Virginia Board of Education Agenda Item

Agenda Item: A **Date:** February 23, 2017

Title	Final Review of Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) for a Passing Score for the Praxis Algebra I (5162) Test for the Mathematics – Algebra I (Add-on) Endorsement		
Presenter	Mrs. Patty S. Pitts, Assistant Superintendent for Teacher Education and Licensure		
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Purpose of Presentation:
Action required by state or federal law or regulation.

Previous Review or Action:
Previous review and action. Specify date and action taken below:
Date: January 26, 2017
Action: First Review

Action Requested:
Final review: Action requested at this meeting.

Alignment with Board of Education Goals: Please indicate (X) all that apply:

	Goal 1: Accountability for Student Learning
	Goal 2: Rigorous Standards to Promote College and Career Readiness
	Goal 3: Expanded Opportunities to Learn
	Goal 4: Nurturing Young Learners
X	Goal 5: Highly Qualified and Effective Educators
	Goal 6: Sound Policies for Student Success
	Goal 7: Safe and Secure Schools
	Other Priority or Initiative. Specify:

Background Information and Statutory Authority:
Goal 5: The approval of a passing score on the professional teacher's assessment supports the goal of highly qualified and effective educators in Virginia's classrooms and schools.

The *Constitution of Virginia* and the *Code of Virginia* provide authority for the Board of Education to promulgate *Licensure Regulations for School Personnel*. Article VIII, Section 4 of the *Constitution of Virginia* states, in part, the following:

> "The general supervision of the public school system shall be vested in a Board of Education…."

The Board of Education has the statutory authority to prescribe licensure requirements. Section 22.1-298.1 of the *Code of Virginia*, states:

§ 22.1-298.1. **Regulations governing licensure.**

A. As used in this section:

"Alternate route to licensure" means a nontraditional route to teacher licensure available to individuals who meet the criteria specified in the regulations issued by the Board of Education.

"Industry certification credential" means an active career and technical education credential that is earned by successfully completing a Board of Education-approved industry certification examination, being issued a professional license in the Commonwealth, or successfully completing an occupational competency examination.

"Licensure by reciprocity" means a process used to issue a license to an individual coming into the Commonwealth from another state when that individual meets certain conditions specified in the Board of Education's regulations.

"Professional teacher's assessment" means those tests mandated for licensure as prescribed by the Board of Education.

"Provisional license" means a nonrenewable license issued by the Board of Education for a specified period of time, not to exceed three years, to an individual who may be employed by a school division in the Commonwealth and who generally meets the requirements specified in the Board of Education's regulations for licensure, but who may need to take additional coursework or pass additional assessments to be fully licensed with a renewable license.

"Renewable license" means a license issued by the Board of Education for five years to an individual who meets the requirements specified in the Board of Education's regulations.

B. The Board of Education shall prescribe, by regulation, the requirements for the licensure of teachers and other school personnel required to hold a license. Such regulations shall include requirements for the denial, suspension, cancellation, revocation, and reinstatement of licensure. The Board of Education shall revoke the license of any person for whom it has received a notice of dismissal or resignation pursuant to subsection F of § 22.1-313 and, in the case of a person who is the subject of a founded complaint of child abuse or neglect, after all rights to any appeal provided by § 63.2-1526 have been exhausted. Regardless of the authority of any other agency of the Commonwealth to approve educational programs, only the Board of Education shall have the authority to license teachers to be regularly employed by school boards, including those teachers employed to provide nursing education.

The Board of Education shall prescribe by regulation the licensure requirements for teachers who teach only online courses, as defined in § 22.1-212.23. Such license shall be valid only for teaching online courses. Teachers who hold a five-year renewable license issued by the Board of Education may teach online courses for which they are properly endorsed.

C. The Board of Education's regulations shall include requirements that a person seeking initial licensure:

1. Complete professional assessments as prescribed by the Board of Education;
2. Complete study in attention deficit disorder;
3. Complete study in gifted education, including the use of multiple criteria to identify gifted students; and
4. Complete study in methods of improving communication between schools and families and ways of increasing family involvement in student learning at home and at school.

D. In addition, such regulations shall include requirements that:

1. Every person seeking initial licensure or renewal of a license demonstrate proficiency in the use of educational technology for instruction;
2. Every person seeking initial licensure and persons seeking licensure renewal as teachers who have not completed such study shall complete study in child abuse recognition and intervention in accordance with curriculum guidelines developed by the Board of Education in consultation with the Department of Social Services that are relevant to the specific teacher licensure routes;
3. Every person seeking initial licensure or renewal of a license shall receive professional development in instructional methods tailored to promote student academic progress and effective preparation for the Standards of Learning end-of-course and end-of-grade assessments;
4. Every person seeking renewal of a license shall complete all renewal requirements, including professional development in a manner prescribed by the Board, except that no person seeking renewal of a license shall be required to satisfy any such requirement by completing coursework and earning credit at an institution of higher education;
5. Every person seeking initial licensure or renewal of a license shall provide evidence of completion of certification or training in emergency first aid, cardiopulmonary resuscitation, and the use of automated external defibrillators. The certification or training program shall be based on the current national evidence-based emergency cardiovascular care guidelines for cardiopulmonary resuscitation and the use of an automated external defibrillator, such as a program developed by the American Heart Association or the American Red Cross. The Board shall provide a waiver for this requirement for any person with a disability whose disability prohibits such person from completing the certification or training;
6. Every person seeking licensure with an endorsement as a teacher of the blind and visually impaired shall demonstrate proficiency in reading and writing Braille;
7. Every teacher seeking an initial license in the Commonwealth with an endorsement in the area of career and technical education shall have an industry certification credential in the area in which the teacher seeks endorsement. If a teacher seeking an initial license in the Commonwealth has not attained an industry certification credential in the area in which the teacher seeks endorsement, the Board may, upon request of the employing school division or educational agency, issue the teacher a provisional license to allow time for the teacher to attain such credential; and
8. (Effective July 1, 2017) Every person seeking initial licensure or renewal of a license shall complete awareness training, provided by the Department of Education, on the indicators of dyslexia, as that term is defined by the Board pursuant to regulations, and the evidence-based interventions and accommodations for dyslexia.

E. The Board's regulations shall require that initial licensure for principals and assistant principals be contingent upon passage of an assessment as prescribed by the Board.

F. The Board shall establish criteria in its regulations to effectuate the substitution of experiential learning for coursework for those persons seeking initial licensure through an alternate route as defined in Board regulations.

G. Notwithstanding any provision of law to the contrary, the Board (i) may provide for the issuance of a provisional license, valid for a period not to exceed three years, pursuant to subdivision D 7 or to any person who does not meet the requirements of this section or any other requirement for licensure imposed by law and (ii) shall provide for the issuance of a provisional license, valid for a period not to exceed three years, to any former member of the Armed Forces of the United States or the Virginia National Guard who has received an honorable discharge and has the appropriate level of experience or training but does not meet the requirements for a renewable license.

H. The Board's licensure regulations shall also provide for licensure by reciprocity:

1. With comparable endorsement areas for those individuals holding a valid out-of-state teaching license and national certification from the National Board for Professional Teaching Standards or a nationally recognized certification program approved by the Board of Education. The application for such individuals shall require evidence of such valid licensure and national certification and shall not require official student transcripts;
2. For individuals who have obtained a valid out-of-state license, with full credentials and without deficiencies, that is in force at the time the application for a Virginia license is received by the Department of Education. The individual must establish a file in the Department of Education by submitting a complete application packet, which shall include official student transcripts. An assessment of basic skills as provided in § 22.1-298.2 and service requirements shall not be imposed for these licensed individuals; however, other licensing assessments, as prescribed by the Board of Education, shall be required; and
3. The Board may include other provisions for reciprocity in its regulations.

Code of Virginia, Section 22.1-16. Bylaws and regulations generally.
Code of Virginia, Section 22.1-299. License required of teachers.
Code of Virginia, Section 22.1-305.2. Advisory Board on Teacher Education and Licensure.

Section 8VAC20-22-70. (Additional Endorsements), of the *Licensure Regulations for School Personnel* states, in part, the following:

A. An individual who holds a teaching license may add an additional endorsement to the license by passing a rigorous academic subject test prescribed by the Board of Education. This testing option does not apply to individuals who are seeking an early/primary preK-3 or elementary education preK-6 endorsement or who hold a technical professional license, vocational evaluator license, pupil personnel services license, school manager license, or division superintendent license….

Currently, the Board of Education requires the following licensure assessments:

- Virginia Communication and Literacy Assessment (VCLA)
- Praxis: Subject Assessments
- Reading for Virginia Educators (RVE)
- School Leaders Licensure Assessment (SLLA) – The SLLA is specific to the Administration and Supervision PreK-12 endorsement.
- Praxis Braille Proficiency Test – The Braille Proficiency Test is specific to the Special Education Visual Impairments PreK-12 endorsement.

The Educational Testing Service (ETS) developed the Praxis Algebra I (5162) test. The Algebra I test is designed to assess the mathematical knowledge and competencies necessary for a beginning Algebra I teacher.

The *Licensure Regulations for School Personnel* require that individuals seeking the Mathematics – Algebra I (add-on) endorsement must hold a license endorsed in another teaching area. The Praxis Algebra I (5162) test is not a required assessment for the Mathematics – Algebra I (add-on) endorsement, but rather an option for individuals holding certain licenses who may wish to add the endorsement by testing.

Upon Board approval, an individual holding a Virginia license with a teaching endorsement (who has met initial subject assessment requirements) may be eligible for the Mathematics – Algebra I (add-on endorsement) by passing the Praxis Algebra I (5162) test. This testing option does not apply to individuals who hold a technical professional license, vocational evaluator license, pupil personnel services license, school manager license, or division superintendent license.

Summary of Important Issues:
In October 2016, a multistate standard-setting study was conducted by ETS for the Praxis Algebra I (5162) test. Participants from 13 states served on the multistate study panel. Virginia was represented by one teacher nominated by a Virginia school division and a teacher educator nominated by a Virginia institution of higher education. A detailed summary of the study, *Multistate Standard-Setting Technical Report – Algebra I (5162)* is attached (Attachment 1) and includes names of participants, methodology, and recommendations. The purposes of the study were to: (a) recommend the minimum passing score for the Praxis Algebra I (5162) test and (b) confirm the importance of the Praxis content specifications for entry-level Algebra I teachers.

The Praxis *Test at a Glance* document (Attachment 2) describes the purpose and structure of the assessment. The Praxis Algebra I (5162) test contains 60 selected-response items covering three content areas:

Principles of Algebra (approximately 23 items);
Functions (approximately 18 items); and
Number and Quantity; Probability and Statistics (approximately 19 items).

The reporting scale for the Praxis Algebra I (5162) test ranges from 100 to 200 scaled-score points. Attachment 2: *Test at a Glance* provides representative descriptions of topics covered in each category.

Costs associated with the administration of Praxis tests will be incurred by the ETS. Test takers are required to pay test fees.

Multistate Standard-Setting Study

The multistate standard-setting study is detailed in Attachment 1. The multistate panel recommended a passing score of 32 out of a possible 50 raw-score points. The scaled score associated with a raw score of 32 is 157 on a 100 to 200 scale.

The multistate standard-setting study provides the estimated Conditional Standard Error of Measurement (CSEM). The CSEM is a statistical phenomenon and is unrelated to the accuracy of scoring. All test results are subject to the standard error of measurement. If a test taker were to take the same test repeatedly, with no change in the test takers level of knowledge and preparation, it is possible that some of the resulting scores would be slightly higher or slightly lower than the scores that precisely reflect the test taker's actual level of knowledge or ability. The difference between a test taker's actual score and their highest or lowest hypothetical score is known as the standard error of measurement.

The CSEM for the recommended passing scores for multistate standard-setting study are shown below. Note that consistent with the recommended passing score, the passing scores at the different CSEM have been rounded to the next highest number, and the rounded values are converted to scaled scores.

Conditional Standard Error of Measurement Summaries
Algebra I (5162)

Passing Scores Within 1 and 2 CSEM of the Recommended Passing Score – Multistate Panel

Recommended passing score (CSEM)		Scale score equivalent
32 (3.43)		157
-2 CSEM	26	140
-1 CSEM	29	148
+1 CSEM	36	168
+2 CSEM	39	176

At the November 14, 2016, meeting, the Advisory Board on Teacher Education and Licensure recommended that the Virginia Board of Education approve the use of the Praxis Algebra I (5162) test as an option to add the Mathematics – Algebra I (add-on) endorsement in accordance with licensure regulations and set a passing score of 148 for the test. The passing score recommended by the Advisory Board is one CSEM below the multi-state panel recommended score. The rationale for ABTEL's recommendation is that the Algebra I (5162) test is a new assessment, and no performance data are available at this time. The Advisory Board also recommended that the passing score be reviewed after sufficient performance data become available for the test.

Impact on Fiscal and Human Resources:
Costs associated with the administration of the Praxis Algebra I (5162) assessment will be incurred by the Educational Testing Service. Prospective teachers are required to pay test fees.

Timetable for Further Review/Action:
Upon approval by the Board of Education, school divisions and institutions of higher education will be notified regarding (1) the use of the Praxis Algebra I (5162) test as an option to add the Mathematics – Algebra I (add-on) endorsement to a teaching license and (2) the passing score for the assessment.

Superintendent's Recommendation:
The Superintendent of Public Instruction recommends that the Board of Education approve the Advisory Board on Teacher Education and Licensure's recommendation to: (1) approve the use of the Praxis Algebra I (5162) test as a professional teacher's assessment as an option to add the Mathematics – Algebra I (add-on) endorsement to a teaching license as prescribed by the licensure regulations; (2) set a passing score of 148 for the test; and (3) review the passing score after sufficient performance data become available.

Rationale:
The Algebra I (5162) test will allow individuals with a teaching license to add the Mathematics – Algebra I (add-on) endorsement by testing in accordance with the licensure regulations. The rationale for ABTEL's recommendation to set the passing score one CSEM below the multi-state panel's recommended score is that the Algebra I (5162) test is a new assessment, and no performance data are available at this time. The Advisory Board also recommended that the passing score be reviewed after sufficient performance data become available for the test.

ATTACHMENTS

ATTACHMENT 1

Multistate Standard-Setting Technical Report

***Praxis*® ALGEBRA I (5162)**

October 2016

ATTACHMENT 2

Test at a Glance

***Praxis*® ALGEBRA I (5162)**

ATTACHMENT 1

Multistate Standard-Setting Technical Report

Praxis® ALGEBRA I (5162)

October 2016

Listening. Learning. Leading.®

Measuring the Power of Learning.™

Multistate Standard-Setting Technical Report

PRAXIS® ALGEBRA I (5162)

Licensure and Credentialing Research

ETS

Princeton, New Jersey

October 2016

EXECUTIVE SUMMARY

To support the decision-making process of education agencies establishing a passing score (cut score) for the *Praxis*® Algebra I (5162) test, research staff from Educational Testing Service (ETS) designed and conducted a multistate standard-setting study.

PARTICIPATING STATES

Panelists from 13 states were recommended by their respective education agencies. The education agencies recommended panelists with (a) experience as either algebra teachers or college faculty who prepare algebra teachers and (b) familiarity with the knowledge and skills required of beginning algebra teachers.

RECOMMENDED PASSING SCORE

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the *Praxis* Algebra I test, the recommended passing score is 32 out of a possible 50 raw-score points. The scale score associated with a raw score of 32 is 157 on a 100–200 scale.

To support the decision-making process for education agencies establishing a passing score (cut score) for the *Praxis*® Algebra I (5162) test, research staff from ETS designed and conducted a multistate standard-setting study in September 2016 in Princeton, New Jersey. Education agencies[1] recommended panelists with (a) experience as either algebra teachers or college faculty who prepare algebra teachers and (b) familiarity with the knowledge and skills required of beginning algebra teachers. Thirteen states (Table 1) were represented by 18 panelists. (See Appendix A for the names and affiliations of the panelists.)

Table 1
Participating States and Number of Panelists

Alaska (1 panelist)	South Carolina (1 panelist)
Colorado (1 panelist)	South Dakota (1 panelist)
Hawaii (1 panelist)	Tennessee (3 panelists)
Kansas (1 panelist)	Virginia (2 panelists)
Louisiana (1 panelist)	West Virginia (1 panelist)
Maryland (2 panelists)	Wyoming (1 panelist)
New Jersey (2 panelists)	

The following technical report contains three sections. The first section describes the content and format of the test. The second section describes the standard-setting processes and methods. The third section presents the results of the standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to education agencies. In each state, the department of education, the board of education, or a designated educator licensure board is responsible for establishing the operational passing score in accordance with applicable regulations. This study provides a recommended passing score, which represents the combined judgments of a group of experienced educators. Each state may want to consider the recommended passing score but also other sources of information when setting the final *Praxis* Algebra I passing score (see Geisinger & McCormick, 2010). A state may accept the recommended passing score, adjust the score upward to reflect more stringent expectations, or adjust the score downward to reflect more lenient

[1] States and jurisdictions that currently use *Praxis* tests were invited to participate in the multistate standard-setting study.

expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the state's needs.

Two sources of information to consider when setting the passing score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of the *Praxis* Algebra I test score and the latter, the reliability of panelists' passing-score recommendation. The SEM allows a state to recognize that any test score on any standardized test—including a *Praxis* Algebra I test score—is not perfectly reliable. A test score only *approximates* what a candidate truly knows or truly can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows a state to gauge the likelihood that the recommended passing score from the current panel would be similar to the passing scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a passing score consistent with the recommended passing score. The larger the SEJ, the less likely the recommended passing score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), each state should consider the likelihood of classification errors. That is, when adjusting a passing score, policymakers should consider whether it is more important to minimize a false-positive decision or to minimize a false-negative decision. A false-positive decision occurs when a candidate's test score suggests that he should receive a license/certificate, but his actual level of knowledge/skills indicates otherwise (i.e., the candidate does not possess the required knowledge/skills). A false-negative decision occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The state needs to consider which decision error is more important to minimize.

OVERVIEW OF THE *PRAXIS*® ALGEBRA I TEST

The Praxis® Algebra I *Test at a Glance* document (ETS, in press) describes the purpose and structure of the test. In brief, the test measures whether entry-level Algebra I teachers have the knowledge/skills believed necessary for competent professional practice.

The two-and-a-half-hour assessment contains 60 selected-response and numeric entry items[2] covering three content areas: *Principles of Algebra* (approximately 23 items), *Functions* (approximately 18 items), and *Number and Quantity; Probability and Statistics* (approximately 19 items).[3] The reporting scale for the *Praxis* Algebra I test ranges from 100 to 200 scale-score points.

PROCESSES AND METHODS

The design of the standard-setting study included an expert panel. Before the study, panelists received an email explaining the purpose of the standard-setting study and requesting that they review the content specifications for the test. This review helped familiarize the panelists with the general structure and content of the test.

The standard-setting study began with a welcome and introduction by the meeting facilitator. The facilitator described the test, provided an overview of standard setting, and presented the agenda for the study. Appendix B shows the agenda for the panel meeting.

REVIEWING THE TEST

The standard-setting panelists first took the test and then discussed it. This discussion helped bring the panelists to a shared understanding of what the test does and does not cover, which serves to reduce potential judgment errors later in the standard-setting process.

The test discussion covered the major content areas being addressed by the test. Panelists were asked to remark on any content areas that would be particularly challenging for entry-level teachers or areas that address content particularly important for entry-level teachers.

[2] Ten of the 60 selected-response and numeric entry items are pretest items and do not contribute to a candidate's score.
[3] The number of items for each content area may vary slightly from form to form of the test.

DEFINING THE JUST QUALIFIED CANDIDATE

Following the review of the test, panelists described the just qualified candidate. The *just qualified candidate description* plays a central role in standard setting (Perie, 2008); the goal of the standard-setting process is to identify the test score that aligns with this description.

The panel created a description of the just qualified candidate —the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate. To create this description, the panel first split into smaller groups to consider the just qualified candidate. The full panel then reconvened and, through whole-group discussion, determined the description of the just qualified candidate to use for the remainder of the study.

The written description of the just qualified candidate summarized the panel discussion in a bulleted format. The description was not intended to describe all the knowledge and skills of the just qualified candidate but only highlight those that differentiate a *just* qualified candidate from a *not quite* qualified candidate. The written description was distributed to panelists to use during later phases of the study (see Appendix C for the just qualified candidate description).

PANELISTS' JUDGMENTS

The standard-setting process for the *Praxis* Algebra I test was a probability-based Modified Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006). In this study, each panelist judged each item on the likelihood (probability or chance) that the just qualified candidate would answer the item correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that the just qualified candidate would answer the item correctly because the item is difficult for the just qualified candidate. The higher the value, the more likely it is that the just qualified candidate would answer the item correctly.

Panelists were asked to approach the judgment process in two stages. First, they reviewed both the description of the target candidate and the item and decided if, overall, who difficult the item would be for the just qualified candidate. The facilitator encouraged the panelists to consider the following rules of thumb to guide their decision:

- Items in the 0 to .30 range were those the just qualified candidate would have a low chance of answering correctly.
- Items in the .40 to .60 range were those the just qualified candidate would have a moderate chance of answering correctly.
- Items in the .70 to 1 range were those that the just qualified candidate would have a high chance of answering correctly.

Next, panelists decided how to refine their judgment within the range. For example, if a panelist thought that there was a high chance that the just qualified candidate would answer the question correctly, the initial decision would be in the .70 to 1 range. The second decision for the panelist was to judge if the likelihood of answering it correctly is .70, .80, .90, .95 or 1.

After the training, panelists made practice judgments and discussed those judgments and their rationales. All panelists completed a post-training evaulation to confirm that they had received adequate training and felt prepared to continue; the standard-setting process continued only if all panelists confirmed their readiness.

Following this first round of judgments (*Round 1*), item-level feedback was provided to the panel. The panelists' judgments were displayed for each item and summarized across panelists. Items were

highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located an item in the same difficulty range) or diverged in their judgments.

The panelists discussed their item-level judgments. These discussions helped panelists maintain a shared understanding of the knowledge/skills of the just qualified candidate and helped to clarify aspects of items that might not have been clear to all panelists during the Round 1 judgments. The purpose of the discussion was not to encourage panelists to conform to another's judgment, but to understand the different relevant perspectives among the panelists.

In Round 2, panelists discussed their Round 1 judgments and were encouraged by the facilitator (a) to share the rationales for their judgments and (b) to consider their judgments in light of the rationales provided by the other panelists. Panelists recorded their Round 2 judgments only for items when they wished to change a Round 1 judgment. Panelists' final judgments for the study, therefore, consist of their Round 1 judgments and any adjusted judgments made during Round 2.

RESULTS

EXPERT PANELS

Table 2 presents a summary of the panelists' demographic information. The panel included 18 educators representing 13 states. (See Appendix A for a listing of panelists.) Seven panelists were teachers, four were college faculty, four were administrators or department heads, and three held other positions. All four faculty members' job responsibilities included the training of teachers candidates who would teach Algebra I courses.

Table 2

Panel Member Demographics

	N	%
Current position		
Teacher	7	39
Administrator/Department Head	4	22
College Faculty	4	22
Mathematics Mentor/Coach	2	11
State Mathematics Content Specialist	1	6
Race		
White	12	67
Black	4	22
Asian	2	11
Gender		
Female	14	78
Male	4	22
Are you currently certified to teach this subject in your state?		
Yes	14	78
No	4	22
Are you currently teaching this subject in your state?		
Yes	14	78
No	4	22
Are you currently supervising or mentoring other teachers of this subject?		
Yes	14	78
No	4	22
At what K–12 grade level are you currently teaching this subject?		
Middle School (6–8 or 7–9)	3	17
High School (9–12 or 10–12)	6	33
Middle and High School	1	6
All Grades	1	6
Not currently teaching at the K–12 level	7	39
Including this year, how many years of experience do you have teaching this subject?		
4–7 years	2	11
8–11 years	7	39
12–15 years	1	6
16 years or more	8	44

Table 2 (continued)
Panel Member Demographics

	N	%
Which best describes the location of your K–12 school?		
Urban	4	22
Suburban	3	17
Rural	4	22
Not currently working at the K–12 level	7	39
If you are college faculty, are you currently involved in the training/preparation of teacher candidates in this subject?		
Yes	4	22
No	0	0
Not college faculty	14	78

STANDARD-SETTING JUDGMENTS

Table 3 summarizes the standard-setting judgments of panelists. The table shows the passing scores—the number of raw points needed to pass the test—recommended by each panelist.

Table 3 also includes estimate of the measurement error associated with the judgments: the standard deviation of the mean and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability or consistency of a panel's standard-setting judgments.[4] It indicates how likely it would be for several other panels of educators similar in makeup, experience, and standard-setting training to the current panel to recommend the same passing score on the same form of the test.

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists' judgments — was observed (see Table 3). The Round 2 average score is the panel's recommended passing score.

[4] An SEJ assumes that panelists are randomly selected and that standard-setting judgments are independent. It is seldom the case that panelists are randomly sampled, and only the first round of judgments may be considered independent. The SEJ, therefore, likely underestimates the uncertainty of passing scores (Tannenbaum & Katz, 2013).

Table 3

Passing Score Summary by Round of Judgments

Panelist	Round 1	Round 2
1	32.00	28.90
2	33.05	30.30
3	26.80	27.85
4	35.75	31.65
5	29.80	29.20
6	33.80	33.20
7	30.75	30.60
8	33.25	31.40
9	36.30	35.90
10	35.00	34.50
11	36.45	35.05
12	34.65	33.60
13	34.40	31.60
14	29.10	30.30
15	33.90	32.70
16	27.00	27.85
17	31.80	28.50
18	31.20	31.60
Average	32.50	31.37
Lowest	26.80	27.85
Highest	36.45	35.90
SD	2.94	2.44
SEJ	0.69	0.57

The panel's passing score recommendation for the *Praxis* Algebra I test is 31.37 (out of a possible 50 raw-score points). The value was rounded to the next highest whole number, 32, to determine the functional recommended passing score. The scale score associated with 32 raw points is 157.

Table 4 presents the estimated conditional standard error of measurement (CSEM) around the recommended passing score. A standard error represents the uncertainty associated with a test score. The scale scores associated with one and two CSEM above and below the recommended passing score are provided. The conditional standard error of measurement provided is an estimate.

Table 4

***Passing Scores Within 1 and 2 CSEM of the Recommended Passing Score*[5]**

Recommended passing score (CSEM)		Scale score equivalent
32 (3.43)		157
-2 CSEM	26	140
-1 CSEM	29	148
+ 1 CSEM	36	168
+ 2 CSEM	39	176

***Note.* CSEM = conditional standard error(s) of measurement.**

FINAL EVALUATIONS

The panelists completed an evaluation at the conclusion of their standard-setting study. The evaluation asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. The responses to the evaluation provided evidence of the validity of the standard-setting process, and, as a result, evidence of the reasonableness of the recommended passing score.

Panelists were also shown the panel's recommended passing score and asked (a) how comfortable they are with the recommended passing score and (b) if they think the score was too high, too low, or about right. A summary of the final evaluation results is presented in Appendix D.

All panelists *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *strongly agreed* or *agreed* that they were prepared to make their standard-setting judgments. All panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the description of the just qualified candidate was at least *somewhat influential* in guiding their standard-setting judgments; 16 of the 18 panelists indicated the description was *very influential*. All of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Two-thirds of the panelists (12 of the 18 panelists) indicated that their own professional experience was *very influential* in guiding their judgments.

All but one of the panelists indicated they were *very comfortable* with the passing score they recommended; one panelist was *somewhat comfortable*. Seventeen of the 18 panelists indicated the

[5] The unrounded CSEM value is added to or subtracted from the rounded passing-score recommendation. The resulting values are rounded up to the next-highest whole number and the rounded values are converted to scale scores.

recommended passing score was *about right* with the remaining panelist indicating that the passing score was *too low*.

SUMMARY

To support the decision-making process for education agencies establishing a passing score (cut score) for the *Praxis* Algebra I test, research staff from ETS designed and conducted a multistate standard-setting study.

ETS provides a recommended passing score from the multistate standard-setting study to help education agencies determine an appropriate operational passing score. For the *Praxis* Algebra I test, the recommended passing score is 32 out of a possible 50 raw-score points. The scale score associated with a raw score of 32 is 157 on a 100–200 scale.

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APPENDIX A

PANELISTS' NAMES & AFFILIATIONS

Participating Panelists With Affiliation

Panelist	**Affiliation**
Lisa Choate	Cannon County High School (TN)
Kusumam Daniel	Abraham Clark High School (NJ)
Raven Hawes	iZone Memphis Shelby County Schools (TN)
Stanetta Henryhand	Richland Northeast High School (SC)
Kimberly Herring	Cumberland County High School (TN)
Myrtle Holland	Musselman Middle School (WV)
Raymond Johnson	Colorado Department of Education (CO)
Shannon Kent	Kaw Valley USD 321 (KS)
Judy Kite	South High School (WY)
Christine Larson	South Dakota State University (SD)
Nicole Marshall	Washington County Public Schools (MD)
Rachel McCloskey	Chalmette High School (LA)
Edward Nolan	Towson University (MD)
Victoria Prizovskaya	Elizabeth School District (NJ)
Dana Scabis	Fairfax County Public Schools (VA)
Mani Sehgal	Hawaii Pacific University (HI)
John Travis	Virginia State University (VA)
Samantha Wuttig	Fairbanks North Star Borough School District (AK)

APPENDIX B

STUDY AGENDA

AGENDA

Praxis® Algebra I (5162)
Standard-Setting Study

Day 1

Welcome and Introduction

Overview of Standard Setting and the *Praxis* Algebra I Test

Review the *Praxis* Algebra I Test

Break

Discuss the *Praxis* Algebra I Test

Define the Knowledge/Skills of a Just Qualified Candidate

Lunch

Define the Knowledge/Skills of a Just Qualified Candidate (*continued*)

Break

Standard-Setting Training

Round 1 Standard Setting Judgments

Collect Materials; End of Day 1

AGENDA

Praxis® Algebra I (5162)
Standard-Setting Study

Day 2

Overview of Day 2

Round 1 Feedback and Round 2 Judgments

Break

Round 1 Feedback and Round 2 Judgments (*continued*)

Lunch

Feedback on Round 2 Recommended Passing Score

Complete Final Evaluation

Collect Materials; End of Study

APPENDIX C

JUST QUALIFIED CANDIDATE DESCRIPTION

Description of the Just Qualified Candidate[6]

A just qualified candidate …

I. Principles of Algebra

1. Understand, interpret, and use algebraic expressions (i.e., all forms of linear, some forms of quadratic, at least one form of exponential)
2. Understands how to use visual and mathematical representations for situations (and represent constraints) with most equations and linear inequalities
3. Understands the reasoning process in justifying the solution of equations and inequalities using varied techniques
4. Knows the varied techniques used to solve systems of equations and inequalities
5. Is familiar with the concept of rate of change of nonlinear functions
6. Interprets the concepts of intercept(s) of a line and slope as a rate of change

II. Functions

7. Understands the concept of function and knows function notation
8. Identify the basic key features (e.g., maximum, minimum, domain range) of functions expressed using multiple representations
9. Knows how to use functions and relations to interpret and model relationships between quantities
10. Is familiar with basic transformations and operations of functions
11. Knows the characteristics of linear, quadratic and exponential models given varied representations

III. Number and Quantity; Probability and Statistics

12. Understands the properties of integer exponents
13. Knows and uses properties of radicals and rational exponents
14. Identifies the results of mathematical operations on rational and irrational numbers
15. Knows how to use units and quantities to interpret the reasonableness of the solution for a given situation (i.e., conversions, contextually or graphically)
16. Knows how to create and interpret data on a single variable (e.g., dotplots, histograms, and boxplots)
17. Understands how to create and interpret scatterplots including linear regression models
18. Identifies how to compute probability of simple and compound events

[6] Description of the just qualified candidate focuses on the knowledge/skills that differentiate a *just* from a *not quite* qualified candidate.

APPENDIX D

FINAL EVALUATION RESULTS

Table D1

Final Evaluation

	Strongly agree		Agree		Disagree		Strongly disagree	
	N	**%**	***N***	**%**	***N***	**%**	***N***	**%**
• I understood the purpose of this study.	18	100	0	0	0	0	0	0
• The instructions and explanations provided by the facilitator were clear.	18	100	0	0	0	0	0	0
• The training in the standard-setting method was adequate to give me the information I needed to complete my assignment.	17	94	1	6	0	0	0	0
• The explanation of how the recommended passing score is computed was clear.	18	100	0	0	0	0	0	0
• The opportunity for feedback and discussion between rounds was helpful.	18	100	0	0	0	0	0	0
• The process of making the standard-setting judgments was easy to follow.	17	94	1	6	0	0	0	0

Table D1 (continued)

Final Evaluation

How influential was each of the following factors in guiding your standard-setting judgments?	Very influential		Somewhat influential		Not influential	
	N	%	*N*	%	*N*	%
• The description of the just qualified candidate	16	89	2	11	0	0
• The between-round discussions	14	78	4	22	0	0
• The knowledge/skills required to answer each test item	13	72	5	28	0	0
• The passing scores of other panel members	1	6	15	83	2	11
• My own professional experience	12	67	6	33	0	0

	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable	
	N	%	*N*	%	*N*	%	*N*	%
• Overall, how comfortable are you with the panel's recommended passing score?	17	94	1	6	0	0	0	0

	Too low		About right		Too high	
	N	%	*N*	%	*N*	%
• Overall, the recommended passing score is:	1	6	17	94	0	0

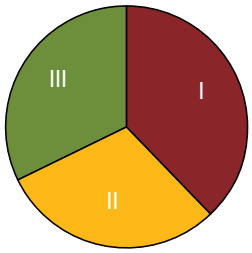
ATTACHMENT 2

Test at a Glance

Praxis® ALGEBRA I (5162)

Algebra I (5162)

Test at a Glance	
Test Name	Algebra I
Test Code	5162
Time	150 minutes
Number of Questions	60
Format	Selected-response and numeric-entry questions; on-screen graphing calculator provided.
Test Delivery	Computer delivered



	Content Categories	Approximate Number of Questions	Approximate Percentage of Examination
I.	Principles of Algebra	23	38%
II.	Functions	18	30%
III.	Number and Quantity; Probability and Statistics	19	32%

About This Test

The *Praxis* Algebra I test is designed to assess the mathematical knowledge and competencies necessary for a beginning Algebra I teacher. Examinees have typically completed a bachelor's program with an emphasis in mathematics or mathematics education. The examinee will be required to understand and work with mathematical concepts, to reason mathematically, to make conjectures, to see patterns, to justify statements using informal logical arguments, and to construct simple proofs. Additionally, the examinee will be expected to solve problems by integrating knowledge from different areas of mathematics, to use various representations of concepts, to solve problems that have several solution paths, and to develop mathematical models and use them to solve real-world problems.

The test is not designed to be aligned with any particular school mathematics curriculum, but it is intended to be consistent with the recommendations of national studies on mathematics education, such as the National Governors Association Center for Best Practices and the Council of Chief State School Officers Common Core State Standards in Mathematics (2010), the National Council of Teachers of Mathematics (NCTM) and the Council of the Accreditation of Educator Preparation (CAEP) NCTM CAEP Standards (2012), and the NCTM Principles and Standards for School Mathematics (2000).

This test may contain some questions that will not count toward your score.

Test Specifications

Test specifications describe the knowledge and skills measured by the test. Study topics to help you prepare to answer test questions can be found on page 28.

I. Principles of Algebra

A. Understands how to write algebraic expressions in equivalent forms

1. Interprets the parts of an expression (e.g., terms, factors, coefficients)
2. Uses the structure of an expression to identify ways to rewrite it
3. Understands how to rewrite quadratic expressions for specific purposes (e.g., factoring/finding zeros, completing the square/finding maxima or minima)
4. Uses the properties of exponents to rewrite expressions for exponential functions

B. Understands how to perform arithmetic operations on polynomials

1. Adds, subtracts, and multiplies polynomials

C. Understands how to create equations and inequalities that describe relationships

1. Creates equations and inequalities in one variable and uses them to solve problems and graph solutions on the number line
2. Creates equations and inequalities to represent relationships between quantities, solves problems, and graphs them on the coordinate plane with labels and scales
3. Represents constraints by equations, inequalities, or systems of equations and/or inequalities and interprets solutions as viable or nonviable options in a modeling context
4. Rearranges formulas to highlight a quantity of interest (e.g., solve $d = rt$ for t)

D. Understands how to justify the reasoning process used to solve equations

1. Explains each step in solving a simple equation

E. Understands how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities

1. Solves linear equations and inequalities, including equations with coefficients represented by letters
2. Uses the method of completing the square to transform any quadratic equation in x into the equivalent form $(x - p)^2 = q$
3. Solves equations using a variety of methods (e.g., using graphs, using the quadratic formula, factoring)
4. Uses different methods (e.g., discriminant analysis, graphical analysis) to determine the nature of the solutions of a quadratic equation

F. Understands how varied techniques (e.g., graphical, algebraic) are used to solve systems of equations and inequalities

1. Explains why, when solving a system of two equations using the elimination method, replacing one or both equations with a scalar multiple produces a system with the same solutions as the solutions of the original system
2. Solves a system consisting of two linear equations in two variables algebraically and graphically
3. Solves a system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically
4. Explains why the x-coordinates of the intersection points of the graphs of $y = f(x)$ and $y = g(x)$ are the solutions of $f(x) = g(x)$
5. Finds the solutions of $f(x) = g(x)$ approximately (e.g., uses technology to graph the functions, makes tables of values, finds successive approximations); includes cases where $f(x)$ and/or $g(x)$ are linear, quadratic, or exponential functions
6. Graphs the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality) and graphs the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes

G. Understands the concept of rate of change of nonlinear functions

1. Calculates and interprets the average rate of change of a function presented symbolically, numerically, or graphically over a specified interval

H. Understands the concepts of intercept(s) of a line and slope as a rate of change

1. Calculates and interprets the intercepts of a line
2. Calculates and interprets the slope of a line presented symbolically, numerically, or graphically
3. Estimates the rate of change of a linear function from a graph

II. Functions

A. Understands the function concept and the use of function notation

1. Understands that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range
2. Uses function notation, evaluates functions, and interprets statements that use function notation in terms of a context
3. Recognizes that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers
4. Determines the domain and range of a function from a function rule (e.g., $f(x) = 2x + 1$), graph, set of ordered pairs, or table

B. Understands how function behavior is analyzed using different representations (e.g., graphs, mappings, tables)

1. For a function that models a relationship between two quantities, interprets key features of graphs and tables (e.g., increasing/decreasing, maximum/minimum) in terms of the quantities
2. Given a verbal description of a relation, sketches graphs that show key features of that relation
3. Graphs functions (i.e., linear, quadratic, exponential, piecewise, absolute value, step) expressed symbolically and identifies key features of the graph
4. Writes a function that is defined by an expression in different but equivalent forms to reveal different properties of the function (e.g., zeros, extreme values, symmetry of the graph)
5. Interprets the behavior of exponential functions (e.g., growth, decay)
6. Understands how to determine whether a function is odd, even, or neither, and any resulting symmetries

C. Understands how functions and relations are used to model relationships between quantities

1. Writes a function that relates two quantities
2. Determines an explicit expression or a recursive process that builds a function from a context
3. Writes arithmetic and geometric sequences both recursively and with an explicit formula, and uses them to model situations
4. Translates between recursive and explicit forms of arithmetic and geometric sequences

D. Understands how new functions are obtained from existing functions (e.g., transformations, inverses)

1. Describes how the graph of $g(x)$ is related to the graph of $f(x)$, where $g(x) = f(x) + k$, $g(x) = k\,f(x)$, $g(x) = f(kx)$, or $g(x) = f(x + k)$ for specific values of k (both positive and negative) and finds the value of k given the graphs
2. Determines whether a function has an inverse and writes an expression for the inverse
3. Combines standard function types using arithmetic operations
4. Performs domain analysis on functions resulting from arithmetic operations

E. Understands differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems

1. Understands that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals
2. Recognizes situations in which one quantity changes at a constant rate per unit interval relative to another
3. Recognizes situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another
4. Constructs linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (including reading these from a table)
5. Observes that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function
6. Interprets the parameters in a linear or exponential function in terms of a context (e.g., $A(t) = Pe^{rt}$)
7. Uses quantities that are inversely related to model phenomena

III. Number and Quantity; Probability and Statistics

A. Understands the properties of radicals and exponents

1. Performs operations involving exponents, including negative and rational exponents
2. Demonstrates an understanding of the properties of exponential expressions
3. Uses the properties of radicals and exponents to rewrite expressions that have radicals or rational exponents
4. Represents and compares very large and very small numbers (e.g., scientific notation, orders of magnitude)
5. Uses order of magnitude to estimate very large and very small numbers
6. Performs calculations on numbers in scientific notation

B. Understands the properties of rational and irrational numbers

1. Recognizes that the sum or product of two rational numbers is rational
2. Recognizes that the sum of a rational number and an irrational number is irrational
3. Recognizes that the product of a nonzero rational number and an irrational number is irrational
4. Recognizes that the sum or product of two irrational numbers can be rational or irrational

C. Understands how to reason quantitatively and use units to solve problems

1. Uses units as a way to understand problems and guide the solution of multistep problems
2. Chooses and interprets units consistently in formulas
3. Chooses and interprets the scale and the origin in graphs and data displays
4. Recognizes the reasonableness of results within the context of a given problem
5. Chooses a level of accuracy appropriate to limitations on measurement when reporting quantities

D. Understands how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., boxplots, dotplots, normal distributions)

1. Represents data with plots on the real number line (e.g., dotplots, histograms, and boxplots)
2. Uses statistics appropriate to the shape of the data distribution to compare center (e.g., median, mean) and spread (e.g., interquartile range, standard deviation) of two or more different data sets
3. Interprets differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers

E. Understands how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series)

1. Summarizes and interprets categorical data for two categories in two-way frequency tables (e.g., joint, marginal, conditional relative frequencies)
2. Recognizes possible associations and trends in the data
3. Represents data for two quantitative variables on a scatterplot, and describes how the variables are related

F. Understands how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient)

1. Uses technology to fit a function to data (i.e., linear regression) and determines a linear correlation coefficient
2. Uses functions fitted to data to solve problems in the context of the data
3. Assesses the fit of a function by plotting and analyzing residuals
4. Interprets the slope and the intercept of a regression line in the context of the data
5. Interprets a linear correlation coefficient
6. Distinguishes between correlation and causation

G. Understands how to compute probabilities of simple and compound events

1. Calculates probabilities of simple and compound events