

Summary Report of the MIT Physics Graduate Qualifying Exam Survey

MIT Physics Graduate Student Council

1 Introduction

The general exam system of the Department of Physics at MIT has often been a topic of abundant discussion among the graduate student population. In order to assess the strengths and shortcomings of the general exam system, the Physics Graduate Student Council crafted a concise survey aiming to elicit both quantitative and qualitative feedback about the exam system from graduate students. The survey itself was split into four sections: one section for each exam and an additional section regarding the exam system as a whole.

For the individual exams (Parts I-III), we asked students first if they had taken the exams and whether they had passed them on their first attempts. We then asked students to provide ranked answers (with five possible levels ranging from strongly disagree to strongly agree) to the following three questions for each exam, as well as the exam system in its entirety:

- (1) Do you feel that the exam fulfills its stated purpose?
- (2) Regardless of whether you feel the exam fulfills its stated purpose, do you feel that studying for and taking the exam was a worthwhile experience?
- (3) Do you think that there should be a change in the format, schedule, or requirements for this exam?

Finally, we provided a section for students to write comments, suggestions, and any other form of qualitative feedback that they thought might be helpful in evaluating each exam and the whole system.

The purpose of this report is to summarize for both students and faculty the results of our survey, so that both parties may be able to discuss general exams with a common reference point in the future. For each exam, we present a brief overview of the survey statistics and many of the recurrent themes that we found in the qualitative feedback sections. Additionally, the complete set of survey statistics can be found in the appendix following the report.

2 Part I

Part I attempts to measure a student's general level of understanding, physical insight, ability to get to the essence of a question, intuitive grasp of orders of magnitude and proper approximations, and knowledge of basic facts.

Total Respondents	123
Respondents who have taken Part I	122
Written comments	40

2.1 Quantitative Data

Nearly 63% of respondents reported passing this exam on the first attempt. Two thirds believed that the Part I exam met its stated goals, and a similar proportion believed that it was a worthwhile experience. Only 12% of the respondents thought that Part I did not meet its goals and 18% felt that Part I was not a worthwhile experience. Just under 40% believed that there should not be a change in the format, scheduling, or requirements of Part I, while about 28% felt that there should be.

2.2 Feedback

The most prominent feedback expressed dissatisfaction with taking a lengthy exam on the first day of orientation (9/40 responses). One respondent observed that this practice sets “a very confrontational tone.” Associated problems noted by respondents include the stress induced from studying, the demoralizing effects if one should fail, and also adverse effects on research and coursework. On the other hand, some respondents liked the fact that they could fulfill a candidacy requirement so soon after arrival.

Another recurrent theme in the comments was the redundancy of Part I and Part II (7/40). Some believed that Part I is a speed test requiring “silly time-saving tricks,” and many thought that Part I and Part II could be combined and as a result perhaps not be given on the first day.

Some students felt that after failing Part I on the first attempt, they were forced to take undergraduate classes and were treated by some faculty with a “condescending” attitude (3/40). Those who indicated this generally believed that the undergraduate classes were unnecessary and the forceful attitude of the faculty was unhelpful.

The list of comments was not without positive feedback. A few students felt that Part I was a good way of “solidifying” their knowledge of basic physics and was “a really useful way to measure how much undergrad physics one really knows” (3/40), while others appreciated being able to “start the first semester of graduate school having already fulfilled a requirement” (3/40).

3 Part II

The purpose of Part II is to certify the student’s mastery of core graduate level material at the level covered in our first year graduate subjects and in the textbooks they use.

Total Respondents	119
Respondents who have taken Part II	116
Written comments	39

3.1 Quantitative Data

About 65% of the respondents reported passing the exam on the first attempt. Nearly 75% felt that Part II fulfilled its stated purpose, by far the highest such positive response for any of the exams. Similarly, the percentage claiming that studying for Part II was worthwhile was high, also at about 75%. The number of students who felt there should be a change in the format, scheduling, or requirements for the exam was about 20%. Most notably, the students who felt very strongly that there should be such a change was exceptionally low at 4.3%, compared with 12.4% for Part I and 12.7% for Part III.

3.2 Feedback

A large number of respondents had praise for the Part II exam (9/39 responses). There was a general feeling that this exam was more useful than Part I and that the questions were less tricky, placed more emphasis on physical knowledge, and were much more helpful for direct application in research (though it should be noted that at least one student thought exactly the opposite). As in the written feedback for Part I, more than one student suggested merging Parts I and II, or just doing away with Part I altogether (4/39).

The most common criticism of Part II was that the small number of questions causes the difficulty to vary considerably from year to year and forces students “to put all [one’s] eggs in one or two baskets for each subject” (9/39). Many felt that this format allows for the frequent possibility that a student is proficient in the subject material but fails because of the misunderstanding of only one or two problems. Some students questioned both the feasibility of assessing knowledge with so few problems and the psychological burden of culminating weeks or months of studying with a random sampling of the physics curriculum.

A number of respondents also felt that the exam did not sync up well with the first year graduate curriculum (5/39). Some thought that the curriculum should be more closely tailored to the exam, or that a more specific and accurate list of subjects tested should be published online. A few suggested adding a

graduate classical mechanics course, since one of the stated purposes of Part II is to test mechanics at a graduate level.

Finally, a few students felt that it would be better not to have to retake the entire exam after failure, but only the exam sections that one failed (4/39). The one comment directly concerning the recent change in exam policy noted that having to retake and pass both questions in a failed area was a bit excessive.

4 Part III

The purpose of the oral portion of the general exam is to test students' broad general knowledge within their field.

Total Respondents	116
Respondents who have taken Part III	74
Written comments	32

4.1 Quantitative Data

Nearly 80% of respondents who had taken this exam passed it on the first attempt. A majority (63%) believed this exam met its stated goals; the fraction of respondents who held this view was somewhat smaller than for Part I (66%) and Part II (73%). Nevertheless, a full 80% of respondents felt that preparing for the exam was a worthwhile experience. Most respondents did not think there should be a change in the format, schedule, or requirements for the oral exam; 23% felt that some sort of change is warranted.

4.2 Feedback

Respondents were not asked to specify their division in the survey, so this summary of comments on the oral exam is integrated over the department.

A significant number of the responses expressing dissatisfaction with Part III dealt with a lack of communication between the committee and the student regarding the expectations of the committee (10/32 responses). Some noted that the structure, content, and difficulty of the exam depends strongly on a student's committee. Others felt intimidated by a lack of guidance or relevant coursework. As one student succinctly stated, "Our Part III expectations were quite vague, so I didn't really know what to study or how to prepare." Several respondents cited the practice of the astrophysics division of distributing a fairly comprehensive list of topics as one possible example to follow. Respondents who volunteered that they had taken the astrophysics exam agreed that the list was helpful.

Other critical responses focused on the possibility of being asked to leave the Ph.D. program after investing three or more years of work, a belief that interdisciplinary students are at a disadvantage on the exam, and the lack of uniformity across divisions. Some respondents also thought that the exam should be made more difficult (3/32). Nevertheless, several comments indicated that studying and preparing for the exam is a rewarding and worthwhile experience, even if the exam itself can be "nerve-racking" at times (7/32).

5 Overall

The purpose of the general examination is to assure the department that its graduates have a broad background in physics and a firm understanding of a particular branch of physics. The format is based on the premise that it is valuable for each student to review his or her general knowledge of physics in a systematic fashion and to measure it against a set of "community" standards.

Total Respondents	117
Written comments	43

5.1 Quantitative Data

Nearly 70% of respondents believed that the general exam system as a whole achieves its stated goals. Less than 9% explicitly indicated that the overall system fails in this regard. In contrast, only 40% of respondents believed that the system should not be changed; 30% thought that some change to the system would be beneficial.

5.2 Feedback

While the specific comments varied across the board, there was a broad agreement that the general exam system as a whole performs a critical evaluation of a Ph.D. candidate. A small portion praised the exam system for its “flexibility” in enforcing so little required coursework while others saw it as “reasonable” or “sufficient,” but with much room for improvement.

A prevalent dissatisfaction with the exams was the amount of stress induced (7/43 responses) and the associated time required to study for each part (8/43). Some students reported depression and insomnia during the ordeal, and one felt that professors at MIT are dismissive of such problems. This student also felt that if the department imposes the burden of these exams on students, it should also take some responsibility for the emotional and psychological effects that ensue. Others attribute a “lower research output” to the time required to study. One estimate places this time as one month for each of Parts I & II and three months for Part III.

There was an opinion that studying for the exams does improve basic physics knowledge, but that much of it is lost by the time of graduation (4/43). Thus the studying process is considered by some a “wasted effort.” Others believed that a similar level of knowledge can be obtained with coursework, and with far less stress. There were also a handful of people who believed that MIT should maintain a difficult exam structure based on the fact that is it, after all, MIT (3/43).

Finally, as one student mentioned, it is an unfortunate fact that some students can work three to four years for a Ph.D. only to be asked to leave with a Masters. The timeline places required general exams quite far along in the Ph.D. program, particularly for those who do not pass each exam on the first attempt.

6 Conclusion

The quantitative results of our survey unambiguously demonstrate that the majority of students feel that the general exams fulfill their stated purpose and that preparing for them is indeed a worthwhile experience. When examining students’ desire for a change in the exams, however, the data are less conclusive. On the whole, it seems that the majority of students either do not want a change or do not have a strong feeling either way, but about a third of the respondents felt that some change is warranted, with 15% strongly hoping for change. With these results in mind we examined the qualitative feedback for each exam in an effort to better understand students’ opinions of each exam and the system as whole. Our findings have been summarized in the previous sections. We now consider possible changes that would alleviate some of the more common student concerns and assess the ease with which these changes might be implemented. We acknowledge that there are many other factors contributing to the functioning of the general exam system that must be taken into account before specific changes can be recommended for implementation.

There are some student concerns that can easily be remedied, particularly with regards to the Part III exam. A large number of students wrote that the expectations for this exam were unclear and that the exam content could vary considerably from semester to semester. While these were not problems for every division, it would still be beneficial to somehow standardize the information available to all students beforehand about their particular exam. This could be accomplished by providing an updated information sheet to the Academic Programs office that includes useful information such as the format of the exam, major concepts covered, and textbooks that might be consulted for preparation. Such sheets should then be periodically updated, or at least checked for validity and relevance, by each division at least every five years.

Another practice found in some divisions is to have the professor in charge of Part III exam committee(s) for a given semester meet with all the students who have signed up to take the exam during that semester. This meeting generally occurs early in the semester and allows students to ask questions and briefly discuss the exam with the committee chair well before taking the exam. Together with an information sheet, this

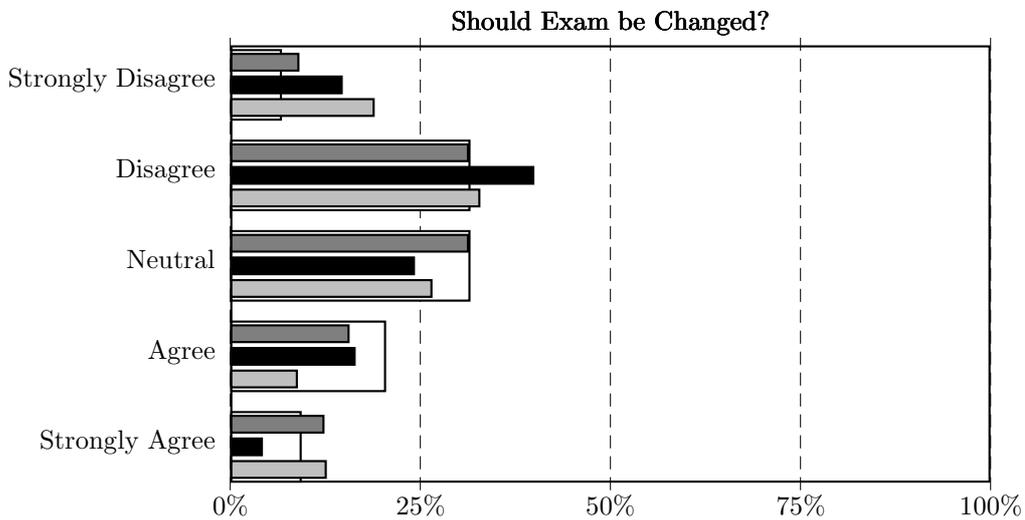
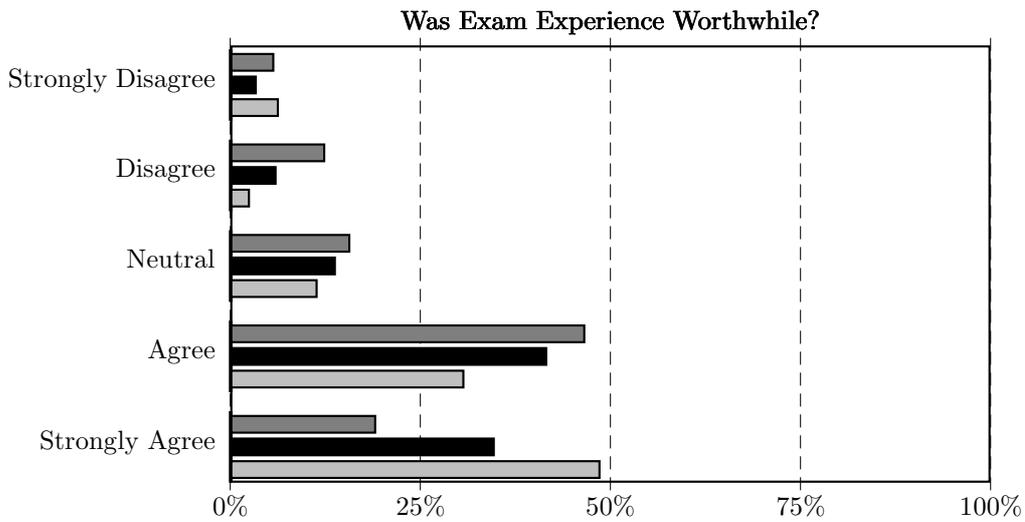
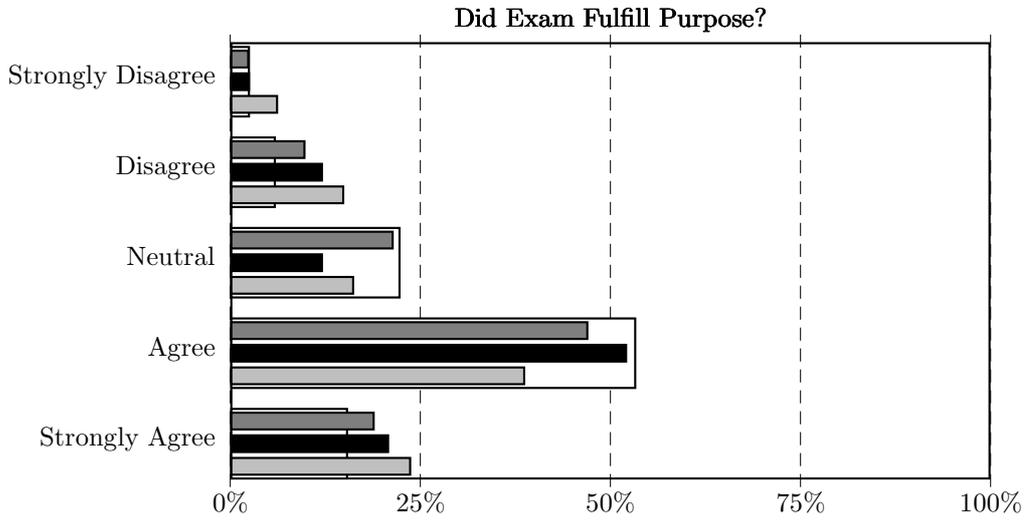
practice would ensure that all students have clear expectations about the content and format of their oral exam early on in their preparation.

There were also similar concerns voiced in the feedback for both Part I and Part II regarding a clear statement of what students are expected to know for each exam. This issue was often brought up in conjunction with the varying style and difficulty of the exams from year to year and the incompleteness and/or incomprehensibility of the available exam solutions. These issues could be addressed by a few easily implemented solutions.

For both Part I and Part II, a more precise list of topics and references could be provided via either an exam information sheet or a review session given by faculty or senior grad students for each exam. Additionally, there could be a greater correlation between the syllabi of the first year subjects (8.311, 8.321, and 8.333) and what is tested on the Part II exam. As it is often department practice to have the teachers of these courses write the questions for the Part II exams, this is already accomplished to some degree, but it could be made even more explicit. Finally, the compilation of a comprehensive, independently checked, and legible set of solutions for the practice exams would further improve and streamline the studying experience for both exams. Students have already begun working toward this last end: in August 2006, the Physics REFS began soliciting students for complete or corrected solutions, which they are compiling and will provide to the department for inclusion with the existing solution sets.

Other student concerns will require more discussion and strategic planning with both faculty and student input before a workable solution can be found. Some of these concerns include the redundancy of the Part I and Part II exams, the administration of the Part I exam on the first day of orientation in the fall, the stress of the exam experience, and the fact that it can take over three years to successfully pass all of the exams, often times to the detriment of research progress. With concerted and dedicated effort from students and faculty, we believe that these issues can also be resolved to the satisfaction and benefit of the entire community.

We hope that our survey and this report have been useful in elucidating the opinions of the graduate student body regarding the very important subject of the general exams. These exams are a critical component of the graduate school experience and preparing for them should be an indispensable and valuable undertaking for all students. As such, it is vital that the general exam experience be made as relevant and educationally beneficial as possible, so that students are not learning physics merely for the sake of passing these exams, but also to assimilate the knowledge in such a way that it will stay with them throughout their careers long after they leave MIT.



Survey Response Data

	Part I		Part II		Part III		Overall	
Taken?	%		%		%			
Yes	122	99.2	116	97.5	74	63.8		
No	1	0.8	3	2.5	42	36.2		
Total	123		119		116			
Passed on First Attempt?	%		%		%			
Yes	76	62.8	75	65.2	58	79.5		
No	45	37.2	40	34.8	15	20.5		
Total	121		115		73			
Fulfilled Purpose?	%		%		%		%	
Strongly Disagree	3	2.5	3	2.6	5	6.3	3	2.6
Disagree	12	9.9	14	12.2	12	15.0	7	6.0
Neutral	26	21.5	14	12.2	13	16.3	26	22.4
Agree	57	47.1	60	52.2	31	38.8	62	53.4
Strongly Agree	23	19.0	24	20.9	19	23.8	18	15.5
Total	121		115		80		116	
Worthwhile?	%		%		%			
Strongly Disagree	7	5.8	4	3.5	5	6.4		
Disagree	15	12.5	7	6.1	2	2.6		
Neutral	19	15.8	16	13.9	9	11.5		
Agree	56	46.7	48	41.7	24	30.8		
Strongly Agree	23	19.2	40	34.8	38	48.7		
Total	120		115		78			
Changes?	%		%		%		%	
Strongly Disagree	11	9.1	17	14.8	15	19.0	8	6.8
Disagree	38	31.4	46	40.0	26	32.9	37	31.6
Neutral	38	31.4	28	24.3	21	26.6	37	31.6
Agree	19	15.7	19	16.5	7	8.9	24	20.5
Strongly Agree	15	12.4	5	4.3	10	12.7	11	9.4
Total	121		115		79		117	

Table 1: Percentages are normalized to the number of relevant respondents.