New York State Regents Examination in Geometry June 2010 Administration Test Design and Development Technical Manual

Prepared by
Riverside Publishing Company

Contents

Introduction and Overview

This technical manual provides evidence about the content validity and item calibrations and documents the development processes used for the New York State Regents Examination in Geometry. The manual first discusses the purpose and use of the three new Regents Examinations in mathematics and the decision to move from the Regents Examinations in Mathematics A and Mathematics B to the Regents Examinations in Integrated Algebra, Geometry, and Algebra 2/Trigonometry. The processes used in the development of the new examinations are presented next. These processes include the development of test specifications, item development, field-test construction, and operational-form construction. The examination form described in this technical manual was built from items that were first field tested with New York State students. The standard and the baseline scale were determined by using operational data from this operational test form. Hereafter, the operational test forms are pre-equated using field-test data.

The Riverside Publishing Company (Riverside) has been contracted by the New York State Education Department (NYSED) to develop the new Regents Examinations in mathematics. Riverside will participate in the development of the examinations by

- arranging and facilitating teacher committees including the test-specifications meeting, the item-writing meetings, the item-review meetings, the field-test-form review meetings, and the operational-test-form review meetings;
- creating and updating the test specifications and other guiding documents;
- managing the item bank including entering new items and updating items as they proceed through the item-review and form-development process;
- developing and composing the field-test forms, operational test forms, and sampler test forms.

Other tasks required to deliver, administer, and score the examinations are completed by the NYSED or other vendors.

Purpose of the New York State Regents Examinations

The NYSED has a long and distinguished history of designing and developing the New York State Regents Examinations for five core curriculum areas taught in the State's high schools: English language arts, foreign languages, mathematics, science, and social studies. Regents Examinations are commencement-level assessments aligned with the State's learning standards and core curricula. For more than a hundred years, New York State high school students have demonstrated their mastery of academic content goals by attaining a prescribed level of success on Regents Examinations.

Before 2008, students' mathematics knowledge was assessed on the Regents Examinations in Mathematics A and Mathematics B. Students who received passing scores on the Regents Examination in Mathematics A met the mathematics examination requirement for graduation.

In 2005, the Board of Regents approved and published a revised learning standard for mathematics and revised performance indicators for pre-K through Grade 12, resulting in the development and phasing in of three new high-school-level mathematics examinations: the Regents Examinations in Integrated Algebra, Geometry, and Algebra 2/Trigonometry. The new mathematics examinations replace the current Regents Examinations in Mathematics A and Mathematics B according to the following phase-in schedule:

- The first administration of the Regents Examination in Integrated Algebra took place in June 2008. The Regents Examination in Mathematics A was also given at that time.
- The last administration of the Regents Examination in Mathematics A took place in January 2009.
- The first administration of the Regents Examination in Geometry took place in June 2009. The Regents Examination in Mathematics B was also given at this time.
- The first administration of the Regents Examination in Algebra 2/Trigonometry took place in June 2010.
- The last administration of the Regents Examination in Mathematics B took place in June 2010.

Test Use and Decisions Based on Assessment

The mathematics graduation requirement for a Regents Diploma requires students to earn three units of credit in high school mathematics and pass one Regents Examination in mathematics with a 65 or higher. Credit granted for Integrated Algebra is limited to two units.

The mathematics graduation requirement for a Regents Diploma with Advanced Designation requires students to earn three units of credit in high school mathematics and pass each of the Regents Examinations in Integrated Algebra, Geometry, and Algebra 2/Trigonometry with a 65 or higher.

Students who complete all coursework and testing requirements for the Regents Diploma with Advanced Designation and who earn a score of 85 or higher on each of the three new Regents Examinations in mathematics may receive a Regents Diploma with Advanced Designation, with an annotation on the diploma that denotes mastery in mathematics.

Target Population

The New York State Regents Examinations in Integrated Algebra, Geometry, and Algebra 2/Trigonometry will replace the Regents Examinations in Mathematics A and Mathematics B for assessing student proficiency with the New York State Learning Standard and content strands in secondary mathematics. All students must participate in the Regents Examination in Integrated Algebra except the 1% of the population of students with disabilities that participates in the New York State Alternate Assessment as recommended by the Committee on Special Education. Participation in the Regents Examination in Geometry is voluntary.

Testing Accommodations

Development Specifications

To ensure the appropriate accessibility of the Regents Examination in Geometry for students with disabilities, the test forms and items are developed in accordance with the following guidelines:

- The font type, size, and spacing are standard across all New York State Regents Examinations, including print contained in charts, graphs, maps, tables, and other graphics and visual stimuli.
- The font size of the regular print edition is 12 points for Regents Examinations. The large-type edition is in a standardized and readable 16-point font.
- Graphics are developed to ensure the best possible visibility in terms of contrast, spacing, and legibility of print labels.
- The large-type test booklet has staples along the spine side rather than a single staple in the upper left corner. This facilitates students' ability to manipulate the pages and to maintain continuity.
- All items using visual stimuli are developed to provide sufficient spacing of lines and labels, as well as bolding of lines and type, to permit clear tactual discernment by students using Braille and large-type editions of the operational forms.
- New York State Regents Examinations are available in both Braille and large-type formats.

Administering Examinations to Students with Disabilities

Principals must ensure that students with disabilities receive the testing accommodations specified in their Individualized Educational Programs (IEP) or Section 504 Accommodation Plans (504 Plans) when they take State examinations. Under certain circumstances, special accommodations may be made for general education students taking State examinations. The guidelines to be followed are provided in section 2, pages 15–16 of the *School Administrator's Manual, 2008 Edition.*

Large-Type Examinations. In general, large-type examinations will be administered according to the same procedures used for regular examinations. Large-type examinations are exact reproductions (136% enlargements) of the regular examinations. They have the same directions and questions as the regular examinations. They may be administered in the same room, at the same time, and with the same directions as the regular examinations.

Braille Examinations. The Braille examinations require no special directions to students. The proctor administering a Braille examination does not need to be able to read Braille. The examination booklet provides the student with complete directions and descriptions. The questions on Braille examinations are the same as those on the printed examinations, with some exceptions:

- Separate or special answer sheets are not provided with copies of Braille editions of Regents Examinations.
- Students may use any special equipment that they ordinarily use in the classroom, such as special rulers and calculators.
- Students may answer the questions in any manner appropriate and familiar to them. They may write, type, or Braille the answers; dictate them to a proctor or a mechanical recording device; or use any combination of these methods.

When the Department transcribes an examination into Braille, questions that contain material that cannot be reproduced in a manner understandable to a visually impaired student are modified. The questions are reworded or replaced with questions that measure skills similar to those measured by the original questions. Unless otherwise noted, the scoring key provided by the Department can be used for both the printed and the Braille editions of the examination.

Reader-Administered Examinations. Proctors will use the regular examination booklet when reading an examination to students with disabilities. Principals will provide proctors with examination booklets one hour in advance of the required starting time so that proctors can become familiar with the examination questions before reading them to the students. When test items are to be read, the entire test will be read, including reading passages and questions. The tests will be read in a neutral manner, without intonation or emphasis, and without otherwise drawing attention to key words or phrases. Passages and questions must be read word-for-word, without clarification or explanation. (However, such content may be read more than once.)

Reference Materials for Regents Examinations. All reference materials for Regents Examinations—tables, charts, graphs, etc.—are available in large type and Braille. These materials will be supplied with the large-type or Braille examinations. When reading a test to a student in accordance with the student's IEP or 504 Plan, the proctor will read the required reference information to the student as long as doing so does not give the student an unfair advantage. Students may *not* use English-language dictionaries, either printed or electronic.

Test Translations

The New York State Regents Examination in Integrated Algebra is translated into and published in languages other than English. The Regents Examinations in Integrated Algebra that are administered in January and June of each year are translated into the following five languages: Chinese, Haitian-Creole, Korean, Russian, and Spanish. The Regents Examination in Integrated Algebra that is administered in August of each year is translated into Spanish.

The New York State Regents Examination in Geometry is not translated into any other languages.

Test Design and Development

Framework of Test Program

The New York State Board of Regents is the governing authority responsible for setting educational policy, standards, and rules. In 1996, the Board approved and published learning standards in seven curricular areas: Mathematics, Science, and Technology (MST); English Language Arts; the Arts; Languages Other Than English; Health, Physical Education, and Family and Consumer Sciences; Social Studies; and Career Development and Occupational Studies.

The learning standards are the foundation for a rigorous system of assessment designed to:

- evaluate higher-order thinking skills and performance abilities, including planning and acquiring resources, designing and problem solving, conducting independent research, and producing real-world products;
- provide information that helps teachers adapt instruction to students' strengths and needs and that informs students, parents, educators, and the general public about what students are expected to know and be able to do.

In recent years, data gathered from international, national, and State assessments have indicated a need for strengthening student performance in mathematics. Results from the Third International Mathematics and Science Study (TIMSS), the National Assessment of Educational Progress (NAEP), and State-developed assessments at the elementary, intermediate, and commencement levels all showed that New York State students need to raise their level of achievement in mathematics.

Accordingly, in 2005 the Board of Regents approved and published the revised learning standard for mathematics and performance indicators for pre-K–12, resulting in the need for the development and phasing in of three new mathematics examinations, specifically the Regents Examinations in Integrated Algebra, Geometry, and Algebra 2/Trigonometry. The new mathematics learning standard as well as the updated Mathematics Core Curriculum are available at http://www.emsc.nysed.gov/ciai/mst/math/standards/.

The new mathematics examinations replace the current Regents Examinations in Mathematics A and Mathematics B according to a specific phase-in schedule. After January 2009 the Regents Examination in Mathematics A will no longer be administered, and after June 2010 the Regents Examination in Mathematics B will no longer be administered. Previously administered Regents Examinations in Integrated Algebra, Geometry, Mathematics A, and Mathematics B are available at http://www.nysedregents.org/ . After June 2010 students will be required to successfully pass any one of the new commencement-level mathematics Regents Examinations in order to meet graduation requirements.

Description of Achievement Levels

Each year, high schools are required to publish and disseminate district report cards that include details on student performance on State assessments disaggregated by school within each district. For high school Regents examinations, there are three achievement levels for the assessments as delineated by these scale-score ranges: 0–64, 65–84, and 85–100.

Students who pass an approved alternative to a Regents examination are considered proficient. Information about the process used to establish the cut scores can be found in a separate standard-setting report for the New York State Regents Examination in Geometry.

Examination Configuration and Format

A meeting was held in March 2007 with forty-two professional New York State educators to determine the test specifications for the Regents Examination in Geometry. The purpose of these specifications is to document the necessary requirements for item types and the emphasis-per-content band. The method used for determining the test specifications was to divide the educators into two groups that made independent recommendations for the test specifications and then came together to agree on a final recommendation that was sent to the New York State Education Department (NYSED). The NYSED considered the recommendation, along with other factors, and provided a final decision on the Geometry test specifications, which are shown on the following page and can be found at http://www.emsc.nysed.gov/osa/math/re/testspecs-geometry.pdf.

Regents Examination in Geometry
Test Specifications

The questions on the Regents Examination in Geometry assess both the content and the process strands of New York State Mathematics Standard 3. Each question is aligned to one content-performance indicator and also to one or more process-performance indicators, as appropriate for the concepts embodied in the task. As a result of the alignment to both content and process strands, the examination assesses students' conceptual understanding, procedural fluency, and problem-solving abilities rather than knowledge of isolated skills and facts.

There are thirty-eight questions on the Regents Examination in Geometry. Table 1 shows the percentage of total credits aligned with each content band.

Table 1. Credit Distribution by Content Band

Content Band	Percentage of Total Credits
Geometric Relationships	8–12%
Constructions	3–7%
Locus	4–8%
Informal and Formal Proofs	41–47%
Transformational Geometry	8–13%
Coordinate Geometry	23–28%

Item Types

The Regents Examination in Geometry includes multiple-choice and constructed-response items. The multiple-choice items are weighted by 2 credits each and the constructed-response items can be worth 2, 4, or 6 credits. Table 2 shows the number of each item type on the examination.

Table 2. Credit Distribution by Item Type

Item Type	Number of Items	Number of Credits
2-credit multiple choice	28	56
2-credit constructed response	6	12
4-credit constructed response	3	12
6-credit constructed response	1	6
Total	38	86

Calculators

Schools must make a graphing calculator available for the exclusive use of each student while that student takes the Regents Examination in Geometry.

Item Mapping by New York State Content Bands

Table 3 lists the alignment of each item on the June 2010 Regents Examination in Geometry to its item type, number of credits, and content band.

Table 3 June 2010 Regents Examination in Geometry Item Map

Item Number	Item Type	Maximum # of Credits	Content Band
1	Multiple Choice	2	Informal and Formal Proofs
2	Multiple Choice	2	Informal and Formal Proofs
3	Multiple Choice	2	Geometric Relationships
4	Multiple Choice	2	Informal and Formal Proofs
5	Multiple Choice	2	Transformational Geometry
6	Multiple Choice	2	Geometric Relationships
7	Multiple Choice	2	Informal and Formal Proofs
8	Multiple Choice	2	Informal and Formal Proofs
9	Multiple Choice	2	Informal and Formal Proofs
10	Multiple Choice	2	Informal and Formal Proofs
11	Multiple Choice	2	Coordinate Geometry
12	Multiple Choice	2	Constructions
13	Multiple Choice	2	Informal and Formal Proofs
14	Multiple Choice	2	Coordinate Geometry
15	Multiple Choice	2	Transformational Geometry
16	Multiple Choice	2	Informal and Formal Proofs
17	Multiple Choice	2	Geometric Relationships
18	Multiple Choice	2	Transformational Geometry
19	Multiple Choice	2	Informal and Formal Proofs
20	Multiple Choice	2	Constructions
21	Multiple Choice	2	Coordinate Geometry
22	Multiple Choice	2	Coordinate Geometry
23	Multiple Choice	2	Informal and Formal Proofs
24	Multiple Choice	2	Informal and Formal Proofs
25	Multiple Choice	2	Locus
26	Multiple Choice	2	Informal and Formal Proofs
27	Multiple Choice	2	Coordinate Geometry
28	Multiple Choice	2	Coordinate Geometry
29	Constructed Response	2	Geometric Relationships
30	Constructed Response	2	Informal and Formal Proofs
31	Constructed Response	2	Informal and Formal Proofs
32	Constructed Response	2	Transformational Geometry
33	Constructed Response	2	Locus
34	Constructed Response	2	Geometric Relationships
35	Constructed Response	4	Informal and Formal Proofs
36	Constructed Response	4	Coordinate Geometry
37	Constructed Response	4	Coordinate Geometry
38	Constructed Response	6	Informal and Formal Proofs

Item Development

After the Regents Examination in Geometry, test specifications were created, a plan was formed to ensure that a sufficient number of items would be field tested in spring 2009 to prepare for three operational test forms (June 2010, August 2010, and January 2011) for the Regents Examination in Geometry.

Table 4 New York Regents Geometry Field-Test Rotation Plan

Item Position	Item Position-Rotation 1	Item Position-Rotation 2	Item Position-Rotation 3	Item Position-Rotation 4	Item Position-Rotation 5	Item Position-Rotation 6
1	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
2	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
3	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
4	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
5	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
6	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
7	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice	Multiple Choice
8	2-Credit Constructed Response	2-Credit Constructed Response	4-Credit Constructed Response	2-Credit Constructed Response	4-Credit Constructed Response	6-Credit Constructed Response
9	4-Credit Constructed Response	2-Credit Constructed Response	4-Credit Constructed Response	6-Credit Constructed Response	2-Credit Constructed Response	2-Credit Constructed Response
10	4-Credit Constructed Response	6-Credit Constructed Response	2-Credit Constructed Response	2-Credit Constructed Response	4-Credit Constructed Response	2-Credit Constructed Response

From this set of field tests, twenty forms would contain items that could be used as items on the operational forms. The other two field-test forms were to be used as year-to-year anchor forms so items developed across years could be equated and thus placed on a common scale. A complete list of the item types found on each field test is located in Appendix A.

The field tests were administered in a spiral design. Forms were administered in such a way that students in each classroom were administered one of the twenty forms. This spiral design worked in concert with the anchoring plan so that equivalent samples were taken from each form. This design also allowed the use of pre-equating for the operational test forms. The field-test data were used to place all items on the same scale, and the resulting information was used to determine the raw-score-to-scale-score

tables. Detailed information about the process of analyzing the field test and equating can be found in the Field Test Analysis, Equating Report.

Item Development Plan

After the field-test plan was developed and approved, an item-development plan was created to ensure the development of a sufficient spread of item types, performance indicators, and content bands to populate the necessary field-test forms after the item and forms review. The plan took into account attrition that would be realized during item review, forms review, and rangefinding. The items from this field test were selected in creating the Regents Examination June 2010 operational form, August 2010 operational form, and January 2011 operational form.

Item Writing

Once the item-development plan was finalized, a representative sample of New York State educators attended an item-writing workshop in March 2008. Each writer was trained on the best practices of developing multiple-choice and constructed-response test items. These best practices included adhering to universal design principles, avoiding bias and sensitivity, ensuring strict alignment to the performance indicators, and ensuring the accessibility of vocabulary and graphics associated with the items.

In the two days of the item-writing workshop, these educators wrote enough items to develop the twenty field-test forms needed, allowing for attrition. The items then went through several rounds of reviews.

Field-Test Plan

The field-test plan consisted of the development of twenty test forms of ten items each. Items on the field-test forms were intentionally placed to mimic the test blueprint of the operational test forms. Due to the limited number of items on each field-test form, the exact operational test blueprint could not be met. Each field test consisted of seven multiple-choice items and three constructed-response items.

To ensure a sufficient n-count for each constructed-response item, a rotation plan was instituted. The expectation was that fewer students would attempt the final item on the field test. Trying to ensure an equal n-count across the various constructed-response items, the forms were created in such a manner that the three rotation plans shown in Table 4 were used evenly across the twenty-two field-test forms. In some forms, the rotation plan differed slightly from the options in Table 4 in order to ensure that the best pool of items was being field tested.

Item-Review Processes

Items go through an extensive review process as part of the content-validity evidence. One of the most important aspects of the internal review process is the focus on removing biased items from the item pool. At each step in the process, the reviewer looks for item characteristics that may cause an item to perform differently for certain subgroups of students. If any such characteristics are present, the item is either edited to remove the bias, or the item is removed completely from the item pool. The most important step taken to reduce bias in items is thoroughly training item writers on bias before items are written. The review steps that items go through are described below.

Editorial Review

The first part of the editorial review was conducted by the Riverside Test Development Specialist (TDS). The TDS was responsible for ensuring quality construct standards according to the following guidelines.

For All Items

- The item assesses the assigned performance indicator.
- The item is clear, concise, and complete.
- The item contains accurate and sufficient content information.
- The item is grade-level appropriate; and the vocabulary and syntax are appropriate for the intended students.
- The item is fair to all students and free of bias and sensitivity issues.
- The item has correct punctuation and is grammatically correct.
- The item is free from spelling and typographical errors.
- The item stands alone. (The answer to an item is not dependent on the content of another item.)
- The equations, tables, charts, graphs, and other art are clear, accurate, and necessary.

For Multiple-Choice Items

- The item has only one correct answer.
- The item has unique and plausible incorrect distractors containing common errors students would make.
- All answer choices are parallel in form and are arranged according to specifications.
- The item is free from absolutes (“none of the above,” “all of the above” as distractors).
- The answer and distractors do not repeat words from the stem.
- The item poses a single problem (although the solution may require more than one step).

For Constructed-Response Items

- The item clearly specifies how the student should respond.
- The item allows for a variety of acceptable responses for the student to get full credit.
- The item is rich enough to elicit an appropriate range of responses covering all possible scores.
- The rubric clearly defines an acceptable answer and answers at each score level.

After the TDS review was completed, a Senior TDS reviewed items for adherence to all the points above. If the Senior TDS had any concerns, the item was rerouted to the TDS for a follow-up review.

After the Senior TDS review, a copyeditor read each item to ensure the following:

- The item adheres to the New York State Regents style.
- There are no spelling errors.
- There are no typographical errors.
- There are no punctuation errors.
- The item is worded in clear and concise language.
- All graphics adhere strictly to the guidelines.

The items were then reviewed by a Senior Copyeditor, who was able to reroute them to the Senior TDS if necessary.

NYSED Item-Card Review

After the reviews described above, item cards were created that included the item, its associated stimuli, and all item information such as the answer, maximum score, performance indicator, and process strands. The item cards were presented to the NYSED mathematics examination specialist for the Regents Examination in Geometry.

After the review by NYSED staff, including test development specialists, content specialists, and examination editors, items were revised as directed.

Field-Test-Forms Committee Review

After the individual items were revised, twenty field-test forms of ten items each were prepared and reviewed by a committee composed of New York State educators and NYSED and Riverside staff. During the review, the committee requested edits to several items as well as changes in the location of items throughout the forms. All edits were incorporated into the field-test forms, and final revisions were approved by the NYSED. The field-test forms were administered to a representative sample of students in schools throughout New York State in spring 2009.

Rangefinding

Rating of the constructed-response questions in the Geometry field test was done by NYSED's scoring contractor, Pearson. Prior to rating, the contractor's scoring directors selected student answers that exemplified each score level for each field-tested constructed-response item based on the rubrics for that item. The contractor then convened a rangefinding committee composed of a representative sample of New York State educators. The purpose of this committee was to review rubrics in light of actual student responses. The committee confirmed that the papers chosen by the contractor's scoring directors for training and practice were at the correct score levels and represented a variety of student responses. Some rubrics were adjusted to reflect student responses that had not been anticipated or to provide clarification for raters. Rangefinding participants once again checked each item to be sure it tested a performance indicator in the core curriculum.

Operational-Forms Review

Once rangefinding was completed, all items were scored and calibrated on a Rasch model. This pool of items was used to populate the Regents Examination in Geometry June 2010 operational form, the August 2010 operational form, and the January 2011 operational form. After the three operational forms were populated, they were sent to the NYSED for review. The forms were brought to a committee of New York State educators who reviewed the forms and made recommendations for minor edits, location changes, and replacement of items. The NYSED then reviewed the forms and, lastly, held a "final eyes" review of the June 2010 operational form with the participation of New York State educators. The final edits were incorporated and approved, and the operational form of the New York State Regents Examination in Geometry was administered in June 2010.

Item-Selection Criteria and Process

Operational test items are selected based on content coverage and individual item statistics. The sets of items on each operational test conform to the test specifications determined by a committee of New York State educators. These test specifications are based on the learning standard established by the NYSED. Classical and Rasch statistics are examined to determine how well each item functions. Items that have a range of difficulties are selected in order to measure students across ability levels.

In order to limit wide fluctuations of raw scores that correspond to scale scores of 65 and 85 across administrations, the average Rasch item difficulty for the operational test is considered. For the Regents Examination in Geometry, an average Rasch difficulty of approximately 0.279 is used as a target for each operational form. In most cases, meeting this target will provide raw score cuts similar in magnitude to other forms. However, some differences with these scores also occur due to the distribution of the Rasch item-difficulty parameters.

The selection of items for the June 2010, August 2010, and January 2011 operational tests was done at the same time. Choosing items for the forms at the same time allows for immediate comparisons of content coverage and statistical properties. Adjustments are made as the test forms are finalized to ensure coverage of as much of the mathematics core curriculum as possible over the course of the three examinations. Adjustments are also made to ensure that the forms are similar in terms of average field-test difficulty. Appendix B lists the classical and IRT item statistics for the June 2010 operational form.

When selecting items for the operational test, some factors have a higher priority than others. The criteria used are listed below in order of importance:

1. The test blueprint is met in terms of item-type and content-band coverage.
2. Items on the test complement each other (no clueing, double jeopardy, balanced answer key distribution, etc.).
3. Individual-item statistics are within appropriate parameters.
4. Overall test-form statistics are within appropriate parameters.

A set of specifications was developed for the Regents Examination in Geometry operational forms that included the content test specifications and psychometric criteria. The items were selected from the field-test pool to ensure that, as much as possible, all criteria were met. Appendix C contains the completed checklist used for the June 2010 operational form of the Regents Examination in Geometry. The first two tables of the checklist are completed to determine whether the test form is in compliance with the test specifications. The remaining tables of the checklist are completed to ensure that the items are compatible and complement each other in terms of content coverage and statistical criteria.

Description of Calibration/Equating Sample

To develop operational forms that can be equated from year to year but have no repeated items, a field-test plan was developed that included two anchor forms in the field-test pool to be used exclusively for year-to-year equating. More specifically, in the 2009 field-test administration, twenty-two forms were fully spiraled. The student sample participating in the field test was selected such that the participants for each form would represent the student population expected to take the operational test. The samples of students ranged from 1137 to 1171 across the field-test forms. In the 2010 field-test administration there were twelve new forms in addition to two anchor forms that were administered in the 2009 field-test administration.

Appendix A Field-Test Item Map

Form Number	Item Number	Item Type ** MC, CR, etc.	Maximum Points	Band
931-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Informal and Formal Proofs
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Locus
	9	CR	2	Transformational Geometry
	10	CR	6	Informal and Formal Proofs
932-09	1	MC	1	Informal and Formal Proofs
	2	MC	1	Coordinate Geometry
	3	MC	1	Locus
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Coordinate Geometry
	10	CR	4	Constructions
933-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Locus
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Coordinate Geometry
	9	CR	2	Geometric Relationships
	10	CR	6	Informal and Formal Proofs

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
934-09	1	MC	1	Coordinate Geometry
	2	MC	1	Locus
	3	MC	1	Informal and Formal Proofs
	4	MC	1	Informal and Formal Proofs
	5	MC	1	Transformational Geometry
	6	MC	1	Informal and Formal Proofs
	7	MC	1	Geometric Relationships
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Coordinate Geometry
	10	CR	4	Locus
935-09	1	MC	1	Informal and Formal Proofs
	2	MC	1	Coordinate Geometry
	3	MC	1	Geometric Relationships
	4	MC	1	Locus
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Transformational Geometry
	9	CR	2	Geometric Relationships
	10	CR	6	Informal and Formal Proofs
936-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Locus
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Coordinate Geometry
	10	CR	4	Transformational Geometry

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
937-09	1	MC	1	Informal and Formal Proofs
	2	MC	1	Coordinate Geometry
	3	MC	1	Geometric Relationships
	4	MC	1	Locus
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Coordinate Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Transformational Geometry
	9	CR	2	Geometric Relationships
	10	CR	6	Informal and Formal Proofs
938-09	1	MC	1	Transformational Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Informal and Formal Proofs
	4	MC	1	Coordinate Geometry
	5	MC	1	Geometric Relationships
	6	MC	1	Constructions
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Locus
	9	CR	4	Informal and Formal Proofs
	10	CR	4	Coordinate Geometry
939-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Constructions
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Locus
	9	CR	2	Transformational Geometry
	10	CR	6	Informal and Formal Proofs

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
940-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Informal and Formal Proofs
	4	MC	1	Geometric Relationships
	5	MC	1	Coordinate Geometry
	6	MC	1	Constructions
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Informal and Formal Proofs
	10	CR	4	Transformational Geometry
941-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Constructions
	8	CR	2	Informal and Formal Proofs
	9	CR	2	Informal and Formal Proofs
	10	CR	6	Informal and Formal Proofs
942-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Locus
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	4	Constructions
	9	CR	4	Informal and Formal Proofs
	10	CR	2	Geometric Relationships

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
943-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Constructions
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Informal and Formal Proofs
	10	CR	4	Coordinate Geometry
944-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Constructions
	8	CR	2	Coordinate Geometry
	9	CR	2	Constructions
	10	CR	6	Informal and Formal Proofs
945-09	1	MC	1	Coordinate Geometry
	2	MC	1	Geometric Relationships
	3	MC	1	Geometric Relationships
	4	MC	1	Constructions
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Coordinate Geometry
	10	CR	4	Transformational Geometry

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
946-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	2	Locus
	10	CR	6	Transformational Geometry
947-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Informal and Formal Proofs
	7	MC	1	Transformational Geometry
	8	CR	2	Constructions
	9	CR	4	Informal and Formal Proofs
	10	CR	4	Informal and Formal Proofs
948-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Coordinate Geometry
	9	CR	2	Constructions
	10	CR	6	Informal and Formal Proofs

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
949-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Locus
	10	CR	4	Informal and Formal Proofs
950-09	1	MC	1	Informal and Formal Proofs
	2	MC	1	Constructions
	3	MC	1	Geometric Relationships
	4	MC	1	Informal and Formal Proofs
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Coordinate Geometry
	8	CR	2	Informal and Formal Proofs
	9	CR	2	Informal and Formal Proofs
	10	CR	6	Coordinate Geometry
951-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Informal and Formal Proofs
	7	MC	1	Transformational Geometry
	8	CR	2	Informal and Formal Proofs
	9	CR	4	Coordinate Geometry
	10	CR	4	Locus

Appendix A Field-Test Item Map (continued)

Form Number	Item Number	Item Type	Maximum Points	Content Band
952-09	1	MC	1	Coordinate Geometry
	2	MC	1	Informal and Formal Proofs
	3	MC	1	Geometric Relationships
	4	MC	1	Coordinate Geometry
	5	MC	1	Informal and Formal Proofs
	6	MC	1	Transformational Geometry
	7	MC	1	Informal and Formal Proofs
	8	CR	2	Coordinate Geometry
	9	CR	2	Geometric Relationships
	10	CR	6	Informal and Formal Proofs

Appendix B Item Statistics for the June 2010 Operational Form

OP Position	NCOUNT	ALPHA	%Blank	M0	M1	M2	M3	M4	M5	M6
1	1171	0.71	0	0	0.89	0.02	0.02	0.07		
2	498	0.69	0	0	0.02	0.87	0.02	0.09		
3	1169	0.59	0	0	0.01	0.02	0.15	0.81		
4	1154	0.64	0	0	0.09	0.05	0.82	0.04		
5	1158	0.69	0.01	0	0.77	0.07	0.03	0.11		
6	1141	0.69	0.01	0	0.06	0.11	0.14	0.68		
7	1157	0.6	0	0	0.15	0.66	0.14	0.05		
8	1160	0.69	0	0	0.08	0.24	0.05	0.63		
9	1154	0.64	0	0	0.62	0.02	0.10	0.25		
10	1157	0.68	0	0	0.58	0.13	0.20	0.09		
11	1140	0.63	0	0	0.14	0.18	0.54	0.14		
12	1141	0.69	0.01	0	0.53	0.16	0.06	0.24		
13	492	0.63	0.02	0	0.51	0.11	0.16	0.21		
14	1160	0.69	0.01	0	0.04	0.33	0.11	0.51		
15	1170	0.74	0.01	0	0.16	0.17	0.16	0.50		
16	492	0.58	0.03	0	0.07	0.2	0.50	0.20		
17	1158	0.69	0.01	0	0.22	0.2	0.48	0.10		
18	1155	0.68	0.01	0	0.3	0.09	0.13	0.47		
19	488	0.63	0.02	0	0.14	0.26	0.47	0.11		
20	1171	0.71	0.01	0	0.16	0.46	0.18	0.19		
21	1153	0.65	0.01	0	0.15	0.26	0.17	0.41		
22	496	0.73	0	0	0.24	0.41	0.27	0.08		
23	1161	0.62	0.01	0	0.12	0.39	0.31	0.17		
24	1161	0.62	0.03	0	0.2	0.38	0.27	0.12		
25	1154	0.64	0	0	0.1	0.42	0.10	0.37		
26	1147	0.58	0.01	0	0.28	0.31	0.20	0.20		
27	1155	0.68	0.02	0	0.31	0.27	0.24	0.15		
28	1147	0.58	0.01	0	0.25	0.29	0.23	0.23		
29	493	0.66	0.03	0.18	0.26	0.54				
30	1141	0.69	0.02	0.34	0.1	0.54				
31	1153	0.65	0.04	0.37	0.19	0.41				
32	1165	0.73	0.02	0.39	0.29	0.3				
33	1157	0.6	0.13	0.36	0.23	0.27				
34	1137	0.71	0.03	0.29	0.23	0.45				
35	1171	0.71	0.07	0.17	0.27	0.09	0.09	0.30		
36	1164	0.74	0.09	0.44	0.17	0.14	0.02	0.15		
37	1140	0.63	0.05	0.59	0.16	0.05	0.03	0.12		
38	1141	0.69	0.11	0.32	0.05	0.23	0.01	0.13	0.03	0.13

Appendix B Item Statistics for the June 2010 Operational Form (continued)

Position	Pvalue	PtBis	Rasch	S1	S2	S3	S4	S5	S6	INFIT
1	0.89	0.35	-2.05							0.99
2	0.87	0.34	-1.98							1.02
3	0.81	0.44	-1.35							0.95
4	0.82	0.44	-1.46							0.94
5	0.77	0.5	-1.29							0.94
6	0.68	0.42	-0.55							1.02
7	0.66	0.49	-0.5							0.94
8	0.63	0.41	-0.33							1.05
9	0.62	0.39	-0.29							1.04
10	0.58	0.49	-0.07							0.94
11	0.54	0.33	0.08							1.12
12	0.53	0.41	0.22							1.06
13	0.51	0.46	0.15							1.01
14	0.51	0.47	0.26							0.96
15	0.5	0.35	0.34							1.15
16	0.5	0.4	0.17							1
17	0.48	0.31	0.35							1.23
18	0.47	0.46	0.34							1.02
19	0.47	0.43	0.34							0.98
20	0.46	0.29	0.49							1.16
21	0.41	0.56	0.59							0.91
22	0.41	0.48	0.64							0.97
23	0.39	0.19	0.79							1.22
24	0.38	0.29	0.84							1.12
25	0.37	0.27	0.94							1.15
26	0.31	0.26	1.16							1.17
27	0.31	0.4	1.19							1.04
28	0.29	0.35	1.27							1.04
29	1.33	0.62	-0.49	-0.14	0.14					0.87
30	1.18	0.62	0.04	1.16	-1.16					0.97
31	1.01	0.7	0.15	0.26	-0.26					0.84
32	0.89	0.66	0.53	-0.24	0.24					0.89
33	0.77	0.67	0.73	0.05	-0.05					0.83
34	1.13	0.66	0.04	0.06	-0.06					0.85
35	1.95	0.74	0.29	-0.76	0.98	0.25	-0.47			0.83
36	1.09	0.71	1.23	-0.03	-0.32	2.13	-1.77			0.81
37	0.81	0.63	1.29	0.23	0.67	0.40	-1.30			0.77
38	1.96	0.8	0.98	0.90	-2.14	2.75	-2.51	1.74	-0.73	0.65

Appendix C Completed Operational-Form Checklist

Criteria	June 2010
Complete test map below.	Yes
Item distribution is in accordance with the test specifications.	Yes

June 2010	Multiple Choice	2-credit Open Ended	4-credit Open Ended	6-credit Open Ended	TOTALS	
Band	2 credits each	2 credits each	4 credits each	6 credits each	**Total Items**	**Total Credits**
Geometric Relationships	3	2			5	10
Constructions	2				2	4
Locus	1	1			2	4
Informal and Formal Proofs	13	2	1	1	17	40
Transformational Geometry	3	1			4	8
Coordinate Geometry	6		2		8	20
Total Items	28	6	3	1	38	
Total Credits	56	12	12	6		86

Item Statistics	June 2010
P-values of all multiple-choice items are between 0.2 and 0.9.	Yes
P-values of all 2-credit constructed-response items are above 0.5.	Yes
P-value mean	0.718
Point-biserial values of all items are greater than or equal to 0.2.	Yes
Point-biserial mean	0.47
Rasch values of all items are between –2.0 and 2.0.	Yes
Rasch weighted average (Each operational form is within ±0.1 of 0.28.)	0.29
Rasch standard deviation (Target is 1.00.)	0.86

Item Distribution	June
Multiple Choice items begin with easiest item (highest p-value) in position 1, and increase to hardest item (lowest p-value) in position 28.	OK- see note
Appropriate 'core' PIs are on the test form, and an attempt has been made to assess every PI over the 3 test forms.	OK
Answer key distribution is nearly equal between answer choices (target is about 7 for each answer choice).	1 = 7 2 = 8 3 = 5 4 = 8
The number of items that have graphics in the stem (charts, pictures, etc.).	16
The number of items that have graphics in the answer choices.	1
There are NOT 2 items on a test form with similar concept skills.	See note
There are NOT more than 2 items in a row with the same answer.	OK
There is no clueing between test items on the same form.	OK
There is no similarity between sampler items and items on the test form.	OK
There is no similarity between released test items and items on the test form.	OK
There are NOT two or more items on the test that have the same or similar graphics.	OK
There are NOT two or more items with similar answers or answer choices.	OK
Items are identical to their appearance on the field test.	OK

Process Strands	June
Process strands are distributed evenly across the test form.	PS = 23 R&P = 12 Com = 3 Con = 3 Rep = 4
The designated percent of credits assigned to each process strand is adhered to. See the table below.	See note

Process Strand	Percent of Credits
Problem Solving	25% or less
Reasoning and Proof	31% or less
Communication	18% or less
Connections	11% or less
Representation	15% or less

Other comments or clarifications:

June 2010

Some re-arranging of the sequence of multiple-choice items, easiest to more difficult, was used to separate items with similar concepts and same answer keys.

Some variation from the specified distributions occurred because the Problem Solving process strand was selected for more than 25% of the items.

June Test blueprint was adjusted to help meet Item Mean Rasch guideline.

PIs not represented across the forms: 5, 7, 8, 11, 12, 68, 73