Minnesota Department of Education

Minnesota Comprehensive Assessments Series II (MCA-II)

Test Specifications for Grade 11 Mathematics

October 1, 2010

MINNESOTA DEPARTMENT OF EDUCATION

MCA-II Test Specifications
for
Grade 11 Mathematics

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Last Revised
October 1, 2010

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THE MINNESOTA COMPREHENSIVE ASSESSMENTS–SERIES II

Introduction

The 1997 legislature enacted into law M.S. 121.113, Statewide Testing and Reporting System, which established annual testing of all students in grades three, five, eight and high school. The Minnesota Comprehensive Assessments (MCAs) in reading and mathematics fulfilled the requirements for statewide testing at grade three. The MCAs in reading, mathematics and writing fulfilled the testing requirement in grade five. The Basic Skills Tests (BSTs) in reading and mathematics, first given in grade eight, fulfilled the requirement for high school graduation. The grade ten writing test served as both BST and an MCA. The MCA reading test in grade ten and the MCA mathematics test in grade eleven were implemented in 2002. Finally, the grade seven MCAs in reading and mathematics were field tested in 2003 and implemented in 2004.

MCA test results are used to compare school sites and districts across the state and to provide feedback on curriculum and instruction in the new standards-based system. All students, including students in special education who are capable of testing and students designated with Limited English Proficiency (LEP), must take the MCAs regardless of anticipated test scores. Unlike the BSTs where students must earn a minimum score to earn a high school diploma, there is no required minimum MCA score for individual students.

The passage of the No Child Left Behind Act (2000) required that the MCAs be expanded to include reading and mathematics in grades 4, 6 and 8. The second generation of Reading and Mathematics MCAs, the MCA-IIs, are aligned with the 2003 Minnesota Academic Standards and became operational in 2006. The 2004 and 2005 administrations of the MCAs gave schools and districts the opportunity to transition to the new academic standards.

Following the 2009 Minnesota Legislative Session, House File 2 was signed into law. Among the numerous education policy and funding provisions in this bill was a qualification in how state funds can be used to support the assessment program. House File 2 prohibits the use of state funds in hand-scoring constructed-response items (CRs) on the Minnesota Comprehensive Assessments-Series II (MCA-II) in reading, science and mathematics, with the exception of mathematics grades 3 to 8 of the 2009–2010 school year. In Reading, constructed-response items were eliminated beginning in the 2009–2010 school year. In mathematics, constructed-response items were eliminated beginning in the 2010-2011 school year.

The test specifications for grade 11 of the MCA-IIs are presented in this document. The reader is encouraged to read the introductory information carefully because many important concepts are presented, including the purpose of the MCA-II, a description of the cognitive levels and other information about the format of the test specifications.

The Purpose of the Test Specifications

All tests, from off-the-shelf, norm-referenced tests (NRT) to customized, standards-based tests like those given in Minnesota, have test specifications. The primary purpose of a set of test specifications is to help test developers build a test that stays consistent over time. Test specifications indicate which strands, sub-strands, standards and benchmarks will be assessed on the test and in what proportions. In addition, test specifications provide the number of items, the type of items to be included and constraints on cognitive levels. Test specifications also clarify, define and/or limit how test items will be written to any given strand, sub-strand, standard or benchmark.

Test specifications do not indicate **what** should be taught: the Academic Standards do. Test specifications do not indicate **how** children should be taught: the classroom teacher does.

The test specifications presented in this document were developed over the course of many days by Minnesota teachers, many of whom were recommended by various education organizations, school districts and other stakeholder groups. The substantive parts of this document are true to their work. The Department thanks these people for their hard work and continued involvement.

The test specifications achieve the goal of a technically sound test that respects teachers' concern for the time students spend taking tests. These test specifications have taken into account the grade and age of the students involved as well as various pedagogical concerns.

As with any test, the MCA-II is a sampling of student knowledge and does not test every standard or benchmark. There are standards and benchmarks that cannot be assessed with a written standardized test. That does not mean that these skills should not be taught or assessed. Teachers need to instruct and assess their students on all of the Academic Standards. The following example illustrates standards that are not included in the MCA-II.

An Example from Grade 11 Mathematics

Strand II. Number Sense

Sub-strand B. Computation and Operation

Standard: Appropriately use calculators and other technologies to solve algebraic, geometric, probabilistic and statistical problems.

Benchmark 5: Students will understand the limitations of calculators such as missing or additional features on graphs due to viewing parameters or misleading representations of zero or very large numbers.

The 2003 Minnesota Academic Standards can be obtained from the Minnesota Department of Education website: (http://education.state.mn.us).

The Purpose of the MCA-II

The purpose of the MCA-II is to measure Minnesota students' achievement with regard to the 2003 Minnesota Academic Standards.

In addition, the MCA-II results can be used to inform curriculum decisions at the district and school level, inform instruction at the classroom level and demonstrate student academic growth from year to year.

Cognitive Levels

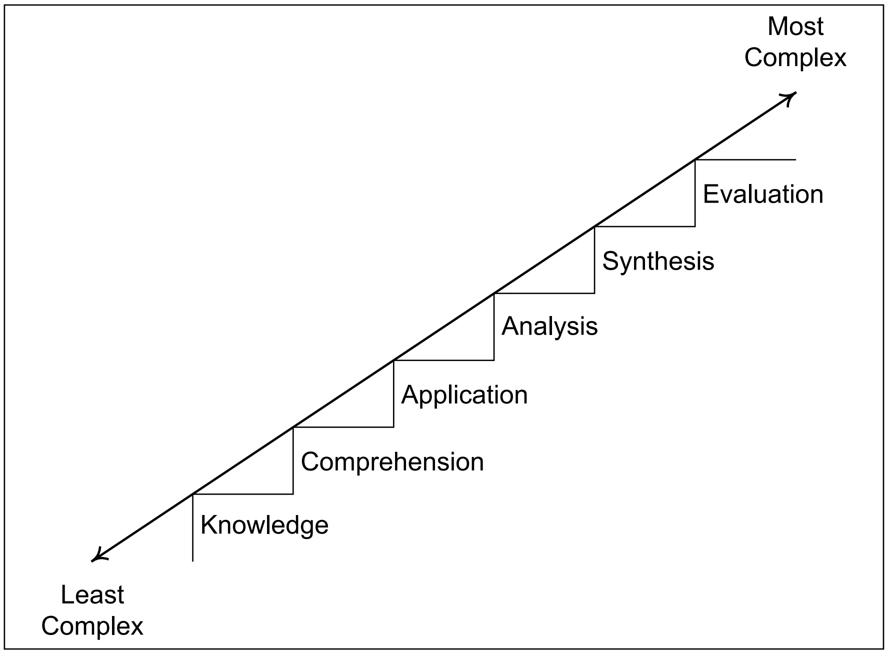
Using a taxonomy or framework to classify items and/or standards helps the test development process and helps teachers understand what students should learn, know and demonstrate at the end of instruction. One such taxonomy is that developed by Benjamin Bloom[1].

Bloom developed a classification of the levels of intellectual behavior. His taxonomy contained three overlapping domains: cognitive, psychomotor and affective. Within the cognitive domain,

[1] Bloom, B., Englehart, M. Furst, E., Hill, W., & Krathwohl, D. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain. New York, Toronto: Longmans, Green.

Bloom identified six levels of complexity ranging from simple recall or recognition of facts to more complex and abstract mental levels. Bloom found that over 95% of the test questions he looked at require students to think only at the lowest level, recall of information.

The following figure depicts Bloom's six levels of cognitive complexity. This structure provides a basis for the cognitive levels used in the MCA-II.



Knowledge: arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, reproduce and state.

Comprehension (Understanding)*: classify, describe, discuss, explain, express, identify, indicate, locate, report, restate, review, select and translate.

Application: apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use and write.

* These Item Specifications use *Understanding* in Level B instead of *Comprehension*. The term *comprehension* is a more global skill necessary at all cognitive levels of reading. *Understanding* is used to avoid confusion with the cognitive skill *comprehension* that is necessary for any level of reading.

Analysis: analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question and test.

Synthesis: arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up and write.

Evaluation: appraise, argue, assess, attach, choose, compare, defend, estimate, evaluate, judge, predict, rate, score, select, support and value.

The department uses this adaptation to align test items with academic standards. It also provides a familiar framework for understanding what students in Minnesota are expected to know and do in reading and mathematics upon the completion of a grade. Minnesota uses the following adaptation of Bloom's Taxonomy to classify both the academic standards and the items on the MCA-II.

Cognitive Level A: consists of Knowledge
Cognitive Level B: consists of Understanding*
Cognitive Level C: consists of Application, Analysis, Synthesis and Evaluation

This alignment will provide the most flexibility when developing the MCA-IIs.

* These Item Specifications use *Understanding* in Level B instead of *Comprehension*. The term *comprehension* is a more global skill necessary at all cognitive levels of reading. *Understanding* is used to avoid confusion with the cognitive skill *comprehension* that is necessary for any level of reading.

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MATHEMATICS

Introduction

As stated in the **Purpose of Test Specifications**, the test specifications indicate which strands, sub-strands, standards and/or benchmarks will be assessed. The following points specifically address the mathematics test specifications of the MCA-II.

Overall Considerations in Mathematics

Overall considerations are broad item development issues that should be addressed during the development of test items. Each of these issues should be considered for all of the items developed for MCA-IIs in mathematics.

1. Each item should be written to measure primarily one benchmark; however, other benchmarks may also be reflected in the item content. When benchmarks are combined for assessment, the individual specification indicates which benchmarks are combined.
2. Mathematical Reasoning standards will be assessed within the context of the standards in the remaining four content strands. Grade 11 will have 15–20% of the items double-coded to Mathematical Reasoning and one of the remaining four content strands.
3. Items should be appropriate for students in terms of grade-level difficulty and life experiences.
4. Items should range in difficulty from easy to challenging.
5. Items should not disadvantage or disrespect any segment of the population in regard to age, gender, race, ethnicity, language, religion, socioeconomic status, disability or geographic region.
6. Items should be written to meet benchmark calculator requirements as specified in the test specifications.
7. Each item should be written to clearly and unambiguously elicit the desired response.
8. A reference sheet of appropriate formulas and conversions is provided to students or use during testing.
9. Items should be written according to the MDE Guidelines for Test Construction.
10. Advisory Panels will review items as specified in the MDE Vendor Guide to Advisory Panels.

Cognitive Levels in Mathematics

As stated in the introduction of the test specifications, items for the MCA-IIs are written to assess three distinct cognitive levels: A, B and C (see pages 3–5). Using these cognitive levels to categorize items ensures that the complexity of the test items matches the complexity of the content domain assessed. Based on the benchmarks included in MCA-II in mathematics, the following table indicates the target minimum percent of test items at Cognitive Levels A, B and C.

Cognitive Level Target Minimum Distribution of Items in Mathematics

Grade	Level A	Level B	Level C
11	30%	30%	5%

Mathematics Test Design

This table provides the total number of items for grade 11. Multiple choice and gridded response items have a point value of one.

Grade Level	MC Items	GR Items	Total Items	Total Points
11	45	10	55	55

Math Item Percentages by Strand and Sub-strand

This table provides an overview of item number ranges for the strands (Roman numerals) assessed in mathematics.

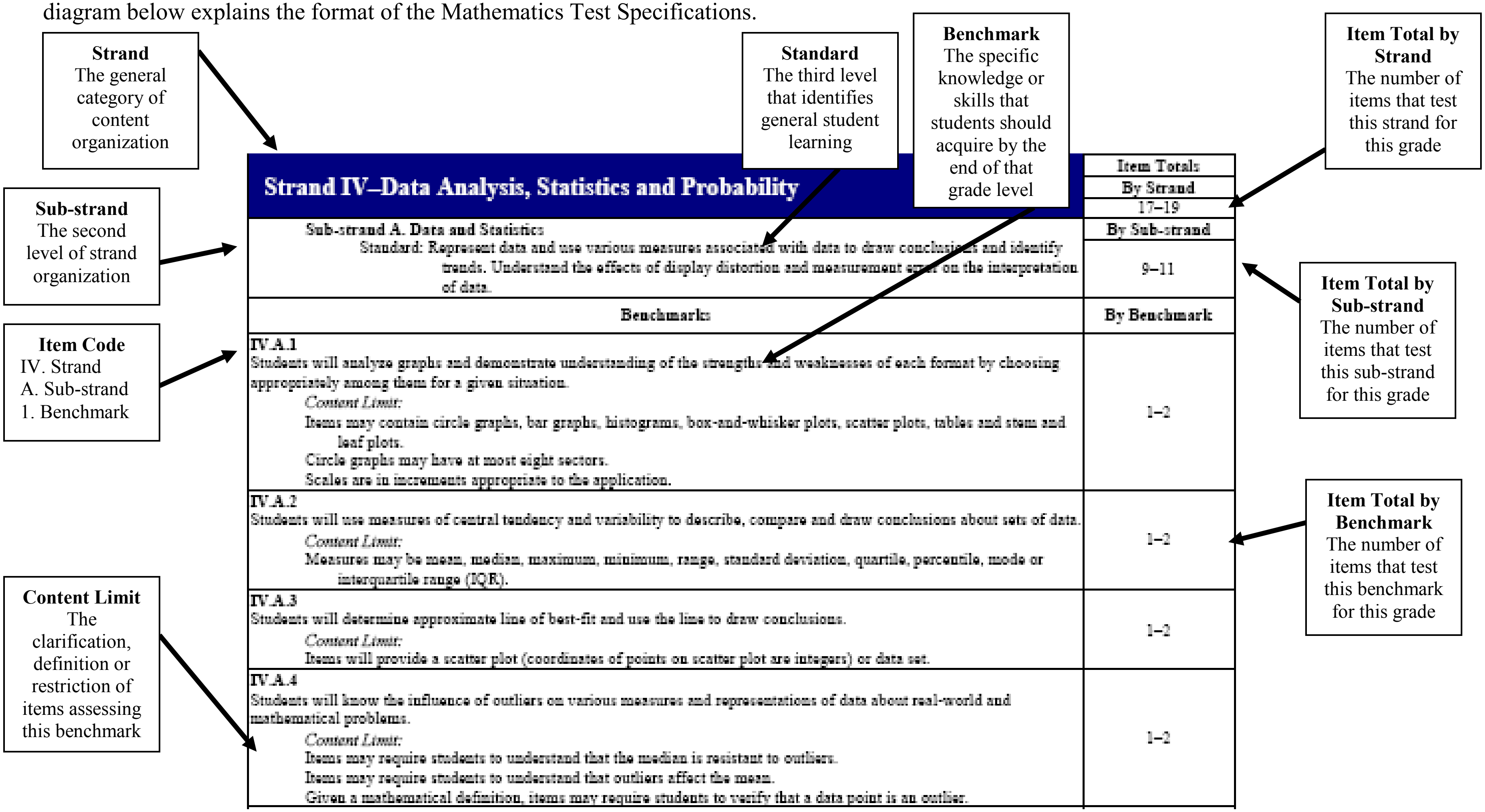
II: Number Sense **Sub-strand A**: Number Sense **Sub-strand B**: Computation and Operation	**Strand III**: Patterns, Functions and Algebra **Sub-strand A**: Patterns and Functions **Sub-strand B**: Algebra (Algebraic Thinking)	**Strand IV**: Data, Statistics and Probability **Sub-strand A**: Data and Statistics **Sub-strand B**: Probability	**Strand V**: Spatial Sense, Geometry and Measurement **Sub-strand A**: Spatial Sense **Sub-strand B**: Geometry **Sub-strand C**: Measurement

Grade Level	Strand II MC & GR	Strand III MC & GR	Strand IV MC & GR	Strand V MC & GR	TOTAL ITEMS	TOTAL POINTS
Grade 11	Embedded	20–22	17–19	16–18	**55**	**55 PTS**

MC: multiple-choice response
GR: gridded response
PTS: points assigned

A Guide to the Mathematics Grade Level Tables

The Test Specifications that follow provide information about how the Minnesota Academic Standards will be assessed on the MCA-II. The diagram below explains the format of the Mathematics Test Specifications.



Strand IV–Data Analysis, Statistics and Probability	Item Totals By Strand 17–19
Sub-strand A. Data and Statistics Standard: Represent data and use various measures associated with data to draw conclusions and identify trends. Understand the effects of display distortion and measurement error on the interpretation of data.	By Sub-strand 9–11
Benchmarks	By Benchmark
IV.A.1 Students will analyze graphs and demonstrate understanding of the strengths and weaknesses of each format by choosing appropriately among them for a given situation. *Content Limit:* Items may contain circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots, tables and stem and leaf plots. Circle graphs may have at most eight sectors. Scales are in increments appropriate to the application.	1–2
IV.A.2 Students will use measures of central tendency and variability to describe, compare and draw conclusions about sets of data. *Content Limit:* Measures may be mean, median, maximum, minimum, range, standard deviation, quartile, percentile, mode or interquartile range (IQR).	1–2
IV.A.3 Students will determine approximate line of best-fit and use the line to draw conclusions. *Content Limit:* Items will provide a scatter plot (coordinates of points on scatter plot are integers) or data set.	1–2
IV.A.4 Students will know the influence of outliers on various measures and representations of data about real-world and mathematical problems. *Content Limit:* Items may require students to understand that the median is resistant to outliers. Items may require students to understand that outliers affect the mean. Given a mathematical definition, items may require students to verify that a data point is an outlier.	1–2

An Explanation of Terms on the Mathematics Grade Level Tables

Strand: This is the most general categorization of content in the Minnesota Academic Standards.

Sub-strand: This is a subcategory of a strand in the Minnesota Academic Standards. Mathematics has two to three sub-strands in each strand.

Standard: This statement explains the general goal of student learning within each sub-strand. One standard exists in each sub-strand.

Benchmark: Each standard is divided into several benchmarks. The benchmark identifies the specific knowledge or skills that students should acquire by the end of that grade level.

Item Code: Test developers use this code to identify the strand, sub-strand and benchmark to which a test item is aligned.

Content Limit: These statements provide more specific clarifications, definitions or restrictions for the benchmark as it is assessed on the MCA-II.

Item Totals

By Strand: This number is the possible number of items that will be on the operational form from a specific strand.

By Sub-strand: This number is the total number of items measuring the sub-strand that could be on the test for the indicated standard. For example, in Grade 11 mathematics, 20–22 items are from Strand III. Of those 20–22 Strand III items, 7–9 items are from Sub-strand A (III.A.).

By Benchmark: The number of items on the operational MCA-II is listed next to each benchmark.

Grade 11

<table>
<tr><td rowspan="3">Strand II–Number Sense</td><td>Item Totals</td></tr>
<tr><td>By Strand</td></tr>
<tr><td>Embedded</td></tr>
<tr><td rowspan="2">Sub-strand A. Number Sense
Standard: Use real numbers, represented in a variety of ways, to quantify information and to solve real-world and mathematical problems.</td><td>By Sub-strand</td></tr>
<tr><td></td></tr>
<tr><td>Benchmarks</td><td>By Benchmark</td></tr>
<tr><td>II.A
These benchmarks are continued from grade 8 and embedded in algebra, probability and geometry in grade 11.</td><td>Embedded</td></tr>
</table>

Strand II–Number Sense	Item Totals By Strand *continued*
Sub-strand B. Computation and Operation Standard: Appropriately use calculators and other technologies to solve algebraic, geometric, probabilistic and statistical problems.	**By Sub-strand** Embedded
Benchmarks	**By Benchmark**
II.B.1 Students will apply the correct order of operations and grouping symbols when using calculators. *Content Limit:* This benchmark is assessed in Grade 8; it is embedded in other Grade 11 items.	Embedded
II.B.2 Students will translate calculator notational conventions to mathematical notation. *Content Limit:* Assessed only at the classroom level.	N/A
II.B.3 Students will recognize the impact of units such as degrees and radians on calculations. *Content Limit:* This benchmark is embedded in grade 11 items from Strand V.	Embedded
II.B.4 Students will recognize that applying an inverse function with a calculator may lead to extraneous or incomplete solutions. *Content Limit:* Assessed only at the classroom level.	N/A
II.B.5 Students will understand the limitations of calculators such as missing or additional features on graphs due to viewing parameters or misleading representations of zero or very large numbers. *Content Limit:* Assessed only at the classroom level.	N/A
II.B.6 Students will understand that use of a calculator requires appropriate mathematical reasoning and does not replace the need for mental computation. *Content Limit:* Assessed only at the classroom level.	N/A

Strand III–Patterns, Functions and Algebra	Item Totals By Strand 20–22
Sub-strand A. Patterns and Functions Standard: Represent and analyze real-world and mathematical problems using numeric, graphic and symbolic methods for a variety of functions.	**By Sub-strand** 7–9
Benchmarks	**By Benchmark**
III.A.1 Students will know the numeric, graphic and symbolic properties of linear, step, absolute value and quadratic functions. *Content Limit:* Items may include rates of change, intercepts, maxima and minima. Items may include intersection between two graphs. Step functions must model real-world situations. Step functions will not be represented symbolically.	1–2
III.A.2 Students will model exponential growth and decay. *Content Limit:* Models may be numeric, graphic and symbolic. When calculation is required, exponents must be integers. Items may have real-world context (e.g., bacterial growth, half-life, compound interest).	1–2
III.A.3 Students will analyze the effects of coefficient changes on linear and quadratic functions and their graphs. *Content Limit:* Changes to coefficients in $ax^2 + bx + c$ are limited to a and c.	1–2
III.A.4 Students will apply basic concepts of linear, quadratic and exponential expressions or equations in real-world problems. *Content Limit:* Exponents must be integers.	1–2
III.A.5 Students will distinguish functions from other relations using graphic and symbolic methods. *Content Limit:* Not more than 10 increments on either side of axes.	1–2

Strand III–Patterns, Functions and Algebra	Item Totals By Strand *continued*
Sub-strand B. Algebra (Algebraic Thinking) Standard: Solve simple equations and inequalities numerically, graphically and symbolically. Use recursion to model and solve real-world and mathematical problems.	**By Sub-strand** 13–15
Benchmarks	**By Benchmark**
III.B.1 Students will translate among equivalent forms of expressions. *Content Limit:* Items may include simplifying algebraic expressions involving nested pairs of parentheses and brackets; simplifying rational expressions; factoring a common monomial term from an expression; applying associative, commutative and distributive laws. A simplified expression should contain at most four terms with at most two variables per term.	1–2
III.B.2 Students will understand the relationship between absolute value and distance on the number line. Students will graph simple expressions involving absolute value. *Content Limit:* At most one absolute value on each side of the equation or inequality. Absolute values will be in the form of $\lvert x–b \rvert = c$; $\lvert x–b \rvert < c$, $\lvert x–b \rvert > c$; $\lvert x–b \rvert \leq c$; $\lvert x–b \rvert \geq c$ (e.g., $\lvert x–3 \rvert = 6$ or $\lvert x+2 \rvert <5$).	1–2
III.B.3 Students will find equations of a line. *Content Limit:* Items will provide two points on the line, a point and the slope of the line or the slope and y-intercept of the line. All answer options will be given in the same form within a MC item, either slope-intercept ($y = mx + b$) or standard form ($ax + by = c$).	1–2

III.B.4 Students will translate among equivalent forms of linear equations and inequalities. *Content Limit:* Translating may require simplification (e.g., $(2x + 2) + 2(x–4) = y$ translates to $y = 4x–6$). Equivalent forms may be slope-intercept, standard or two-point. All answer options will be given in the same form within a MC item, either slope-intercept ($y = mx + b$) or standard form ($ax + by = c$).	1–2
III.B.5 Students will use a variety of models to represent functions and patterns in real-world and mathematical problems. *Content Limit:* Models may include equations, inequalities, algebraic formulas, written statements, tables, graphs or spreadsheets of linear, quadratic, exponential, absolute value and step functions. Step functions must model real-world situations. Step functions will not be represented symbolically.	2–3
III.B.6 Students will apply the laws of exponents to perform operations on expressions with integer exponents. *Content Limit:* A simplified expression should contain at most two variables. Multiplication and division operations should only be performed on monomials. Items may include scientific notation with appropriate treatment of significant digits.	1–2
III.B.7 Students will solve linear equations and inequalities in one variable with numeric, graphic and symbolic methods. *Content Limit:* Forms of the linear equations or inequalities are not limited (e.g., $4(x + 5)–3x = 6(x + 10)$ is acceptable). Items may include context.	1–2
III.B.8 Students will determine solutions to quadratic equations in one variable with numeric, graphic and symbolic methods. *Content Limit:* All solutions are real. Solutions determined from a graph will be integer solutions. Items may include context.	1–2

III.B.9 Students will use appropriate terminology and mathematical notation to define and represent recursion. *Content Limit:* x_1 is the initial term in the sequence x_{n+1} is the next term. The term a_n is also included in appropriate terminology. Items require only addition and multiplication to find the n^{th} term (arithmetic and geometric only). III.B.9 and III.B.10 will not both have 0 items in the same administration.	0–1
III.B.10 Students will create and use recursive formulas to model and solve real-world and mathematical problems. *Content Limit:* Progressions are limited to arithmetic and geometric. Items will not require identification past tenth term. III.B.10 and III.B.9 will not both have 0 items in the same administration.	0–1
III.B.11 Students will solve systems of two linear equations and inequalities with 2 variables using numeric, graphic and symbolic methods. *Content Limit:* Inequalities will only be solved graphically. Items may include context.	1–2
III.B.12 Students will understand how slopes can be used to determine whether lines are parallel or perpendicular and determine equations for parallel lines and perpendicular lines. *Content Limit:* Items may provide a line and a point not on that line. Items may require students to determine the equation of the line passing through a given point and parallel to a given line. Items may require students to determine the equation of the line passing through a given point and perpendicular to a given line. Items may include context.	1–2

Strand IV–Data Analysis, Statistics and Probability	Item Totals By Strand 17–19
Sub-strand A. Data and Statistics Standard: Represent data and use various measures associated with data to draw conclusions and identify trends. Understand the effects of display distortion and measurement error on the interpretation of data.	**By Sub-strand** 9–11
Benchmarks	**By Benchmark**
IV.A.1 Students will analyze graphs and demonstrate understanding of the strengths and weaknesses of each format by choosing appropriately among them for a given situation. *Content Limit:* Items may contain circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots, tables and stem and leaf plots. Circle graphs may have at most eight sectors. Scales are in increments appropriate to the application.	1–2
IV.A.2 Students will use measures of central tendency and variability to describe, compare and draw conclusions about sets of data. *Content Limit:* Measures may be mean, median, maximum, minimum, range, standard deviation, quartile, percentile, mode or interquartile range (IQR).	1–2
IV.A.3 Students will determine approximate line of best-fit and use the line to draw conclusions. *Content Limit:* Items will provide a scatter plot (coordinates of points on scatter plot are integers) or data set.	1–2
IV.A.4 Students will know the influence of outliers on various measures and representations of data about real-world and mathematical problems. *Content Limit:* Items may require students to understand that the median is resistant to outliers. Items may require students to understand that outliers affect the mean. Given a mathematical definition, items may require students to verify that a data point is an outlier.	1–2

IV.A.5 Students will distinguish between correlation and causation. *Content Limit:* Items may provide several statements about correlation and causation of a situation and require the student to select the correct statement (e.g., high correlation does not guarantee causation). Items will not require calculation of correlation coefficients.	1–2
IV.A.6 Students will interpret data credibility in the context of measurement error and display distortion. *Content Limit:* Items will assess either measurement error or display distortion, but not both in the same item. Items may address the effect of sample size on measurement error.	1–2
IV.A.7 Students will compare outcomes of voting methods. *Content Limit:* Voting methods may include majority, plurality, ranked by preference, run-off and pair-wise comparison.	1–2

Strand IV–Data Analysis, Statistics and Probability	Item Totals By Strand *continued*
Sub-strand B. Probability Standard: Use appropriate counting procedures, calculate probabilities in various ways and apply theoretical probability concepts to solve real-world and mathematical problems.	**By Sub-strand** 8–10
Benchmarks	**By Benchmark**
IV.B.1 Students will select and apply appropriate counting procedures to solve real-world and mathematical problems. *Content Limit:* Items may involve computing probabilities. Items may include combinations and permutations.	1–2
IV.B.2 Students will calculate probabilities and relate the results in real-world and mathematical problems. *Content Limit:* Items may use area, trees, unions and intersections to calculate probabilities. Items may involve both the concept of mutually exclusive events or not mutually exclusive events. Items may involve independent or dependent events. Items may involve conditional probability.	1–2
IV.B.3 Students will use probability models in real-world and mathematical problems. *Content Limit:* Models may include area and binomial models. Binomial probabilities will involve at most 4 events.	1–2
IV.B.4 Students will determine the expected values of random variables for simple probability models. *Content Limit:* Sample spaces will include at most four possible outcomes. Probabilities for each outcome may be given or may have to be computed.	1–2

IV.B.5 Students will know the effect of sample size on experimental and simulation probabilities. *Content Limit:* Items may require the application of the Law of Large Numbers. Items will not require the application of the Central Limit Theorem. Items may require the interpretation of confidence intervals, but will not require the calculation of confidence intervals.	1–2
IV.B.6 Students will calculate probabilities. *Content Limit:* Items use a variety of experimental, simulation and theoretical methods.	1–2

Strand V–Spatial Sense, Geometry and Measurement	Item Totals By Strand 16–18
Sub-strand A. Spatial Sense Standard: Use models to represent and understand two- and three-dimensional shapes and how various motions affect them. Recognize the relationship between different representations of the same shape.	**By Sub-strand** 1–2
Benchmarks	**By Benchmark**
V.A.1 Students will use models and visualization to understand and represent various three-dimensional objects and their cross sections from different perspectives. *Content Limit:* Items are limited to top view, side view, front view or net. Shapes are limited to polyhedra, combinations of polyhedra, cylinders and cones. No figures will be oblique. All visible sides of views are clearly labeled. Prisms will have a base with at most six sides. Pyramids will have a base with at most six sides. Cross sections are limited to rectangular prisms, cones, cylinders, rectangular pyramids and triangular pyramids.	1–2

Strand V–Spatial Sense, Geometry and Measurement	Item Totals By Strand *continued*
Sub-strand B. Geometry Standard: Apply basic theorems of plane geometry, right triangle trigonometry, coordinate geometry and a variety of visualization tools to solve real-world and mathematical problems.	**By Sub-strand** 13–15
Benchmarks	**By Benchmark**
V.B.1 Students will know and use theorems about triangles and parallel lines in elementary geometry to justify facts about various geometrical figures and solve real-world and mathematical problems. *Content Limit:* Theorems may include criteria for two triangles to be congruent or similar. Theorems may include facts about angles formed by parallel lines cut by a transversal. Items may involve the application of these theorems to solve real-world and mathematical problems involving other plane figures.	1–2
V.B.2 Students will know and use theorems about circles to justify geometrical facts and solve real-world and mathematical problems. *Content Limit:* Theorems may include the relationship involving tangent lines and radii. Theorems may include the relationship between inscribed and central angles. Theorems may include the relationship between the measure of the central angle and the length of the related arc. Items may involve the application of these theorems to solve real-world and mathematical problems.	1–2

V.B.3 Students will use properties of two- and three-dimensional figures to solve real-world and mathematical problems. *Content Limit:* Use 3.14 as an approximation for π. Situations may include finding area, perimeter, volume and surface area. Situations may include applying direct or indirect methods of measurement. Situations may include applying the Pythagorean theorem and its converse. Situations may include properties of 45-45-90 and 30-60-90 triangles.	2–3
V.B.4 Students will apply the basic concepts of right triangle trigonometry to determine unknown sides or unknown angles when solving real-world and mathematical problems. *Content Limit:* Concepts may include sine, cosine and tangent. Items will not require the use of the reciprocals or inverses of sine, cosine and tangent. Items will provide a table of decimal approximations of three trigonometry values for each angle given in the item or students may use trigonometry values from a calculator.	1–2
V.B.5 Students will use coordinate geometry. *Content Limit:* Concepts may include distance between two points or midpoint of a line segment. Concepts may include slope of a line, slopes of parallel lines or slopes of perpendicular lines.	1–2
V.B.6 Students will use numeric, graphic and symbolic representations of transformations to solve real-world and mathematical problems. *Content Limit:* Transformations may include rotations, reflections, translations and change of scale.	1–2

V.B.7 Students will perform basic constructions with a straightedge and compass. *Content Limit:* Items may require analysis or justification of the steps in a construction. Items may provide construction diagrams for midpoint of a line segment, perpendicular bisector of a line segment, the perpendicular to a line through a point not on the line, the perpendicular to a line through a point on the line and angle bisector. Constructions are best assessed in the classroom.	0–1
V.B.8 Students will draw accurate representations of planar figures using a variety of tools. *Content Limit:* This benchmark is best assessed in the classroom.	0–1

Strand V–Spatial Sense, Geometry and Measurement	Item Totals By Strand *continued*
Sub-strand C. Measurement Standard: Use the interconnectedness of geometry, algebra and measurement to explore real-world and mathematical problems.	**By Sub-strand** 2–3
Benchmarks	**By Benchmark**
V.C. Students will demonstrate an understanding of the interconnectedness of geometry, algebra and measurement. *Content Limit:* Measurements will be provided with the item. Items may include context.	2–3

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