OKLAHOMA SCHOOL TESTING PROGRAM

TEST BLUEPRINT AND ITEM SPECIFICATIONS MATHEMATICS

2016-2017 GRADE 8

OKLAHOMA STATE DEPARTMENT OF EDUCATION
CHAMPION EXCELLENCE

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OKLAHOMA SCHOOL TESTING PROGRAM
TEST AND ITEM SPECIFICATIONS

Grade 8 Mathematics Test

Purpose

The purpose of the Grade 8 test is to measure Oklahoma students' levels of proficiency over the Oklahoma Academic Standards. Students are required to respond to a variety of items that assess identified content strands and standards outlined in the Grade 8 Test Blueprint.

Test Structure, Format, and Scoring

The Grade 8 Mathematics test will consist of 50 operational items and 10 field-test items, written at a reading level about two grade levels below a Grade 8 audience. The total 60 items will be divided into two test sections.

Each item is scored as correct or incorrect. Only operational items contribute to the total test score. Thus, for example, if a test contains 50 operational items, only those 50 items (not the 10 field-test items) contribute to a student's scaled score on the test.

The student's raw score is converted to a scaled score using the number correct scoring method.

Test Alignment with Oklahoma Academic Standards

Criteria for Aligning the Test with the Oklahoma Academic Standards Content Strands and Standards
1. Categorical Concurrence The test is constructed so that there are at least five items measuring each OAS strand. The number of items, six, is based on estimating the number of items that could produce a reasonably reliable estimate of a student's mastery of the content measured.
2. Range-of-Knowledge Correspondence The test is constructed so that every standard for each OAS strand has at least one corresponding assessment item.
3. Source of Challenge Each test item is constructed in such a way that the major cognitive demand comes directly from the targeted OAS strand or standard being assessed, not from specialized knowledge or cultural background that the test-taker may bring to the testing situation.

OKLAHOMA SCHOOL TESTING PROGRAM

TEST BLUEPRINT MATHEMATICS
2016-2017 GRADE 8

This blueprint describes the content and structure of an assessment and defines the ideal number of test items by strand and standard of the Oklahoma Academic Standards (OAS).

IDEAL PERCENTAGE OF ITEMS	IDEAL NUMBER OF ITEMS	STRANDS AND STANDARDS
18%	9	**NUMBER AND OPERATIONS**
	9	PA.N.1 Real Number Operations
46%	23	**ALGEBRAIC REASONING AND ALGEBRA**
	6	PA.A.1 Linear and Non-Linear Functions
	8	PA.A.2 Linear Function Representations and Problem Solving
	9	PA.A.3 Algebraic Expressions (4) PA.A.4 Equations and Inequalities (5)
20%	10	**GEOMETRY AND MEASUREMENT**
	10	PA.GM.1 Pythagorean Theorem (4) PA.GM.2 Surface Area and Volume (6)
16%	8	**DATA AND PROBABILITY**
	8	PA.D.1 Data Analysis and Scatter Plots (4) PA.D.2 Probability (4)
100%	50	**TOTAL**

Please note this blueprint does not include items that may be field-tested.
A minimum of 6 items is required to report a standard.

Depth-of-Knowledge Assessed by Test Items

The Grade 8 test will approximately reflect the following "depth-of-knowledge (DOK)" distribution of items:

Depth-of-Knowledge	OAS Standards Percent of DOK 2016-2017
Level 1—Recall	10–20%
Level 2—Skills/Concept	65–75%
Level 3—Strategic Thinking	15–25%

DOK Ranges are based on the DOK of the new OAS standards. The standards increase grade-level expectations, increase rigor, and set the expectation for students to be college- and career-ready.

- **Level 1** (Recall and Reproduction) requires the student to recall facts, terms, definitions, or simple procedures, perform simple algorithms or apply formulas. One-step, well-defined, or straight algorithmic procedures should be included at this level.
- **Level 2** (Skills and Concepts) requires the student to make some decisions as to how to approach the problem or activity. Level 2 activities include making observations and collecting data; classifying, comparing, and organizing data; and organizing and displaying data in tables, charts, and graphs.
- **Level 3** (Strategic Thinking) requires reasoning, planning, using evidence, and a higher level of thinking. Level 3 activities include making conjectures, drawing conclusions from observations, citing evidence and developing a logical argument for concepts, explaining phenomena in terms of concepts, and using concepts to solve nonroutine problems.
- **Level 4** (Extended Thinking) requires complex reasoning, planning, developing, and thinking most likely requiring an extended amount of time. The cognitive demands of the item should be high and the work should be very complex. Students are required to make several connections (relate ideas within the content area or among content areas) and have to select one approach among many alternatives on how the situation should be solved in order to be at this highest level.

Note: These descriptions are adapted from Review Background Information and Instructions, Standards and Assessment Alignment Analysis, CCSSO TILSA Alignment Study, May 21–24, 2001, Version 2.0. For an extended description of each depth-of-knowledge level, see the web site at http://facstaff.wcer.wisc.edu/normw/TILSA/INFO and INSTR Align Anal 513.pdf

Universal Design Considerations

Universal Design, as applied to assessments, is a concept that allows the widest possible range of students to participate in assessments and may even reduce the need for accommodations and alternative assessments by expanding access to the tests themselves. In the Oklahoma Grade 8 tests, modifications have been made to some items to simplify and clarify instructions as well as to provide maximum readability, comprehensibility, and legibility. This includes such things as reducing the language load in content areas other than Language Arts, increasing the font size, displaying fewer items per page, and boxing the items to assist visual focus.

Online Administration

Test questions will be presented one at a time.

The stimulus and question will appear on the screen at the same time.

Answers may be selected by using the mouse to click on the radio button to the left of the answer choice.

Navigation buttons appear at the bottom of the page for each question. For longer items, a scroll bar will appear on the right-hand side of the window to allow scrolling through the answer choices.

Tools (including a scientific calculator on the Grade 8 Mathematics assessment) appear at the bottom of the screen/page to aid in answering questions.

Students will be able to use scratch paper for all online assessments. This paper must be taken up and destroyed by the test administrator immediately following the test. The test administrator must not look at what the student has written on the scratch paper.

Testing Schedules

This section appears in all of the test specification documents and is provided to give the reader a general sense of the overall testing program at this particular grade level.

Each Grade 8 test is meant to be administered in two sessions within one day with a break given between sessions or on consecutive days. Estimated time for scheduling purposes is given in the table below.

Grade 8 Mathematics Online Test Time Schedule	
Distributing login information	Approximately 5 minutes
Test instructions/tutorial and reviewing sample items	Approximately 15 minutes
Total:	Approximately 20 minutes
Administering Section 1 of the G8 Mathematics Online Test	Approximately 40 minutes
Administering Section 2 of the G8 Mathematics Online Test	Approximately 40 minutes

Item Types

The test will consist of a combination of multiple choice and technology enhanced items.

Most stems are positively worded—avoiding the use of the word "not." If a negative is required, it is underlined for emphasis (e.g., if a bag has the same number of red, blue, and black marbles, what is the probability that a marble randomly selected from the bag is not red?).

Multiple-Choice Item Guidelines

- All items must clearly indicate what is expected in a response and direct students to focus on their responses.
- Each multiple-choice item has a stem (question, statement, and/or graphic component) and four answer options—the correct answer and three distractors. Distractors will be developed based on the types of errors students are most likely to make.

- Multiple-choice item stems ask a question or pose a clear problem so that students will know what to do before looking at the answer choices. Students should not need to read all answer choices before knowing what is expected. A stem will seldom include an incomplete sentence.

Technology Enhanced Item Guidelines

- Technology Enhanced Items (TEIs) should be used to more authentically address some aspects of the OAS performance expectations and/or provide more opportunity for students to construct rather than select their response.
- Interaction types are: match, hot-spot, drag-and-drop and drop-down. Each TEI contains only one interaction type per item.
- For each TEI, the interaction type used is that which is the most appropriate and enhancing to the construct to be measured.
- Each TEI is structured to contain the question (content) first followed by directions for how to complete the interaction in that item. Consistent style and language are used in these directions (e.g., "Drag the pictures," "Click the object," etc).
- See sample item 3 on page 15 for an example of a drop-down item. See Appendix A for examples of the other three TEI interactions. Please note that the sample TEIs shown in the appendix do not come from Grade 8.

In summary, Grade 8 test items assess whether students understand algebraic concepts and procedures, whether they can communicate their understandings effectively in mathematical terms, and whether they can approach problems and develop viable solutions.

Stimulus Materials

Stimulus materials are the tables, charts, graphs, passages, and illustrations students must use in order to respond to items. The following characteristics are necessary for stimulus materials:

1. A stimulus that gives information must precede a question or a set of questions.
2. When students are given information to evaluate, they should know the question and the purpose of the information.
3. Passages, graphics, tables, etc., provide sufficient information for assessment of multiple objectives.
4. Stimulus materials for a set of items may be a combination of multiple stimuli.
5. Information in stimulus materials is based on situations students would encounter in or beyond school.
6. For conceptual items, stimulus materials are necessary but not conceptually sufficient for student response.
7. There is a balance of graphic and textual stimulus materials within a test form. Approximately 50 percent of the items will have appropriate pictorial or graphical representations. Graphs, tables, or figures are clearly associated with their intended items. Graphics appear either on the same page as the stimulus or on the facing page.

General Considerations—Oklahoma School Testing Program

1. Items deal with issues and details that are of consequence in the stimulus and central to students' understanding and interpretation of the stimulus.
2. Test items are varied and address all OAS standards listed in the Test Blueprint.
3. To the greatest extent possible, no item or response choice clues the answer to any other item.
4. All items reviewed and approved by the Oklahoma Item Review Committee are assigned an OAS strand, standard and/or objective. The Test Blueprints and score reports reflect the degree to which each OAS strand and standard is represented on the test.
5. Test items are tied closely and particularly to the stimuli from which they derive, so that the impact of outside (prior) knowledge, while never wholly avoidable, is minimized.
6. Each multiple-choice item contains a question and four answer options, only one of which is correct. Correct answers will be approximately equally distributed among A, B, C, and D responses.
7. The four choices are approximately the same length, have the same format, and are syntactically and semantically parallel; students should not be able to rule out a wrong answer or identify a correct response solely because it looks different from the other answer choices.
8. Distractors adopt the language and sense of the material in the stimuli so that students must think their way to the correct answer rather than simply identify incorrect responses by virtue of a distractor's obviously inappropriate nature.
9. Distractors should always be plausible (but, of course, incorrect) in the context of the stimulus.
10. Order of presentation of item types is dictated by logic (chronologically, spatially, etc.).
11. Items are worded precisely and clearly. The better focused an item, the more reliable and fair it is certain to be, and the more likely all students will understand it in the same way.
12. The range of items measuring an OAS standard consisting of more than one skill will provide a balanced representation of those skills.
13. Items should be focused on what all students should know and be able to do as they complete their Grade 8 coursework.
14. The responses "Both of the above," "All of the above," "None of the above," and "Neither of the above" will not be used.
15. The material presented is balanced, culturally diverse, well written, and of interest to Grade 8 test level students. The stimuli and items are fairly presented in order to gain a true picture of students' skills.
16. Across all forms, a balance of gender and active/passive roles by gender is maintained.
17. Forms attempt to represent the ethnic diversity of Oklahoma students.
18. Approved calculators and the formula sheet on page 9 may be used on the Grade 8 Mathematics test. No other resource materials may be used by students during the test. More information regarding the calculator policy can be found at http://sde.ok.gov/sde/assessment-administrator-resources-administrators.
19. The stimuli avoid subject matter that might prompt emotional distress on the part of the students.
20. Permission to use stimuli from copyrighted material is obtained as necessary by testing vendor.

Considerations Specific to the Grade 8 Mathematics Test

It is necessary to create test items that are reliable, fair, and targeted to the Oklahoma Academic Standards listed on the following pages. There are some general considerations and procedures for effective item development.

These considerations include, but are not limited to, the following:

1. Each test form contains items assessing all content standards.
2. Test items that assess each standard are not limited to one particular type of response format.
3. Test questions attempt to focus on content that is authentic and that Grade 8 level students can relate to and understand.
4. Test items are worded precisely and clearly. The better focused an item, the more reliable and fair it is likely to be, and the more likely all students will understand what is required of them.
5. All items are reviewed to eliminate language that shows bias or that would otherwise likely disadvantage a particular group of students. That is, items do not display unfair representations of gender, race, ethnicity, disability, culture, or religion; nor do items contain elements that are offensive to any such groups.
6. Items are written so that calculations are kept to a minimum, and numbers are selected to minimize the time spent on computations.
7. All test items and answer choices have appropriate labels and units.
8. Most graphs are placed on a gray grid, with the x- and y-axes labeled and marked.

All items developed using these specifications are reviewed annually by Oklahoma educators and approved by the Oklahoma State Department of Education. The distribution of newly developed items is based on difficulty, cognitive ability, percentage of art/graphics, and grade-level appropriateness as determined by an annual Item Development Plan approved by the Oklahoma State Department of Education.

Oklahoma State Testing Program
8th Grade Mathematics Formula Sheet

UNIT CONVERSIONS

1 foot = 12 inches	1 pound = 16 ounces	1 cup = 8 fluid ounces
1 yard = 3 feet	1 ton = 2000 pounds	1 pint = 2 cups
1 mile = 5280 feet	1 kilogram = 1000 grams	1 quart = 2 pints
1 mile = 1760 yards		1 gallon = 4 quarts
1 meter = 100 centimeters		
1 meter = 1000 millimeters		

AREA

Square	$A = s^2$	Parallelogram	$A = bh$
Rectangle	$A = lw$	Circle	$A = \pi r^2$
Triangle	$A = \frac{1}{2}bh$	Trapezoid	$A = \frac{1}{2}(b_1 + b_2)h$

CIRCUMFERENCE

Circle	$C = \pi d$ or $C = 2\pi r$

VOLUME

Rectangular Prism	$V = Bh$ or $V = lwh$	Right Cylinder	$V = Bh$ or $V = \pi r^2 h$

SURFACE AREA

Rectangular Prism	$S = 2B + Ph$ or $S = 2lw + 2lh + 2wh$
Cylinder	$S = 2\pi rh + 2\pi r^2$

LINEAR EQUATIONS

Slope-intercept	$y = mx + b$	Slope formula	$m = \frac{y_2 - y_1}{x_2 - x_1}$
Point-slope	$y - y_1 = m(x - x_1)$	Direct Variation	$y = kx$

OTHER

$d = rt$		Pythagorean Theorem	$a^2 + b^2 = c^2$

School Year 2016-2017

Overview of Item Specifications

For each OAS strand, item specifications are organized under the following headings:

- OAS Strand
- OAS Standard
- OAS Objectives
- Item Specifications
    a. Emphasis
    b. Stimulus Attributes
    c. Format
    d. Content Limits
    e. Primary Process Standard(s)
    f. Distractor Domain
    g. Sample Test Items

The headings "OAS Strands" and "OAS Standards" state the OAS strand followed by the OAS standard being measured in the mathematics section of the Oklahoma Academic Standards document.

For each standard, the information under the heading "Item Specifications" highlights important points about a test item's emphasis, format, content limits, and distractor domain. Sample test items are provided with each strand to illustrate these specifications. Although it is sometimes possible to score single items for more than one concept, all items in these tests are written to address a single standard as the primary concept.

Note: With the exception of content limits, the Item Specifications offer suggestions of what might be included and do not provide an exhaustive list of what can be included. For this reason, Item Specifications are only meant to be a supplemental resource for classroom instruction.

In addition, the sample test items are not intended to be definitive in nature or construction—the stimuli and the test items that follow them may differ from test form to test form, as may their presentations. Sample test items are not intended to predict a student's performance on the actual test, but rather to allow students to familiarize themselves with the item types and formats that they may see on the test.

STANDARDS & SAMPLE ITEMS

OAS STRAND—NUMBER & OPERATIONS (N): STANDARD PA.N.1

OAS STANDARD

PA.N.1 Read, write, compare, classify, and represent real numbers and use them to solve problems in various contexts.

OAS OBJECTIVES

PA.N.1.1 Develop and apply the properties of integer exponents, including $a^0 = 1$ (with $a \neq 0$), to generate equivalent numerical and algebraic expressions.

PA.N.1.2 Express and compare approximations of very large and very small numbers using scientific notation.

PA.N.1.3 Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation.

PA.N.1.4 Classify real numbers as rational or irrational. Explain why the rational number system is closed under addition and multiplication and why the irrational system is not. Explain why the sum of a rational number and an irrational number is irrational; and the product of a non-zero rational number and an irrational number is irrational.

PA.N.1.5 Compare real numbers; locate real numbers on a number line. Identify the square root of a perfect square to 400 or, if it is not a perfect square root, locate it as an irrational number between two consecutive positive integers.

ITEM SPECIFICATIONS

Emphasis:

- Demonstrate an understanding of the properties of integer exponents and generate equivalent expressions that involve integer exponents.
- Demonstrate an understanding of scientific notation.
- Demonstrate an ability to multiply and divide numbers expressed in scientific notation.
- Demonstrate an understanding of the rational number system and the irrational number system.
- Demonstrate an understanding of perfect squares and square roots, and integers and approximate square roots.
- Demonstrate an ability to classify real numbers as rational or irrational.
- Demonstrate an ability to locate real numbers on a number line.

Stimulus Attributes:

- Test items may include calculator displays, tables, graphs, charts, maps, scale drawings, data sets, other diagrams, number lines, two- and three-dimensional geometric figures, coordinate graphs, 10-by-10 grids, and counting manipulatives.

Format:

- Use the rules of exponents in mathematical and real-life contexts, including $a^0 = 1$ (with $a \neq 0$)
- Demonstrate an understanding of the magnitude of very large and very small numbers and the role of scientific and exponential notation in the representation of these numbers
- Use the rules of exponents in mathematical and real-life contexts to generate equivalent numerical and algebraic expressions
- Demonstrate the concepts of positive and negative exponents using patterns
- Demonstrate an understanding of scientific notation
- Compare, order, and translate among representations of rational numbers

ITEM SPECIFICATIONS

Format (continued):

- Classify real numbers as rational or irrational
- Demonstrate an understanding of the rational and irrational number system
- Use numbers to explore, estimate, and identify square roots and perfect squares in mathematical, geometric, and real-world contexts
- Use graphic representations including arrays and models of multiples to explore, estimate, and identify square roots and perfect squares in mathematical, geometric, and real-world contexts
- Use a number line to locate real numbers

Content Limits:

- Limit mathematical and real-life contexts to age-appropriate situations
- Limit to no more than two operations on exponential or scientific numbers
- Limit to integer exponents with the same base
- Limit decimals to ten-thousandths
- Limit computations involving only fractions to halves, thirds, fourths, fifths, sixths, eighths, tenths, and twelfths
- Limit graphic representations to common two-dimensional geometric figures
- Limit arrays to two-dimensional arrays
- Limit classifications to rational or irrational
- Limit square roots to up to the square root of 400

Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop the Ability to Communicate Mathematically
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Incorrect use of rules or properties
- Comparison errors
- Common errors
- Rounding errors
- Use of incorrect equivalencies
- Incorrect interpretation of data display

1 **Which of the following is equivalent to the expression below?**

$$\frac{4^8}{4^2}$$

A 4^4

B 4^6

C 4^{10}

D 4^{16}

Correct Response: B
Depth-of-Knowledge: 2

2 **A space shuttle travels at 2.6×10^4 feet per second. An hour is 3.6×10^3 seconds. This expression can be used to find the number of feet the space shuttle travels in an hour.**

$$(2.6 \times 10^4)\ (3.6 \times 10^3)$$

How many feet does the shuttle travel in an hour?

A 6.2×10^1 feet

B 6.2×10^{12} feet

C 9.36×10^7 feet

D 9.36×10^{12} feet

Correct Response: C
Depth-of-Knowledge: 2

3

Complete the statements to describe the outcomes of operations with the following numbers.

- a and b are non-zero rational numbers.
- x and y are irrational numbers.

Select the word that best completes each statement. To select a word, click the menu and then click the desired word. To choose a different word, click the menu and click the new word.

$a + b$ is -Select an Answer- ▼ rational.

$x \cdot y$ is -Select an Answer- ▼ irrational.

$a + x$ is -Select an Answer- ▼ rational.

$b \cdot x$ is -Select an Answer- ▼ irrational.

Correct Response: always; sometimes; never; always
Depth-of-Knowledge: 2

OAS STRAND—ALGEBRAIC REASONING & ALGEBRA (A): STANDARD PA.A.1

OAS STANDARD

PA.A.1 Understand the concept of function in real-world and mathematical situations, and distinguish between linear and nonlinear functions.

OAS OBJECTIVES

PA.A.1.1 Recognize that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable.

PA.A.1.2 Use linear functions to represent and explain real-world and mathematical situations.

PA.A.1.3 Identify a function as linear if it can be expressed in the form $y = mx + b$ or if its graph is a straight line.

ITEM SPECIFICATIONS

Emphasis:

- Identify a relationship that forms a function.
- Determine the dependent and independent variables of various relations and functions represented mathematically and in real-world contexts.
- Use linear functions to represent real-world and mathematical situations.
- Identify characteristics of linear functions expressed graphically and numerically.

Stimulus Attributes:

- Test items may include graphs, diagrams, tables, and situations.

Format:

- Identify the dependent and independent variables of various relations and functions represented algebraically, graphically, numerically, and in tables
- Identify rates of constant change
- Identify the meaning of rates of change in real-world contexts
- Distinguish between linear and nonlinear data represented graphically, numerically, in equation form, and in tables, etc.
- Identify the appropriate situation that corresponds to an algebraic equation
- Identify the appropriate algebraic equation that represents a situation described graphically or verbally

Content Limits:

- Exclude relations that include xy
- Exclude step functions and trigonometric functions
- Limit real-world contexts to those that are of age-appropriate recognition
- Limit to linear equations
- Limit real-world and mathematical contexts to age appropriate situations

ITEM SPECIFICATIONS

Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop the Ability to Communicate Mathematically
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Interchange range and domain
- Common algebraic misconceptions
- Conceptual errors

4 **A smoothie shop makes $3.00 for every smoothie sold after subtracting the costs of ingredients and packaging. They have additional costs of $150.00 per day. Which linear model expresses how much the shop makes, *p*(*x*), for selling *x* smoothies in a day?**

A $p(x) = 3x$

B $p(x) = 3x - 150$

C $p(x) = 150x - 3$

D $p(x) = 3x + 150$

Correct Response: B
Depth-of-Knowledge: 1

5 **A taxi company charges a base fee of $2.00 plus $0.50 per mile. Which of these represents the cost of a taxi ride, *c*(*x*), for the distance of *x* miles?**

A $c(x) = 2.5x$

B $c(x) = 50x + 2$

C $c(x) = 0.50x + 2$

D $c(x) = 2x + 0.50$

Correct Response: C
Depth-of-Knowledge: 1

OAS STRAND—ALGEBRAIC REASONING & ALGEBRA (A): STANDARD PA.A.2

OAS STANDARD

PA.A.2 Recognize linear functions in real-world and mathematical situations; represent linear functions and other functions with tables, verbal descriptions, symbols, and graphs; solve problems involving linear functions and interpret results in the original context.

OAS OBJECTIVES

PA.A.2.1 Represent linear functions with tables, verbal descriptions, symbols, and graphs; translate from one representation to another.

PA.A.2.2 Identify, describe, and analyze linear relationships between two variables.

PA.A.2.3 Identify graphical properties of linear functions including slope and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional relationship.

PA.A.2.4 Predict the effect on the graph of a linear function when the slope or y-intercept changes. Use appropriate tools to examine these effects.

PA.A.2.5 Solve problems involving linear functions and interpret results in the original context.

ITEM SPECIFICATIONS

Emphasis:

- Use a variety of representations of linear functions and translate from one representation to another.
- Identify, describe, and analyze linear relationships between two variables.
- Identify graphical properties of linear functions.
- Predict the effect on the graph of a linear function when the slope or y-intercept changes.
- Solve real-world and mathematical problems involving linear functions and interpret the results.

Stimulus Attributes:

- Test items may include tables, graphs, data sets, algebraic equations, situations, coordinate graphs, number lines, balances, other diagrams, and two- and three-dimensional geometric figures.

Format:

- Identify the appropriate situation that corresponds to a linear equation
- Identify the appropriate linear equation that represents a situation described graphically or verbally
- Identify, write, and solve multi-step linear equations involved in mathematical and real-world situations
- Translate between algebraic and geometric representations of linear equations
- Analyze attributes of algebraic and geometric representations of linear equations
- Select and apply appropriate formulas for mathematical and real-world situations
- Formulas may or may not be given
- Analyze the effect on the graph of a linear function when the slope or y-intercept changes

STANDARD PA.A.2 continued

ITEM SPECIFICATIONS

Content Limits:

- Limit real-world and mathematical contexts to age appropriate situations
- Limit to linear equations
- Limit linear equations to integer or common fraction coefficients
- Limit equations to slope-intercept form
- Limit change of slope to opposites, integers, and common fractions, or simple identification of steepness, or closer to vertical or horizontal (without calculation)
- Limit multistep processes to no more than two steps for each component stage

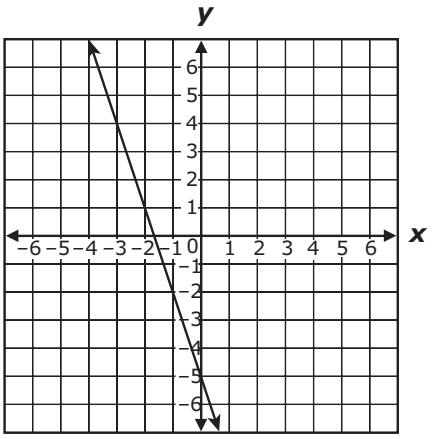
Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop the Ability to Communicate Mathematically
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

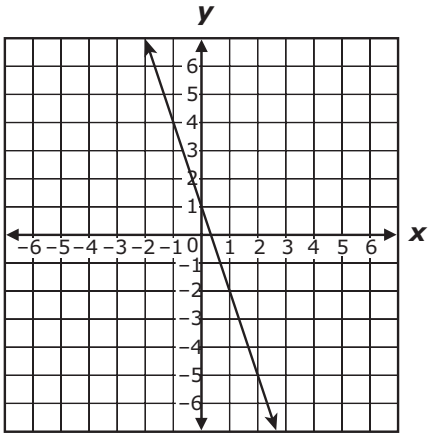
- Computational errors
- Interchange range and domain
- Common algebraic misconceptions
- Common errors
- Incorrect procedures
- Inappropriate operations with variables
- Use of inappropriate formulas

6 **The graph of the equation $y = -3x - 5$ is shown below.**

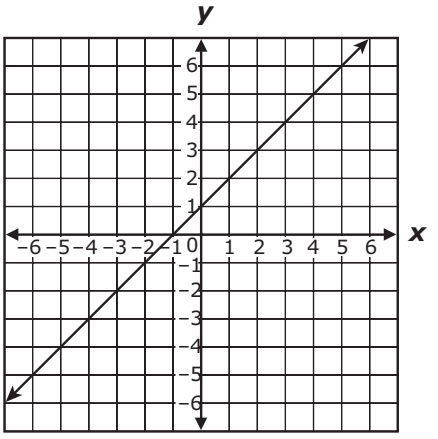


Which best represents the graph of the equation $y = -3x - 5$ when the slope is changed to 1 and the y-intercept remains the same?

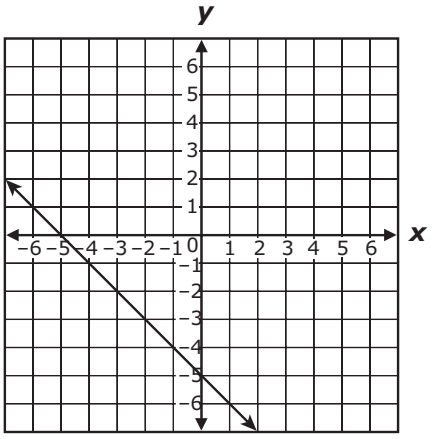
A



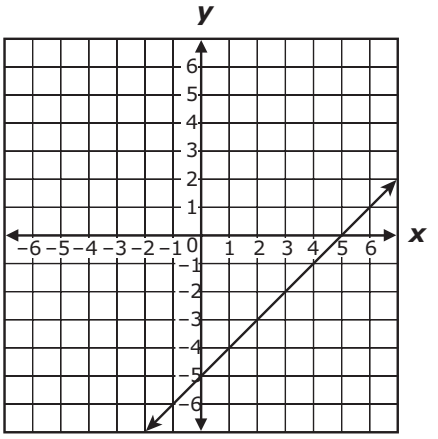
B



C



D



Correct Response: D
Depth-of-Knowledge: 2

OAS STRAND—ALGEBRAIC REASONING & ALGEBRA (A): STANDARD PA.A.3

OAS STANDARD

PA.A.3 Generate equivalent numerical and algebraic expressions and use algebraic properties to evaluate expressions.

OAS OBJECTIVES

PA.A.3.1 Use substitution to simplify and evaluate algebraic expressions.

PA.A.3.2 Justify steps in generating equivalent expressions by identifying the properties used, including the properties of operations (associative, commutative, and distributive laws) and the order of operations, including grouping symbols.

ITEM SPECIFICATIONS

Emphasis:

- Simplify and evaluate algebraic expressions using substitution.
- Justify steps in generating equivalent expressions by identifying the properties used.

Stimulus Attributes:

- Test items may include illustrations of the following: tables, graphs, charts, data sets, equivalency statements, and algebraic expressions.

Format:

- Use variables as unknowns
- Substitute numerical values for variables in algebraic expressions
- Use the rules for order of operations with rational numbers to find the values of numerical and algebraic expressions
- Items may include parentheses and other grouping symbols
- Identify applications of the properties of operations

Content Limits:

- Properties of operations to include associative, commutative, and distributive laws
- Limit exponents to whole numbers

Primary Process Standards:

- Develop Accurate and Appropriate Procedural Fluency
- Develop Mathematical Reasoning
- Develop the Ability to Communicate Mathematically

Distractor Domain:

- Common errors
- Incorrect procedures
- Computational errors
- Incorrect use of rules or properties
- Order of operations errors

7 **The total amount of money, in dollars, Sandy earns for working *h* hours is represented by this expression.**

$$15h$$

How much money does Sandy earn for working 35 hours?

A $20

B $50

C $525

D $1535

Correct Response: C
Depth-of-Knowledge: 1

OAS STRAND—ALGEBRAIC REASONING & ALGEBRA (A): STANDARD PA.A.4

OAS STANDARD

PA.A.4 Represent real-world and mathematical problems using equations and inequalities involving linear expressions. Solve and graph equations and inequalities symbolically and graphically. Interpret solutions in the original context.

OAS OBJECTIVES

PA.A.4.1 Illustrate, write, and solve mathematical and real-world problems using linear equations with one variable with one solution, infinitely many solutions, or no solutions. Interpret solutions in the original context.

PA.A.4.2 Represent, write, solve, and graph problems leading to linear inequalities with one variable in the form $px + q > r$ and $px + q < r$, where p, q, and r are rational numbers.

PA.A.4.3 Represent real-world situations using equations and inequalities involving one variable.

ITEM SPECIFICATIONS

Emphasis:

- Demonstrate an ability to represent and solve mathematical and real-world problems using linear equations and interpret solutions in the original context.
- Demonstrate an ability to represent and solve mathematical and real-world problems using linear inequalities.
- Represent real-world situations using equations and inequalities.

Stimulus Attributes:

- Test items may include algebraic equations, strict and non-strict inequalities, graphs, number lines, tables, and situations.

Format:

- Illustrate linear equations
- Write linear equations
- Solve linear equations
- Solve linear inequalities graphically
- Solve linear inequalities algebraically
- Identify the appropriate situation that corresponds to an algebraic equation
- Identify the appropriate algebraic equation that represents a situation described graphically or verbally
- Identify the appropriate situation that corresponds to an algebraic inequality
- Identify the appropriate algebraic inequality that represents a situation described graphically or verbally

Content Limits:

- Limit inequalities to rational coefficients
- Limit real-world and mathematical contexts to age appropriate situations
- Limit to linear equations

ITEM SPECIFICATIONS

Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop the Ability to Communicate Mathematically
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Common algebraic misconceptions
- Incorrectly filled or blank points on number lines
- Misdirected arrows on number lines or wrong shading of graphs

8 **A wall in Cynthia's attic is a triangle with an area of 6 square meters and a base of 4 meters. What is the height, in meters, of the triangular wall?**

A 3 meters

B 4 meters

C 12 meters

D 24 meters

Correct Response: A
Depth-of-Knowledge: 2

9 **The product of 24 and *n* is greater than −96. Which inequality represents the possible values for *n*?**

A $n > -4$

B $n > -120$

C $n < -4$

D $n < -120$

Correct Response: A
Depth-of-Knowledge: 2

10 **Tom has read 11 pages of a 215-page book. He will read 6 pages each day until he finishes the book. Which equation can be used to find the number of days, *d*, it will take Tom to finish reading the book?**

A $6 + 11d = 215$

B $11 + 6d = 215$

C $17d = 215$

D $6d = 215$

Correct Response: B
Depth-of-Knowledge: 2

OAS STRAND—GEOMETRY & MEASUREMENT (GM): STANDARD PA.GM.1

OAS STANDARD

PA.GM.1 Solve problems involving right triangles using the Pythagorean Theorem.

OAS OBJECTIVES

PA.GM.1.1 Informally justify the Pythagorean Theorem using measurements, diagrams, or dynamic software and use the Pythagorean Theorem to solve problems in two and three dimensions involving right triangles.

PA.GM.1.2 Use the Pythagorean Theorem to find the distance between any two points in a coordinate plane.

ITEM SPECIFICATIONS

Emphasis:

- Demonstrate the ability to use the Pythagorean Theorem to solve problems involving right triangles.
- Demonstrate the ability to use the Pythagorean Theorem to find the distance between two points in a coordinate plane.

Stimulus Attributes:

- Plane geometric figures, word problems, dynamic software, and three-dimensional figures.

Format:

- Identify situations in which the use of the Pythagorean Theorem is appropriate in finding missing lengths of the sides of geometric figures and line segments given in various contexts through age appropriate word problems
- Justify the Pythagorean Theorem

Content Limits:

- Limit geometric figures to right triangles, rectangles, or combined forms which include triangles, rectangles, circles, or half-circles
- Limit final answer choices to whole numbers (after rounding) and radicals (simplification not needed, except for perfect squares)
- Limit real-life and mathematical contexts to age appropriate situations

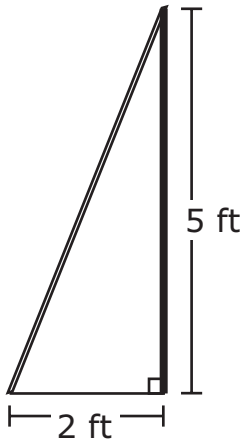
Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Incorrect procedures

11 **A wire is attached to the top of a 5-foot tall pole. The other end of the wire is secured to the ground 2 feet from the base of the pole.**



What is the length, in feet (ft), of the wire?

A $\sqrt{7}$ ft

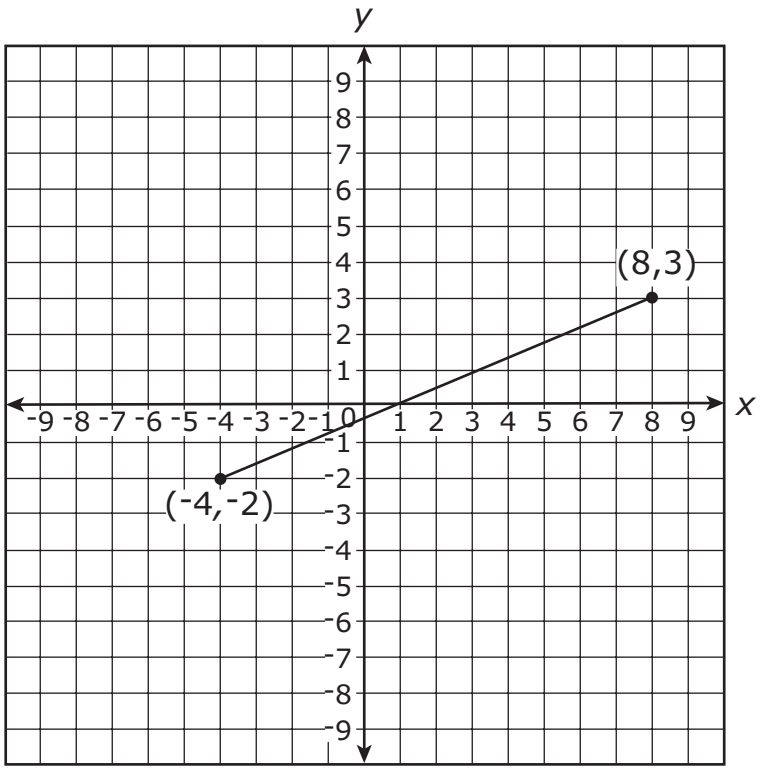
B $\sqrt{14}$ ft

C $\sqrt{21}$ ft

D $\sqrt{29}$ ft

Correct Response: D
Depth-of-Knowledge: 2

12



What is the length of the segment connecting the points that have the coordinates (−4, −2) and (8, 3)?

A 12

B 13

C 14

D 15

Correct Response: B
Depth-of-Knowledge: 2

OAS STRAND—GEOMETRY & MEASUREMENT (GM): STANDARD PA.GM.2

OAS STANDARD

PA.GM.2 Calculate surface area and volume of three-dimensional figures.

OAS OBJECTIVES

PA.GM.2.1 Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as cm^2.

PA.GM.2.2 Calculate the surface area of a cylinder, in terms of π and using approximations for π, using decomposition or nets. Use appropriate measurements such as cm^2.

PA.GM.2.3 Develop and use the formulas $V = lwh$ and $V = Bh$ to determine the volume of rectangular prisms. Justify why base area (B) and height (h) are multiplied to find the volume of a rectangular prism. Use appropriate measurements such as cm^3.

PA.GM.2.4 Develop and use the formulas $V = \pi r^2 h$ and $V = Bh$ to determine the volume of right cylinders, in terms of π and using approximations for π. Justify why base area (B) and height (h) are multiplied to find the volume of a right cylinder. Use appropriate measurements such as cm^3.

ITEM SPECIFICATIONS

Emphasis:

- Determine the surface area of rectangular prisms and cylinders.
- Determine the volume of rectangular prisms and cylinders.

Stimulus Attributes:

- Test items may include rectangular prisms, cylinders, and other geometric solids.

Format:

- Determine the surface area of right rectangular prisms using decomposition or nets
- Determine the surface area of a cylinder, using decomposition or nets
- Use formulas for determining volume of right rectangular prisms and right cylinders

Content Limits:

- Limit solids to rectangular prisms and cylinders

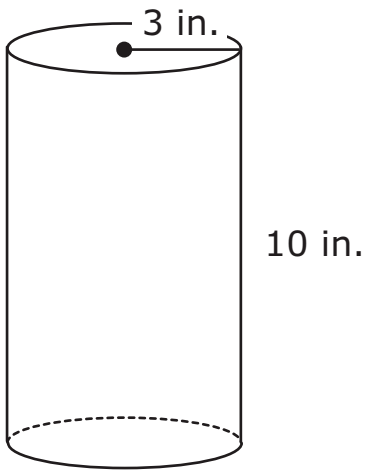
Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop the Ability to Communicate Mathematically
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Incorrect procedures
- Interchange volume and surface area

13 **Jason decorated the outside of this cylinder.**



What is the surface area of the cylinder, in square inches (sq in.)?

A 72π sq in.

B 78π sq in.

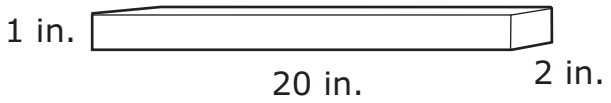
C 192π sq in.

D 260π sq in.

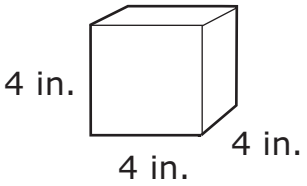
Correct Response: B
Depth-of-Knowledge: 1

14 **Caitlin wants to pack her craft supplies in the box with the greatest volume. Which box has the <u>greatest</u> volume?**

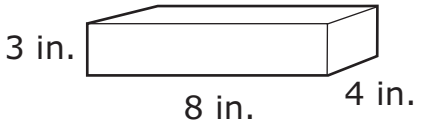
A



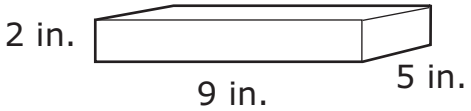
B



C



D



Correct Response: C
Depth-of-Knowledge: 2

OAS STRAND—DATA & PROBABILITY (D): STANDARD PA.D.1

OAS STANDARD

PA.D.1 Display and interpret data in a variety of ways, including using scatterplots and approximate lines of best fit. Use line of best fit and average rate of change to make predictions and draw conclusions about data.

OAS OBJECTIVES

PA.D.1.1 Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet and use a calculator to examine this impact.

PA.D.1.2 Explain how outliers affect measures of central tendency.

PA.D.1.3 Collect, display, and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels, and units.

ITEM SPECIFICATIONS

Emphasis:

- Demonstrate an ability to create data displays.
- Understand the impact that inserting or deleting a data point has on the mean and the median of a data set.
- Understand how outliers affect measures of central tendency.
- Estimate a line of best fit for a set of data displayed in a scatterplot and use the line to make predictions.

Stimulus Attributes:

- Test items may include graphs, scatter plots, and data tables.

Format:

- Determine the outcome on the mean and mean when a data point is inserted or deleted from a data set
- Determine the affect of outliers on the measures of central tendency
- Identify characteristics of a scatter plot
- Determine the best-fit line of a set of data
- Interpret the results of data using linear models

Content Limits:

- Limit data displayed to strong positive or negative correlations
- Limit data sets to 20 data points
- Limit data sets to numerical data

Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop Mathematical Reasoning
- Develop a Deep and Flexible Conceptual Understanding
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Computational errors
- Common algebraic misconceptions

15 **Brandon used an indoor rock-climbing wall seven times. His climbing times, in minutes, are shown in this list.**

35, 16, 17, 18, 13, 13, 14

Why is the median the most useful measure of central tendency for these times?

A The median is not affected by an outlier.

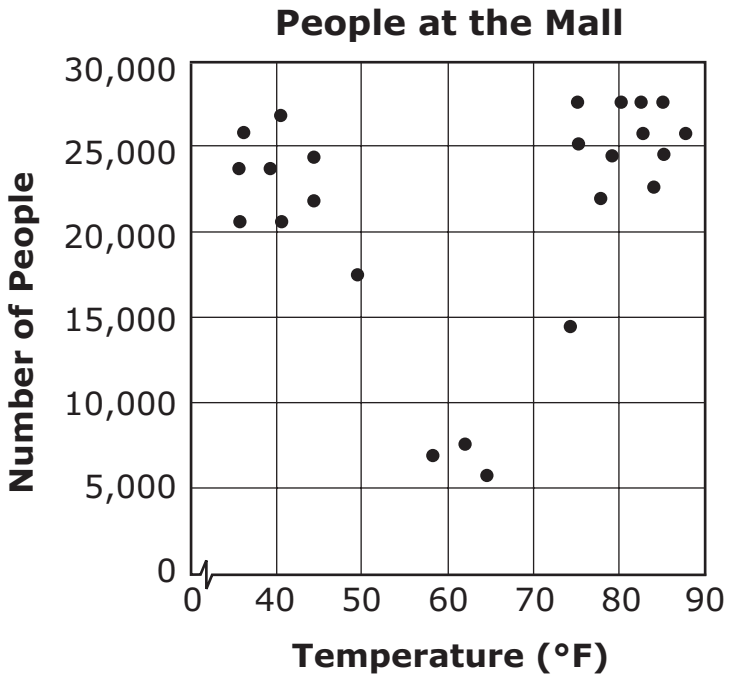
B The median is equal to the range of the data.

C The median is the time that occurs most often.

D The median is a larger value than the mean of the data.

Correct Response: A
Depth-of-Knowledge: 2

16 **This scatter plot shows the number of people at a mall each day and the average temperature for the day.**



Based on the scatter plot, which statement is true?

A The number of people at the mall always increases as the temperature rises.

B The number of people at the mall always decreases as the temperature rises.

C Fewer people are at the mall when the temperature is between 70 °F and 90 °F.

D Fewer people are at the mall when the temperature is between 50 °F and 70 °F.

Correct Response: D
Depth-of-Knowledge: 2

OAS STRAND—DATA & PROBABILITY (D): STANDARD PA.D.2

OAS STANDARD

PA.D.2 Calculate experimental probabilities and reason about probabilities to solve real-world and mathematical problems.

OAS OBJECTIVES

PA.D.2.1 Calculate experimental probabilities and represent them as percents, fractions, and decimals between 0 and 1 inclusive. Use experimental probabilities to make predictions when actual probabilities are unknown.

PA.D.2.2 Determine how samples are chosen (random, limited, or biased) to draw and support conclusions about generalizing a sample to a population.

PA.D.2.3 Compare and contrast dependent and independent events.

ITEM SPECIFICATIONS

Emphasis:

- Demonstrate the ability to determine and predict experimental and actual probabilities in specified mathematical and real-world contexts.
- Explain how samples are chosen to make conclusions about a population.
- Demonstrate an ability to compare and contrast dependent and independent events.

Stimulus Attributes:

- Test items may include illustrations of coordinate graphs, number lines, tables, graphs, and charts, such as frequency charts, line, bar, or picture graphs, Venn diagrams, stem-and-leaf plots, box-and-whisker plots, scatter plots, histograms, circle graphs, data sets, spinners, and other diagrams.

Format:

- Predict the probability of the outcome of a specified event or experiment in a mathematical or real-world context based on “or,” “and,” or “not” statements
- Express probabilities in various forms, including decimal, fraction, and percent
- Probability can be with or without replacement
- Determine how samples are chosen
- Compare and contrast dependent and independent events

Content Limits:

- Limit sample to no more than 20 pieces of data
- Limit real-world contexts to age-appropriate situations
- Limit to experimental probabilities

Primary Process Standards:

- Develop Strategies for Problem Solving
- Develop Mathematical Reasoning
- Develop the Ability to Make Conjectures, Model, and Generalize

Distractor Domain:

- Common errors
- Incorrect procedures
- Computational errors
- Incorrect use of rules or properties
- Use of incorrect equivalencies

17 **Nancy has a bag of different colored golf balls. Each ball is white, yellow, or green.**

Nancy takes a ball from the bag without looking, records the color, and then returns the ball to the bag. She repeats this process until she has recorded the color of a ball 10 times. Her results are shown.

- **White: 7**
- **Yellow: 2**
- **Green: 1**

Nancy will take another golf ball from the bag without looking. Based on Nancy's data, what is the probability she will take a green golf ball from the bag?

A $\frac{1}{10}$

B $\frac{1}{9}$

C $\frac{1}{7}$

D $\frac{1}{3}$

Correct Response: A
Depth-of-Knowledge: 2

APPENDIX A: SAMPLE TECHNOLOGY ENHANCED ITEMS (TEIS) FROM GRADES 6, 7, AND 10

The three sample TEIs in this appendix do not come from Grade 8, but are included to provide an understanding of how each interaction type used in Grade 8 works. For an example of a drop-down interaction, see sample item 3 on page 15.

A1

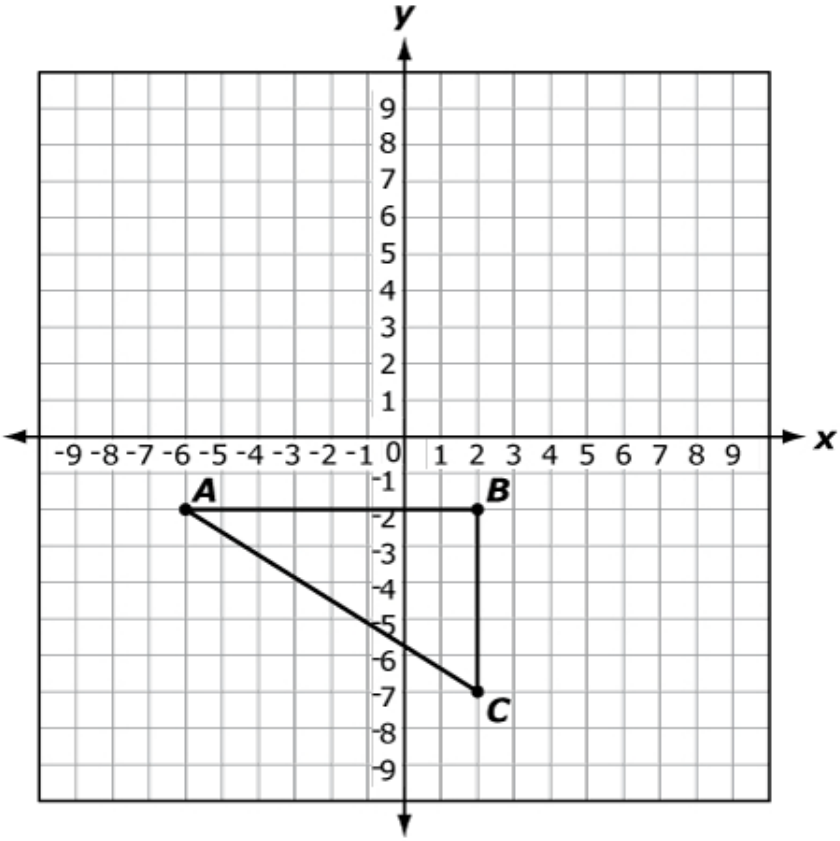
Match the expression in the left column to each equivalent expression in the right column. To connect expressions, click an expression in the left column and then an expression in the right column, and a line will automatically be drawn between them. To remove a connection, hold the pointer over the line until it turns red, and then click it. Each expression in the left column matches to only one expression in the right column.

5(6 + 8)	40 + 48
48 + 30	8 + 30
(5 + 6) x 8	6(5 + 8)
5 + 48	40 + 30
6 x 5 + 8	5 + 6 x 8

Correct Response: 1A – 2D; 1B – 2C; 1C – 2A; 1D –2E; 1E – 2B
Depth-of-Knowledge: 2
OAS Standard: 6.A.2.1

A2

Triangle *ABC* is translated 8 units up to create new triangle *A'B'C'*.



Which ordered pairs show the coordinates of the vertices of triangle *A'B'C'*?

To select the coordinates for a vertex, click the ordered pair. To deselect the coordinates, click on the ordered pair again.

(2, –2)	(–6, 6)	(–6, –10)	(2, 6)
(2, –10)	(10, –7)	(2, 1)	(10, –2)

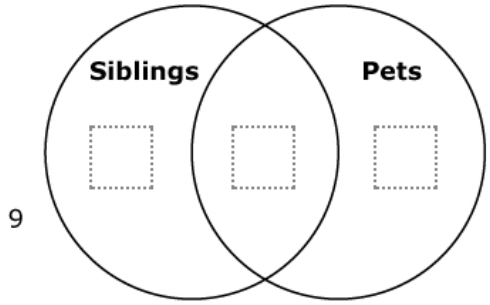
Correct Response: (–6, 6); (2, 1); (2, 6)
Depth-of-Knowledge: 2
OAS Standard: 7.GM.4.3

A3

Paige surveyed 50 of her classmates about whether they have any siblings and whether they have any pets.

She found that 40% of her classmates have pets. Of those students with pets, 70% also have siblings.

Paige started this Venn diagram to show her results. Complete her diagram by showing the missing numbers.
To place a number in the diagram, click and hold the number and then drag it to the desired space.



1	2	6	7	9	12	14	16	21	25

Correct Response: 21, 14, 6
Depth-of-Knowledge: 3
OAS Standard: A1.D.2.2

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