Publications/lms2eau1.pdf)

explains a common version of the first system.

### 7.2 Class Descriptors

Essays and dissertations will be assessed with reference to the following class descriptors.

**For BEE and CCD**

90–100 Work of potentially publishable standard, as evidenced by its clear individual narrative and insight. The work should show depth and accuracy, and should have a clear focus. It is likely to go beyond the normal level for part B (or C as appropriate). The standard one sees in winners of one of the examination prizes.

80–89 Work in this range will be at the level of a strong candidate for a DPhil applicant. The project will be an easy choice as a winner of a college essay prize. It will have depth, accuracy and a clear focus. It
will show a strong command of material at least at the level of part B or C as appropriate. It is likely to contain original material, which may take the form of new mathematical propositions, new examples, or new calculations, for example.

70–79 The work submitted is of a generally high order, with depth, clarity and accuracy, but may have minor errors in content and/or deficiencies in presentation. It may contain original material, at least in the sense of new examples or calculations.

60–69 The candidate shows a good grasp of their subject, but without the command and clarity required for first class marks. Presentation, referencing and bibliography should be good, and the mathematics should have no more than minor errors.

50–59 The work shows an adequate grasp of the subject, but is likely to be marred by having material at too low a level, by serious or frequent errors, a high proportion of indiscriminate information, or poor presentation and references.

40–49 The candidate shows reasonable understanding of parts of the basic material, but reveals an inadequate competence with others. The material may be at too low a level. There are likely to be high levels of error or irrelevance, muddled or superficial ideas, or very poor writing style.

30–39 The candidate shows some limited grasp of at least part of the material.

0–29 Little evidence of understanding of the topic. The work is likely to show major misunderstanding and confusion.

For BOE and COD

70–100 The candidate shows clear focus on the question, with precise and accurate details (mathematical and other), imaginative selection of examples and appropriate selection and quality (rather than quantity) of sources, and cogent argument, supported by evidence.

Within this band the following finer gradations may be helpful:

90–100 A polished work of high individuality, well researched and of potentially publishable quality (in a gazette of a professional society say).

80–89 Demonstrates strong individuality of content or insight. Would be an appropriate entry for a national or university prize.
70–79 Work of high or very high quality, but perhaps lacking the originality that would be expected of publishable work. Might be a good candidate, for example, for a college prize.

60–69 Work that addresses the given topic, with solid command of factual content, reasonable range of examples and sources, coherent argument and analysis, and correct referencing and bibliography.

(Essays at the lower end of this range may lack some of these qualities or show them only intermittently.)

50–59 Work with some use of facts, sources, and arguments, but marred by one or more of a failure to address the topic, serious or frequent errors of fact, a high proportion of indiscriminate information, speculation or unsupported argument, and incomplete or inaccurate referencing.

40–49 The candidate shows some knowledge of the topic but the work is marred by several of the following: high levels of error or irrelevance, muddled or superficial ideas, incoherent or non-existent argument, incompetent use of sources, or very poor writing style.

30–39 The work demonstrates a little knowledge of the topic but no coherent argument.

0–29 The work demonstrates almost no knowledge of the topic.

7.3 Prizes

The examiners will award one or two Gibbs Dissertation Prizes of £100 each for the best Part C dissertations.

7.4 Late Submission of or Failure to Submit Coursework

It is vital that you submit your work by the given deadline as any late submission will be reported to the Proctors and a late submission penalty may be applied. The late submission penalty tariff is set out in the examination conventions (http://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/examination-conventions). Please see the examination conventions and the Oxford Student website (http://www.ox.ac.uk/students/academic/exams/submission) for advice on what to do if you are unable to submit your work on time due to medical emergency or other urgent cause.
8 Plagiarism

Plagiarism is presenting someone else’s work or ideas as your own, with or without their consent, by incorporating it into your work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition. Plagiarism may be intentional or reckless, or unintentional. Under the regulations for examinations, intentional or reckless plagiarism is a disciplinary offence. Please see the University’s guidance on plagiarism [http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism](http://www.ox.ac.uk/students/academic/guidance/skills/plagiarism) for further information.