OREGON STATEWIDE ASSESSMENT

Mathematics
TEST SPECIFICATIONS
and BLUEPRINTS
2012-2014

HIGH SCHOOL
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Introduction

The primary purpose of the Test Specifications and Blueprints is to provide the consistency necessary for the development and administration of the Oregon Assessment of Knowledge and Skills (OAKS). OAKS provides critical data for Oregon’s accountability system which meets Peer Review Requirements of the Elementary and Secondary Education Act. All students in grades 3 through 8 are required to take the reading and mathematics assessments. All students in grades 5 and 8 are required to take the science assessment. In high school, at grade 11, reading, writing, mathematics, and science are required assessments.

OAKS is also one way for students to demonstrate proficiency in the Essential Skills of reading, writing, and mathematics, which will be necessary for earning a high school diploma beginning with seniors graduating in 2011-2012. The requirement in mathematics to demonstrate proficiency in Applying Mathematics in a Variety of Settings will begin with the class of 2014. In addition, English Language Proficiency Assessment (ELPA) is required for non-English speaking students until they acquire sufficient skills in English to exit the program. Social Sciences is an optional assessment.

Test specifications provide guidelines for item writers, who are typically Oregon teachers, on what content may be tested and how items must be written. These specifications lead to test blueprints that outline test design and the number of questions to be tested in each score reporting category (SRC). The Test Specifications and Blueprints document is an important resource, not only for item writers and reviewers, but for educators administering OAKS and the general public who are interested in understanding the content and format of test items.

Background

The purposes of the Oregon Statewide Assessment Program are (1) to provide information on individual student achievement on performance standards set by the State Board of Education at grade and benchmark levels; (2) to provide information for federal Elementary and Secondary Education Act requirements and for policy decisions by the legislature, the governor, the State Board of Education, and local school districts; (3) to support instructional program improvement efforts; and (4) to inform the public about student achievement in Oregon schools.

The Oregon Statewide Assessment is different from national norm-referenced tests used in many districts and states. The Oregon Statewide Assessment is a criterion-referenced assessment based on the Oregon Content Standards. As a result, the types of scores produced from the Oregon Statewide Assessment are somewhat different from those produced by national norm-referenced tests.

Oregon educators contribute to the test development and alignment process by serving on advisory committees called Content and Assessment Panels. Stakeholders in these committees are involved in each phase of the development of these specifications to assure that they accurately and clearly explain the overall design of the test and describe the specific content that might appear on the test to measure the knowledge and skills described in the content standards.

The Oregon Assessment of Knowledge and Skills test questions use multiple-choice and computer-scored constructed response formats. Each multiple-choice item has only one correct answer while computer-scored constructed response items may have many correct answers. A computer electronically collects and scores responses which are scored against the answer key to produce a raw score. The raw score is
converted to a scale score called a Rasch unit or RIT score. Students receive a scale score based on the number of questions answered correctly compared to the total number of questions on the form—taking into account the difficulty of the questions. Students are not penalized for guessing.

The content of these specifications reflects the skill expectations outlined in the State of Oregon Mathematics Content Standards for Kindergarten through Grade 8, adopted in December 2007, and the Oregon High School Mathematics Content Standards, adopted in June 2009. These standards were developed, in part, to align to the 2006 *Curriculum Focal Points for Pre-kindergarten through Grade 8 Mathematics: A Quest for Coherence*, published by the National Council of Teachers of Mathematics. The high school standards were developed in the same vein as those for grades K-8, to allow students to be accountable for fewer topics, but to understand the concepts more deeply.

**Statewide and Local Assessments**

Statewide assessments are multiple-choice and computer-scored constructed response tests of knowledge and skills that are developed and scored by the state. Local assessments include performance assessments that may be scored using statewide scoring guides that are administered and scored at the local level (see Appendix F). Local assessments **are not included** in state accountability reports, e.g. AYP reports.

**Paper/Pencil Administration**

Paper/Pencil fixed form tests are no longer administered in Oregon. All tests are computer-adaptive, as of 2011-2012.

**Electronic Administration**

For the mathematics OAKS online tests, two testing opportunities are offered each year for students in grades 3-8 to participate in fully-adaptive testing. Three opportunities are offered each year for high school students in grades 9-12 who have had the opportunity to learn the high school content. In this fully-adaptive format, the accuracy of the student’s responses to questions determines the next item the student will see. Having the tests fully adaptive allows for more precision in measurement and less frustration for the students.

Beginning with 2011-2012, students who need to have the test read to them may access the text-to-speech function of OAKS Online. The OAKS Online test delivery system will also be available to students with visual impairments who use Braille, providing the same number of testing opportunities as the general student test. (Beginning with 2011-2012, the paper-based Braille assessments will no longer be available.)

Online practice tests of sample items for each grade are available for students who may need practice using a scrollbar, new item types, or other features of OAKS Online. The practice tests are also adaptive in order to simulate the actual OAKS test; you must use Mozilla Firefox to access the practice tests. Downloadable fixed-form sample tests are also available, with answer keys provided. Sample tests and OAKS Online Practice tests can be found at [http://www.ode.state.or.us/search/page/?id=441](http://www.ode.state.or.us/search/page/?id=441).

**Transition to Common Core State Standards and Smarter Balanced Common Assessment**

Beginning with the 2014-2015 school year, Oregon will be utilizing assessments based on the Common Core State Standards for English/Language Arts and Mathematics. The 2014-15 assessment for these subjects will comply with all criteria set forth by Smarter Balanced Common Assessment. Oregon is part of the collaborative consortium of states developing Smarter Balanced and will also use common achievement standards. This work is underway and will be in development until the transition is made in fall 2014.

See [www.ode.state.or.us/go/commoncore](http://www.ode.state.or.us/go/commoncore) for up-to-date information on the Common Core State Standards and [http://www.smarterbalanced.org/](http://www.smarterbalanced.org/) for information on the Smarter Balanced Common Assessment.
On the OAKS mathematics tests:

- Students are strongly encouraged to use calculators. Rulers, manipulatives, and other tools commonly available to all students are also encouraged. No problems require the use of a calculator and no more than a four-function calculator is needed for any problem, although scientific calculators are highly recommended for use at grades 8 and 10. On-screen calculators are included in the OAKS Online tests, but students are also allowed to use the calculators they regularly use for class work. (See the Test Administration Manual for guidelines.)

- For each of the grades 3-8, this statement precedes all the core standards: “It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.” Therefore, any content standard may be assessed using a context or a problem-solving situation.

- Likewise for high school, “It is essential that the high school mathematics content standards be addressed in instructional contexts that promote problem solving, reasoning and proof, communication, making connections, designing and analyzing representations, and reflecting on solutions.” Similarly, any content standard may be assessed using a context or a problem-solving situation.

- For all grades, every student should understand and be able to apply all mathematical concepts and skills from previous grade levels to the standards of their current grade.

- Each OAKS mathematics test item will measure only one Score Reporting Category (SRC). The Score Reporting Categories are the three “core standards” for each grade. Each core standard is associated with four to nine content standards. Grades 3-8 each have approximately 20 content standards. The high school standards include three disciplines of mathematics – Algebra, Geometry, and Statistics. Within each discipline “strand” there are two to three core standards. These core standards provide the major concepts and processes for teaching and learning across the grades. Beneath each of these core standards are from three to eight content standards which provide the details necessary for curriculum and assessment. The score reporting categories are shown in the diagram on the next page.

- The new mathematics standards also frequently mention “fluency” with skills and concepts. See the page following the Score Reporting Categories chart for a complete statement as to the intended meaning of “fluency” for OAKS Online.

The pages following the Fluency Statement contain a more detailed examination of the test content for mathematics.
<table>
<thead>
<tr>
<th>Grade</th>
<th>First Core Standard</th>
<th>Second Core Standard</th>
<th>Third Core Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3.1 <strong>Number and Operations:</strong> Develop an understanding of fractions and fraction equivalence.</td>
<td>3.2 <strong>Number and Operations, Algebra, and Data Analysis:</strong> Develop understandings of multiplication and division, and strategies for basic multiplication facts and related division facts.</td>
<td>3.3 <strong>Geometry and Measurement:</strong> Describe and analyze properties of two-dimensional shapes, including perimeters.</td>
</tr>
<tr>
<td>4</td>
<td>4.1 <strong>Number and Operations:</strong> Develop an understanding of decimals, including the connections between fractions and decimals.</td>
<td>4.2 <strong>Number and Operations and Algebra:</strong> Develop fluency with multiplication facts and related division facts, and with multi-digit whole number multiplication.</td>
<td>4.3 <strong>Measurement:</strong> Develop an understanding of area and determine the areas of two-dimensional shapes.</td>
</tr>
<tr>
<td>5</td>
<td>5.1 <strong>Number and Operations and Data Analysis:</strong> Develop an understanding of and fluency with addition and subtraction of fractions and decimals.</td>
<td>5.2 <strong>Number and Operations and Algebra:</strong> Develop an understanding of and fluency with division of whole numbers.</td>
<td>5.3 <strong>Geometry, Algebra, and Measurement:</strong> Analyze 3-D shapes, including volume and surface area.</td>
</tr>
<tr>
<td>6</td>
<td>6.1 <strong>Number and Operations:</strong> Develop an understanding of and fluency with multiplication and division of fractions and decimals.</td>
<td>6.2 <strong>Number and Operations and Probability:</strong> Connect ratio, rate, and percent to multiplication and division.</td>
<td>6.3 <strong>Algebra:</strong> Write, interpret, and use mathematical expressions and equations.</td>
</tr>
<tr>
<td>7</td>
<td>7.1 <strong>Number and Operations and Algebra:</strong> Develop an understanding of operations on all rational numbers and solving linear equations.</td>
<td>7.2 <strong>Number and Operations, Algebra and Geometry:</strong> Develop an understanding of and apply proportionality, including similarity.</td>
<td>7.3 <strong>Measurement and Geometry:</strong> Develop an understanding of and use formulas to determine surface area and volume.</td>
</tr>
<tr>
<td>8</td>
<td>8.1 <strong>Algebra:</strong> Analyze and represent linear functions, and solve linear equations and systems of linear equations.</td>
<td>8.2 <strong>Data Analysis and Algebra:</strong> Analyze and summarize data sets.</td>
<td>8.3 <strong>Geometry and Measurement:</strong> Analyze two- and three-dimensional spaces and figures by using distance and angle.</td>
</tr>
<tr>
<td>HS</td>
<td><strong>Algebra</strong> (H.1A, H.2A, H.3A)</td>
<td><strong>Geometry</strong> (H.1G, H.2G, H.3G)</td>
<td><strong>Statistics</strong> (H.1S, H.2S)</td>
</tr>
</tbody>
</table>
What are the Main Messages of NCTM's *Principles and Standards (2000)* Regarding Computation?

**Computational fluency is an essential goal for school mathematics (p. 152):**

**Embedding Fluency in Conceptual Understanding**

- The methods that a student uses to compute should be grounded in understanding (pp. 152-55).
- Students can achieve computational fluency using a variety of methods and should, in fact, be comfortable with more than one approach (p. 155).
- Students should have opportunities to invent strategies for computing using their knowledge of place value, properties of numbers, and the operations (pp. 35 and 220).
- Students should investigate conventional algorithms for computing with whole numbers (pp. 35 and 155).

**Goals of Fluency**

- Students should know the basic number combinations for addition and subtraction by the end of grade 2 and those for multiplication and division by the end of grade 4 (pp. 32, 84, and 153).
- Students should be able to compute fluently with whole numbers by end of grade 5 (pp. 35, 152, and 155).
- Students should be encouraged to use computational methods and tools that are appropriate for the context and purpose, including mental computation, estimations, calculators, and paper and pencil (pp. 36, 145, and 154).

**What is Computational Fluency?**

*NCTM Principles and Standards of School Mathematics* (2000) defines computational fluency as having efficient and accurate methods for computing that are based on well understood properties and number relationships.

The National Math Panel Report cites the NCTM definition of computational fluency in its report when it uses this phrase. For further clarity, on page 41 of chapter 3 of the Task Group Reports of the National Mathematics Advisory Panel, there is a discussion of the critical foundations for the study of algebra: (1) fluency with whole numbers, (2) fluency with fractions, and (3) particular aspects of geometry and measurement. The National Mathematics Advisory Panel Final Report (2008), page 17-20, reiterate three clusters of concepts and skills – called Critical Foundations of Algebra – reflecting their judgment about the most essential mathematics for students to learn thoroughly prior to algebra course work.
1. Fluency with whole numbers

By the end of the elementary grades, children should have a robust sense of number. This sense of number must include understanding place value, and the ability to compose and decompose whole numbers. It must clearly include a grasp of the meaning of the basic operations of addition, subtraction, multiplication, and division, including use of the commutative, associative, and distributive properties; the ability to perform these operations efficiently; and the knowledge of how to apply the operations to problem solving. Computational facility rests on the automatic recall of addition and related subtraction facts, and of multiplication and related division facts. It requires fluency with the standard algorithms for addition, subtraction, multiplication, and division. Fluent use of the algorithms not only depends on the automatic recall of number facts but also reinforces it. A strong sense of number also includes the ability to estimate the results of computations and thereby to estimate orders of magnitude, e.g., how many people fit into a stadium, or how many gallons of water are needed to fill a pool.

2. Fluency with Fractions

Before they begin algebra course work, middle school students should have a thorough understanding of positive as well as negative fractions. They should be able to locate both positive and negative fractions on the number line; represent and compare fractions, decimals, and related percents; and estimate their size. They need to know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percentages. They should encounter fractions in problems in the many contexts in which they arise naturally, for example, to describe rates, proportionality, and probability. Beyond computational facility with specific numbers, the subject of fractions, when properly taught, introduces students to the use of symbolic notation and the concept of generality, both being an integral part of Algebra (Wu, 2001).

3. Particular Aspects of Geometry and Measurement

Middle-grade experience with similar triangles is most directly relevant for the study of algebra: Sound treatments of the slope of a straight line and of linear functions depend logically on the properties of similar triangles. Furthermore, students should be able to analyze the properties of two- and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas.
Content Standards Map

The following pages contain an examination of the test content for mathematics.

- The top row states the core standard (Score Reporting Category).
- The first column lists the content standard. Below the content standard we show “Assessable Academic Vocabulary” - vocabulary that can be used in test items without explanation. Below the vocabulary, we show symbols and notation that can be used without explanation.
- The second column lists Boundaries of Assessable Content to clarify language in the content standard. Below the Boundaries, we show standards from previous grades linked to this standard.
- Finally, the third column gives some sample items that are very similar to the type of questions asked on a test related to the content standard. Previously operational released items are in Times New Roman font, while “ideas” for test items are in Arial Gray font.

- Following all the standards pages is a comprehensive list of all the Assessable Academic Vocabulary for the grade level. Assessable Academic Vocabulary from previous grades may also be used without explanation.
### Core Standard: H.1A Algebra and Numeracy

Demonstrate a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th><strong>Content Standard:</strong></th>
<th><strong>Boundaries of Assessable Content:</strong></th>
<th><strong>Sample Items:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1A.1 Compare, order, and locate real numbers on a number line.</td>
<td>- Items assessing this standard include locating real numbers on a number line, comparing two real numbers, and ordering real numbers, i.e. smallest to largest.</td>
<td>Which number has the greatest value?</td>
</tr>
<tr>
<td><strong>Assessable Academic Vocabulary:</strong></td>
<td>- Problems may include a mixture of fractions, decimals (repeating and non-repeating), pi, and/or square roots.</td>
<td>A. $3.5^5$ C. $3,100$</td>
</tr>
<tr>
<td>real numbers</td>
<td></td>
<td>B. $4.2 \times 10^2$ D. $200^2$</td>
</tr>
<tr>
<td>number line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rational numbers</td>
<td></td>
<td>Which number has the greatest value?</td>
</tr>
<tr>
<td>irrational numbers</td>
<td><strong>Content Connections from Previous Grades:</strong> 4.1.4, 7.1</td>
<td>A. $\left(\frac{1}{2}\right)^4$</td>
</tr>
<tr>
<td><strong>Symbols and Notation:</strong></td>
<td><strong>Sample Items:</strong></td>
<td>B. $\sqrt{5}$</td>
</tr>
<tr>
<td>$\neq$ &quot;is not equal to&quot;</td>
<td></td>
<td>C. $\frac{7}{3}$</td>
</tr>
<tr>
<td>&lt; &quot;is less than&quot;</td>
<td></td>
<td>D. $2.324$</td>
</tr>
<tr>
<td>$\leq$ &quot;is less than or equal to&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Core Standard: H.1A Algebra and Numeracy

Demonstrate a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Score Reporting Category 1

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1A.2</td>
<td>Items assessing this standard include performing computations with real numbers, evaluating and simplifying expressions involving real numbers and/or algebraic symbols, and determining if expressions are equivalent.</td>
<td>If ( a = 6 ) and ( b = -10 ), which of the following expressions gives you the greatest value?</td>
</tr>
<tr>
<td></td>
<td>Real numbers and variables may include</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. ( a - \frac{b}{a} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. ( a \div (a - b) )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. ( a^2 \div (a - b) )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. ( a \div a - b^2 )</td>
</tr>
<tr>
<td></td>
<td>Symbols and Notation: ( \pi ) &quot;pi&quot;</td>
<td>Using the algebraic expression</td>
</tr>
<tr>
<td></td>
<td>(</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Assessable Academic Vocabulary:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>evaluate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>equivalent expressions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>absolute value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>integer exponents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>square roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( \pi )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>scientific notation</td>
</tr>
<tr>
<td></td>
<td>Content Connections from Previous Grades:</td>
<td>(Evaluate an algebraic expression for given values of the variables, which may include absolute value.)</td>
</tr>
<tr>
<td></td>
<td>7.1</td>
<td></td>
</tr>
</tbody>
</table>
Core Standard: H.1A Algebra and Numeracy

Demonstrate a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1A.3 Express square roots in equivalent radical form and their decimal approximations when appropriate.</td>
<td>Items assessing this standard include writing square roots in simplest radical form. The square roots may include variables as well as real numbers. When appropriate, calculators may be used to find decimal approximations for square roots.</td>
<td>(Write $\sqrt{50}$ in simplest radical form, determine if two radical expressions are equivalent, or give a decimal approximation for a square root.)</td>
</tr>
</tbody>
</table>

Assessable Academic Vocabulary:
- Square root
- Radical sign
- Simplify
- Simplest radical form

Symbols and Notation:
- $\sqrt{}$ "radical sign"
- $\sqrt{25}$ "square root of 25"

Content Connections from Previous Grades:
- 8.3

Sample Items:
- (Simplify, $\sqrt{64a^2b^2}$)
- (Given that the area of a square is 12, what is the length of one of its sides?)
- (Write $8\sqrt{128}$ in simplest radical form)
- Find the approximate value of $8\sqrt{128}$ to the nearest whole number.)
**Core Standard: H.1A Algebra and Numeracy**

Demonstrate a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
</table>
| H.1A. 4 Develop, identify, and/or justify equivalent algebraic expressions, equations, and inequalities using the properties of exponents, equality and inequality, as well as the commutative, associative, inverse, identity, and distributive properties. | • Items assessing this standard must include using one or more of the following properties to justify two algebraic expressions or equations are equivalent:  
  - properties of exponents  
  - properties of equality  
  - properties of inequality  
  - commutative property  
  - associative property  
  - inverse property  
  - identity property  
  - distributive property  
  • Expressions may include variables and/or real numbers.  
  • Students may be asked to simplify an algebraic expression using any of the properties listed above. | Simplify:  
\[-13x + (-7x) + 5x\]  
A. \(-25x\)  
B. \(-15x\)  
C. \(15x\)  
D. \(25x\) |

**Assessable Academic Vocabulary:**

equivalent expressions  
equivalent equations  
inequalities  
properties of exponents  
properties of equality  
properties of inequality  
commutative property  
associative property  
inverse property  
identity property  
distributive property

**Symbols and Notation:**

\((n^2)^3\) “n squared, raised to the third power”  
\(>\) “is greater than”  
\(\geq\) “is greater than or equal to”  
\(\neq\) “is not equal to”  
\(<\) “is less than”  
\(\leq\) “is less than or equal to”

**Content Connections from Previous Grades:**

6.3, 7.1.4

**Sample Items:**

Which of the following expressions is NOT equivalent to \((a + b)(x + y)\)?

A. \((a + b)x + (a + b)y\)
B. \(a(x + y) + b(x + y)\)
C. \((b + a)(y + x)\)
D. \(ax + by\)
E. \(ax + bx + ay + by\)

Source: NAEP 2005 Released Item

(Identify an expression equivalent to the above, such as \(x(-13 + (-7) + 5)\).)

(Justify that two algebraic expressions or equations are equivalent using a combination of properties of exponents.)
**Core Standard: H.1A Algebra and Numeracy**

Demonstrate a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1A.5 Factor quadratic expressions limited to factoring common monomial terms, perfect-square trinomials, differences of squares, and quadratics of the form $x^2 + bx + c$ that factor over the integers</td>
<td>- Items assessing this standard include factoring quadratics of the form $ax^2 + bx + c$, where $a=1$, and the quadratic factors over the integers. Students will also be asked to factor perfect-square trinomials, difference of squares, and common monomial terms in quadratic expressions that may not have a leading coefficient of 1.</td>
<td>(Factor a quadratic of the form $x^2 + bx + c$, which factors over the integers, such as $x^2 + 3x - 4$)</td>
</tr>
<tr>
<td><strong>Assessable Academic Vocabulary:</strong></td>
<td><strong>Content Connections from Previous Grades:</strong> 6.3</td>
<td>(Factor a quadratic expression by using a common monomial term, such as $4x^2 + 12x - 20$)</td>
</tr>
<tr>
<td>factor</td>
<td></td>
<td>(Factor perfect-square trinomials. Factor a quadratic $ax^2 + bx + c$, where “b” and “c” are both positive, and where $b$ and $c$ have different signs, such as $9x^2 - 12x + 4$)</td>
</tr>
<tr>
<td>greatest common factor</td>
<td></td>
<td>(Factor a quadratic which is the difference of two squares, such as $16x^2 - 25$)</td>
</tr>
<tr>
<td>difference of squares</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Core Standard: H.2A Algebra

Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Score Reporting Category 1

<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2A.1 Identify, construct, extend, and analyze linear patterns and functional relationships that are expressed contextually, numerically, algebraically, graphically, in tables, or using geometric figures.</td>
</tr>
</tbody>
</table>

### Assessable Academic Vocabulary:
- numerically
- algebraically
- extend
- linear pattern

### Symbols and Notation:

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A man spent ( \frac{1}{2} ) of his life in Mexico, ( \frac{1}{3} ) of his life in America, ( \frac{1}{7} ) of his life in Brazil, and his remaining 2 years in Argentina. How old was he when he moved to Argentina?</td>
</tr>
<tr>
<td>A. 80 years old</td>
</tr>
<tr>
<td>B. 84 years old</td>
</tr>
</tbody>
</table>

Yvonne has studied the cost of tickets over time for her favorite sports team. She has created a model to predict the cost of a ticket in the future. Let \( C \) represent the cost of a ticket in dollars and \( y \) represent the number of years in the future. Her model is as follows.

\[
C = 2.50y + 13
\]

Based on this model, how much will the cost of a ticket increase in two years?

A. $5  
B. $8  
C. $13  
D. $18  
E. $26  

(Analyze a pattern from a table that does not have sequential x-values and identify the equation for the table of values.)

### Content Corrrections from Previous Grades:
6.3, 8.1.1
<table>
<thead>
<tr>
<th>Core Standard:</th>
<th>H.2A Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td></td>
</tr>
<tr>
<td>Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.</td>
<td></td>
</tr>
</tbody>
</table>

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2A.2 Given a rule, a context, two points, a table of values, a graph, or a linear equation in either slope intercept or standard form, identify the slope of the line, determine the x and/or y intercept(s), and interpret the meaning of each.</td>
</tr>
</tbody>
</table>

**Assessable Academic Vocabulary:**
- slope
- x-intercept
- y-intercept
- slope-intercept form: $y=mx+b$
- standard form: $Ax+By=C$

**Sample Items:**

A rental car costs $59 each day, and 35¢ for each mile driven. The graph records this information. The rate of change for this situation could be written as _________.

- A. $\frac{1}{4}$ dollars per mile
- B. 0.35 dollars per mile
- C. $\frac{4}{1.40}$ dollars per mile
- D. $\frac{59}{1}$ dollars per day

What is the slope of the line shown in the graph above?

- A. $\frac{1}{3}$
- B. $\frac{2}{3}$
- C. 1
- D. $\frac{3}{2}$
- E. 3

*Source: NAEP 1992 Released Item*
**Core Standard: H.2A Algebra**

Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.

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<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
</table>
| H.2A.3 Determine the equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, determine an equation of a new line, parallel or perpendicular to a given line, through a given point. | - Items assessing this standard include determining the equation of a line given any of the following:  
  - two points on the line  
  - a slope and one point on the line  
  - a graph  
  - a parallel line and a given point  
  - a perpendicular line and a given point  
- Linear equations may be written in slope-intercept form or standard form.  
- Students may be asked to find the equation for a line parallel or perpendicular to a given line through a point, but the line referenced may only be represented by two points rather than an equation. | Line A is the graph for the equation \( y = -2x + 4 \). Line B is perpendicular to line A. Which is the equation of the graph of line B? |

### Assessable Academic Vocabulary:
- equation of a line
- parallel
- perpendicular

### Symbols and Notation

### Content Connections from Previous Grades:
8.1

---

*Sample Items:*

Given the graph of a line, write the equation of the line perpendicular to this line through a particular point.

Given two points on a line or the graph of a line, write the equation of a line parallel to this given line through a particular point.
<table>
<thead>
<tr>
<th>Core Standard: H.2A Algebra</th>
<th>Score Reporting Category 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.</td>
<td>It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2A.4 Fluently convert among representations of linear relationships given in the form of a graph of a line, a table of values, or an equation of a line in slope-intercept and standard form.</td>
<td>Items assessing this standard include converting fluently among one or more of the following representations of linear relationships:</td>
</tr>
<tr>
<td>Assessable Academic Vocabulary:</td>
<td>○ graph of a line</td>
</tr>
<tr>
<td>slope-intercept form: ( y = \text{mx} + \text{b} )</td>
<td></td>
</tr>
<tr>
<td>standard form: ( \text{Ax} + \text{By} = \text{C} )</td>
<td></td>
</tr>
<tr>
<td>Symbols and Notation</td>
<td>○ table of values</td>
</tr>
<tr>
<td>Content Connections from Previous Grades:</td>
<td>○ equation written in slope-intercept form</td>
</tr>
<tr>
<td>8.1.1, 8.1.2, 8.1.3</td>
<td>○ equation written in standard form</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which of the following is the graph of the line with equation ( y = -2x + 1 )?</td>
</tr>
<tr>
<td>A.</td>
</tr>
<tr>
<td>B.</td>
</tr>
<tr>
<td>E.</td>
</tr>
</tbody>
</table>

Source: NAEP 2007 Released Item

(Given a table of values, write the equation of the line in slope-intercept form.)

(Given a graph of a line, write the equation of the line in standard form.)
Core Standard: H.2A Algebra
Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.

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Content Standard:
H.2A.5 Given a linear function, interpret and analyze the relationship between the independent and dependent variables. Solve for x given f(x) or solve for f(x) given x.

Assessable Academic Vocabulary:
- independent variable
- dependent variable

Symbols and Notation
- \( f(x) \) “f of x”

Boundaries of Assessable Content:
- Identify the relationship between the independent and dependent variables of a linear function.
- Analyze the relationship between the independent and dependent variables, given a linear function in a table, context or graph.
- Solve for f(x) given x.
- Solve for x given f(x).

Sample Items:
Solve for x.
\[ 2x + 10 = 16 \]
A. 2   B. 3   C. 11   D. 13

The following question refers to the graph shown below.

What is the value of \( g(1) \)?
A. 2   B. 4   C. 5   D. 6   E. 8

Source: NAEP 1990 Released Item
<table>
<thead>
<tr>
<th>Core Standard: H.2A Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.</td>
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<td>Score Reporting Category 1</td>
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It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2A.6 Analyze how changing the parameters transforms the graph of ( f(x) = mx + b ).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessable Academic Vocabulary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>transform</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols and Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) ) “f of x”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items assessing this standard include analyzing transformations of the graph of ( f(x) = mx + b ).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Given a linear equation such as ( f(x) = 2x + 3 ):</td>
</tr>
<tr>
<td>• What happens when 3 changes to 5?</td>
</tr>
<tr>
<td>• What happens when 2 changes to -1?</td>
</tr>
<tr>
<td>• What happens when 2 changes to -1 and 3 changes to 5 simultaneously? )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1.2</td>
</tr>
<tr>
<td>Core Standard: H.2A Algebra</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.</td>
</tr>
<tr>
<td>It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2A.7 Write, use, and solve linear equations and inequalities using graphical and symbolic methods with one or two variables. Represent solutions on a coordinate graph or number line.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessable Academic Vocabulary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbols and Notation</td>
</tr>
<tr>
<td>≠ &quot;is not equal to&quot;</td>
</tr>
<tr>
<td>&lt; &quot;is less than&quot;</td>
</tr>
<tr>
<td>≤ &quot;is less than or equal to&quot;</td>
</tr>
<tr>
<td>&gt; &quot;is greater than&quot;</td>
</tr>
<tr>
<td>≥ &quot;is greater than or equal to&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items assessing this standard include writing, using, and solving linear equations and inequalities using graphical and symbolic methods with</td>
</tr>
<tr>
<td>one variable.</td>
</tr>
<tr>
<td>two variables.</td>
</tr>
<tr>
<td>Represent solutions with one variable on a number line.</td>
</tr>
<tr>
<td>Represent solutions with two variables on a coordinate graph.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>You can receive a reduced ticket price at the local movie theater if you are 65 or older, or if you are younger than 12.</td>
</tr>
<tr>
<td>Which graph displays this information?</td>
</tr>
<tr>
<td>A.</td>
</tr>
<tr>
<td>B.</td>
</tr>
<tr>
<td>C.</td>
</tr>
<tr>
<td>D.</td>
</tr>
<tr>
<td>The graph shows the solution to which of these inequalities?</td>
</tr>
<tr>
<td>A. ( y &gt; 3x + 3 )</td>
</tr>
<tr>
<td>B. ( y &lt; 3x + 3 )</td>
</tr>
<tr>
<td>C. ( y &gt; x + 3 )</td>
</tr>
<tr>
<td>D. ( y &lt; x + 3 )</td>
</tr>
</tbody>
</table>
**Core Standard:** H.2A Algebra  
Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
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<th>Sample Items:</th>
</tr>
</thead>
</table>
| H.2A.8            | Solve systems of two linear equations graphically and algebraically, and solve systems of two linear inequalities graphically. | Find the solution to the following system of two linear equations: $y = 9x - 3$  
$4x + 2y = 5$
A. $\left( \frac{4}{11}, \frac{3}{11} \right)$  
B. $\left( \frac{1}{2}, \frac{3}{2} \right)$  
C. $\left( \frac{8}{13}, \frac{7}{13} \right)$  
D. $\left( \frac{11}{13}, \frac{4}{13} \right)$  
In the solution of the system of equations above, what is the value of $x$?  
A. −1  
B. 2  
C. 3  
D. 4  
E. 5  
(Source: NAEP 2005 Released Item) |
|                   | Solve systems of two linear equations graphically. | (Solve a system of two linear inequalities graphically. That is, identify the graph of the solution from a graph obtained by graphing the two inequalities.) |
|                   | Solve systems of two linear equations algebraically which may include using substitution, elimination, or matrices. | |
|                   | Solve systems of two linear inequalities graphically. | |
| **Assessable Academic Vocabulary:** | | |
| system of linear equations | | |
| system of linear inequalities | | |
| **Symbols and Notation** | | |
| < "is less than" | | |
| ≤ "is less than or equal to" | | |
| > "is greater than" | | |
| ≥ "is greater than or equal to" | | |
| **Content Connections from Previous Grades:** | | |
| 8.1.5, 8.1.6 | | |
Core Standard: H.3A Algebra
Use quadratic and exponential equations and functions to represent relationships.

Score Reporting Category 1

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<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.3A.1 Given a quadratic or exponential function, identify or determine a corresponding table or graph.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessable Academic Vocabulary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>quadratic function</td>
</tr>
<tr>
<td>exponential function</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols and Notation:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items assessing this standard give students a quadratic or exponential function. Students have to identify a corresponding table or graph or determine a corresponding table or graph.</td>
</tr>
<tr>
<td>Quadratic and exponential functions may be expressed using function notation or y=</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which function describes the table?</td>
</tr>
</tbody>
</table>
| ![Table](X|Y)
| 3 | 4 | 5 | 6 | 7 |
| 10 | 17 | 26 | 37 | 50 |
| A. \( y = x^2 + 1 \) |
| B. \( y = 3x + 1 \) |
| C. \( y = 4x - 2 \) |
| D. \( y = x + 7 \) |

(Given a quadratic function, identify a corresponding table or graph.)

(Determine the graph of an exponential function showing decay given a table of values or the function itself.)
Core Standard: **H.3A Algebra**  
Use quadratic and exponential equations and functions to represent relationships.

Score Reporting Category 1

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<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
</table>
| **H.3A.2** Given a table or graph that represents a quadratic or exponential function, extend the pattern to make predictions. | - Items assessing this standard use tables or graphs that represent a quadratic or exponential function and extend the pattern to make predictions.  
- The independent variable values in the table will have a constant difference (e.g. -2, -1, 0, 1, 2, … or 2, 4, 6, … etc) | **Which formula best describes the table of values shown?**  

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>81</td>
</tr>
<tr>
<td>-2</td>
<td>36</td>
</tr>
<tr>
<td>-1</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>3</td>
<td>81</td>
</tr>
</tbody>
</table>

A. \( y = -27x \)  
B. \( y = 27x \)  
C. \( y = (3x)^2 \)  
D. \( y = 3x^2 \) |

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8.1.4</strong></td>
<td></td>
</tr>
</tbody>
</table>

Assessable Academic Vocabulary:  

Symbols and Notation:  

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Mathematics Test Specifications  
and Test Blueprints

Oregon Department of Education  
Office of Assessment and Information Services
Core Standard: H.3A Algebra
Use quadratic and exponential equations and functions to represent relationships.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.3A.3 Compare the characteristics of and distinguish among linear, quadratic, and exponential functions that are expressed in a table of values, a sequence, a context, algebraically, and/or graphically, and interpret the domain and range of each as it applies to a given context.</td>
<td>Items assessing this standard use any of the following to compare and distinguish among linear, quadratic, and exponential functions:</td>
<td>This graph is an example of what type of function?</td>
</tr>
<tr>
<td>Assessable Academic Vocabulary:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exponential</td>
<td>o a table of values</td>
<td>A. Absolute Value</td>
</tr>
<tr>
<td>linear</td>
<td>o a sequence</td>
<td>B. Exponential</td>
</tr>
<tr>
<td>quadratic</td>
<td>o a context</td>
<td>C. Linear</td>
</tr>
<tr>
<td>domain</td>
<td>o an equation</td>
<td>D. Quadratic</td>
</tr>
<tr>
<td>range</td>
<td>o a graph</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols and Notation:</th>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; b &lt; 1$</td>
<td>Find the coordinates of the minimum point of the given graph.</td>
</tr>
<tr>
<td>“0 is less than b is less than 1”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Items:</td>
</tr>
<tr>
<td>This graph is an example of what type of function?</td>
</tr>
<tr>
<td>A. Absolute Value</td>
</tr>
<tr>
<td>B. Exponential</td>
</tr>
<tr>
<td>Find the coordinates of the minimum point of the given graph.</td>
</tr>
<tr>
<td>A. $(-0.5, 0)$</td>
</tr>
<tr>
<td>B. $(1, -15)$</td>
</tr>
</tbody>
</table>
Core Standard: H.3A Algebra
Use quadratic and exponential equations and functions to represent relationships.

Score Reporting Category 1

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<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>H.3A.4</strong> Given a quadratic or exponential function, interpret and analyze the relationship between the independent and dependent variables, and evaluate the function for specific values of the domain.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessable Academic Vocabulary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>independent variable</td>
</tr>
<tr>
<td>dependent variable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols and Notation:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Items assessing this standard use quadratic or exponential functions to do the following:</td>
</tr>
<tr>
<td>- Interpret and analyze the relationship between the independent and dependent variables. This may include determining for which values of ( x ) the ( y ) values are increasing or decreasing. It also includes identifying the vertex, intercepts, or other important point of the function.</td>
</tr>
<tr>
<td>- Evaluate the function for specific values of the domain. A student may also need to solve the function to find a specific value in the domain.</td>
</tr>
<tr>
<td>- Functions may be written using ( f(x) = ) or ( y = . )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ball is tossed into the air. The height of the ball as a function of time can be described by the equation ( h = -16t^2 + 72t ). In this equation ( h ) is the height of the ball in feet and ( t ) is time in seconds. After how many seconds will the ball hit the ground?</td>
</tr>
<tr>
<td>- A. 4 seconds</td>
</tr>
<tr>
<td>- B. 4.5 seconds</td>
</tr>
<tr>
<td>- C. 9 seconds</td>
</tr>
<tr>
<td>- D. 56 seconds</td>
</tr>
<tr>
<td>Every year the population of Springfield decreases by a factor of ( \frac{1}{6} ). If the population of Springfield on Jan. 1, 1980 was 33,521, what was the approximate population on Jan. 1, 2000?</td>
</tr>
<tr>
<td>- A. 92</td>
</tr>
<tr>
<td>- B. 111</td>
</tr>
<tr>
<td>- C. 132</td>
</tr>
<tr>
<td>- D. 587</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Given a quadratic function, describe where the turning point is.)</td>
</tr>
<tr>
<td>(Given an exponential function, determine for what values of the domain the function increasing (or decreasing).)</td>
</tr>
</tbody>
</table>
Core Standard: H.3A Algebra
Use quadratic and exponential equations and functions to represent relationships.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.3A.5 Given a quadratic equation of the form $x^2 + bx + c = 0$ with integral roots, determine and interpret the roots, the vertex of the parabola that is the graph of $y = x^2 + bx + c$, and an equation of its axis of symmetry graphically and algebraically.</td>
</tr>
</tbody>
</table>

**Assessable Academic Vocabulary:**
- roots
- x-intercepts
- vertex
- axis of symmetry
- parabola

**Symbols and Notation:**

**Boundaries of Assessable Content:**
- Items assessing this standard use a quadratic equation of the form $x^2 + bx + c = 0$ with integral roots to do the following:
  - Determine and interpret the roots. This may be done by factoring, using the quadratic formula, or graphing.
  - Determine and interpret the vertex of the parabola (graph of $y = x^2 + bx + c$). This may be done using $x = \frac{-b}{2a}$ to find the x-coordinate and then using substitution to find the y-coordinate or by graphing.
  - Determine and interpret the axis of symmetry using $x = \frac{-b}{2a}$ or the graph of the parabola.

**Sample Items:**
(Use the equation: $x^2 - 2x - 8 = 0$
  A. Find the roots by factoring.
  B. Graph the equation $y = x^2 - 2x - 8$
  C. Locate and label the following:
     1) The zeroes
     2) The vertex of the parabola
     3) The axis of symmetry of the parabola)

(Given that a parabola has x-intercepts at (3, 0) and (1, 0) and vertex at (2, -1), find the equation of the parabola.)
**Core Standard: H.1G Geometry**

Apply properties of two-dimensional figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1G.1 Identify, apply, and analyze angle relationships among two or more lines and a transversal to determine if lines are parallel, perpendicular, or neither.</td>
<td>Items assessing this standard use alternate interior angles, alternate exterior angles, corresponding angles, and same-side interior angles (also named consecutive interior angles) between two lines and a transversal to determine if lines are parallel, perpendicular, or neither.</td>
<td>Lines $m$ and $n$ are parallel. What is the value of $x - y + z$?</td>
</tr>
<tr>
<td><strong>Assessable Academic Vocabulary:</strong> parallel perpendicular transversal alternate interior angles alternate exterior angles corresponding angles same-side interior angles consecutive interior angles supplementary</td>
<td>Write and solve algebraic equations from angles given as expressions to determine if pairs of angles are congruent or supplementary.</td>
<td></td>
</tr>
<tr>
<td><strong>Symbols and Notation:</strong> $\parallel$ “parallel” $\perp$ “perpendicular” Arrows for parallel lines Right angle Congruent angle symbols</td>
<td><strong>Content Connections from Previous Grades:</strong> 8.3.1</td>
<td>Which statement is true?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines $m$ and $n$ are parallel. What is the value of $x - y + z$?</td>
</tr>
</tbody>
</table>

![Diagram](attachment:diagram.png)

Which statement is true?

A. Line AD is parallel to line BC.
B. Line AD is perpendicular to line BC.
C. Line AB is parallel to line BC.
D. Line AC is perpendicular to line BC.
### Core Standard: H.1G Geometry
Apply properties of two-dimensional figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Content Standard:
H.1G.2 Apply theorems, properties, and definitions to determine, identify, and justify congruency or similarity of triangles and to classify quadrilaterals.

### Assessable Academic Vocabulary:
- congruent triangles
- SSS
- SAS
- ASA
- AAS
- HL
- similar triangles
- scale factor
- classify
- quadrilateral

### Symbols and Notation:
- Congruency marks for sides and angles:
  ![Congruency Marks]
- Parallel sides marked with arrows:
  ![Parallel Sides Arrow]

### Boundaries of Assessable Content:
- Items assessing this standard use theorems, properties, and definitions to:
  - determine, identify, and justify congruent triangles.
  - determine, identify, and justify similar triangles
  - classify quadrilaterals.
- Write and solve algebraic equations from expressions in triangles to determine if triangles are similar or congruent.
- Write and solve algebraic equations from expression in figures to classify quadrilaterals.

### Content Connection from Previous Grades:
- 3.3, 5.3.1, 6.2.1, 7.2.4

### Sample Items:
Quadrilateral ABCD, with diagonal $\overline{BD}$, has $\overline{AB} \cong \overline{CD}$. Which statement would make $\triangle BAD \cong \triangle DCB$?

A. $\angle C \cong \angle A$
B. $\overline{AB} \parallel \overline{CD}$
C. $\overline{AD} \parallel \overline{CB}$
D. $\overline{AB} \parallel \overline{BC}$

Which of the following pairs of geometric figures must be similar to each other?

A. Two equilateral triangles
B. Two isosceles triangles
C. Two right triangles
D. Two rectangles
E. Two parallelograms

Source: NAEP 2005 Released Item
Core Standard: H.1G Geometry
Apply properties of two-dimensional figures.

Score Reporting Category 2

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Content Standard:
H.1G.3. Apply theorems of corresponding parts of congruent and similar figures to determine missing sides and angles of polygons.

Assessable Academic Vocabulary:
Corresponding Parts of Congruent Triangles are Congruent (CPCTC)

Congruent
congruent figures
similar
similar figures

Symbols and Notation:
Congruency marks for sides and angles:

Or

Parallel sides marked with arrows:

Boundaries of Assessable Content:
- Items assessing this standard solve for missing sides and/or angles using corresponding parts in congruent polygons.
- Items assessing this standard solve for missing sides and/or angles using corresponding parts in similar polygons.
- Write and solve algebraic equations from expressions for corresponding parts in congruent or similar polygons to solve for a variable or a side or angle measurement.

Content Connections from Previous Grades:
3.3, 6.2.1, 7.2.4

Sample Items:
\( \triangle \) CAT is similar to \( \triangle \) DOG.

What is the measure of \( \angle DG \)?

A. 16
B. 18
C. 20
D. 24

If trapezoid \( \text{WXYZ} \parallel \text{LMOP} \), what is the measure of \( \angle Q \)?

\( \text{A} \quad 32^\circ \quad \text{B} \quad 90^\circ \quad \text{C} \quad 122^\circ \quad \text{D} \quad 148^\circ \)
### Core Standard: H.1G Geometry

Apply properties of two-dimensional figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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</table>
| H.1G.4 Use trigonometric ratios (sine, cosine and tangent) and the Pythagorean Theorem to solve for unknown lengths in right triangles. | - Items assessing this standard solve for missing sides in right triangles using sine, cosine, tangent, and/or the Pythagorean Theorem.  
- Write the sine of an angle as the ratio of its opposite leg to its hypotenuse.  
- Write the cosine of an angle as the ratio of its adjacent leg to its hypotenuse.  
- Write the tangent of an angle as the ratio of its opposite leg to its adjacent leg.  
- Answers may be exact or approximate. | Ted wants to measure the height of the football stands. He walks to point A 250 feet from the stands. He measures the angle from the ground to the top of the stands to be 17.75°. How high are the football stands? |

#### Assessable Academic Vocabulary:

- sine  
- cosine  
- tangent  
- Pythagorean Theorem

#### Symbols and Notation:

- \( \sin \theta \) “sine of angle \( \theta \)”  
- \( \cos \theta \) “cosine of angle \( \theta \)”  
- \( \tan \theta \) “tangent of angle \( \theta \)”

#### Content Connections from Previous Grades:

- 8.3.4, 8.3.5

#### Sample Items:

1. Ted wants to measure the height of the football stands. He walks to point A 250 feet from the stands. He measures the angle from the ground to the top of the stands to be 17.75°. How high are the football stands?
   - A. 76 feet  
   - B. 80 feet  
   - C. 238 feet  
   - D. 781 feet

2. In circle A the radius of the circle is 17, CD = 16 and \( \overline{AB} \) is perpendicular to \( \overline{CD} \). Use the information to find the length of \( \overline{AB} \).
   - A. 5.7  
   - B. 8.0  
   - C. 15.0  
   - D. 16.0
**Core Standard: H.1G Geometry**
Apply properties of two-dimensional figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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</table>
| H.1G.5 Determine the missing dimensions, angles, or area of regular polygons, quadrilaterals, triangles, circles, composite shapes, and shaded regions. | • Items assessing this standard use formulas, trigonometry, the Pythagorean Theorem, ratios, and properties of polygons and circles to determine missing dimensions, angles or area.  
• Use area formulas and/or proportions to solve for area of shaded regions.  
• Write and solve algebraic equations to find missing dimensions.  
• Apply properties of polygons and circles. | ![Image](image)  
The area of the shaded region is ______.  
A. $4 - \pi$  
B. $\pi - 4$  
C. $8 - 4\pi$  
D. $8 - 4\pi$ |

**Assessable Academic Vocabulary:**
regular polygon  
composite shape  
region

**Symbols and Notation:**

**Content Connections from Previous Grades:**
3.3, 4.3, 5.3.2, 7.3, 8.3

---

A roller coaster has a large rise and drop followed by a complete circle. The following diagram shows measurements for the track. An extra 20 feet are needed for cutting and welding. How many feet of track should be ordered? (Use $\pi = 3.14$)

![Diagram](image)  
A. 280 feet  
B. 407 feet  
C. 415.6 feet  
D. 1537.4 feet
<table>
<thead>
<tr>
<th>Core Standard: H.1G Geometry</th>
<th>Score Reporting Category 2</th>
</tr>
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<tbody>
<tr>
<td>Apply properties of two-dimensional figures.</td>
<td>It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.</td>
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</tbody>
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</tr>
</thead>
</table>
| H.1G.6 Determine if three given lengths form a triangle. If the given lengths form a triangle, classify it as acute, right, or obtuse. | - Items assessing this standard ask students to use the triangle inequality theorem and an extension of the converse of the Pythagorean Theorem.  
- Determine if three sides form a triangle.  
- Determine the range of lengths for the third side of a triangle given two sides of the triangle.  
- Determine if a triangle is acute, right, or obtuse given three lengths. | (Two sides of a triangle have lengths of 6 cm and 8 cm. Give a length for the third side so as to form each type of triangle:  
A. Right triangle ____  
B. Acute triangle ____  
C. Obtuse triangle ____)  
(Which length could NOT be used for the third side of the triangle described above?  
A. 1 cm  B. 3 cm  C. 10 cm  D. 13 cm)  
(Determine which group of three line segments (lengths given) could be used to form a triangle?)  
(Given three lengths of the sides of a triangle, determine if the triangle is acute, right, or obtuse)  
(Given two sides of a triangle, find the range of lengths for the third side.) |

Assessable Academic Vocabulary:  
- acute triangle  
- right triangle  
- obtuse triangle  

Symbols and Notation:  

Content Connections from Previous Grades:  
3.3.1, 5.3.1, 8.3.4
Core Standard: H.1G Geometry
Apply properties of two-dimensional figures.

Score Reporting Category 2

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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</tr>
</thead>
<tbody>
<tr>
<td>H.1G.7 In problems involving circles, apply theorems and properties of chords, tangents, and angles; and theorems and formulas of arcs and sectors.</td>
<td>- Items assessing this standard ask students to find lengths of chords, find values for angles or lengths using tangents, and find angle measures inside and outside a circle. Students will use formulas and/or proportions to find lengths of arcs and areas of sectors.</td>
<td>Quadrilateral ABCD is inscribed in circle O, and ( \angle C ) is a right angle, as shown above. Segment AB is not parallel to segment DC. Which of the following statements must be true?</td>
</tr>
<tr>
<td>Assessable Academic Vocabulary:</td>
<td>- Find area of a circle.</td>
<td>A. ( A \equiv \angle B )</td>
</tr>
<tr>
<td>chord tangent inscribed angle circumscribed angle arc sector</td>
<td>- Find circumference of a circle.</td>
<td>B. ( \angle B \equiv \angle D )</td>
</tr>
<tr>
<td></td>
<td>- Write and solve algebraic equations using expressions for lengths of chords or measures of angles.</td>
<td>C. ( \angle B ) is a right angle.</td>
</tr>
<tr>
<td></td>
<td>- Answers may be exact or approximate.</td>
<td>D. Segment AC is a diameter of circle O.</td>
</tr>
<tr>
<td>Symbols and Notation:</td>
<td></td>
<td>E. Segment BD is a diameter of circle O.</td>
</tr>
<tr>
<td>( \widehat{AB} ) “arc AB”</td>
<td></td>
<td>Source: NAEP 2009 Released Item</td>
</tr>
<tr>
<td>Content Connections from Previous Grades: 6.2.5, 7.3</td>
<td></td>
<td>Each of the 12 sides of the figure above has the same length. Which of the following angles has a measure of 90°?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A. Angle ABI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Angle ACG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Angle ADF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. Angle ADJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. Angle AEH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source: NAEP 2005 Released Item</td>
</tr>
</tbody>
</table>
### Core Standard: H.2G Geometry
Apply properties of three-dimensional solids.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Content Standard:
H.2G.1 Identify, classify, model, sketch, and label representations of three-dimensional objects from nets and from different perspectives.

### Assessable Academic Vocabulary:
- net
- three-dimensional

### Boundaries of Assessable Content:
- Items assessing this standard require students to know two-dimensional shapes used in nets as well as the ability to identify a three-dimensional figure given its net or views from different perspectives.
- Identify views of a three-dimensional shape from different perspectives.
- Label a three-dimensional shape given labels on its net.
- Classify two- and three-dimensional figures.

### Sample Items:

#### Sample Item 1:
In the figure, points A, E, and H are on a plane that intersects a right prism. What is the intersection of the plane with the right prism?

- A. A line
- B. A triangle
- C. A quadrilateral
- D. A pentagon
- E. A hexagon

Source: NAEP 1990 Released Item

#### Sample Item 2:
If the figure above is folded on the dotted lines so that all the points labeled P touch each other, what three-dimensional figure will result?

Source: NAEP 2005 Released Item

(Given a picture of a square pyramid, identify which picture is a net for the pyramid.)
### Core Standard: H.2G Geometry

Apply properties of three-dimensional solids.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
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</table>

H.2G.2 Identify and apply formulas for surface area and volume of spheres; right solids, including rectangular prisms and pyramids; cones; and cylinders; and compositions thereof. Solve related context-based problems.

**Assessable Academic Vocabulary:**
- surface area
- volume
- sphere
- prism
- pyramid
- cone
- cylinder
- lateral area
- base area
- slant height
- height

**Symbols and Notation:**  
Formula sheet

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
</table>

- Items assessing this standard require students to find surface area and volume of three-dimensional figures. Students may need to find a missing dimension to calculate the surface area or volume.
- Determine whether a word problem requires surface area or volume for its solution.
- Be able to understand formulas for surface area and volume.
- Answers may be exact or approximate.

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
</table>

When an elastic toy ball is fully inflated, it has a diameter of 7 inches. If some of the air is removed, the diameter is only 5 inches. What is the DIFFERENCE in the volume between the two sizes?

- A. 15 in$^3$
- B. 114 in$^3$
- C. 523 in$^3$
- D. 913 in$^3$

What is the volume left in the cylinder after the shaded cone region is removed?

- A. $1,024\pi$ in$^3$
- B. $1,536\pi$ in$^3$
- C. $2,048\pi$ in$^3$
- D. $4,096\pi$ in$^3$
Core Standard: H.2G Geometry
Apply properties of three-dimensional solids.

Score Reporting Category 2

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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<th>Content Standard:</th>
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<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.2G.3 Identify and apply formulas to solve for the missing dimensions of spheres and right solids, including rectangular prisms and pyramids, cones, and cylinders, both numerically and symbolically.</td>
<td>Items assessing this standard require students to solve for missing dimensions of three-dimensional figures. Students may need to solve for the missing dimensions using trigonometry, the Pythagorean Theorem, or a formula involving a given surface area or volume.</td>
<td>(A square pyramid is to be formed from 25 cubic feet of concrete. The base of the pyramid is a square with sides of 5 feet. Find the height of the pyramid.)</td>
</tr>
<tr>
<td></td>
<td>Be able to understand formulas for surface area and volume.</td>
<td>(Find the slant height of a cone given its height and radius.)</td>
</tr>
<tr>
<td></td>
<td>Write and solve algebraic equations.</td>
<td>(Find the radius of a sphere given its surface area.)</td>
</tr>
<tr>
<td></td>
<td>Answers may be exact or approximate.</td>
<td>(Find the height of a cylinder given its volume and radius.)</td>
</tr>
</tbody>
</table>

Assessable Academic Vocabulary:

- surface area
- volume
- sphere
- prism
- pyramid
- cone
- cylinder
- lateral area
- base area
- slant height
- height

Symbols and Notation:

- Formula sheet

Content Connections from Previous Grades:

3.3, 5.3, 7.3
### Core Standard: H.2G Geometry
Transform and analyze figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

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<th>Content Standard:</th>
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<tbody>
<tr>
<td>H.3G.1 Recognize and identify line and rotational symmetry of two-dimensional figures.</td>
<td>- Items assessing this standard require students to identify two-dimensional figures with rotational symmetry or line(s) of symmetry. Students may have to draw the line(s) of symmetry, determine the number of lines of symmetry, or determine the measure of the rotational symmetry in a figure.</td>
</tr>
<tr>
<td></td>
<td>- Identify and recognize line and rotational symmetry for polygons given in words (e.g. rhombus).</td>
</tr>
</tbody>
</table>

#### Assessable Academic Vocabulary:
- line symmetry
- rotational symmetry

#### Symbols and Notation:

### Sample Items:
Triangle ABC has been rotated 90° to form triangle AB’C’.
How does the area of the image compare to the area of the original triangle?

- A. Area doubles
- B. Area is smaller
- C. Area is larger
- D. Area is the same

In which of the following figures is the dashed line NOT a line of symmetry?

- A.
- B.
- C.
- D.
- E.

Source: NAEP 2005 Released Item
### Core Standard: H.3G Geometry
Transform and analyze figures.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Content Standard:
H.3G.2 Identify and perform single and composite transformations of geometric figures in a plane, including translations, origin-centered dilations, reflections across either axis or \( y = \pm x \), and rotations about the origin in multiples of 90°.

### Assessable Academic Vocabulary:
- transformation
- translation
- reflection
- rotation
- dilation
- scale factor
- preimage
- image

### Symbols and Notation:
\[
T(x, y) \rightarrow (x + 3, y - 2)
\]
“T of x, y maps to x plus 3, y minus 2”
\[
\langle x + 3, y - 2 \rangle \text{ “x plus 3, y minus 2”}
\]
\[
(x, y) \rightarrow (2x, 2y) \text{ “x, y maps to 2x, 2y”}
\]

### Boundaries of Assessable Content:
- Items assessing this standard require students to identify a given transformation using by identifying the picture of the image or the formula used to create the image from the preimage. Students may have to perform a single or composite transformation to answer questions about the ordered pairs or picture of the image.
- Be able to graph ordered pairs and connect them to make a geometric figure.
- Know the equations for the lines that are the x-axis and y-axis.
- Know translations, reflections, and rotations have congruent preimages and images.
- Know that dilations have similar preimages and images. Able to apply scale factor to describe and identify dilations.
- Understand how to apply composite transformations to a preimage.

### Sample Items:
The coordinates of point A are (-5, 3).
If A is reflected over the y-axis, then translated 3 units right and 4 units down, the new coordinates of A are:
- A. (5, 3)
- B. (8, -1)
- C. (-2, -1)
- D. (-2, -7)

Which best describes the transformation of the shaded trapezoid to the unshaded trapezoid?

Determine what a translation of this quadrilateral would look like:
- A. Dilation
- B. Reflection
- C. Rotation
- D. Translation

### Content Connections from Previous Grades:
3.3, 7.2, 8.1
Core Standard: H.3G Geometry
Transform and analyze figures.

Score Reporting Category 2

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
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<tr>
<td>Transform and analyze figures.</td>
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<tbody>
<tr>
<td>H.3G.3 Apply a scale factor to determine similar two- and three-dimensional figures, are similar. Compare and compute their respective areas and volumes of similar figures.</td>
</tr>
</tbody>
</table>

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<tr>
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</thead>
<tbody>
<tr>
<td>scale factor</td>
</tr>
<tr>
<td>similar figures</td>
</tr>
<tr>
<td>area</td>
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<tr>
<td>surface area</td>
</tr>
<tr>
<td>volume</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbols and Notation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a : b “ratio of a to b”</td>
</tr>
<tr>
<td>( \frac{a}{b} ) “ratio of a to b”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundaries of Assessable Content:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items assessing this standard require students to use ratios and proportions to solve for areas and volumes of similar figures. Students may be given two surface areas and one volume for two similar figures and be asked to find the volume of the second figure.</td>
</tr>
<tr>
<td>Identify the scale factor between two similar figures.</td>
</tr>
<tr>
<td>Be able to understand formulas for surface area and volume.</td>
</tr>
<tr>
<td>Write and solve algebraic equations.</td>
</tr>
<tr>
<td>Square and cube numbers as well as find the square root and cube root of numbers.</td>
</tr>
<tr>
<td>Answers may be exact or approximate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Smiths want to build a new doghouse with a volume 4 times that of their old one. What might the dimensions of the new doghouse be? Shown is a picture of the original doghouse without the roof.</td>
</tr>
</tbody>
</table>

![Doghouse Diagram](image)

<table>
<thead>
<tr>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 7 ft by 6.5 ft by 6 ft</td>
</tr>
<tr>
<td>B. 2 ft by 2.5 ft by 6 ft</td>
</tr>
<tr>
<td>C. 3 ft by 4 ft by 5 ft</td>
</tr>
<tr>
<td>D. 4 ft by 5 ft by 6 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Content Connections from Previous Grades:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3, 5.3, 7.2, 7.3</td>
</tr>
</tbody>
</table>
Core Standard: H.3G Geometry
Transform and analyze figures.

Score Reporting Category 2

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.3G.4 Apply slope, distance, and midpoint formulas to solve problems in a coordinate plane.</td>
<td>Items assessing this standard require students to solve word problems on a coordinate grid, justify properties of two-dimensional shapes on a coordinate grid, find midpoints or endpoints of segments among other problems related to using slope, distance, and midpoint formulas for solving or justification purposes.</td>
<td>Determine the midpoint of a segment whose endpoints are ((-3, 4)) and ((3, 10)).</td>
</tr>
<tr>
<td></td>
<td>Be able to understand formulas for slope, distance, and midpoint.</td>
<td>A. ((0, 7))  B. ((3, 7))  C. ((0, -3))  D. ((-3, 3))</td>
</tr>
<tr>
<td></td>
<td>Understand that distinct lines with equal slopes are parallel. Also understand that slopes with a product of -1 are perpendicular.</td>
<td>What is the area of triangle A ((-2, 0)), B ((4, 0)), and C ((2, 7))?</td>
</tr>
<tr>
<td></td>
<td>Understand that Pythagorean Theorem or the distance formula can be used to find the distance between two points on a coordinate plane.</td>
<td>A. 18 square units  B. 21 square units  C. 24 square units  D. 36 square units</td>
</tr>
<tr>
<td></td>
<td>Write and solve algebraic equations.</td>
<td>Which of the coordinates listed for Point C will make figure ABC a triangle with 2 congruent sides?</td>
</tr>
<tr>
<td></td>
<td>Answers may be exact or approximate.</td>
<td>A. ((5, -6))  B. ((4, 1))  C. ((1, 4))  D. ((-6, 4))</td>
</tr>
</tbody>
</table>

Assessable Academic Vocabulary:
slope
distance formula
midpoint formula

Symbols and Notation:

Content Connections from Previous Grades:
8.1, 8.3
### Core Standard: H.1S  Data Analysis
Analyze and interpret empirical data.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Content Standard:

H.1S.1 Given a context, determine appropriate survey methods, analyze the strengths and limitations of a particular survey, observational study, experiment, or simulation, and the display of its data.

### Assessable Academic Vocabulary:
empirical data, observational study, experiment, survey, strength of a survey, limitation of a survey, data display.

### Boundaries of Assessable Content:
- Items assessing this standard include understanding survey methods. Specifically, given a context, students will:
  - identify the population and questions needed to conduct an appropriate survey
  - determine appropriate survey methods (e.g., mail, phone, random phone calls, etc)
  - analyze the strengths and limitations of a survey, observational study, experiment or simulation.
  - analyze the strengths and limitations of the data display corresponding to a survey, observational study, experiment, or simulation.
- Data displays include bar graphs, histograms, line graphs, stem-and-leaf plots, box-plots, and circle graphs.

### Sample Items:
Sarah wants to estimate the number of students in her high school who own horses. Which survey would best help her make an accurate estimation?

- A. Sarah surveys 50 students from the Horseback Riding Club.
- B. Sarah surveys 30 randomly chosen students from her high school.
- C. Sarah surveys 15 students from her Sophomore English Class.
- D. Sarah surveys her 5 best friends.

The principal of a high school would like to determine why there has been a large decline during the year in the number of students who buy food in the school’s cafeteria. To do this, 25 students from the school will be surveyed. Which method would be the most appropriate for selecting the 25 students to participate in the survey?

- A. Randomly select 25 students from the senior class.
- B. Randomly select 25 students from those taking physics.
- C. Randomly select 25 students from a list of all students at the school.
- D. Randomly select 25 students from a list of students who eat in the cafeteria.
- E. Give the survey to the first 25 students to arrive at school in the morning.

Source: NAEP 2009 Released Item

### Content Connections from Previous Grades:
5.1.7, 8.2
Core Standard: H.1S Data Analysis
Analyze and interpret empirical data.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Content Standard:
H.1S.2 Evaluate data-based reports by considering the source of the data, the design of the study, and the way the data was analyzed and displayed.

Assessable Academic Vocabulary:
data display evaluate source of data

Symbols and Notation:

Boundaries of Assessable Content:
- Items assessing this standard evaluate data-based reports by considering one or more of the following:
  - the source of the data
  - the design of the study
  - the way the data was analyzed
  - the way the data was displayed
- Data displays include bar graphs, histograms, line graphs, stem-and-leaf plots, box-plots, and circle graphs.

Sample Items:
A random sample of graduates from a particular college program reported their ages and incomes in response to a survey. Each point on the scatterplot represents the age and income of a different graduate. Based on the data in the scatterplot, predictions can be made about the income of a 35 year old and the income of a 55 year old. For which age is the prediction more likely to be accurate?

35 year old
55 year old

Source: NAEP 2009 Released Item

Benita and Jeff each surveyed some of the students in their eighth-grade homerooms to determine whether chicken or hamburgers should be served at the class picnic. The survey forms are shown below.

Benita reported that 100 percent of those in her survey wanted chicken. Jeff reported that 75 percent of those in his survey wanted hamburger.

Which survey, Benita's or Jeff's, would probably be better to use when making the decision about what to serve?

Explain why that survey would be better.

Source: NAEP 2007 Released Item
Core Standard: **H.1S Data Analysis**

**Score Reporting Category 3**

Analyze and interpret empirical data.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

**Content Standard:**

H.1S.3 Compare and draw conclusions about two or more data sets using graphical displays or central tendencies and range.

**Assessable Academic Vocabulary:**

- graphical display
- measures of central tendencies
- mean
- median
- mode
- range
- histogram
- bar graph
- circle graph
- line graph
- box-plot
- stem-and-leaf plot

**Boundaries of Assessable Content:**

- Use graphical displays to compare and draw conclusions about two or more data sets.
- Graphical displays include bar graphs, histograms, line graphs, stem-and-leaf plots, box-plots, and circle graphs.
- Using mean, median, mode and/or range, compare and draw conclusions about two or more data sets.

**Sample Items:**

How much more is the average price of a giant pizza than the average price of a medium pizza?

<table>
<thead>
<tr>
<th></th>
<th>Medium</th>
<th>Giant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese</td>
<td>$7.00</td>
<td>$10.00</td>
</tr>
<tr>
<td>Pepperoni</td>
<td>$9.00</td>
<td>$13.00</td>
</tr>
<tr>
<td>Hawaiian</td>
<td>$11.00</td>
<td>$14.00</td>
</tr>
<tr>
<td>Vegetarian</td>
<td>$12.00</td>
<td>$16.00</td>
</tr>
</tbody>
</table>

A. $3.50  B. $3.75  C. $4.00  D. $8.00

The total distances covered by two runners during the first 28 minutes of a race are shown in the graph above. How long after the start of the race did one runner pass the other?

A. 3 minutes  C. 12 minutes
B. 8 minutes  D. 14 minutes
E. 28 minutes

Source: NAEP 1999 Released Item
### Core Standard: H.1S Data Analysis

Analyze and interpret empirical data.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

### Content Standard:

H.1S.4 Use or construct a scatter plot for a given data set, determine whether there is a(n) linear, quadratic, exponential, or no trend. If linear, determine if there is a positive or negative correlation among the data; and, if appropriate, sketch a line of best fit, and use it to make predictions.

### Assessable Academic Vocabulary:

- scatter plot
- linear trend
- quadratic trend
- exponential trend
- no trend
- positive correlation
- negative correlation
- line of best fit

### Boundary of Assessable Content:

<table>
<thead>
<tr>
<th>Items assessing this standard include the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Construct a scatter plot given a data set.</td>
</tr>
<tr>
<td>o Use a scatter plot to determine whether the data shows a(n) linear, quadratic, exponential or no trend.</td>
</tr>
<tr>
<td>o Use a scatter plot with a linear trend to determine if there is a positive or negative correlation. Students may have to identify the line of best fit graphically or algebraically (write an equation). Students may have to use their line to make predictions related to the data.</td>
</tr>
<tr>
<td>o Scatter plots may be drawn in any quadrant on a coordinate plane.</td>
</tr>
<tr>
<td>o Students may need to consider whether their data shows a strong or weak correlation.</td>
</tr>
</tbody>
</table>

### Content Connections from Previous Grades:

- 5.1.7, 8.2

### Sample Items:

From the scatter plot you can conclude the following for the group of students that studied only the night before the final exam.

- A. More time studying, the better the grade.
- B. Less time studying, the better the grade.
- C. Less time studying, the lower the grade.
- D. Time studying did not relate to the grade.

A random sample of graduates from a particular college program reported their ages and incomes in response to a survey. Each point on the scatterplot represents the age and income of a different graduate.

Which equation best fits the data?

- A. \( y = -1,000x + 15,000 \)
- B. \( y = 10,000x + 15,000 \)
- C. \( y = 1,000x + 15,000 \)
- D. \( y = 10,000x \)
- E. \( y = 1,000x \)

Source: NAEP 2009 Released Item
Core Standard: H.1S Data Analysis
Analyze and interpret empirical data.

Score Reporting Category 3
It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1S.5 Construct, analyze, and interpret tables, scatter plots, frequency distributions, and histograms of data sets.</td>
<td>Items assessing this standard include constructing, analyzing, and interpreting the following: o tables o scatter plots o frequency distributions o histograms</td>
<td>The pictograph shows the results of surveying 25 kids. If this same trend continues and 100 kids were surveyed, how many would like baseball?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessable Academic Vocabulary:</th>
<th>Content Connections from Previous Grades: 5.1.7, 8.2, H.2A</th>
</tr>
</thead>
<tbody>
<tr>
<td>scatter plot</td>
<td></td>
</tr>
<tr>
<td>frequency distribution</td>
<td></td>
</tr>
<tr>
<td>histogram</td>
<td></td>
</tr>
</tbody>
</table>

| Symbols and Notation: | |
|----------------------||

Sample Items:
The pictograph shows the results of surveying 25 kids.
If this same trend continues and 100 kids were surveyed, how many would like baseball?

A. 16     B. 20     C. 24     D. 25

The scatterplot shows data for groups R and S. Which of the following statements is true about the correlation between the x and y values of group R and the correlation between the x and y values of group S?
A. The x and y values appear to be negatively correlated in both R and S.
B. The x and y values appear to be positively correlated in both R and S.
C. The x and y values appear to be negatively correlated in R, but positively correlated in S.
D. The x and y values appear to be positively correlated in R, but negatively correlated in S.
E. The x and y values appear to be more highly correlated in R than in S.

Source: NAEP 2009 Released Item

LEGEND
* represents a data point in group R.
* represents a data point in group S.
Core Standard: H.2S Probability
Apply basic principles of probability.

Score Reporting Category 3
It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Content Standard:
H.2S.1 Identify, analyze, and use experimental and theoretical probability to estimate and calculate the probability of simple events.

Assessable Academic Vocabulary:
probability
experimental probability
theoretical probability
simple event

Symbols and Notation:
P(Event) “Probability of Event”

Boundaries of Assessable Content:
• Items assessing this standard include using experimental probability and theoretical probability to estimate the probability of simple events. Compute simple theoretical probability.
• Compute simple experimental probability given necessary values.
• Analyze estimates and calculations of theoretical and experimental probabilities. A student may need to find an experimental probability and use proportions or calculate the number of times something is likely to occur given a probability.
• Determine the size of the sample space needed to calculate probabilities.
• Answers may be exact or approximated.

Sample Items:
Malik was given a bag of blue, green, red, and white marbles for an experiment. Without looking, he randomly pulled out a marble, wrote down its color and replaced it. After ten tries he had these results: six blue, three red, and one white. Using this information, which color marble is most likely to be pulled out next?

A. Blue   B. Green   C. Red   D. White

GENDER AND COLOR OF PUPPIES

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>1</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
</tr>
</tbody>
</table>

The table above shows the gender and color of 7 puppies. If a puppy selected at random from the group is brown, what is the probability it is a male?

A. \( \frac{1}{4} \)  B. \( \frac{2}{7} \)  C. \( \frac{1}{3} \)  D. \( \frac{1}{2} \)  E. \( \frac{2}{3} \)

Source: NAEP 2009 Released Item

Content Connections from Previous Grades:
6.2, 7.2, 8.2

(Tina counts 36 deer and tags them in a forest. She goes back 6 months later and sees 70 deer, 10 of which are tagged. Estimate the number of deer in the forest.)
Core Standard: H.2S Probability
Apply basic principles of probability.

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Content Standard:

H.2S.2 Determine the sample space of a probability experiment.

Assessable Academic Vocabulary:
sample space

Symbols and Notation:

\{ \text{heads, tails} \} “the set heads, tails”

Boundaries of Assessable Content:

- Items assessing this standard include listing a sample space as well as determining the number of items in the sample space.
- Solutions may require the multiplication counting principle.
- Make lists to determine the sample space.
- Understand the relationship between the sample space and the probability of an event.

Content Connections from Previous Grades:

6.2, 7.2

Sample Items:

A basketball team has 10 players. Five of the players are guards, three are forwards, and two are centers. If the coach must choose two guards, two forwards, and one center to start the game, how many possible combinations are there?

A. 60 B. 252 C. 1,440 D. 30,240

How many different three-digit whole numbers can be written using each of the digits 4, 5, and 6 exactly once?

A. 3 B. 6 C. 9 D. 24 E. 27

Source: NAEP 2011 Released Item

Li’s English book weighs 3 pounds, her math book weighs 5 pounds, her history book weighs 4 pounds, and her science book weighs 6 pounds. How many different combinations of one or more books can Li pack in her backpack so that the total weight of the books is 12 pounds or less?

A. 9 B. 10 C. 11 D. 12 E. 18

Source: NAEP 2007 Released Item

(A bag has four marbles. Two are blue, one green, one red. What is the sample space for choosing two marbles with replacement?)
Core Standard: H.2S Probability
Apply basic principles of probability.

Score Reporting Category 3

It is essential that these standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

<table>
<thead>
<tr>
<th>Content Standard:</th>
<th>Boundaries of Assessable Content:</th>
<th>Sample Items:</th>
</tr>
</thead>
</table>
| H.2S.3 Compute and interpret probabilities for independent, dependent, complementary, and compound events using various methods (e.g., diagrams, tables, area models, and counting techniques). | - Items assessing this standard will include various methods to compute probabilities. Students may use the various methods learned to solve the problem or may be asked to interpret a method and explain why it shows the requested probability.  
- A student may have to find the probability of an event or be given the probability of an event and use that to determine the probability of the complementary event.  
- Counting techniques include multiplication counting rule and may include some combinations and permutations. | If the spinner shown is spun, what is the probability it would NOT land on 3?  
A. $\frac{1}{6}$  
B. $\frac{1}{3}$  
C. $\frac{5}{6}$  
D. $\frac{7}{8}$ |

Assessable Academic Vocabulary:
- independent events
- dependent events
- complementary events
- compound events
- area models
- counting techniques
- with replacement
- without replacement

Symbols and Notation:
- P(Event) “Probability of Event”

Content Connections from Previous Grades:
- 6.2, 7.2

Tim rolls two six-sided dice. (The numbers 1 through 6 are on the six faces of each die.) If the sum is odd, what is the probability the sum is 5?
A. $\frac{1}{18}$  
B. $\frac{1}{9}$  
C. $\frac{2}{9}$  
D. $\frac{1}{2}$

A pair of six-sided dice is rolled, and the result is a sum less than 10. What is the probability both dice have the same numerical value? (The numbers 1 through 6 are on the six faces of each die.)
A. $\frac{1}{9}$  
B. $\frac{2}{15}$  
C. $\frac{1}{6}$  
D. $\frac{5}{18}$
Assessable Academic Vocabulary Summary List for High School
(Note: Assessable Academic Vocabulary from previous grades may also be used without explanation.)

AAS
absolute value
acute triangle
algebraically
alternate exterior angles
alternate interior angles
arc
area
area models
ASA
associative property
axis of symmetry
bar graph
base area
box-plot
chord
circle graph
circumscribed angle
classify
commutative property
complement
complementary events
composite shape
compound events
cone
congruent
congruent figures
congruent triangles
consecutive interior angles
corresponding angles
Corresponding Parts of Congruent Triangles are Congruent (CPCTC)
cosine
counting techniques
cylinder
data display
dependent events
dependent variable
difference of squares
dilation
distance formula
distributive property
domain
empirical data
equation of a line
equivalent equations
equivalent expressions
evaluate
experiment
exponential
exponential function
exponential trend
extend
factor
greatest common factor
height
histogram
HL
identity property
image
independent events
independent variable
inequalities
inscribed angle
integer exponents
inverse property
irrational numbers
lateral area
limitation of a survey
line graph
line of best fit
line symmetry
linear
linear pattern
linear trend
mean
measures of central tendencies
median
midpoint formula
mode
negative correlation
net
no trend
number line
numerically
observational study
obtuse triangle
parabola
parallel
perpendicular
pi (π)
positive correlation
preimage
prism
probability
properties of equality
properties of exponents
properties of inequality
pyramid
Pythagorean Theorem
quadratic
quadratic function
quadratic trend
quadrilateral
radical sign
range
rational numbers
real numbers
reflection
region
regular polygon
right triangle
roots
rotation
rotational symmetry
same-side interior angles
sample space
SAS
scale factor
scatter plot
scientific notation
sector
similar
similar figures
similar triangles
simple event
simplest radical form
simplify
sine
slant height
slope
slope-intercept form (y=mx+b)
source of data
sphere
square root
SSS
standard form (Ax+By=C)
stem-and-leaf plot
strength of a survey
supplementary
surface area
survey
system of linear equations
system of linear inequalities
tangent
theoretical probability
three-dimensional
transform
transformation
translation
transversal
vertex
volume
with replacement
without replacement
x-intercept
y-intercept
Item Specifications

Oregon Assessment of Knowledge and Skills (OAKS) is a statewide assessment scored by the state. It is a required assessment that provides the base for the accountability system. The OAKS also measures proficiency in the Essential Skills and is one way to determine student’s eligibility for a high school diploma or modified diploma beginning with the graduating class of 2014.

Criteria for All OAKS Test Questions

Test items must:

- be appropriate for students in terms of grade-level difficulty, cognitive complexity, reading level, interests and experience.
- be free of age, gender, ethnic, religious, socioeconomic, or disability stereotypes or bias.
- provide clear and complete instructions to students.

Graphics Criteria

Graphics are used in OAKS to provide both necessary and supplemental information. Some graphics contain information that is necessary for answering the question, while other graphics illustrate or support the context of the question.

- Graphic displays, their corresponding items and answer choices will appear on the same screen for online items.
- Shading and color will be minimized. It will be used to make a figure’s size, shape or dimensions clear, and not solely for artistic effect.
- When objects or regions of particular colors must be identified from a graphic, the objects or regions will be labeled as to their color.
- Graphics used for computer scored constructed response items are displayed within a grid space and allow students to manipulate answer graphics and answer choices.

Item Style and Format Criteria for Multiple-Choice Items

- Test items will be in the form of questions - or sentences that require completion.
- Each item will have three, four, or five answer choices. Students will be told in the test directions to choose the best answer from among the choices.
- Answer choices will be arranged one of three ways beneath the question: vertically, horizontally, or in two columns (i.e., A and B in the left column, C and D in the right column).
- Neither “None of the above” nor “All of the above” will be used as one of the answer choices. “There is not enough information to tell” is an allowed answer choice.
- Test items may be worded in the negative (“Which of these is NOT …”), but this structure will be used only when it offers substantial advantages for the item construction.
- Items should be free of absolute wording, such as “always” and “never,” and may have qualifying words (e.g., least, most, except) printed in CAPS for emphasis.
- Masculine pronouns should NOT be used to refer to both sexes. Plural forms should be used whenever possible to avoid gender-specific pronouns (e.g., instead of “The student will make changes so that he …,” use “The students will make changes so that they…..”).
- An equal balance of male and female names should be used, including names representing different ethnic groups.
• Test items aligned to standards may contain extraneous information.
• Stacked English-Spanish test items are used on electronic tests for the English-Spanish OAKS.
• Each Score Reporting Category will have items with a range of difficulty and complexity levels.
• Each test item will measure only one Score Reporting Category.

Item Style and Format Criteria for Computer-Scored Constructed Response Items

• Test items will be in the form of questions that ask for at least one object to be created or matched to an existing picture.
• Each item may have many discrete and correct answer choices.
• Test items may be worded so that not all answer choices are used to construct the correct response.
• An equal balance of male and female names should be used including names representing different ethnic groups.
• Test items aligned to standards may contain extraneous information but only to enhance the students’ understanding of the question.
• Side-by-side English-Spanish test items of this type are under development.

Additional Criteria for Mathematics Test Questions

• Except in translation items (name to numeral, numeral to name), numbers will be expressed as numerals.
• In general, numbers zero through nine should be presented as words, and numbers 10 and above should be presented as numerals. In the item stem, any numbers needed to compute answers should be presented as numerals.
• Commas will be used in numbers with four or more digits.
• Decimal numbers less than one will be written with leading zeros.
• All fractions will be written with a horizontal bar separating the numerator and denominator.
• If the answer choices for an item are strictly decimal numerals or integers, they should be arranged in ascending or descending order, with the place values of digits aligned. An exception would be when this ordering of options might give a clue as to the correct option. When the item requires the identification of relative size or magnitude, choices should be arranged as they are presented in the item stem.
• If the answer choices for an item are neither strictly numerical nor denominate numbers, the choices should be arranged by the logic presented in the question or by length.
• Answer choices will include units, as appropriate.
• Computations required in test items will not be so complicated that they take an inordinate amount of time to complete, even with calculators. Instead, reasoning within the context of the items is emphasized.
• Test items will be appropriate for students in the assigned grade in terms of reading level, interests, and experience. For mathematics test items, the reading level should be approximately one grade level below the grade level of the test, except for specifically assessed mathematical terms or concepts.
• Standard units of measure should be spelled out, except in graphics where an abbreviation may be
used (e.g., ft or yd). Abbreviations that also spell a word must be punctuated to avoid confusion. For example, to avoid confusion with the preposition “in,” the abbreviation “in.” should be used for the unit of measure “inches.” If an abbreviation is used in a graphic, an explanation of the meaning of the abbreviation should be included in the stem. Metric units may be abbreviated.

In addition (See: Test Administration Manual at http://www.ode.state.or.us/go/tam )

- Students are strongly encouraged to use calculators – either the on-screen calculator, their own, or one provided by the school.
- Rulers, manipulative and other tools commonly available to all students are also encouraged. No problems require the use of a calculator and no more than a four-function calculator is needed for any problem, although scientific calculators are highly recommended for use at grades 8 and 10.
- A reference sheet containing appropriate formulas and conversions is provided to students. If formulas not on the sheet are needed, they should be included with the item.
Mathematics Test Blueprint

Introduction

The blueprints used to construct Knowledge and Skills Tests for Mathematics prescribe the:

- Score Reporting Categories (SRC) included on each test,
- The cognitive demand and difficulty level of items as distributed on a test form,
- the number and percentages of test items from each SRC included on each test, and
- the total number and percentages of operational and field test items included for each test.

Teachers and other educators have historically played a vital role in the development of these specifications and blueprints by serving on Content and Assessment Panels and other review groups. These groups have advised the Department as content standards have been developed, and have helped establish priorities on which standards to assess and the weighting of the strands within each content area assessment.

Alignment of Test Items to Content Standards

Test items are carefully aligned to content standards at the appropriate grade level through a rigorous process at two points in the test item development process:

- At item development workshops, item writers are provided with adopted content standards and content standard elements to which they must write test items; during a peer review process, this alignment is verified by another grade level item developer and the grade-level facilitator.
- Alignment of items to the standards is further verified during a review by members of a Content and Assessment Panel, who ensure items not only match the standards, but also verify overall quality and appropriateness. Reviewers either accept items as a strong match to the targeted standards, edit items to achieve a strong match, or reject items which do not strongly match the standards.

The Appendix to this document includes additional evidence describing procedures ensuring alignment during item development, including descriptions of Item Development and the Life of an Item.

Content Coverage

Prior to item writing activities, item databases are reviewed to determine the extent that the available items represent the emphasis and content in the standards. If any content standards are underrepresented in the item pool, they are identified and targeted specifically for additional item development. This assures that the item pools will have sufficient numbers of items aligned to the each of the content standards to allow the test algorithm to deliver tests which follow the blueprint for content, difficulty, and cognitive complexity.

For electronic administration, all tests and the item pools from which they are constructed follow the weighting of each score reporting category as reflected in the chart titled “Weighting of Mathematics Score Reporting Categories.” Items aligned to the same SRC are selected to provide a range of difficulty so that the progressive nature of the test is maintained as students of varied
ability levels are presented with items most appropriate to their ability from that pool. Although a student may not see an item addressing every one of the standards in a single test event, the item pool contains multiple items for each content standard at a variety of difficulty levels and cognitive complexity.

In addition, the adaptive algorithm specifically considers alignment criteria when drawing test items. As a result, we accomplish the dual purpose of creating a test form that is appropriately developed for each student and it meets the criteria set forth for alignment (e.g., balance of representation, depth of knowledge).

In order to report subscores, or scores for SRCs, no fewer than six items will be used for each SRC. Online tests report total test scores and scores for SRCs. (Subscores)

**Additional Test Design Criteria**

Each item assesses only one SRC at one grade.

Each item assesses only one content standard at one grade.

Online-adaptive test opportunities provide a range and breadth of items within each SRC and content standard. Test pools attempt to provide a minimum of one item at each difficulty level for each content standard. Test pools range in size from 800 to 1500 items.

Key placement cannot be controlled for online-adaptive assessments, so to ensure more random correct keys, item writers are instructed to rotate the correct key for their items during item authoring.

English test blueprints provide the criteria for all English-Spanish tests. Test pools and are designed to match the English test opportunities.
Weighting of Mathematics Score Reporting Categories

The chart below shows the score reporting categories for each of the grades and the percentage of questions on a test that assess each score reporting category. For example, at grade 5, 35% of the items on a test assess Number and Operations and Data Analysis, which equals about 14 items on a 40-item test. The second chart, on the next page, is an expanded view of the criteria for test weighting.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Reporting Category 1</th>
<th>Weight</th>
<th>Score Reporting Category 2</th>
<th>Weight</th>
<th>Score Reporting Category 3</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Number and Operations</td>
<td>35%</td>
<td>Number and Operations, Algebra, and Data Analysis</td>
<td>35%</td>
<td>Geometry and Measurement</td>
<td>30%</td>
</tr>
<tr>
<td>4</td>
<td>Number and Operations</td>
<td>35%</td>
<td>Number and Operations and Algebra</td>
<td>35%</td>
<td>Measurement</td>
<td>30%</td>
</tr>
<tr>
<td>5</td>
<td>Number and Operations and Data Analysis</td>
<td>35%</td>
<td>Number and Operations and Algebra</td>
<td>35%</td>
<td>Geometry, Algebra, and Measurement</td>
<td>30%</td>
</tr>
<tr>
<td>6</td>
<td>Number and Operations</td>
<td>35%</td>
<td>Number and Operations and Probability</td>
<td>35%</td>
<td>Algebra</td>
<td>30%</td>
</tr>
<tr>
<td>7</td>
<td>Number and Operations and Algebra</td>
<td>35%</td>
<td>Number and Operations, Algebra and Geometry</td>
<td>35%</td>
<td>Measurement and Geometry</td>
<td>30%</td>
</tr>
<tr>
<td>8</td>
<td>Algebra</td>
<td>40%</td>
<td>Data Analysis and Algebra</td>
<td>30%</td>
<td>Geometry and Measurement</td>
<td>30%</td>
</tr>
<tr>
<td>HS</td>
<td>Algebra</td>
<td>50%</td>
<td>Geometry</td>
<td>30%</td>
<td>Statistics</td>
<td>20%</td>
</tr>
</tbody>
</table>
## Mathematics Test Blueprint- High School
### Content Coverage and Weighting

<table>
<thead>
<tr>
<th>Score Reporting Categories</th>
<th>Number of OAKS Online Items</th>
<th>Target % of Questions Assessed per Test*</th>
<th>Online Test Pool Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>18-22</td>
<td>50%</td>
<td>730</td>
</tr>
<tr>
<td>Geometry</td>
<td>10-14</td>
<td>30%</td>
<td>570</td>
</tr>
<tr>
<td>Statistics</td>
<td>6-10</td>
<td>20%</td>
<td>260</td>
</tr>
<tr>
<td><strong>Operational Item Total</strong></td>
<td></td>
<td></td>
<td><strong>1560</strong></td>
</tr>
<tr>
<td><strong>Field Test Item Total</strong></td>
<td></td>
<td></td>
<td><strong>5</strong></td>
</tr>
<tr>
<td><strong>Total Items on Test</strong></td>
<td></td>
<td></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

*During an individual student testing session, the test algorithm selects items from each SRC, targeting the percentages indicated. Furthermore, items are selected to match the target item difficulty level, determined by the student's performance on previous items, and also to match the Cognitive Demand Distribution Goals for the test. The numbers of items available in the item pool for each SRC are sufficient to allow three tests per student each year, without the student seeing any item more than once.*
**Target Cognitive Demand and Item Difficulty Distribution**

The mathematics test pools are designed so that items having a range of Cognitive Demand and a range of difficulty are included for each student test opportunity. The target item pool difficulty distribution for the High School test is outlined in the chart. A target range of cognitive demand item delivery is also included. (See Appendix B, Cognitive Demand and RIT by Difficulty for all grades). The three Cognitive Demand levels used to qualify Oregon’s test items are:

- **Recall**: Item requires a student to recall a fact, information or procedure.
- **Skill/Concept**: Item requires a student to use skill or concept, including thinking that requires two or more steps.
- **Strategic Thinking**: Item requires a student to use reason, develop a plan or use a sequence of steps.

Online adaptive tests provide students with questions at the beginning of the test at or about the mean RIT level and as the student responds, the test item delivery system makes adjustments by selecting appropriate items for each student based upon their correct and incorrect responses.

Student scores on each test will vary due to performance and the set of unique test items issued to the student. Generally, students will earn scores between the maximum high and minimum low range. The following are the possible high and low RIT student scores for High School tests, within one or two points, based on a given year’s item pool.

<table>
<thead>
<tr>
<th>RIT Level</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>High RIT</td>
<td>300</td>
</tr>
<tr>
<td>Low RIT</td>
<td>182</td>
</tr>
</tbody>
</table>
Achievement Level Descriptors

Achievement level descriptors describe what students know and can do based on their performance on statewide knowledge and skills tests in the various content areas. These may be used by educators to target instruction and inform parents and students of the expectations for students to be considered proficient at a particular grade level.

The Achievement Level Descriptors are based on a sampling of a larger set of content outlined in the *State of Oregon Content Standards for Kindergarten through Grade 8* (2007) and the *State of Oregon High School Mathematics Standards* (2009). Results for individual students are only one indicator of student ability as measured at the time of testing. These statements give a general description of what most students know and can do within a particular band of achievement and are presented in the order of the way they are reported rather than by importance or test emphasis.

Students who score at or within a particular level of achievement possess the bulk of the abilities described at that level and generally have mastered the skills described in the preceding achievement levels.

Achievement Level Descriptors for each subject area were developed by groups of parents, educators, and business people who worked with state officials to establish the minimum scores required for Exceeds, Meets, Nearly Meets and Does Not Yet Meet.
# Mathematics Oregon Achievement Level Descriptors – High School

The achievement level descriptors are cumulative.

<table>
<thead>
<tr>
<th>General Policy Definitions (Apply to all grades and all subjects)</th>
<th>Does Not Yet Meet</th>
<th>Nearly Meets</th>
<th>Meets</th>
<th>Exceeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students do not demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate partial mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate mastery of grade-level knowledge and skills exceeding the requirement for proficiency.</td>
<td></td>
</tr>
</tbody>
</table>

| Mathematics Policy Definitions (Apply to all grades) | Students demonstrate limited mastery of mathematical knowledge and skills through the direct application of a concept or procedure in simplified and familiar situations with occasional success. | Students demonstrate partial mastery of mathematical knowledge and skills through the direct application of concepts and procedures in familiar situations with regular success. They are able to explain some of their steps. | Students demonstrate mastery of mathematical knowledge and skills through selecting from an assortment of strategies and integrating concepts and procedures in a variety of situations with consistent success. They are able to explain steps and procedures. |

| Mathematics Achievement Level Descriptors High School Algebra | Sometimes perform computations with real numbers accurately. Inconsistently order or locate real numbers on a number line. Inconsistently simplify expressions involving real numbers and/or algebraic symbols. Inconsistently solve linear equations given the equation. Identify slope from a graph. Identify solutions of systems of linear equations using given tables or graphs. Inconsistently identify and graph linear, quadratic, and exponential functions using tables, graphs, and equations. Sometimes find the domain and range given the graph. Inconsistently solve quadratic equations or understand the meaning of the solutions. | Perform computations with real numbers accurately. Order or locate real numbers on a number line. Evaluate and simplify basic expressions involving real numbers and/or algebraic symbols. (This excludes factoring beyond numeric GCF.) Solve problems involving linear equations using tables, graphs, or symbols. Determine slope. Sometimes solve linear inequalities and graph the solution. Identify and graph linear, quadratic, and exponential functions using tables, graphs, and equations. Identify the domain and range from a graph. Solve routine quadratic equations. Identify the axis of symmetry graphically. | Apply efficient strategies for performing computations with real numbers. Order and locate real numbers on a number line. Consistently evaluate, create, and determine equivalent expressions involving real numbers and/or algebraic symbols. Represent linear relationships and solve problems involving systems of linear equations using tables, graphs, and symbols. Solve linear inequalities and systems of linear inequalities and graph the solution sets. Work with function notation. Distinguish between, manipulate, and apply linear, quadratic, and exponential functions in routine and non-routine situations using tables, graphs, and equations. Identify the domain and range from a table, graph, or equation. Solve quadratic equations graphically and algebraically and explain the relationship between the two strategies. Determine the vertex and axis of symmetry graphically and algebraically. | Fluently apply efficient strategies for performing computations with real numbers. Justify the result using mathematical properties. Consistently evaluate, create, justify, and determine equivalent expressions involving real numbers and/or algebraic symbols. Represent, solve, interpret the meaning of, and convert among representations of linear equations and inequalities, including systems of linear inequalities. Distinguish between, manipulate, and apply linear, quadratic, and exponential functions. Identify the domain and range from a table, graph, equation, or a context. Make inferences or predictions, using tables, graphs, and equations. Solve quadratic equations graphically and algebraically and communicate why a method was chosen and its relationship to the solution. |

Adopted 10/28/2010
## Mathematics Oregon Achievement Level Descriptors – High School

The achievement level descriptors are cumulative.

<table>
<thead>
<tr>
<th>General Policy Definitions (Apply to all grades and all subjects)</th>
<th>Does Not Yet Meet</th>
<th>Nearly Meets</th>
<th>Meets</th>
<th>Exceeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students do not demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate partial mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate mastery of grade-level knowledge and skills exceeding the requirement for proficiency.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics Policy Definitions (Apply to all grades)</th>
<th>Does Not Yet Meet</th>
<th>Nearly Meets</th>
<th>Meets</th>
<th>Exceeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students demonstrate limited mastery of mathematical knowledge and skills through the direct application of a concept or procedure in simplified and familiar situations with occasional success.</td>
<td>Students demonstrate partial mastery of mathematical knowledge and skills through the direct application of concepts and procedures in familiar situations with regular success. They are able to explain some of their steps.</td>
<td>Students demonstrate mastery of mathematical knowledge and skills through selecting from an assortment of strategies and integrating concepts and procedures in a variety of situations with consistent success. They are able to explain steps and procedures.</td>
<td>Students demonstrate mastery of mathematical knowledge and skills through the use of multiple reasoning strategies and apply them in new and complex situations with consistent success. They are able to analyze their strategies and solutions.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics Achievement Level Descriptors High School Geometry</th>
<th>Does Not Yet Meet</th>
<th>Nearly Meets</th>
<th>Meets</th>
<th>Exceeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconsistently apply properties of two and three dimensional figures.</td>
<td>Identify and compare properties of two and three dimensional figures.</td>
<td>Understand and apply properties of geometric figures and relationships between figures in two and three dimensions.</td>
<td>Understand and apply properties of geometric figures and analyze relationships between figures in two and three dimensions.</td>
<td></td>
</tr>
<tr>
<td>Inconsistently determine area, surface area, and/or volume given dimensions. Inconsistently solve for missing dimensions.</td>
<td>Determine area, surface area, and/or volume given dimensions. Often solve for missing dimensions.</td>
<td>Determine area, surface area, and/or volume. Solve for missing dimensions. Solve related context-based problems.</td>
<td>Determine area, surface area, and/or volume for non-routine figures. Solve for missing dimensions using multiple equations.</td>
<td></td>
</tr>
<tr>
<td>Inconsistently use theorems or solve problems related to congruent and similar figures in two and three dimensions.</td>
<td>Use some theorems and solve problems related to congruent and similar figures in two- and three-dimensions.</td>
<td>Consistently integrate the use of theorems and/or algebraic equations to solve problems related to congruent and similar figures in two and three dimensions, including right triangle trigonometry.</td>
<td>Consistently and efficiently integrate the use of theorems and/or algebraic equations to solve and justify relationships between congruent and similar figures in two and three dimensions.</td>
<td></td>
</tr>
<tr>
<td>Inconsistently solve problems using coordinate geometry when the two-dimensional figures have numeric coordinates.</td>
<td>Use coordinate geometry to solve problems involving two-dimensional figures with numeric coordinates.</td>
<td>Use coordinate geometry to justify properties, explain conjectures, and solve problems involving two-dimensional figures with numeric coordinates.</td>
<td>Use coordinate geometry to justify properties, explain conjectures, and solve problems involving two-dimensional figures with numeric and symbolic coordinates.</td>
<td></td>
</tr>
<tr>
<td>Inconsistently identify and perform single transformations of geometric figures on a coordinate plane.</td>
<td>Identify and perform single transformations of geometric figures on a coordinate plane.</td>
<td>Identify and perform single and composite transformations (2) of geometric figures on a coordinate plane.</td>
<td>Fluently identify and perform single and composite transformations (more than 2) of geometric figures on a coordinate plane.</td>
<td></td>
</tr>
</tbody>
</table>

Adopted 10/28/2010
## Mathematics Oregon Achievement Level Descriptors – High School

The achievement level descriptors are cumulative.

<table>
<thead>
<tr>
<th>Does Not Yet Meet</th>
<th>Nearly Meets</th>
<th>Meets</th>
<th>Exceeds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Policy Definitions</strong> (Apply to all grades and all subjects)</td>
<td>Students do not demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate partial mastery of grade-level knowledge and skills required for proficiency.</td>
<td>Students demonstrate mastery of grade-level knowledge and skills required for proficiency.</td>
</tr>
<tr>
<td><strong>Mathematics Policy Definitions</strong> (Apply to all grades)</td>
<td>Students demonstrate limited mastery of mathematical knowledge and skills through the direct application of a concept or procedure in simplified and familiar situations with occasional success.</td>
<td>Students demonstrate partial mastery of mathematical knowledge and skills through the direct application of concepts and procedures in familiar situations with regular success. They are able to explain some of their steps.</td>
<td>Students demonstrate mastery of mathematical knowledge and skills through selecting from an assortment of strategies and integrating concepts and procedures in a variety of situations with consistent success. They are able to explain steps and procedures.</td>
</tr>
<tr>
<td><strong>Mathematics Achievement Level Descriptors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High School Statistics</strong></td>
<td>• Inconsistently identify survey methods and evaluate data-based reports.</td>
<td>• Identify the strengths and limitations of survey methods and evaluate data-based reports using given data displays and analyses.</td>
<td>• Determine and analyze survey methods and evaluate data-based reports.</td>
</tr>
<tr>
<td></td>
<td>• Inconsistently compare and draw conclusions about independent data sets and data in graphical displays, including central tendencies and range.</td>
<td>• Compare and draw conclusions about independent data sets and data in graphical displays, including central tendencies, range, and line of best fit.</td>
<td>• Compare, analyze, draw conclusions about, and interpret independent data sets and data in graphical displays, including central tendencies, range, and line of best fit.</td>
</tr>
<tr>
<td></td>
<td>• Inconsistently compute and interpret simple theoretical and experimental probabilities. Sometimes determine the sample space of a probability experiment.</td>
<td>• Compute and interpret simple theoretical and experimental probabilities. Often determine the sample space of a probability experiment.</td>
<td>• Compute, analyze, and interpret theoretical and experimental probabilities. Determine the sample space of a probability experiment.</td>
</tr>
</tbody>
</table>

Adopted 10/28/2010
LOCAL ASSESSMENTS REQUIRED BY OAR 581-22-0615
ASSESSMENT OF ESSENTIAL SKILLS

Local Performance Assessments
School districts and public charter schools that offer instruction at grades 3 through 8 or high school must administer annual local performance assessments for students in grades 3 through 8 and at least once in high school for the skill areas of writing, speaking, mathematics problem solving, and scientific inquiry. The purpose of the local performance assessment requirement is to ensure that students in grades 3 through high school are afforded opportunities to learn and to receive feedback regarding their progress toward meeting specific state standards throughout their years in public schools.

A local performance assessment is a standardized measure (e.g., activity, exercise, problem, or work sample scored using an official state scoring guide), embedded in the school district’s or public charter school’s curriculum that evaluates the application of students’ knowledge and skills. Local performance assessments must be designed to closely align with state standards and to promote independent, individual student work.

School districts and public charter schools may either use a work sample scored using an official state scoring guide or a comparable measure adopted by the school district or public charter school to satisfy the local performance assessment requirement. Appendix E – Work Samples and State Scoring Guides of the 2009-10 Test Administration Manual provides guidance for those school districts and public charter schools choosing to use a work sample to satisfy this requirement.

Assessment of Proficiency in the Essential Skills
As part of the new graduation requirements, high school students must demonstrate proficiency in a set of Essential Skills, which are defined as process skills that cross academic disciplines and are embedded in the content standards. Starting with the graduating class of 2012, high school students must demonstrate proficiency in the Essential Skills of Reading, Writing, Speaking, and Mathematics.

Students may demonstrate proficiency in these Essential Skills using any of the assessment options approved by the State Board of Education.

As of May 2009, the Oregon Assessment of Knowledge and Skills (OAKS) is one of the approved assessment options for the Essential Skills of Reading, Writing, and Mathematics. Another approved option for the Essential Skills of Writing, Speaking, and Mathematics is the completion of work samples scored locally using an official state scoring guide. Appendix D – Requirements for Assessment of Essential Skills of the 2009-10 Test Administration Manual provides guidance for those school districts and public charter schools choosing to use a work sample to satisfy this requirement.

The Assessment of Essential Skills Review Panel (AESRP), which consists of experts from school districts and post-secondary education institutions, reviews and recommends additions or changes to the list of approved assessment options. The AESRP bases its recommendations on evidence provided by the school districts, research organizations, and other experts that the proposed assessment option accurately measures the Essential Skill. The State Board of Education then makes the determination whether to adopt the AESRP’s recommendations. ODE anticipates that the State Board of Education will approve additional assessment options based on recommendations from the AESRP in the coming months. In addition, the AESRP is developing a set of criteria for approval by the State Board of Education that school districts and public charter schools may use in developing local assessment options.
Appendices

The Appendices of this document include ancillary materials provided to students to complete mathematics testing; and additional assessment documents that deal with test construction and design.

Included in this section are:

Appendix A: Oregon Achievement Standards Summary for All Subjects
Appendix B: Cognitive Demand and Item Difficulty Distribution Goals
Appendix C: Item Development Process
Appendix D: Life of an Item
Appendix E: Mathematical Problem Solving Official Scoring Guide Background and Resources
Appendix F: Official Formula Sheet and Conversion Tables
# ACHIEVEMENT STANDARDS

## 2012-13 Achievement Standards Summary

The charts below show the achievement standards (requirements to meet and exceed) for Oregon’s Assessments of Knowledge and Skills (OAKS) by content area and grade or benchmark level. All students are required to take reading/literature and mathematics assessments in grades 3-8 and 11; in writing in grades 4, 7, and 11; and science in grades 5, 8, and 11. Assessments in social sciences are optional; however, they may be required by some districts or schools. For detailed assessment information, refer to the 2011-12 Test Administration Manual (www.ode.state.or.us/go/TAM). It provides timelines, options, and procedures that ensure both test reliability and validity from classroom to classroom, teacher to teacher, school to school, and district to district.

### Grade 3

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>211</td>
<td>224</td>
</tr>
<tr>
<td>Mathematics</td>
<td>212</td>
<td>219</td>
</tr>
<tr>
<td>Writing, Speaking, Science, Social Sciences</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

### Grade 4

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>216</td>
<td>226</td>
</tr>
<tr>
<td>Writing **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Composite Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Minimum score in each trait</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Conventions score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 32 to 39* (out of 48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 3 (out of 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Not doubled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 40 to 48 (out of 48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 4 (out of 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Not doubled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>219</td>
<td>227</td>
</tr>
<tr>
<td>Speaking, Science, and Social Sciences</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

### Grade 5

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>221</td>
<td>230</td>
</tr>
<tr>
<td>Mathematics</td>
<td>225</td>
<td>234</td>
</tr>
<tr>
<td>Science</td>
<td>226</td>
<td>239</td>
</tr>
<tr>
<td>Social Sciences #</td>
<td>215</td>
<td>225</td>
</tr>
<tr>
<td><strong>Optional state test; may be required by districts or schools.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing, Speaking</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

### Grade 6

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>226</td>
<td>237</td>
</tr>
<tr>
<td>Mathematics</td>
<td>227</td>
<td>237</td>
</tr>
<tr>
<td>Writing, Speaking, Science, Social Sciences</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

### Grade 7

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>229</td>
<td>241</td>
</tr>
<tr>
<td>Writing **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Composite Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Minimum score in each trait</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Conventions score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 40 to 49* (out of 60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 3 (out of 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Doubled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voice and Word Choice are not included in the achievement standard. <strong>A composite score of 28 to 31 points nearly meets the standard. Scores in this range indicate that the writing is close to meeting the standard and that local performance assessments could be used to provide a more comprehensive view of student proficiency in writing.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>232</td>
<td>242</td>
</tr>
<tr>
<td>Speaking, Science, and Social Sciences</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

### Grade 8

<table>
<thead>
<tr>
<th>Content Area</th>
<th>MEET</th>
<th>EXCEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>232</td>
<td>242</td>
</tr>
<tr>
<td>Mathematics</td>
<td>234</td>
<td>245</td>
</tr>
<tr>
<td>Science</td>
<td>235</td>
<td>247</td>
</tr>
<tr>
<td>Social Sciences #</td>
<td>231</td>
<td>241</td>
</tr>
<tr>
<td><strong>Optional state test; may be required by districts or schools.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing, Speaking</td>
<td>No state test</td>
<td></td>
</tr>
</tbody>
</table>

**Due to legislative action during the 2011 session the state writing assessment at grades 4 & 7 were suspended for the 2011-2012 and 2012-2013 school years.**
### ACHIEVEMENT STANDARDS

<table>
<thead>
<tr>
<th>High School</th>
<th>Achievement Standards for Oregon Statewide Assessments</th>
<th>Oregon Assessment of Knowledge and Skills (OAKS) is one option to provide evidence of proficiency in Essential Skills.</th>
<th>Notes</th>
<th>Essential Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading/Literature</td>
<td>236 Meets 247 Exceeds</td>
<td>Content of the 2011-2012 OAKS Reading/Literature Assessment is based on the Grade Level Content Standards adopted in 2002-2003.</td>
<td>Read and comprehend a variety of text.</td>
<td></td>
</tr>
</tbody>
</table>
| Writing | • 40 to 49 (out of 60)  
• 3 (out of 6)  
• Conventions score | • 50 to 60  
• 4 (out of 6)  
• Doubled | *A composite score of 35 to 39 points nearly meets the standard. Scores in this range indicate that the writing is close to meeting the standard and that local performance assessments could be used to provide a more comprehensive view of student proficiency in writing.  
• Score on Voice and Word Choice traits are not included in the achievement standard.* | Write clearly and accurately. |
| Mathematics | 236 Meets 251 Exceeds | Content of the 2011-12 OAKS Mathematics test is based on the Content Standards adopted in 2009 for high school and 2007 for grades K-8. | Apply mathematics in a variety of settings. |
| Science | 240 Meets 252 Exceeds | Content of the 2011-12 OAKS Science test is based on the Content Standards adopted in 2009. | |
| Social Sciences | 239 Meets 249 Exceeds | Optional State Assessment; content of the 2011-12 OAKS Social Sciences Assessment is based on the Content Standards adopted in 2001. | |

### Achievement Standards for Demonstrating Proficiency in Essential Skills for High School Diploma

<table>
<thead>
<tr>
<th>Essential Skill</th>
<th>OAKS Assessment</th>
<th>Required Scores</th>
<th>Other Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading (Class of 2012 &amp; beyond)</td>
<td>Reading/Literature</td>
<td>236 Meets 247 Exceeds</td>
<td>Other approved standardized test; Work samples</td>
</tr>
<tr>
<td>Writing (Class of 2013 &amp; beyond)</td>
<td>Writing Performance Assessment</td>
<td>40 Meets 50 Exceeds</td>
<td>Work samples</td>
</tr>
<tr>
<td>Apply Mathematics (Class of 2014 &amp; beyond)</td>
<td>Mathematics</td>
<td>236 Meets 251 Exceeds</td>
<td>Other approved standardized test; Work samples</td>
</tr>
</tbody>
</table>

1. In future years, Achievement Standards may change for the purposes of accountability and earning a high school diploma.

2. For purposes of demonstrating mastery of Essential Skills, students must meet the achievement standards in effect during their 8th grade year. However, students may use achievement standards adopted in their 9th through 12th grade years that are equal to or lower than the achievement standards approved as of March 1 of the students’ 8th grade year. In addition, students may demonstrate proficiency in the Essential Skills using additional assessment options adopted in their 9th through 12th grade years.
Local Performance assessments evaluate the application of students’ knowledge and skills. OAR 581-022-0615 Assessment of Essential Skills requires students to complete one or more local performance assessments for each assessed skill area per year in grades 3-8 and at least once in high school. The table below outlines the achievement standards for work samples scored with an official state scoring guide and used as a local performance assessment. For detailed assessment information refer to the 2011-12 Test Administration Manual at www.ode.state.or.us/go/TAM. It provides work sample guidelines, options, and procedures that help ensure both work sample reliability and validity from classroom to classroom, teacher to teacher, school to school, and district to district.

<table>
<thead>
<tr>
<th>Skill Area (Official State Scoring Guide)</th>
<th>Grade</th>
<th>Achievement Standard for Purpose of Local Performance Assessment</th>
<th>Notes about Work Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing</td>
<td>Grade 3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Grades 4-8 and High School</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Speaking</td>
<td>Grade 3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Grades 4-8 and High School</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mathematics Problem Solving¹</td>
<td>Grades 3-8 and High School</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Scientific Inquiry²</td>
<td>Grades 3-8 and High School</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Related Web Links:
Official State Scoring Guides: [www.ode.state.or.us/search/page/?id=32](http://www.ode.state.or.us/search/page/?id=32)
Exemplars of scored work samples are currently found on subject-specific assessment pages linked from: [www.ode.state.or.us/search/page/?id=1307](http://www.ode.state.or.us/search/page/?id=1307)

¹ Revised mathematics problem scoring guide was adopted by the State Board of Education (May 19, 2011) for use beginning with the 2011-2012 school year.

² Revised scientific inquiry scoring guides and newly-developed engineering design scoring guides were adopted by the State Board of Education (May 19, 2011) for use beginning with the 2011-2012 school year.
Using Work Samples to Assess Essential Skills for the Oregon Diploma

Essential Skills graduation requirements are determined based on when a student is first enrolled in grade 9, which is referred to as the cohort year. These requirements are applied to students earning either the regular or modified diploma. Students who entered grade 9 in the 2008-2009 school year (most of whom will graduate in 2012) are required to demonstrate proficiency in the Essential Skill of Reading. The remaining implementation timeline is described in the table below.

Work samples are one assessment option that high school students may use to demonstrate they are proficient in the Essential Skills. Regarding demonstration of proficiency in the Essential Skills, districts must:
- provide students with instruction in and multiple assessment opportunities to demonstrate proficiency in the Essential Skills for the purpose of earning a high school or modified diploma.
- allow students to use assessment options adopted in a student’s 9th through 12th grade years.
- allow students to use achievement standards adopted in their 9th through 12th grade years that are equal to or lower than the achievement standards approved as of March 1 of the students’ 8th grade year.

At the high school level, students may use work samples to fulfill both the local performance assessment and the Essential Skills requirements.

The table below describes the achievement standard for work samples scored for the purpose of demonstrating proficiency in the Essential Skills with regard to conferring a high school diploma.

<table>
<thead>
<tr>
<th>Essential Skill</th>
<th>Number and Types of Work Samples</th>
<th>Scoring Guide</th>
<th>First Implementation</th>
<th>Achievement Standard for Purpose of Conferring High School Diploma (Cut Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read and comprehend a variety of text</td>
<td>2 total work samples:</td>
<td>Official Reading Scoring Guide</td>
<td>Students who entered grade 9 in 2008-2009</td>
<td>Total score of 12 (6-point scale) across 3 traits with no trait lower than a 3; score of 5 or 6 on all traits to exceed.</td>
</tr>
<tr>
<td></td>
<td>at least one must be informative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the second may be informative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>or literary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write clearly and accurately</td>
<td>2 total work samples:</td>
<td>Official Writing Scoring Guide</td>
<td>Students who entered grade 9 in 2009-2010</td>
<td>Score of 4 (6-point scale) to meet in each of the 4 required traits; score of 5 or 6 to exceed.</td>
</tr>
<tr>
<td></td>
<td>One must be in either expository</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>or persuasive mode, the other may be in any of the four approved modes:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>expository</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>persuasive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>narrative (personal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>narrative (fictional)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply mathematics in a variety of settings</td>
<td>2 total work samples:</td>
<td>Official Mathematics Problem Solving Scoring Guide</td>
<td>Students who entered grade 9 in 2010-2011</td>
<td>Score of 4 (6-point scale) to meet in each required trait; score of 5 or 6 to exceed.</td>
</tr>
<tr>
<td></td>
<td>One each from two of these:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>algebra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>geometry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>statistics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Cognitive Demand and Item Difficulty Distribution Goals

Oregon recognizes the importance of Cognitive Demand (Depth of Knowledge) as part of test specification. To that end, we are implementing a strategy to overtly incorporate a test design process that includes the three dimensions of content, difficulty, and depth of knowledge.

✓ The first step in the process is convening our content panels to ask for their determination as to the appropriate allocation of Cognitive Demand (Depth of Knowledge), given the content standards.
✓ The second is analyzing the gap between the Cognitive Demand (Depth of Knowledge) available in our current item pools against the recommendations of the content panels.
✓ The third step involves engaging item writers to write items to fill in the critical gaps. These items would then be reviewed through our standard processes.

We anticipate being able to include Cognitive Demand (Depth of Knowledge) as an explicit part of the test specifications in the near future. The three Cognitive Demand (Depth of Knowledge) levels to be addressed in Mathematics are:

- **Recall**: includes the recall of information such as a fact, definition, term, or implementing a simple procedure. In mathematics, a one-step, well defined and straight-forward algorithmic procedure should be included at this lowest level.

- **Skill/Concept**: includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, follow a set procedure, or perform a clearly defined series of steps.

- **Strategic Thinking**: includes tasks which require reasoning, planning, using evidence, explaining their thinking or to making conjectures, and a higher level of thinking than the previous two levels. The cognitive demands are complex and abstract. The complexity does not result from the fact that there are multiple answers but because the task requires more demanding reasoning.
### 2012-2014 Target Difficulty Distribution Goals and Cognitive Demand Distribution Goals for Mathematics

<table>
<thead>
<tr>
<th>Grade 3</th>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>Grade 4</th>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>Grade 5</th>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>Grade 6</th>
<th>Target Item Pool Difficulty Distribution Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>187-204 33%</td>
<td></td>
<td>193-212 33%</td>
<td></td>
<td>201-217 33%</td>
<td></td>
<td>202-219 33%</td>
</tr>
<tr>
<td></td>
<td>205-212 33%</td>
<td></td>
<td>213-220 33%</td>
<td></td>
<td>218-225 33%</td>
<td></td>
<td>220-228 33%</td>
</tr>
<tr>
<td></td>
<td>213-231 33%</td>
<td></td>
<td>221-241 33%</td>
<td></td>
<td>226-246 33%</td>
<td></td>
<td>229-247 33%</td>
</tr>
<tr>
<td>RIT Range</td>
<td>187-231</td>
<td></td>
<td>RIT Range</td>
<td>193-241</td>
<td></td>
<td>RIT Range</td>
<td>201-246</td>
</tr>
<tr>
<td>Mean RIT</td>
<td>208</td>
<td></td>
<td>Mean RIT</td>
<td>217</td>
<td></td>
<td>Mean RIT</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td><img src="#" alt="Target Cognitive Demand Distribution Goals" /></td>
<td></td>
<td><img src="#" alt="Target Cognitive Demand Distribution Goals" /></td>
<td></td>
<td><img src="#" alt="Target Cognitive Demand Distribution Goals" /></td>
<td></td>
<td><img src="#" alt="Target Cognitive Demand Distribution Goals" /></td>
</tr>
<tr>
<td>Recall</td>
<td>35%</td>
<td></td>
<td>Recall</td>
<td>35%</td>
<td></td>
<td>Recall</td>
<td>35%</td>
</tr>
<tr>
<td>Skill/Concept</td>
<td>50%</td>
<td></td>
<td>Skill/Concept</td>
<td>50%</td>
<td></td>
<td>Skill/Concept</td>
<td>50%</td>
</tr>
<tr>
<td>Strategic Thinking</td>
<td>15%</td>
<td></td>
<td>Strategic Thinking</td>
<td>15%</td>
<td></td>
<td>Strategic Thinking</td>
<td>15%</td>
</tr>
</tbody>
</table>

### Grade 7

<table>
<thead>
<tr>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>212-226 33%</th>
<th>227-233 33%</th>
<th>234-252 33%</th>
<th>RIT Range</th>
<th>212-252</th>
<th>Mean RIT</th>
<th>231</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Cognitive Demand Distribution Goals</td>
<td>Recall 30%</td>
<td>Skill/Concept 50%</td>
<td>Strategic Thinking 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Grade 8

<table>
<thead>
<tr>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>212-228 33%</th>
<th>229-236 33%</th>
<th>237-257 33%</th>
<th>RIT Range</th>
<th>212-257</th>
<th>Mean RIT</th>
<th>233</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Cognitive Demand Distribution Goals</td>
<td>Recall 30%</td>
<td>Skill/Concept 50%</td>
<td>Strategic Thinking 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### High School

<table>
<thead>
<tr>
<th>Target Item Pool Difficulty Distribution Goals</th>
<th>213-229 33%</th>
<th>230-235 33%</th>
<th>236-253 33%</th>
<th>RIT Range</th>
<th>213-253</th>
<th>Mean RIT</th>
<th>232</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Cognitive Demand Distribution Goals</td>
<td>Recall 25%</td>
<td>Skill/Concept 50%</td>
<td>Strategic Thinking 25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cognitive Complexity/Depth of Knowledge Levels for Mathematics

**RECALL** includes the recall of information such as a fact, definition, term, or implementing a simple procedure. In mathematics, a one-step, well defined and straightforward algorithmic procedure should be included at this lowest level. Other key works that signify Recall include “identify,” “recall,” and “measure.” Verbs such as “describe” and “explain” could be classified at different levels, depending on what is to be described and explained. Some examples that represent, but do not constitute all of, Recall performance, are:

- Perform a simple algorithm.
- Recall a fact, term, formula, or property.
- Identify an example of a concept.
- Calculate a sum, difference, product, or quotient.
- Identify an equivalent representation.

**SKILL/CONCEPT** includes the engagement of some mental processing beyond a habitual response. A Skill/Concept assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Recall requires students to demonstrate a rote response, follow a set procedure, or perform a clearly defined series of steps. Key words that generally distinguish a Skill/Concept item include “classify,” “organize,” “estimate,” and “observe.” These actions imply more than one step. For example, to compare data requires first identifying characteristics of objects or phenomena and then grouping or ordering the objects. Some action verbs, such as “explain,” “describe,” or “interpret,” could be classified at different levels depending on the object of the action. For example, interpreting information from a simple graph or reading information from the graph would be at Skill/Concept. Interpreting information from a complex graph that requires some decisions on what features of the graph need to be considered and how information from the graph can be aggregated is at Strategic Thinking. Skill/Concept activities are not limited only to number skills, but may involve visualization skills and probability skills. Some examples that represent, but do not constitute all of, Skill/Concept performance, are:

- Describe non-trivial patterns.
- Apply experimental procedures.
- Observe and collect data.
- Classify, organize and compare data.
- Organize and display data in tables, graphs, and charts.
- Represent a situation mathematically in more than one way.
- Solve a word problem requiring multiple steps.
- Compare figures or statements.

- Evaluate an expression in an equation or formula for a given variable. (Here, evaluate is used in the context of substitution and calculation with open expressions.)
- Answer (Solve) a routine one-step word problem
- Draw or measure simple geometric figures.
- Read or select information from a graph, table, or figure.
- Interpret a visual representation.
- Extend a pattern.
- Use information from a graph, table, or figure to solve a problem requiring multiple steps.
- Formulate a routine problem, given data and conditions.
- Interpret a simple argument.
STRATEGIC THINKING requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is at Strategic Thinking. Activities that require students to make conjectures are also at this level. The cognitive demands at Strategic Thinking are complex and abstract. The complexity does not result from the fact that there are multiple answers but because the task requires more demanding reasoning. An activity that has more than one possible answer and requires students to justify the response they give would most likely be at Strategic Thinking. Some examples that represent, but do not constitute all of, Strategic Thinking performance, are:

- Draw conclusions from observations.
- Cite evidence and develop a logical argument for concepts.
- Explain phenomena in terms of concepts.
- Decide which concepts to apply in order to solve a complex problem.
- Describe how different representations can be used for different purposes.
- Perform or adapt a complex procedure having multiple steps and multiple decision points.
- Identify similarities and differences between procedures and concepts.
- Formulate an original problem, given a situation.
- Solve a non-routine or novel problem.
- Solve a problem in more than one way.
- Explain and justify a solution to a problem.
- Describe, compare, and contrast solution methods.
- Formulate a mathematical model for a complex situation.
- Appraise the assumptions made in a mathematical model.
- Critique or develop a deductive argument.
- Develop a mathematical justification.

EXTENDED THINKING involves high cognitive demands and complex reasoning, planning, developing and thinking, most likely over an extended period of time. Extended thinking is not considered to be assessable through the OAKS multiple choice items, but could be assessed through appropriate Work Sample or Local Performance Assessment tasks. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require apply significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Skill/Concept. However, if the student is to conduct a river study that requires taking into consideration a number of variables, this would be at Extended Thinking. At Extended Thinking, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections – relate ideas within the content area or among content areas – and have to select one approach among many alternative on how the situation should be solved, in order to be at his highest level. Some examples that represent, but do not constitute all of, Extended Thinking performance, are:

- Design and conduct experiments and project
- Develop and prove conjectures
- Connect a finding to related concepts and phenomena
- Synthesize ideas into a new concept.
- Critique experimental designs
APPENDIX C: ITEM DEVELOPMENT PROCESS

Oregon’s item development process is consistent with industry practice and takes approximately two years, including writing, reviewing, and field-testing new items. Just as the development of Oregon’s content and performance standards is an open, consensus-driven process, the development of test items and prompts to measure those constructs is grounded in a similar philosophy.

Item Writing

For the Knowledge and Skills (multiple-choice) tests and the Writing Performance Assessment, most item writing takes place during either onsite, remote and/or online item writing workshops, in which Oregon teachers across the five main content areas write and review items. The process remains the same regardless of workshop format.

Item writers are typically Oregon teachers who have received training in item construction, are familiar with test specifications, and have demonstrated skill in writing items that pass content and sensitivity panel review. Item writers receive professional development compensation for their time and travel expenses. Among other security precautions, ODE requires item writers to sign confidentiality forms assuring that they will work with the items in a secure manner.

All items are written to measure specific subdomains of the content standards at a variety of specified levels of cognitive complexity. Cognitive complexity is represented by the following classification, developed from Bloom’s (1956) educational taxonomy:

- **Recall**: Recall, label, or locate information; define or describe facts or processes.
- **Skill/Concept (Basic Application)**: Use information or conceptual knowledge, often requiring two or more steps; summarize, classify, or explain information or processes; make predictions or generalizations; solve problems.
- **Strategic thinking**: Analyze, critique, compare or contrast; create new information; or organize presented information.
- **Extended thinking**: Make connections and extensions (exclusively assessed in the Writing Performance Assessment and local performance assessments).

During the item writing workshop, writers draft items, document rationale of distracters, and conduct peer reviews of each other’s items. Examples of items are provided, and facilitators provide process guidance and additional review. Writers and reviewers evaluate the strength and clarity of the match between the drafted item and the standard it measures. All issues are worked out or solved multiple times by multiple reviewers who verify that distracters are plausible, that answers are correct, and that each item has only a single correct answer.

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Within ITS and CIMS, each item is given a unique item identification number to facilitate the monitoring and tracking of changes to and usage of the item throughout the review process and each item’s history. ITS provides authorized users with access to each item’s alignment and attributes, field-test results and use, response rationales, and previous versions.

Although item writing workshops may still occur annually, ODE has recently moved toward distributed item writing in which consistently strong item writers author additional items throughout the year. Items still go through the review process previously described. Item writers are trained on the use of secure item entry using ITS, and graphic drafts are scanned by the item writers and securely transmitted to ODE.

**Committee/Panel Review**

ODE convenes a series of advisory groups to advise ODE both on assessment-related policy and on item development. ODE seeks to ensure that membership on these advisory groups reflects the demographics of Oregon’s student population. Each advisory group has approximately 15–35 members who serve three-year terms with one-third of the members rotating out each year and being replaced by new representatives. The following table describes the structure of these groups.

---

**Figure 1. Sample Oregon Item Writing Form**

<table>
<thead>
<tr>
<th>Writer ID</th>
<th>Grade</th>
<th>Correct Key</th>
<th>Key Words</th>
<th>Sample Content Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SRC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General Population</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Estimated Item Difficulty**
- Easy
- Medium
- Hard

**Standard Code**
- MC

**Related Essential Skill(s) #**
(See pg. 8 in notebook)

**Graphic**
- M [ ]

**Level of Complexity**
- FT – Recall
- S/C – Skill & Concept
- ST – Strategic Thinking

**Item ID**
- M [ ]

---

<table>
<thead>
<tr>
<th>Foils</th>
<th>Rationale (Why a student might select this option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

Following item writing workshops, items are entered into the Item Tracking System (ITS). Oregon’s original graphics are initially entered into the ODE’s Comprehensive Item Management System (CIMS) and then transferred to ITS.
### Structure of ODE Assessment-Related Advisory Groups

<table>
<thead>
<tr>
<th>Committee/Panel</th>
<th>Number of Members</th>
<th>Meeting Frequency</th>
<th>Who Nominates Members?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment Policy Advisory Committee</td>
<td>15–20</td>
<td>2-3 times a year</td>
<td>School districts, COSA, OSBA, OEA, ESDs, and OPTA</td>
</tr>
<tr>
<td>Sensitivity Panel</td>
<td>15–20</td>
<td>4–6 times a year</td>
<td>School districts, OEA, ESDs (application process)</td>
</tr>
<tr>
<td>English/Language Arts Content and</td>
<td>35</td>
<td>4-6 times a year</td>
<td>School districts, OEA, ESDs, and self-nominate (application process)</td>
</tr>
<tr>
<td>Assessment Panel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics Content and Assessment</td>
<td>35</td>
<td>4-6 times a year</td>
<td>School districts, OEA, ESDs, and self-nominate (application process)</td>
</tr>
<tr>
<td>Panel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Content and Assessment Panel</td>
<td>35</td>
<td>4-6 times a year</td>
<td>School districts, OEA, ESDs, and self-nominate (application process)</td>
</tr>
<tr>
<td>Social Sciences Content and Assessment</td>
<td>25</td>
<td>1-2 times a year</td>
<td>School districts, OEA, ESDs, and self-nominate (application process)</td>
</tr>
<tr>
<td>Panel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Language Proficiency Content</td>
<td>35</td>
<td>1–2 times a year</td>
<td>School districts, OEA, ESDs, and self-nominate (application process)</td>
</tr>
<tr>
<td>and Assessment Panel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Oregon’s Accommodations and Modifications Review Panel is not described here.

Source: [http://www.ode.state.or.us/teachlearn/testing/dev/panels/structurecapanels.doc](http://www.ode.state.or.us/teachlearn/testing/dev/panels/structurecapanels.doc)

Panel members commit up to 6 school days of service with an additional 3 or 4 days during the summer. However, panels will be convened remotely rather than in person as secure technology improvements allow distributed work. Although committee members on district contracts are not compensated for their service, they do receive travel reimbursement for committee travel of more than 70 miles, and substitute teachers are provided for service during the school year. When classroom teacher members work for ODE during non-contract time, they are compensated at an hourly wage as temporary employees.

ESDs who are knowledgeable about assessment-related issues. The purpose of the Committee is to advise ODE on both the procedural and policy implications of Oregon’s assessment system, as well as the feasibility of proposed improvements to Oregon’s assessment system. Committee members provide input regarding the various elements of the state assessment system such as educational technology, electronic reporting, operational assessment issues, and test administration.

In addition to seeking advice on assessment-related policy, ODE requires that all items generated for use on Oregon statewide assessments must pass a series of rigorous reviews before they can be used in field and operational tests. All items go through both a content and a sensitivity review as part of the

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*Appendix C*

Mathematics, High School

Mathematics Test Specifications

and Test Blueprints

C-3

Oregon Department of Education

Office of Assessment and Information Services
item development process; only those items that measure the grade-level expectations and meet both overall quality and sensitivity criteria are carried forward to the field-test stage.

ODE Content and Assessment Panels exist for each of the content areas for which statewide tests are given: English/Language Arts (this panel reviews Writing and Reading/Literature assessment items), Mathematics, Science, Social Sciences, and English Language Proficiency.

Most members of these panels are classroom teachers, with some representation from higher education, district curriculum and assessment personnel, and related businesses. Criteria for panel selection include the following:

- Knowledge of Oregon’s content standards and expertise in the subject area and its eligible content
- Teaching experience at the grade level or benchmark to which the individual will be assigned
- Geographical location to ensure that all regions of Oregon are represented
- Gender and ethnic diversity to ensure that the panel represents the diversity of Oregon’s student population

Current item writers are not allowed to serve on item review committees. However, in some cases, content and assessment panel experts may be utilized as item writing facilitators.

Items are accepted, rejected, or modified by the Content and Assessment Panel to make sure they represent the constructs embodied in grade-specific content standards and test specifications. In addition to judgments of content relevance, the panels appraise the technical quality of items, looking for items that are free from such flaws as (a) inappropriate readability level, (b) ambiguity, (c) incorrectly keyed answers and distracters, (d) unclear instructions, and (e) factual inaccuracy. The panels for each content area use the following review process:

1. Three content panel members review each item independently and complete an Item Review Form (IRF) (figure 1) using a pre-assigned reviewer ID.

2. Then, the three content panel members review the item collectively, and item reviewers make a recommendation for each item on the IRF to either (a) accept the item as written, (b) accept the item with revisions, or (c) reject the item (sometimes an alternate question is offered that entails a simple revision).

3. When all three reviewers agree that an item should be accepted or rejected, no further discussion is needed. If one or more of the reviewers feel that an item should be revised, then they attempt to reach a consensus and produce a “master copy” of their recommendation. The same is true if one or two of the reviewers reject an item that another reviewer finds acceptable with or without revisions.

4. In most cases, recommendations are followed and revisions are made, or items are eliminated. The ODE assessment specialist can override the recommendation, but this occurs rarely and only for compelling reasons.
The content panels perform specific checks on items to confirm that:

- the SRC and subcategory match.
- the key is correct.
- alternate valid interpretations making the distracters correct do not exist.
- the item is grade-level appropriate in content and reading levels.
- the item is of overall high quality (wording and grammar, graphic quality, curricular importance, etc).
- the identified level of difficulty (i.e., easy, medium, hard) is correct.
- Reading/Literature passages are appropriate in content and reading levels. Science and Social Sciences stimuli align to appropriate content and reading skills.
- the level of cognitive complexity (i.e., recall, skill/concept or strategic thinking) is appropriate to the item and correctly identified.

Following review by the content panel, and according to panel feedback, ODE assessment specialists edit and revise items in ITS in preparation for review by the Sensitivity Panel.

All items that pass review by the content specialist are next presented to the sensitivity panel. The sensitivity panel reviews convenes day-long meetings, four to six times a year. The panel reviews items from all grade levels and content areas for bias, controversial content, and overly emotional issues.
In general, the sensitivity panel ensures that items:

- present racial, ethnic, and cultural groups in a positive light.
- do not contain controversial, offensive, or potentially upsetting content.
- avoid content familiar only to specific groups of students because of race or ethnicity, class, or geographic location.
- aid in the elimination of stereotypes.
- avoid words or phrases that have multiple meanings.

Following the sensitivity panels and according to panel feedback, ODE assessment specialists edit and revise items in the ITS system.

**EXPERT REVIEW**

Next, ODE assessment specialists submit the new items for review by experts that have experience in the roles of item writer and content and assessment panel member. Expert reviewers add an additional quality control check for the online assessments. Experts have received extensive professional development in ITS to review items in a web-preview format providing the exact rendering provided in the online assessments. Experts review each item and confirm that:

- the key is correct.
- alternate valid interpretations making the distracters correct do not exist.
- the item is grade-level appropriate in content and reading levels.
- the item is of overall high quality (wording and grammar, graphic quality, curricular importance, etc).

Following the expert review in most cases, recommendations are followed and revisions are made, or items are eliminated. The ODE assessment specialist can override the recommendation, but this occurs rarely and only for compelling reasons.

**FIELD TESTING**

Once the items have been reviewed by the content and assessment panel, the sensitivity panel, and an expert reviewer, all Mathematics, Reading/Literature, Science, and Social Sciences test items are field tested. Field test items identified by the ODE assessment specialists are embedded in the operational tests by content area. As students take the operational tests, they also respond to approximately 5-8 field test items embedded in the test.

ODE then receives data files of the student responses, which ODE analyzes to determine whether the field test items are behaving as expected. The ODE assessment specialists eliminate those items which the data analysis indicate performed weakly. ODE assessment staff calibrate the difficulty level for those items that performed successfully in preparation for using the item operationally.
TRANSLATION OF ITEMS TO SPANISH

Concurrent with the field testing of items in English, all Mathematics, Science, and Social Sciences test items are translated into Spanish. All required grade-level and benchmark-level statewide tests for Mathematics and Science are offered in English-Spanish tests. English-Spanish tests are also available for Social Sciences. Stacked English-Spanish items are used on electronic tests. Side-by-side English-Spanish and English-Russian Paper/Pencil assessments are available in Mathematics and Science.

Following translation by ODE’s translation vendor, the translated items are reviewed by ODE’s Spanish- and Russian-speaking experts to ensure that each item accurately conveys the intent of the English text. While the procedure described below specifically addresses Spanish translation, ODE follows a similar procedure for translation of Paper/Pencil items into Russian.

The following linguistic guidelines are used by ODE’s translation vendor and Spanish-speaking experts:

- Students are expected to have subject knowledge and use proper terminology/vocabulary for that subject. In other words, what is expected from English-speaking students is also expected from Spanish-speaking students.
- ODE uses formal Spanish (usted, not tú) for test items and includes proper verb conjugation.
- ODE strives to use Global Spanish language that will be interpreted and understood by all Spanish speakers from anywhere in the world. Global Spanish language includes words used worldwide by most Spanish speakers.

After the ODE Spanish reviewers complete a review of the newly translated items, extensive research is conducted by a small group of reviewers on any word that has not met group consensus. Every attempt is made to choose the most correct translation based upon grade level and cultural relevance. A variety of resources are used for selecting the proper translated words including: dictionaries from Mexico, South America and Spain (e.g. Diccionario Hispanoamericano de Dudas, Diccionario de Matemáticas), and ODE’s list of translated terms for Science at http://www.ode.state.or.us/search/page/?id=517 and for Mathematics at http://www.ode.state.or.us/search/page/?id=500.

ADDITIONAL EXPERT REVIEW OF ITEMS

On an annual basis, ODE assessment specialists review items from the field test pool for inclusion within the operational test. This level of review acts as an additional quality control for the online assessments. In addition, whenever ODE transitions to a different test delivery system, ODE submits all of its Reading/Literature, Mathematics, Science, and Social Sciences items for an additional level of expert review to ensure that all items appear consistently from year to year when presented to students.

ITEM USE AND RELEASE

Approximately every three years, ODE releases one sample test for each content area and grade-level and benchmark-level comprised of items used on previous test forms. These items are no longer secure and are taken out of the pool of eligible test items.

Released items are provided in the form of practice tests. Practice tests for Reading/Literature, Mathematics, Social Sciences, and Science are available on ODE’s Website at http://www.ode.state.or.us/search/page/?id=1222.

Sample Writing prompts are also available at http://www.ode.state.or.us/teachlearn/subjects/elarts/writing/assessment/usingsampleprompts.pdf.
1. Phase 1: Item Writing
   - **SITES**
     A. Assessment staff schedules and coordinates item writing activities, and recruits Oregon teachers to construct items to be entered into an item database.
   - **WRITING**
     B. Item Writing: Teachers receive professional development training on item development, including a focus on standards alignment and item content and format. Items are written explicitly to measure Oregon academic content standards.
   - **REVIEW**
     C. Teachers review items written by their peers.
   - **ENTRY**
     D. After items are written, assessment staff enter items into a database.

2. Phase 2: Item Review
   - **SORT**
     A. Assessment Specialist sorts and organizes items for review.
   - **REVIEW**
     B. Subject Specific Content and Assessment Panels, consisting of Oregon teachers, review test items with respect to content validity and grade appropriateness.
   - **EDIT**
     C. Assessment Specialist edits and revises items according to content panel feedback.
   - **FIELD TEST**
     A. Assessment Specialist identifies items to be field tested.
   - **EMBED**
     B. Field test items are embedded in an operational test.
   - **TEST**
     C. Students complete operational tests with embedded field test items.

3. Phase 3: Field Testing
   - **EDIT**
     E. Assessment Specialist edits and revises items according to Sensitivity Panel feedback.
   - **PROCESS**
     D. Data files of student responses are submitted to ODE for analysis.

Bank of **POTENTIAL** items
Bank of **REVIEWED** items
Bank of **FIELD** items
**Phase 4: Data Analysis of Field Test Items**

**ANALYZE**
A. Assessment staff generates psychometric data to determine if the item "behaves" as expected.

**REVIEW**
B. Assessment Specialist reviews data to determine which items should be "dropped" because of weak performance.

**CALIBRATE**
C. Assessment staff calibrate the difficulty of field test items that meet the successful criteria.

---

**Phase 5: Test Construction**

**SELECT**
A. Assessment Specialist selects items for operational testing.

**RANGE**
B. Assessment Specialist balances items across Score Reporting Categories (SRCs) (such as Geometry in Mathematics or Vocabulary in Reading/Literature) and range of difficulty according to test specifications.

**CONSTRUCT**
C. Assessment staff construct tests, online test pools, and finalize Administration Manual.

**REVIEW**
D. Assessment staff and expert reviewers proofread test items and stimuli for errors.

**FINAL**
E. Final Operational Tests and pools are prepared.

---

**Phase 6: Data Analysis of Operational Test Items**

**PRESENTED**
A. Tests are sent to contractor for print distribution or delivery online.

**SCORES**
B. Students complete the operational test and receive instant scores when using online delivery.

**TEST**
C. Assessment staff analyze item statistics to verify the item performs as expected.

**PROCESS**
D. Assessment staff analyze item statistics to make sure items are not biased against a particular subgroup (e.g., students with disabilities, ethnic groups, or gender).

**TARGET**
E. Item performance tables which describe how well each item performs are used to review items and pools of items to identify any additional items to be dropped.
The Mathematics Problem Solving Official Scoring Guide was adopted by the State Board of Education in May 2011 for scoring work samples beginning with the 2011-2012 school year. This scoring guide reflects significant efforts of Oregon educators working to capture the essentials of problem solving, based on the following:

- Over-arching statement in the Mathematics Content Standards for Kindergarten through Grade 8 and High School that it is essential that these standards be addressed in instructional contexts that promote problem solving, reasoning, communication, making connections, designing and analyzing representations, and reflecting on solutions.

- Essential Skill Apply Mathematics in a Variety of Settings
  This skill includes all of the following:
  - Interpret a situation and apply workable mathematical concepts and strategies, using appropriate technologies where applicable.
  - Produce evidence, such as graphs, data, or mathematical models, to obtain and verify a solution.
  - Communicate and defend the verified process and solution, using pictures, symbols, models, narrative or other methods.

- Language and intent of the National Council of Teachers of Mathematics’ Process Standards
- Standards for Mathematical Practice, from the Common Core State Standards (2010)

This scoring guide reflects input by the Oregon Council of Teachers of Mathematics (OCTM), Oregon Mathematics Specialists, and ODE’s mathematics content panel during 2009-10, and at the 2010 Oregon Math Leaders Conference.

The most recent version of the Mathematics Problem Solving Official Scoring Guide and other support documents may be accessed at http://www.ode.state.or.us/search/page/?=32. The Plain Language Student Versions may be accessed at http://www.ode.state.or.us/search/page/?=2667.

Sample anchor papers, student versions, and other support materials are under development. Professional development on the new scoring guide is was piloted in training sessions during the 2010-11 school year by the OCTM Professional Development Cadre and extensive training opportunities are planned for the 2011-2012 school year. Refer to the Work Sample Resources web page for mathematics for updated support documents and training opportunities. (http://www.ode.state.or.us/search/page/?id=2707)
Use of Formula and Conversion Sheets

The Formula and Conversion Sheets have been revised to reflect the content in the 2007 Grades 3-8 and 2009 High School Standards. They are reorganized to be used in Grade 3-5, Grades 6-8, and in High School. While all students may have access to any of the sheets, these show the information appropriate to the grade levels. Note that grade 3 standards do not necessitate any formulas or conversion factors, based on the standards. Also, variables are not introduced until grade 6, so the formulas for grades 4-6 are stated in words. Grade 6 standards do not necessitate any formulas other than those needed for grades 4 and 5, since grade 6 has no new geometry content, however, in grade 6, students may be using variables, so students in grade 6 may prefer either the formula sheet for grades 3-5 or the one for grades 6-8.

All Formula and Conversion Sheets in English and Spanish are available at http://www.ode.state.or.us/search/page/?=2346

The Formula and Conversion Sheets may be used during classroom instruction at any time.
### Appendix F

#### Official Formula Sheet and Conversion Table

<table>
<thead>
<tr>
<th>MEASUREMENTS</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 meter = 100 centimeters</td>
<td>1 gram = 1000 milligrams</td>
<td>1 liter = 1000 cubic centimeters</td>
<td></td>
</tr>
<tr>
<td>1 kilometer = 1000 meters</td>
<td>1 pound = 16 ounces</td>
<td>1 cup = 8 fluid ounces</td>
<td></td>
</tr>
<tr>
<td>1 yard = 3 feet</td>
<td>1 kilogram = 1000 grams</td>
<td>1 pint = 2 cups</td>
<td></td>
</tr>
<tr>
<td>1 mile = 5280 feet</td>
<td>1 ton = 2000 pounds</td>
<td>1 quart = 2 pints</td>
<td></td>
</tr>
<tr>
<td>1 hour = 60 minutes</td>
<td></td>
<td></td>
<td>1 gallon = 4 quarts</td>
</tr>
<tr>
<td>1 minute = 60 seconds</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### AREA (A)

- \( A = lw \) for a rectangle
- \( A = bh \) for a parallelogram
- \( A = \frac{1}{2}bh \) for a triangle

\[ A = \pi r^2 \]

\[ C = 2\pi r = \pi d \]

Arc Length: \( \delta = \left( \frac{m}{360} \right) 2\pi r \)

#### SURFACE AREA (SA) and VOLUME (V)

- \( SA = 2(lw + wh + lh) \) for a rectangular prism
- \( V = \frac{1}{3}Bh \) for a cone
- \( SA = 4\pi r^2 \) for a sphere

#### Trigonometric Identities

- \( \sin A = \frac{a}{c} \)
- \( \cos A = \frac{b}{c} \)
- \( \tan A = \frac{a}{b} \)

#### Coordinate Geometry

- Distance between points \((x_1, y_1)\) and \((x_2, y_2)\): \(d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\)
- Midpoint of line segment between \((x_1, y_1)\) and \((x_2, y_2)\): \(\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)\)
- Slope of line through \((x_1, y_1)\) and \((x_2, y_2)\): \(m = \frac{y_2 - y_1}{x_2 - x_1}\)