Examiners' Report: Preliminary Examination in Mathematics and Philosophy
Trinity Term 2022

November 30, 2022

Part I

A. STATISTICS

(1) Numbers and percentages in each class

See Table 1. Overall, 18 candidates were classified.

Table 1: Numbers in each class (Preliminary Examination)

	Numbers					Percentages %				
	2022	(2021)	(2019)	(2018)	(2017)	2022	(2021)	(2019)	(2018)	(2017)
Distinction	7	7	7	6	4	38.89	35	35	42.86	23.53
Pass	10	11	11	7	13	55.56	55	55	50	76.47
Partial Pass	0	2	2	1	0	0	1	10	7.14	0
Incomplete	1	0	0	0	0	5.56	0	0	0	0
Fail	0	0	0	0	0	0	0	0	0	0
Total	17	20	20	14	17	100	100	100	100	100

B. NEW EXAMINING METHODS AND PROCEDURES

The methods and procedures reverted to the examining methods used prior to the COVID-19 pandemic.

C. CHANGES IN EXAMINING METHODS AND PROCEDURES CURRENTLY UNDER DISCUSSION OR CONTEMPLATED FOR THE FUTURE

None.

D. NOTICE OF EXAMINATION CONVENTIONS FOR CANDIDATES

The Notice to Candidates, containing details of the examinations and assessments, was issued to all candidates at the beginning of Trinity term. The Examination Conventions in full were made available at

https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/examination-conventions.

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

Acknowledgements

First, the Moderators should like to thank the Undergraduate Studies Administration Team and their coordinating officer, Clare Sheppard.

We should also like to thank Charlotte Turner-Smith for her invaluable experience with the Mitigating Circumstances Panel, and Matthew Brechin and Waldemar Schlackow for maintaining and running the examination database and their assistance during the final examination board meeting.

We should like to thank the lecturers for their feedback on proposed exam questions; the assessors for their extraordinary assistance with marking; and the team of graduate checkers for their rapid work checking the marks on the papers.

Finally the Moderators are extremely grateful to Haleigh Bellamy for her fantastic work running the examinations process this year – thank you!

Timetable

The examinations began on Monday 20th June and ended on Friday 24th June.

Marking and marks processing

In Mathematics, the Moderators and Assessors marked the scripts according to the mark schemes and entered the marks. Small adjustments to some mark schemes were made at this stage, and care was take to ensure these were consistently applied to all candidates.

A team of graduate checkers, supervised by Haleigh Bellamy and Clare Sheppard, sorted all the scripts for each paper and carefully cross checked these against the mark scheme to spot any unmarked parts of questions, addition errors, or wrongly recorded marks. A number of errors were corrected, with

each change checked and signed off by a Moderator, at least one of whom was present throughout the process.

In Philosophy all scripts were single marked except for failing scripts, which were double-marked.

Determination of University Standardised Marks

Marks for each individual assessment are reported as a University Standard Mark (USM) which is an integer between 0 and 100 inclusive. For the papers that are common with Mathematics, the same scaling functions as applied for candidates in Mathematics were used.

The scripts of those candidates at the boundaries between outcome classes were scrutinised carefully to determine which attained the relevant qualitative descriptors and changes were made to move those into the correct class.

Mitigating Circumstances were then considered using the banding produced by the Mitigating Circumstances Panel, and appropriate actions were taken and recorded.

Recommendations for Next Year's Examiners and Teaching Committee

There are no recommendations specific to Mathematics & Philosophy. General recommendations are made in the report on the Preliminary Examination in Mathematics.

B. EQUAL OPPORTUNITIES ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER

The breakdown of the final classification by gender is as follows. Here gender is the gender as recorded on eVision.

Table 2: Breakdown of results by gender

Class	Number								
	2022			2021			2019		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Distinction	3	4	7	1	6	7	0	7	7
Pass	6	4	10	1	10	11	6	5	11
Partial Pass	0	0	0	2	0	2	2	0	2
Incomplete	1	0	0	0	0	0	0	0	0
Fail	0	0	0	0	0	0	0	0	0
Total	10	8	18	4	16	20	8	12	20
Class	Percentage								
	2022			2021			2019		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Distinction	30	50	38.89	25	37.5	31.25	0	58.33	35
Pass	60	50	55.56	25	62.5	43.75	75	41.67	55
Partial Pass	0	0	0	50	0	25	25	0	10
Incomplete	10	0	5.56	0	0	0	0	0	0
Fail	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100

C. STATISTICS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

Mathematics I

	Maths and Philosophy		Single School	
Question	Mean	Std Dev	Mean	Std Dev
Q1	16.18	2.86	15.77	3.03
Q2	18	2.96	16.52	3.97
Q3	14	5.86	13.37	4.56
Q4	11.64	1.69	11.31	3.49
Q5	9.69	2.56	8.97	3.40
Q6	5.33	2.42	8.46	3.94
Q7	13.47	3.27	11.54	3.45

Mathematics II

	Maths and Philosophy		Single School	
Question	Mean	Std Dev	Mean	Std Dev
Q1	16.76	2.25	16.35	3.03
Q2	12.3	3.95	11.76	3.97
Q3	12.86	2.54	13.16	4.56
Q4	15.44	3.98	15.86	3.49
Q5	12.67	6.03	13	3.40
Q6	13.93	3.26	15.17	3.94
Q7	12.63	5.06	11.14	3.45

Mathematics III(P)

	Maths and Philosophy		Single School	
Question	Mean	Std Dev	Mean	Std Dev
Q1	12.63	5.38	14.22	4.80
Q2	9.20	3.42	14.87	3.71
Q3	13.73	3.98	14.92	3.74
Q4	12.77	3.68	14.16	4.23
Q5	12.57	3.48	12.39	4.26
Q6	12.60	3.78	14.28	4.26

Elements of Deductive Logic

AvgUSM	StdDevUSM
69.06	10.42

Introduction to Philosophy

AvgUSM	StdDevUSM
66.06	3.96

D. COMMENTS ON PAPERS AND ON INDIVIDUAL QUESTIONS

See reports from Mathematics Examiners for Mathematics questions.

Report on Elements of Deductive Logic

Mean: 69.1

Standard deviation: 10.1

(Please note that figures in the report below also include candidates for Preliminary Examinations in Computer Science & Philosophy and Physics & Philosophy.)

The overall average mark for this paper was 65.0, with a standard deviation of 14.4. In order of popularity, the questions were: Q3, Q8, Q4, Q2, Q1, Q6, Q5, Q7. Broadly, this reflects how well candidates performed, with more popular questions also having higher average marks (see below for details). No scaling was applied to this examination, and no candidates failed.

Question 1 (entailment between sets)

Average: 63.3

Standard deviation: 23.1

This was a relatively straightforward question, which should have been familiar from the lectures. It was therefore surprising that it was not more popular, and that those candidates who attempted the question did not perform better. Candidates tended to lose several marks on the questions about entailment between sets. A number of sensible proposals for modifications of L2 for empty domains were made.

Question 2 (partial structure formalization, interpolation)

Average: 61.1

Standard deviation: 22.4

This question presented formalisations in L2 of certain statements about structures of L1; candidates then asked which properties these formalized relations satisfied. Few candidates were able to identify all these properties correctly, or to unpack the formalized statements in part c). That said, several correct statements of the Interpolation Theorem were given.

Question 3 (* – negated biconditional)

Average: 69.1

Standard deviation: 18.0

Candidates performed well on the first parts, but proof systems were often very incomplete. Oddly, many soundness proofs focused on the existing rules rather than new ones.

Question 4 (completeness for AND/OR language)

Average: 65.8

Standard deviation: 22.2

There are infinitely many max-consistent sets (one for each atomic). Quite a bit of confusion here, with zero being a surprisingly popular answer. In parts b) and c), quite a few answers didn't seem to realize that close attention to the relevant ND system was required, or that there is a step in reasoning between every Gamma_n being consistent and their union being consistent.

Question 5 (incompleteness proofs with alternative semantics)

Average: 57.8

Standard deviation: 18.8

Pretty variable answers. Some clearly got the idea, and did well. Others didn't seem to really understand the suggestion for proving incompleteness – often these instead asserted without proof that the omission of a certain rule made a certain entailment unprovable, when the whole point was to provide an alternative semantics to demonstrate this. Few candidates fully completed part c). Most saw that the rules would be sound if we interpreted $\Phi * \Psi$ as Φ<->Ψ; few saw that it would also be sound if we interpreted $\Phi * \Psi$ as Ψ->Φ. With that observation, it's then easy to see both why the system is incomplete and how it could be completed.

Question 6 (formalizing syntax, compactness)

Average: 63.5

Standard deviation: 20.6

This was mostly completed pretty well. The idea behind (d) was that something is a sentence if and only if it is a sentence of complexity 1 or a sentence of complexity 2 or a sentence of complexity 3. . . ; but that, by compactness, there could be no adequate formalization of this disjunction in D-.

Question 7 (disjunctive syllogism, universal instantiation, ND proofs)

Average: 55.6

Standard deviation: 20.2

Most candidates gave adequate answers to parts a) and b), noting that $\forall$ D would need to be restricted to ensure v does not occur freely in Φ. Perfor-

mance on part c) was typically less good, with many candidates struggling with the more difficult proofs and counterexamples.

Question 8 (formalizing time and causation, including argument)

Average: 72.5

Standard deviation: 13.0

Very popular; the translations were typically accurate and at least reasonably idiomatic. Formalizations of the argument in b) tended to be good. Few people managed to actually complete the proof in b), but most had picked up enough marks that this didn't hurt them too badly.

Report on Introduction to Philosophy

Mean: 65.9

Standard deviation: 3.9

Section A: General Philosophy

Please see the Examiners' Report for the Preliminary Examination in Philosophy, Politics, and Economics for detailed discussion of individual questions on Section A.

Section B: Frege and the Foundations of Arithmetic

In general, this section was answered reasonably well. Essays were typically well-structured and points were explained clearly; moreover, most candidates showed a reasonable level of familiarity with the text and the secondary literature. Most answers could, however, have been a little sharper, providing a central argument that directly addresses the question, and considering possible responses; and omitting material (whether technical or philosophical) that is not directly needed for this argument. All questions received at least two answers; below are comments on the more popular or unusual ones.

Question 10 *How compelling are Frege's arguments that number-ascriptions do not assign properties to objects?*

By far the most popular question on this section, which produced many competent and some very strong answers. Weaker answers failed to adequately distinguish the claim that number ascriptions assign properties to physical objects from other aspects of Mill's view of mathematics. Some were also a little superficial, surveying a number of different arguments in a relatively disjointed manner, instead of simply defending the one they thought strongest against possible responses. Strong answers often considered some sophisticated defences of the numbers-are-properties-of-physical-

objects view, or noted that Frege's objections seemed a lot less powerful if the objects in question could be sets or extensions.

Question 12 *Explain, with relevant mathematical details, Frege's derivation of the principle of mathematical induction. Does this derivation amount to a reduction of that principle to logic and definitions?*

Answers generally contained a reasonable amount of detail about Frege's account, although not all of it was crucial – the most important points were Frege's definition of the ancestral, of the successor operation, and hence of "number". Candidates didn't quite dedicate enough space to really address the second half of the question – a good place to start would have been to note that the derivation does not rely on any ontologically committal principles, but does require the use of second-order quantification.

Question 13 *'All the reasons to think that Hume's Principle isn't analytic would have been equally good reasons to think that Basic Law V isn't analytic either. So the inconsistency of Basic Law V is irrelevant to the correct assessment of Frege's logicism.' Is this right?*

The second most popular question. Answers varied in quality, with some only demonstrating a very superficial familiarity with core objections, like that neither principle could be analytic because both carry ontological commitments. Some stronger answers focused on more detailed objections, such as the worry that Hume's Principle entails the existence of an anti-zero, which is inconsistent with ZFC – although it would have been good to note that, by parallel reasoning, Basic Law V entails the existence of a universal set. The best answers often questioned the inference rather than the premise, noting, for example, that concerns about bad company or the desideratum that analytic truths should be ontologically non-committal are reinforced by the inconsistency of Basic Law V.

E. NAMES OF MEMBERS OF THE BOARD OF EXAMINERS

Prof. Dan Ciubotaru, Prof. James Read, Prof. Bernhard Salow, Prof. Tom Sanders (Chair)