

Chapter 2: LEAP Mathematics, Grade 8

This chapter provides specifications for the Mathematics test for grade 8 LEAP. It describes the content and format of the test, provides the number and types of items, and explains how the standards and benchmarks for each strand of Mathematics are assessed.

Test Structure

The Mathematics test consists of three sessions. Students are allowed as much time as they need to complete each session, but suggested times are provided in the *Test Administration Manual*; it explains the procedures for allowing students additional time to complete a session of the test.

Session 1: 30 multiple-choice items without calculators

Session 2: 30 multiple-choice items with calculators

Session 3: 4 constructed-response items with calculators

Item Types

The multiple-choice items consist of a stem and four answer options (A, B, C, and D). Response options that are numbers are shown in ascending or descending order of magnitude, unless such ordering cues the answer.

The constructed-response items require students to supply a numerical answer (a number sentence or an arithmetical solution), a short written answer, or some other type of constructed response.

Test Description

Sessions 1 and 2:

These multiple-choice items assess a student's knowledge and conceptual understanding in all strands of mathematics. Whenever possible, concepts and skills are assessed in realistic contexts.

Any benchmark assessed without calculators is also eligible for assessment in the session permitting calculators, with the exception of estimation.

Session 3:

The four constructed-response items involve a number of separate steps and require application of multiple skills. They are designed to assess one or more of the strands and/or benchmarks, requiring students to demonstrate the connection of the strand to the other strands and to real-life situations.

The question format for this session is open-ended, including numerical answers, short written answers, and other types of constructed response (for example, draw a graph or geometrical pattern). Students may be required to explain in writing how they arrived at their answers.

Constructed-response items may have more than one possible solution or more than one path to the solution. Students' responses are scored for accuracy of the answer, proper operations used, and appropriate problem-solving approach or strategy. Partial credit is allowed, and calculators are permitted.

Whenever possible, test questions assess mathematical skills and knowledge in realistic contexts. These items are presented in terms of practical situations and problems that students are likely to encounter in their daily lives.

A test item may call upon skills related to more than one standard or benchmark. Nevertheless, for assessment purposes, each test item is keyed to a single standard or benchmark reflecting the *primary* skill it measures.

Readability level of test questions is minimized to the extent possible (except for necessary mathematical terms), so that students' reading ability does not interfere with their ability to demonstrate their mathematical knowledge and skills.

Mathematical formulas and equivalencies: Students are not required to recall formulas or unit conversions from memory. A separate Mathematics Reference Sheet containing grade-appropriate formulas and equivalencies needed to solve measurement or geometry items is provided. Students are expected to select the proper formula or conversion needed to solve a given problem. The Mathematics Reference Sheet can be found at the end of the Mathematics section of the guide. It is also available on the Louisiana Department of Education Web site in a version suitable for printing.

Mathematical tools: A ruler is provided during testing. School districts are responsible for making calculators available to all students for the appropriate sessions of the test.

Calculator Recommendations and Restrictions:

It is recommended that a calculator be made available to **each** student for instructional and assessment purposes. As with all instructional materials, each individual district and school should determine which calculator best supports its mathematics curriculum and instructional program. The calculator that the student uses as part of his/her regular mathematics instruction is the calculator that should be used on the Mathematics portion of LEAP.

Calculators recommended for instruction and assessment:

5–8 students: a scientific calculator

Calculators NOT permitted on statewide assessment:

- handheld or laptop computers
- pocket organizers
- calculators with paper tape
- calculators that talk or make noise
- calculators with QWERTY (typewriter-style) keypads
- electronic writing pads or pen input devices

Scoring the Mathematics Sessions

Multiple-choice items have four response options (A, B, C, and D) and are scored 1 if correct and 0 if incorrect.

Constructed-response items are scored according to an item-specific rubric, from 0 to 4 points. The specific rubric for each item is developed from the general 4-point scoring rubric for LEAP, GEE, and *i*LEAP.

General Scoring Rubric for LEAP Mathematics Constructed-Response Items

Score Level	Description of Score Level
4	<ul style="list-style-type: none">• The response demonstrates in-depth understanding of the relevant content and/or procedures.• The student completes all important components of the task accurately and communicates ideas effectively.• Where appropriate, the student offers insightful interpretations and/or extensions.• Where appropriate, the student uses more sophisticated reasoning and/or efficient procedures.
3	<ul style="list-style-type: none">• The response demonstrates understanding of major concepts and/or processes, although less important ideas or details may be overlooked or misunderstood.• The student completes the most important aspects of the task accurately and communicates clearly.• The student's logic and reasoning may contain minor flaws.
2	<ul style="list-style-type: none">• The student completes some parts of the task successfully.• The response demonstrates gaps in conceptual understanding.
1	<ul style="list-style-type: none">• The student completes only a small portion of the tasks and/or shows minimal understanding of the concepts and/or processes.
0	<ul style="list-style-type: none">• The student's response is incorrect, irrelevant, too brief to evaluate, or blank.

Mathematics Test Specifications

Sixty 1-point, multiple-choice items plus four 4-point items equals a 76-point test. The table below provides the test specifications for the multiple-choice sessions of the grade 8 LEAP Mathematics assessment. The values in the table do not include the constructed-response items. The four constructed-response items vary across test forms from year to year.

Grade 8 Mathematics Test Specifications

Strand	Distribution
Number and Number Relations	20%
Algebra	15%
Measurement	15%
Geometry	20%
Data Analysis, Probability, and Discrete Math	20%
Patterns, Relations, and Functions	10%

STRANDS, STANDARDS AND BENCHMARKS ASSESSED

This section presents the strands/standards and benchmarks assessed on the grade 8 LEAP Mathematics assessment. The section includes the text of each benchmark, followed by a list of abilities that students **may** be expected to demonstrate to give evidence of facility with the concepts or skills described in the benchmark statement.

Each of the six mathematics strands is associated with a single standard. The *strand* name serves as a label referring to the full text of its associated *standard*. Each strand has several benchmarks that describe what a student should know and be able to do in the context of the strand.

Strand N: Number and Number Relations

Standard: In problem-solving investigations, students demonstrate an understanding of the real number system and communicate the relationships within that system using a variety of techniques and tools.

Strand A: Algebra

Standard: In problem-solving investigations, students demonstrate an understanding of concepts and processes that allows them to analyze, represent, and describe relationships among variable quantities and to apply algebraic methods to real-world situations.

Strand M: Measurement

Standard: In problem-solving investigations, students demonstrate an understanding of the concepts, processes, and real-life applications of measurement.

Strand G: Geometry

Standard: In problem-solving investigations, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional geometry, and justify their findings.

Strand D: Data Analysis, Probability, and Discrete Math

Standard: In problem-solving investigations, students discover trends, formulate conjectures regarding cause-and-effect relationships, and demonstrate critical thinking skills in order to make informed decisions.

Strand P: Patterns, Relations, and Functions

Standard: In problem-solving investigations, students demonstrate an understanding of patterns, relations, and functions that represent and explain real-world situations.

Explanation of Benchmark Codes

Mathematics benchmarks are coded by strand, benchmark number, and grade cluster. The first part of the code refers to the strand (for example, Number and Number Relations). The second part is the benchmark number. The third part refers to the grade cluster (E, M, H).

Examples of Mathematics Codes

Code	Translation
N-1-E	Number and Number Relations, benchmark 1, elementary
G-5-M	Geometry, benchmark 5, middle school
A-3-H	Algebra, benchmark 3, high school

Content Limits

Grade 8 test items are subject to the following content limits. Depending on the particular benchmark assessed, items may involve:

- whole numbers through one million (in standard notation or words)
- any of the four operations with integers
- any of the four operations with fractions (denominators 2–12)
- any of the four operations with decimal numbers to ten thousandths place
- decimal and percent equivalents of common fractions, including halves, thirds, fourths, fifths, eighths, and tenths
- percent equivalents of decimal fractions
- calculating squares, cubes, or other powers, and finding square roots

For purposes of statewide assessment, calculating with monetary units (dollars and cents) is assessed under Number and Number Relations, rather than under the Measurement strand.

Strand N: Number and Number Relations

Assessment at grade 8 includes integers, common fractions, and decimal fractions, as well as evaluation of numerical expressions using order of operations (addition, subtraction, multiplication, and division). Students should understand that addition and subtraction, multiplication and division are inverse operations. Word problems that translate readily into algorithms are still appropriate for assessing computation skills at this level, but problems involving ratios and proportional reasoning play a significant role in assessment under this strand.

Benchmark Assessed	
N-1-M	demonstrating that a rational number can be expressed in many forms, and selecting an appropriate form for a given situation (for example, fractions, decimals, and percents)

Specifically, students may be required to:

- recognize or compute the decimal equivalent of a given fraction and the percent equivalent of a given decimal fraction
- relate fractions, decimal, and percent equivalents for halves, thirds, fourths, fifths, eighths, and tenths (for example, understand the connection between $\frac{1}{5}$, 0.20, and 20%)
- find a different representation of fractions
- understand and use the following terms in solving problems: prime, composite, multiple, divisor, and factor (both as nouns and verbs)
- find greatest common factor (GCF) and least common multiple (LCM) in the context of problem solving
- in a problem-solving context, read and use whole number exponents

Benchmark Assessed	
N-2-M	demonstrating number sense and estimation skills to describe, order, and compare rational numbers (for example, magnitude, integers, fractions, decimals, and percents)

Specifically, students may be required to:

- understand the relative magnitude of rational numbers from one million through ten-thousandths in decimal notation, and use the symbols =, >, < to represent order relations
- estimate or compare quantities expressed as positive or negative integers, fractions, or decimals
- estimate the effects of given operations on these quantities and determine reasonableness of solutions in the context of word problems

Benchmark Assessed
N-3-M reading, writing, representing, and using rational numbers in a variety of forms (for example, integers, mixed numbers, and improper fractions)

Specifically, students may be required to:

- demonstrate a conceptual, verbal, and numerical understanding of mixed numbers and improper fractions
- understand the meaning of positive and negative integers by using them to describe real-world situations

Benchmark Assessed
N-4-M demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply, and divide) and their relationships to each other

Specifically, students may be required to:

- recognize which operation(s) to use to solve a given problem
- use order of operations (including grouping symbols and exponents)
- solve order of operations problems involving any of the following properties:

Commutative property:

Addition: $[a + b = b + a]$

Multiplication: $[5 \times 3 = 3 \times 5]$

Associative property:

Addition: $[a + (b + c) = (a + b) + c]$

Multiplication: $[3 \times (2 \times 7) = (3 \times 2) \times 7]$

Distributive property for multiplication with:

Addition: $[a \times (b + c) = (a \times b) + (a \times c)]$

Subtraction: $[3 \times (6 - 2) = (3 \times 6) - (3 \times 2)]$

Benchmark Assessed
N-5-M applying an understanding of rational numbers and arithmetic operations to real-life situations

At grade 8, the primary focus for assessment of this benchmark is word problems involving integers (where the sign is relevant to the solution), fractions, decimals, and percents. In the

section administered without calculators, problems requiring computing with fractions are limited to common fractions. Students should be taught to use calculators to solve more difficult fractional problems.

Specifically, students may be required to:

- understand and use the words *sum*, *difference*, *product*, and *quotient* in the context of word problems
- solve problems involving positive and negative integers, fractions, decimals, and percents
- find unit cost and percent of increase and decrease (percent of discount). *Note:* Items assessing this skill may be scored under this strand or under the Measurement strand.

Benchmark Assessed	
N-8-M	demonstrating a conceptual understanding and applications of proportional reasoning (for example, determining equivalent ratios, finding a missing term of a given proportion)

Ratio and proportion are assessed mainly in the context of numerical problem solving, but may also include the foundation skills: find an equivalent ratio for a given ratio, or find the missing part of a given proportion. Students may be asked to demonstrate these specific skills and to compute with ratios and proportions in problem situations. Problems involving *rate* are covered under the Measurement strand, rather than under Number and Number Relations.

Benchmarks Not Directly Assessed:

The following benchmarks are *not* directly assessed on LEAP because it would not be possible to determine which method the student selected or used to answer a question (for example, mental math or scratch paper).

- N-6-M constructing, using, and explaining procedures to compute and estimate with rational numbers employing mental math strategies
- N-7-M selecting and using appropriate computational methods and tools for given situations involving rational numbers (for example, estimation, or exact computation using mental arithmetic, calculator, computer, or paper and pencil)

Strand A: Algebra

Benchmark Assessed	
A-1-M	demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (for example, symbolically represent real-world problems as linear terms, equations, or inequalities)

Specifically, students may be required to:

- match verbal statements to algebraic expressions, equations, and inequalities
- use number sentences or formulas to represent real world problems
- represent real-world problems involving addition, subtraction, multiplication, or division as linear equations or inequalities
- recognize and use exponential expressions (for example, x^2 and x^3) and square root signs

Benchmark Assessed	
A-2-M	modeling and developing methods for solving equations and inequalities (for example, using charts, graphs, manipulatives, and/or standard algebraic procedures)

Specifically, students may be required to:

- use various methods to solve for variables in inequalities and multistep equations
- graph solution sets on a number line
- solve linear equations involving addition, subtraction, multiplication, or division
- graph linear equations
- graph inequalities on a number line

Benchmark Assessed	
A-4-M	analyzing tables and graphs to identify relationships exhibited by the data and making generalizations based upon these relationships

Specifically, students may be required to:

- analyze linear patterns (patterns in linear functions) in tables and graphs and represent them algebraically
- create equations based on information found in tables and graphs

Note: Other skills involving tables and graphs are assessed under the Data Analysis, Probability, and Discrete Math strand.

Benchmark Assessed	
A-5-M	demonstrating the connection of algebra to the other strands and to real-life situations

This benchmark will not be directly assessed in the multiple-choice sessions of the test but is eligible for assessment in the constructed-response session of the test.

Benchmark Not Directly Assessed

The following benchmark is *not* directly assessed on LEAP.

A-3-M representing situations and number patterns with tables, graphs, and verbal and written statements, while exploring the relationships among these representations (for example, multiple representations for the same situation)

Strand M: Measurement

This strand focuses on solving real-world measurement problems. By grade 8, students should know how to measure, record, and communicate the perimeter and area of plane figures and the volume of containers. Design problems involving measurement may be included under this strand. Students are provided with a Mathematics Reference Sheet of formulas and equivalencies (unit conversions) for items assessing Measurement.

Benchmark Assessed	
M-1-M	applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences

Specifically, students may be required to:

- understand and use the names of all common units in the customary (English) and metric systems, in the context of word problems
- measure length and read linear measurements to sixteenth-inch or millimeter
- understand the concepts of elapsed time and time change across time zones
- determine (in customary or metric units) *perimeter* of an illustrated or described figure, and *area* of a square, rectangle, triangle, or figure formed from these
- find volume and surface area of cylinders and rectangular solids (cube, rectangular prism) from a diagram
- solve mathematical problems involving measurements in the customary and metric systems, including use of any of the following units:
 - Linear:* inches, feet, yards, miles, millimeters, centimeters, decimeters, meters, kilometers
 - Capacity:* cups, liquid pints and quarts, gallons, milliliters, liters, kiloliters
 - Weight/Mass:* ounces, pounds, tons, milligrams, grams, kilograms
 - Temperature:* degrees on the Fahrenheit or Celsius scale
 - Time:* seconds, minutes, hours, days, weeks, months, years, decades, centuries
- understand rate measures and rate of change (for example, words per minute, miles per hour, calories burned per hour, water rising over time)
- understand and express quantities representing rates, using appropriate units, and solve problems involving a variety of types of rates

Benchmark Assessed	
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M-2-M	demonstrating an intuitive sense of measurement (for example, estimating and determining reasonableness of measures)
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Assessment focuses on estimation skills involving measurements in the customary and metric systems. Items may include estimating the results of calculations involving measurement or, for example, the size of a familiar object in the real world.

Specifically, students may be required to:

- estimate perimeter using standard (customary or metric) units
- estimate area of a square, rectangle, triangle, and figures formed from them, using standard (customary or metric) units
- estimate and determine reasonableness of results of calculations involving length, perimeter, area, and volume
- demonstrate an intuitive sense of the magnitude of common units in relation to real-world applications (for example, estimate the length, area, or volume of a familiar object or the distance between two known points)
- distinguish between the process of counting, calculating, and measuring, and:
 - recognize which of these processes are involved in a given situation
 - understand what kind of numbers result from these processes (for example, exact vs. approximate; with or without label; etc.)

Benchmark Assessed	
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M-3-M	selecting appropriate units and tools for tasks by considering the purpose for the measurement and the precision required for the task (for example, length of a room in feet rather than inches)
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On LEAP, items involve selecting appropriate *units* of measure for a given situation. Selecting appropriate tools is not assessed. Students are expected to identify/select appropriate units for measuring length, area, mass (weight), time, speed, volume, and temperature, considering purpose of measurement and precision required.

Benchmark Assessed	
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M-4-M	using intuition and estimation skills to describe, order, and compare formal and informal measures (for example, ordering cup, pint, quart, gallon; comparing a meter to a yard)
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Assessment focuses on the relative magnitude of *units* of measure within and between the customary and metric systems, building on skills assessed in previous grades through test items of higher difficulty. Students may be required to compare or order *units* (or

measurements in stated units) and distinguish between them (for example, greatest/smallest).

Specifically, students may be required to:

- compare approximate relationships of units *across systems* (customary and metric) in terms of intuitive reference points, not formal computation (for example, a liter is a little more than a quart; a meter is a little longer than a yard)
- compare or order measurements *within the same system* (customary or metric), using any of the units cited below:

Linear: inches, feet, yards, miles, millimeters, centimeters, decimeters, meters, kilometers

Capacity: cups, liquid pints and quarts, gallons, milliliters, liters, kiloliters

Weight/Mass: ounces, pounds, tons, milligrams, grams, kilograms

Temperature: degrees on the Fahrenheit or Celsius scale

Benchmark Assessed	
M-5-M	converting from one unit of measurement to another within the same system

Note: Comparisons between systems, customary and metric, should be based on intuitive reference points, not formal computation.

Assessment at grade 8 extends to translating from square inches to square feet and from square feet to square yards. Test items present a practical context and require students to express a given measurement in different units of the *same* system.

Benchmark Assessed	
M-6-M	demonstrating the connection of measurement to the other strands and to real-life situations

This benchmark will not be directly assessed in the multiple-choice sessions of the test but is eligible for assessment in the constructed-response session of the test.

Strand G: Geometry

By grade 8, the relationships among the concepts of point, line, plane, angle, two-dimensional figure, and solid figure become an important focus in addition to the attributes and properties of two- and three-dimensional figures. Graphing ordered pairs, graphing lines from sets of ordered pairs, and transforming simple geometric designs on the coordinate plane are also important competencies.

Figure skills cited for grade 4 (identify, name, describe by attributes, draw, compare, and contrast two-dimensional figures) are extended to include basic three-dimensional figures—cylinder, rectangular solid, cube, cone, pyramid, sphere—and their corresponding two-dimensional representations. Understanding of circles is expanded to include radius, diameter, and circumference and relationships among them.

Formulas required to solve Geometry problems are provided on the Mathematics Reference Sheet.

Note: Determining properties of circles is tested under Geometry benchmark G-5-M, while determining perimeter, area, and volume of other figures are tested under the Measurement strand.

Benchmark Assessed	
G-1-M	using estimation skills to describe, order, and compare geometric measures

Test items may require students to compare or order geometric measures, or to estimate a measurement without using a measurement tool. For example, students may be asked to estimate the approximate measurement of an angle or, given one measurement for an illustrated figure, to estimate the measurement of another element in the figure.

Benchmark Assessed	
G-2-M	identifying, describing, comparing, constructing, and classifying geometric figures and concepts

Specifically, students may be required to:

- know basic properties of common one, two, and three-dimensional figures and understand related terms (for example, center, diameter, radius, circumference, arc, sector, central angle, chord, and tangent of a circle; isosceles and equilateral triangle)
- relate polyhedra to their two-dimensional patterns (tetrahedra, pyramid, prism, cone, cylinder)

- identify figures (for example, trapezoid, octagon) as polygons, and understand language associated with polygons (that is, closed, sides, vertices, diagonals, interior angles, exterior angles, equilateral, equiangular, regular)
- demonstrate conceptual and practical understanding of symmetry, similarity, and congruence, and identify similar and congruent figures (for example, recognize reductions and expansions in similar figures in two and three dimensions)
- classify right, obtuse, and acute angles
- identify/classify, and/or draw segments, rays, and angles; straight, parallel, and perpendicular lines; intersecting lines, diagonals, diameters, radii, and altitudes
- identify or draw two-dimensional figures with given specifications
- understand the terms *distance* (between two points, two lines, or from a point to a line) and *midpoint*, *bisect* and *bisector* in regard to lines

Benchmark Assessed	
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G-3-M	making predictions regarding transformations of geometric figures (for example, make predictions regarding translations, reflections, and rotations of common figures)
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Specifically, students may be required to:

- predict the results of and perform transformations (translations, reflections, rotations) in problems set in a real-world context (that is, make predictions regarding slides, flips, and turns of common figures)
- understand and apply the concept of reflections in relation to symmetry in both two and three dimensions

Benchmark Assessed	
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G-5-M	making and testing conjectures about geometric shapes and their properties
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Test items require students to apply an understanding of geometric properties and the relationships among those properties.

Specifically, students may be required to:

- construct or use scale drawings
- apply concepts, properties and relationships of points, lines and line segments, rays, planes, diagonals; right, acute, obtuse, supplementary, complementary, corresponding, vertical, and alternate interior angles; cube and rectangular prism (for example, use angle relationships in solving problems)
- apply concepts, properties and relationships of two-dimensional figures (for example, equilateral/isosceles triangle, square, rectangle, parallelogram, rhombus, trapezoid,

pentagon, hexagon, octagon, regular/irregular polygon) and three-dimensional figures (for example, cube, cylinder, cone, pyramid, sphere, and rectangular prism)

- understand the relationship between perimeter and area (of a rectangle, square, parallelogram, rhombus, or triangle) and between circumference and area of a circle (for example, How will changes in dimensions affect perimeter and area?)
- understand and use the Pythagorean Theorem, including recognizing situations in which the theorem is relevant (with pictorial illustration)
- recognize that π is the relationship between circumference and diameter of any circle
- determine the area, circumference, diameter and radius of a circle; apply these measures in practical contexts

Benchmark Assessed	
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G-6-M	demonstrating an understanding of the coordinate system (for example, locate points, identify coordinates, and graph points in a coordinate plane to represent real-world situations)
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Specifically, students may be required to:

- locate point(s) on a coordinate plane given its coordinates
- identify the coordinates of a point on a coordinate graph
- graph on the coordinate plane to represent real-world problems, including graphing ordered pairs in all four quadrants

Note: Graphing linear equations and inequalities will be assessed under Algebra.

Benchmark Assessed	
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G-7-M	demonstrating the connection of geometry to the other strands and to real-life situations (for example, applications of the Pythagorean Theorem)
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This benchmark will not be directly assessed in the multiple-choice sessions of the test but is eligible for assessment in the constructed-response session of the test.

Benchmark Not Directly Assessed:

The following benchmark is *not* directly assessed on LEAP.

G-4-M constructing two- and three-dimensional models

Strand D: Data Analysis, Probability, and Discrete Math

Students should be able to read, interpret, and summarize the information in bar, line, and circle graphs and extrapolate from obvious trends revealed by these graphs in order to make predictions. Analyses may include use of fractions and percents. Students should also be able to construct, label, and scale bar and line graphs and plot data sets on them.

Benchmark Assessed	
D-1-M	systematically collecting, organizing, describing, and displaying data in charts, tables, plots, graphs, and/or spreadsheets

Collecting data is not assessed on LEAP. At the classroom level, assessment of this benchmark could include collecting data through such methods as surveys, experiments, and simulations.

Specifically, students may be required to:

- organize and display data using frequency distributions, charts and tables, bar graphs, line graphs, and circle graphs
- organize and display data using scatter plots, stem-and-leaf plots, box-and-whisker plots, Venn diagrams, and/or spreadsheets
- match a data set or graph to a described situation, and vice versa

Benchmark Assessed	
D-2-M	analyzing, interpreting, evaluating, drawing inferences, and making estimations, predictions, decisions, and convincing arguments based on organized data (for example, analyze data using concepts of mean, median, mode, range, random samples, sample size, bias, and data extremes)

Specifically, students may be required to:

- analyze/describe by calculating or using the concepts of mean, median, mode, and range in analyzing data and solving problems
- obtain, interpret, and use information from a variety of graphs, charts and tables (for example, pictograph; bar, line, or circle graph; stem-and-leaf plot or scatter plot)
- understand the effects of extreme values in a data set
- demonstrate an understanding of precision, accuracy, and significant digits
- analyze data considering random sampling, sample size, bias, and data extremes
- analyze discrete and continuous data including the interpretations of the corresponding graphs
- analyze given data using statistical tools, looking for patterns in the data and making conjectures based on the patterns

Benchmark Assessed	
D-3-M	describing informal thinking procedures (for example, solving elementary logic problems using Venn diagrams, tables, charts, and/or elementary logic operatives to solve logic problems in real-life situations; reach valid conclusions in elementary logic problems involving “and, or, not, if/then”)

Specifically, students may be required to:

- use Venn diagrams involving two or three overlapping categories to solve logic problems
- demonstrate informal treatment of elementary logic (*and, or, not, if/then*), with and without using Venn diagrams

Benchmark Assessed	
D-4-M	analyzing various counting and enumeration procedures with and without replacement (for example, find the total number of possible outcomes or possible choices in a given situation)

Specifically, students may be required to:

- understand the concept of a sample and sampling with/without replacement
- find the total number of possible outcomes or possible choices in a given situation
- use basic counting principles, informal and formal combination and permutation procedures, and other counting procedures/applications in a real-life context

Benchmark Assessed	
D-5-M	comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs)

Specifically, students may be required to:

- understand the meaning of *equally likely* and *equally probable*
- for concrete situations, represent probabilities as common fractions
- determine probability from data displayed in tables and graphs
- use experimental data presented in tables or graphs to make outcome predictions based on the probability of independent events; and explain predictions based on an understanding of the logic of probability

- illustrate or apply the concepts of complementary events, equally likely events (for example, fair games), mutually exclusive events, non–mutually exclusive events, independent, and dependent events
- calculate single-event and multiple-event probability, including occurrence of mutually exclusive and independent events, and of non–mutually exclusive and dependent events

Benchmark Assessed	
D-6-M	demonstrating the connection of data analysis, probability, and discrete math to other strands and to real-life situations

This benchmark will not be directly assessed in the multiple-choice sessions of the test but is eligible for assessment in the constructed-response session of the test.

Strand P: Patterns, Relations, and Functions

Students should be able to discern, formulate, describe, and extend number and shape patterns. They also should be able to apply pattern recognition to determining inputs or outputs from “function machines.”

Note: Representing number patterns as algebraic equations or graphs is assessed under the Algebra strand.

Benchmark Assessed	
P-1-M	describing, extending, analyzing, and creating a wide variety of numerical, geometrical, and statistical patterns (for example, skip counting of rational numbers, and simple exponential number patterns)

Specifically, students may be required to:

- find a specific missing element(s) in a numerical or geometrical sequence, pattern, or display
- analyze and continue numerical patterns (involving multiplicative or additive patterns, fractions and negative numbers, simple exponential number patterns, and patterns with prime numbers). *Note:* This skill is an extension of skip counting, assessed at previous grades.
- enumerate terms in numerical patterns/sequences
- analyze and continue sequences of shapes, designs, positions, and quantity of objects, with attention to patterning. *Note:* Transformations (translations, reflections, rotations) involving geometric shapes and measures is assessed under the Geometry strand.

Benchmark Assessed	
P-3-M	analyzing relationships to explain how a change in one quantity results in a change in another (for example, change in the dimensions of a rectangular solid affects the volume)

Specifically, students may be required to:

- illustrate patterns of changes in the lengths of the side(s) and corresponding areas of polygons. Illustrate patterns of changes in the lengths of the side(s) and corresponding volumes of rectangular solids
- given a function table, predict output from input
- match a pattern rule to a given input/output table
- interpret horizontal and vertical bar graphs to discover patterns in data. *Note:* Other uses of bar graphs are assessed under the Data Analysis, Probability, and Discrete Math strand.

Benchmark Assessed	
P-4-M	demonstrating the pervasive use of patterns, relations, and functions in other strands and in real-life situations

This benchmark will not be directly assessed in the multiple-choice sessions of the test but is eligible for assessment in the constructed-response session of the test.

Benchmark Not Directly Assessed

The following benchmark is *not* directly assessed on LEAP.

P-2-M describing and representing relationships using tables, rules, simple equations, and graphs

Sample Test Items: Grade 8 Mathematics

Sample Multiple-Choice Items

Questions 1 through 24 are sample multiple-choice items, arranged by standard and benchmark. The items test students' ability to solve math problems. Most items are provided in context and require students to use information from stories, graphs, or tables to solve a problem.

1. Danielle is inviting five girls to her birthday party. For lunch, she and her five friends will eat nine small pizzas. If everybody at the party eats the same amount, how much will each girl eat?
- A. $\frac{1}{2}$ pizza
 - B. $\frac{2}{3}$ pizza
 - C. $1\frac{1}{2}$ pizzas
 - D. $1\frac{2}{3}$ pizzas

Correct response: C

This item measures benchmark N-3-M: reading, writing, representing, and using rational numbers in a variety of forms (for example, integers, mixed numbers, and improper fractions).

2. Chris placed parentheses in the expression $4 \times 8 + 2$ and calculated the answer to be 40. Which of the following expressions shows where Chris placed the parentheses?
- A. $4 \times 8 + (2)$
 - B. $(4 \times 8) + 2$
 - C. $4 \times (8 + 2)$
 - D. $(4 \times 8 + 2)$

Correct response: C

This item measures benchmark N-4-M: demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply, and divide) and their relationships to each other.

3. Mei's bank balance was \$42.67. Her deposits and withdrawals since then can be represented as +\$50, -\$15, -\$21, +\$16.25, +\$25. What is her bank balance now?
- A. \$55.25
 - B. \$97.92
 - C. \$107.42
 - D. \$127.25

Correct response: B

This item measures benchmark N-5-M: applying an understanding of rational numbers and arithmetic operations to real-life situations.

4. The Moss family went out to dinner. The dinner for the family cost \$48.00 before the tip. They want to leave a 15% tip. Which of the following amounts represents the 15% tip left by the Moss family?
- A. \$0.72
 - B. \$7.20
 - C. \$14.80
 - D. \$15.00

Correct response: B

This item measures benchmark N-5-M: applying an understanding of rational numbers and arithmetic operations to real-life situations.

5. A restaurant has small tables (s) and large tables (l). Small tables seat four people each, and large tables seat eight people each. Which inequality shows the maximum number of people (p) that can be seated at the restaurant?
- A. $p \geq 8l + 4s$
 - B. $p \leq 8l + 4s$
 - C. $p > 8l + 4s$
 - D. $p < 8l + 4s$

Correct response: B

This item measures benchmark A-1-M: demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (for example, symbolically represent real-world problems as linear terms, equations, or inequalities).

6. At a football game, $\frac{4}{10}$ of the people watching the game are girls. If the rest of the 435 people watching the game are boys (b), which of the following equations could be used to determine the total number of boys watching the game?
- A. $b = \frac{4}{10} + 435$
- B. $b = \frac{6}{10} + 435$
- C. $b = 435 - \frac{4}{10} \times 435$
- D. $b = 435 - \frac{6}{10} \times 435$

Correct response: C

This item measures benchmark A-1-M: demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (for example, symbolically represent real-world problems as linear terms, equations, or inequalities).

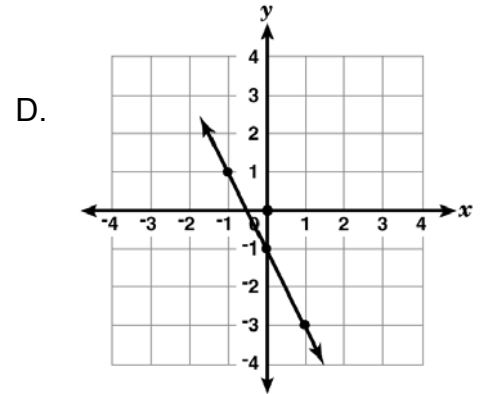
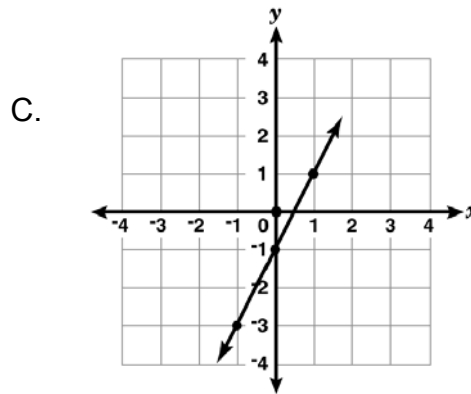
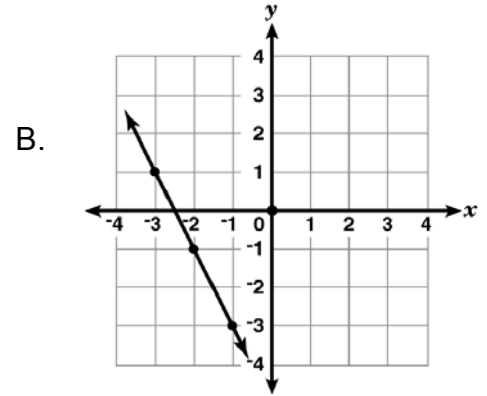
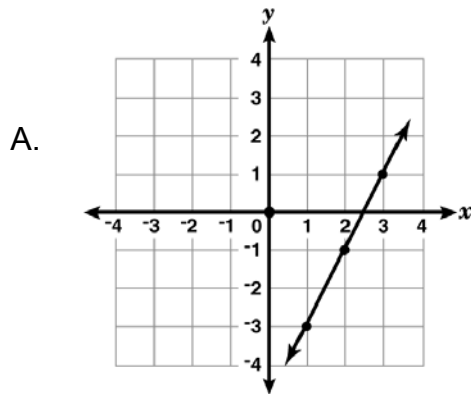
7. Sarah's car gets 27 miles per gallon and can travel a maximum of 408 miles without refueling. What is the maximum number of gallons of gas that the tank in Sarah's car can hold?
- A. 13 gallons
- B. 15 gallons
- C. 24 gallons
- D. 27 gallons

Correct response: B

This item measures benchmark A-2-M: modeling and developing methods for solving equations and inequalities (for example, using charts, graphs, manipulatives, and/or standard algebraic procedures).

8. Which of the following graphs represents this linear equation?

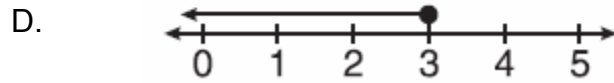
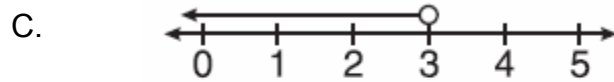
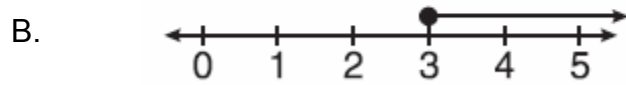
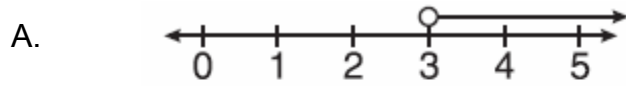
$$y = 2x - 5$$



Correct response: A

This item measures benchmark A-2-M: modeling and developing methods for solving equations and inequalities (for example, using charts, graphs, manipulatives, and/or standard algebraic procedures).

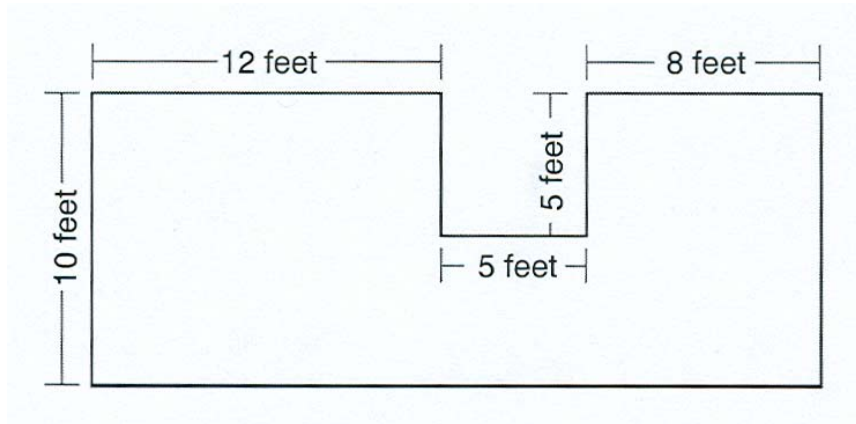
9. Which graph represents $x \geq 3$?



Correct response: B

This item measures benchmark A-2-M: modeling and developing methods for solving equations and inequalities (for example, using charts, graphs, manipulatives, and/or standard algebraic procedures).

10. Mary plans to put carpeting in her house. The floor plan shows the part of her house that will be carpeted. How many square feet of carpet does she need?



- A. 175 square feet
- B. 200 square feet
- C. 225 square feet
- D. 250 square feet

Correct response: C

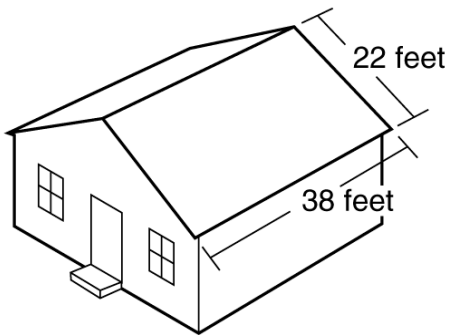
*This item measures benchmark **M-1-M**: applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences.*

11. Alex spends 40 minutes on his paper route every day. If he earns \$6 a day from his paper route, how much does he get paid per hour?
- A. \$6
 - B. \$8
 - C. \$9
 - D. \$10

Correct response: C

*This item measures benchmark **M-1-M**: applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences.*

12. The roof on a house is going to be shingled at a cost of \$125 for every 100 square feet. A diagram of the house is shown below.



What will the cost be for shingling the **entire** roof?

- A. \$836
- B. \$1,306
- C. \$1,672
- D. \$2,090

Correct Response: D

*This item measures benchmark **M-1-M**: applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences.*

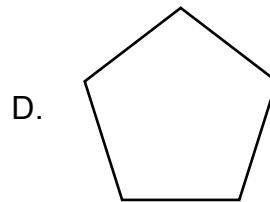
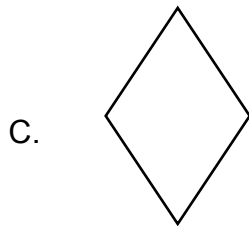
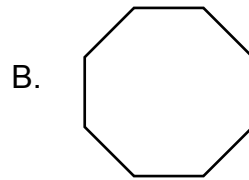
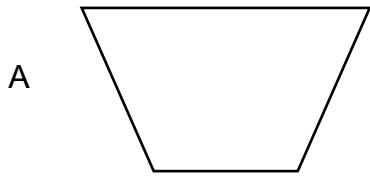
13. Gena's living room has an area of 36 square yards. What is the area of Gena's living room in **square feet**?

- A. 36
- B. 72
- C. 144
- D. 324

Correct response: D

*This item measures benchmark **M-5-M**: converting from one unit of measurement to another within the same system.*

14. Which figure has exactly one line of symmetry?



Correct response: A

This item measures benchmark G-2-M: identifying, describing, comparing, constructing, and classifying geometric figures and concepts.

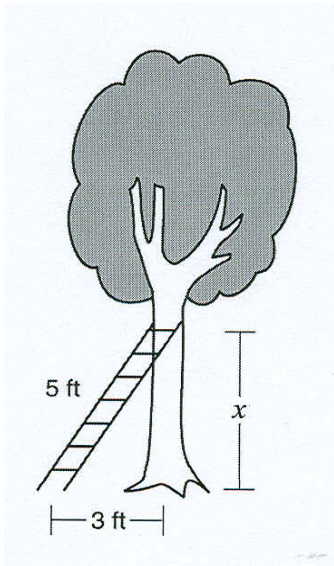
15. Which of the following questions **must** be answered in order to determine if a quadrilateral is a trapezoid?

- A. How many obtuse angles does the quadrilateral have?
- B. How many right angles does the quadrilateral have?
- C. How many congruent sides does the quadrilateral have?
- D. How many pairs of parallel sides does the quadrilateral have?

Correct response: D

This item measures benchmark G-2-M: identifying, describing, comparing, constructing, and classifying geometric figures and concepts.

16. Helen's cat, Kitty, is stuck in the tree. In order to rescue Kitty, Helen must lean a five foot ladder against the tree, as shown in the diagram below. The distance between the bottom of the tree and the ladder is three feet.



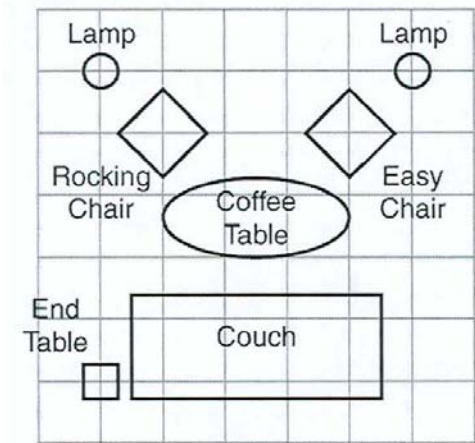
How high above the ground is the top of the ladder, represented by the variable x ?

- A. 3 feet
- B. 4 feet
- C. 5 feet
- D. 6 feet

Correct Response: B

This item measures benchmark G-5-M: making and testing conjectures about geometric shapes and their properties.

17. Derek is helping to arrange furniture in his family's new living room. He is using the coordinate plane shown below.



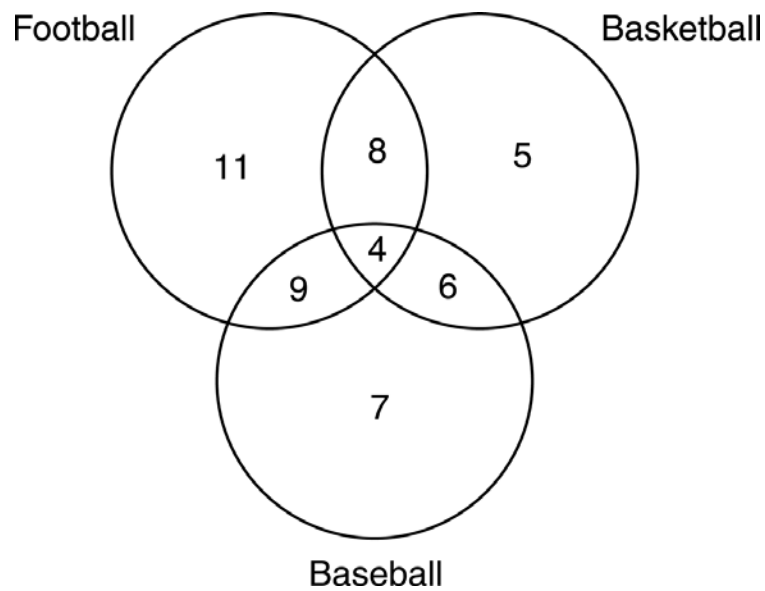
If the center of the end table is located at the coordinates $(0,0)$, what are the coordinates of the center of the easy chair?

- A. $(0,4)$
- B. $(4,0)$
- C. $(0,0)$
- D. $(4,4)$

Correct response: D

*This item measures benchmark **G-6-M**: demonstrating an understanding of the coordinate system (for example, locate points, identify coordinates, and graph points in a coordinate plane to represent real-world situations).*

18. The Venn diagram below shows how many boys play football, basketball, and baseball at Bayou Middle School.



How many boys play at least two sports?

- A. 4
- B. 23
- C. 27
- D. 50

Correct response: C

This item measures benchmark D-3-M: describing informal thinking procedures (for example, solving elementary logic problems using Venn diagrams, tables, charts, and/or elementary logic operatives to solve logic problems in real-life situations; reach valid conclusions in elementary logic problems involving “and, or, not, if/then”).

19. Mr. Color, the clown, has two favorite colored pairs of pants, three bright t-shirts, and two favorite pairs of boots. Beginning on Monday, Mr. Color wore a different outfit each day using only these clothes. If he wore the maximum number of different outfits, on what day of the week would he have to wear a repeat outfit for the first time?
- A. Monday
 - B. Tuesday
 - C. Friday
 - D. Saturday

Correct response: D

This item measures benchmark D-5-M: comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs).

20. Debbie keeps her marble collection in a jar. Of the 50 marbles in the jar, 15 are red, 10 are blue, 20 are green, and 5 are yellow. Debbie randomly chooses 30 marbles from the jar. How many of these marbles can she expect to be red?
- A. 3 marbles
 - B. 6 marbles
 - C. 9 marbles
 - D. 12 marbles

Correct response: C

This item measures benchmark D-5-M: comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs).

21. What is the probability that a student in Ms. Washington's class completed the test in 30 minutes?

Math Test Results—Ms. Washington's Class

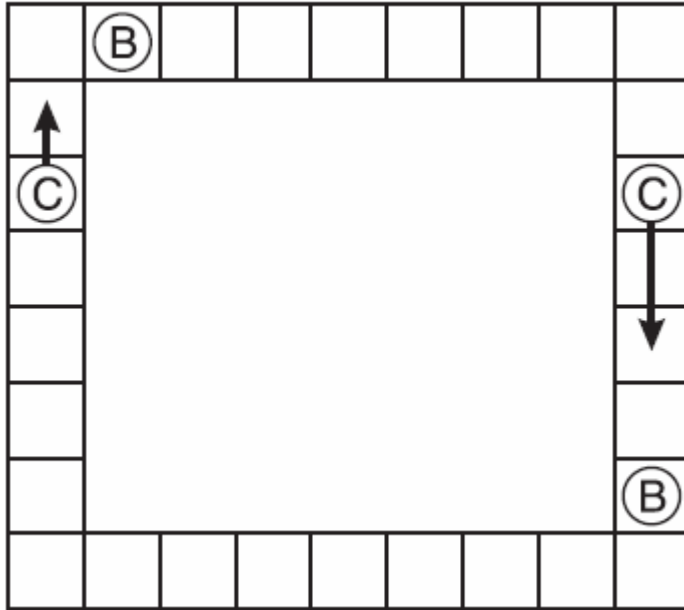
Time to Complete Test (in minutes)	Number of Students
38	7
36	3
34	1
32	6
30	10

- A. $\frac{1}{20}$
- B. $\frac{10}{17}$
- C. $\frac{10}{27}$
- D. $\frac{10}{30}$

Correct response: C

This item measures benchmark D-5-M: comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs).

22. Bruce and Calvin are playing the board game shown below.



It is Calvin's turn to roll a number cube labeled from 1 to 6. If one of Calvin's tokens (C) lands on a space already occupied by one of Bruce's tokens (B), Bruce's token is knocked off. Calvin has the choice of moving either of his tokens. What is the probability that Calvin will be able to knock off one of Bruce's tokens?

- A. $\frac{1}{36}$
- B. $\frac{1}{7}$
- C. $\frac{2}{12}$
- D. $\frac{1}{3}$

Correct response: D

This item measures benchmark D-5-M: comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs).

23. Look at this sequence of numbers.

1, 2, 4, 5, 10, 11, 22, 23, 46, . . .

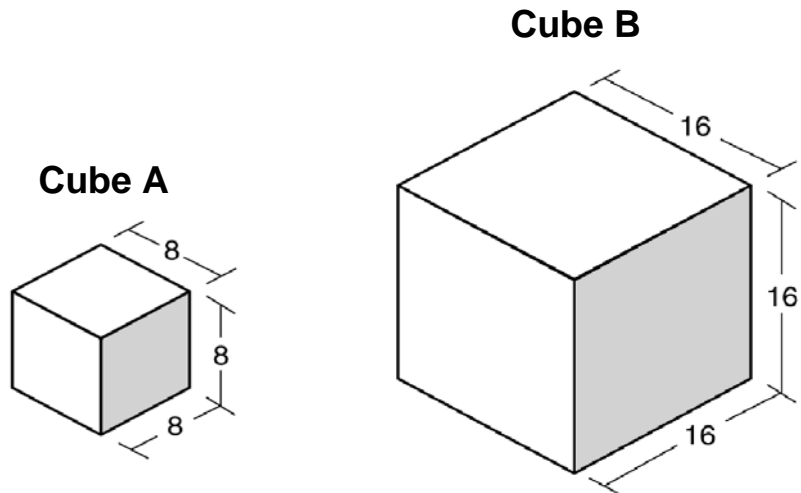
Which of the following could be the next three numbers?

- A. 47, 48, 49
- B. 47, 48, 96
- C. 47, 94, 95
- D. 92, 93, 94

Correct response: C

*This item measures benchmark **P-1-M**: describing, extending, analyzing, and creating a wide variety of numerical, geometrical, and statistical patterns (for example, skip counting of rational numbers, and simple exponential number patterns).*

Use the cubes below to answer question 24.



24. Which of the following correctly describes the volume of cube B compared to the volume of cube A?
- A. The volume of cube B is 2 times the volume of cube A.
 - B. The volume of cube B is 4 times the volume of cube A.
 - C. The volume of cube B is 6 times the volume of cube A.
 - D. The volume of cube B is 8 times the volume of cube A.

Correct response: D

This item measures benchmark P-3-M: analyzing relationships to explain how a change in one quantity results in a change in another (for example, change in the dimensions of a rectangular solid affects the volume).

Sample Constructed-Response Items

Questions 25 through 30 show sample constructed-response items. Each item involves a number of separate steps and the application of multiple skills. The constructed-response items are designed to assess one or more of the benchmarks/strands. The items are scored using an item-specific rubric on a scale of 0 to 4 points.

Use the advertisements below to answer question 25.

The image shows two store advertisements for CD players. Store A's sign is a rectangle with a double border, containing the text: "SALE SALE", "50% OFF ALL CD PLAYERS", and "SALE SALE". Store B's sign is a rectangle with a double border, containing the text: "SALE", "30% OFF ALL CD PLAYERS", and "SALE". To the right of Store B's sign is a speech bubble containing the text: "One-Day Special! Take an additional 20% off any sale price". An arrow points from the speech bubble to the "30% OFF ALL CD PLAYERS" text on Store B's sign.

25. Pictured above are signs advertising sales at two stereo equipment stores. The original price of a CD player is \$110 at both stores.
- A. What is the sale price of the CD player at Store A? Show your work.
 - B. What is the sale price of the CD player at Store B without the one-day special? Show your work.
 - C. Store B is having a one-day special—an additional 20% off any sale price. Will the final sale price of the CD player be the same at both stores? Explain your answer or show your work.

*The content standard for this item is **Number and Number Relations**. In problem-solving investigations, students demonstrate an understanding of the real number system and communicate the relationships within that system using a variety of techniques and tools.*

Scoring Rubric:

Score	Description
4	The student's response earns 6 points.
3	The student's response earns 5 points.
2	The student's response earns 3 or 4 points.
1	The student's response earns 1 or 2 points. OR The student's response demonstrates minimal understanding of calculating percent discount.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Points assigned:*Part A:*

- 2 points for correct answer (**\$55**) with correct work/explanation

OR

- 1 point for correct answer without correct work/explanation **OR** correct procedure (might contain a minor calculation or transcription error)

Part B:

- 2 points for correct answer (**\$77**) with correct work/explanation

OR

- 1 point for correct answer without correct work/explanation **OR** correct procedure (might contain a minor calculation or transcription error)

Part C:

- 2 points for correct answer [**No** or correct based on previous incorrect part(s)] with work/explanation

OR

- 1 point for correct procedure that contains a minor calculation error **OR** correct discounted price for Store B's one-day special (\$61.60); answer is not provided and/or work/explanation is incomplete or missing **OR** correct 20% discount for Store B's one-day special (\$15.40) with work/explanation **OR** demonstration of understanding that a 50% discount does not equal a 20% discount off already discounted price (70% of original price or 30% discount)

Scoring Notes:

- To receive a score of 4, there must be indication somewhere in the response of the appropriate units of measurement (\$). Otherwise, do not penalize the student.
- Do not award credit for correct answer based on incorrect strategy. However, award 1 point for answer if the intent of the strategy is correct but strategy is written incorrectly (for example, $30 \times 110 = 33$, 20% of 77 is 61.60).
- If student provides narrative explanation in part C, student must indicate that the 50% discount is a greater discount.

26. Leanne goes to college in Louisiana, and her family lives in New York. Last week, Leanne’s mother made four evening telephone calls to her. Listed below are the charges for the telephone calls.

Charges	Minutes
\$0.60	4
\$1.50	10
\$1.80	12
\$4.50	30

- A. Based on this information, what would the charge be for a 50-minute evening phone call?
- B. What is the maximum number of minutes a phone call could be made for less than \$5.00? Explain your reasoning.
- C. What would be the cost (c) of an n -minute phone call to Leanne from her mother? Write your answer in the form of an equation where c is the cost, and n is the number of minutes.

*The content standard for this item is **Algebra**. In problem-solving investigations, students demonstrate an understanding of concepts and processes that allows them to analyze, represent, and describe relationships among variable quantities and to apply algebraic methods to real-world situations.*

Scoring Rubric:

Score	Description
4	The student's response earns 4 points.
3	The student's response earns 3 points.
2	The student's response earns 2 points.
1	The student's response earns 1 point. OR The student's response demonstrates minimal understanding of the pattern of rates.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Correct responses:

Part A: $50 \times 0.15 = \$7.50$ (1 point)

Part B: $500/15 = 33.33$ minutes or 33 minutes would cost less than \$5.00 (1 point for correct answer and 1 point for explanation or work demonstrating the correct process)

Part C: $c = 0.15n$ or $c / .15 = n$; also acceptable $c = 15n$ or $c/15 = n$ (1 point)

27. Serena’s parents drove her to the Gulf Coast Beach.
- The trip from home to the beach took $2\frac{1}{2}$ hours at an average speed of 56 mph.
 - On the return trip, they drove at an average speed of 60 mph.
- A. How far is the beach from their home? Justify your answer.
- B. How long did it take them to drive home from the beach? Justify your answer.
- C. The following week they went back to the beach. Due to highway roadwork, they knew they would drive at an average speed of 45 mph. What time must they leave from home to arrive at the beach at 9:00 A.M.? Justify your answer.

*The content standard for this item is **Measurement**. In problem-solving investigations, students demonstrate an understanding of the concepts, processes, and real-life applications of measurement.*

Scoring Rubric:

Score	Description
4	The student’s response earns 6 points.
3	The student’s response earns 4 or 5 points.
2	The student’s response earns 3 points.
1	The student’s response earns 1 or 2 points. OR The student’s response demonstrates minimal understanding of the rate-distance-time relationship.
0	The student’s response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Correct responses:

Part A: $2\frac{1}{2}$ hours at 56 mph = 140 miles

Part B: 140 miles/60 mph = $2\frac{1}{3}$ hours or 2 hours, 20 minutes

Part C: 140 miles/45 mph = 3.11 hours or 3 hours and 7 minutes. They would need to leave at approximately 5:50 A.M.

Points assigned:

Part A (2 points):

- 2 points for correct answer with justification

OR

- 1 point for correct answer with no justification or for incorrect answer due to an arithmetic error with correct procedure shown

Part B (2 points):

- 2 points for correct answer with justification (may be based on an incorrect answer to part A)

OR

- 1 point for correct answer with no justification or for incorrect answer due to an arithmetic error with correct procedure shown (may be based on an incorrect answer to part A)

Part C (2 points):

- 2 points for correct answer with justification (may be based on an incorrect answer to part A)

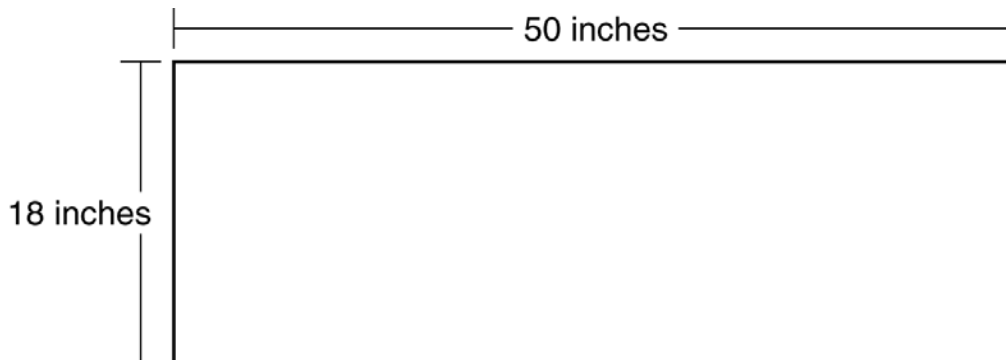
OR

- 1 point for correct answer with no justification or for incorrect answer due to an arithmetic error with correct procedure shown (may be based on an incorrect answer to part A)

Note: An answer of 5:49 A.M. (9 o'clock minus 3 hours and 11 minutes) for part C receives only 1 point.

28. Juanita works in a paint store. The store sells paint in 1-gallon and 1-quart cans. The 1-gallon cans have a diameter of $6\frac{1}{2}$ inches, and the 1-quart cans have a diameter of 4 inches.

A. Juanita is placing cans of paint on the shelves in rows and columns. The shelves are 18 inches wide and 50 inches long. How many 1-gallon cans of paint will fit on a shelf? Justify your answer.



B. How many 1-quart cans of paint will fit on a shelf? Justify your answer.

C. Juanita put as many 1-gallon cans of paint as possible on a shelf. Then she decided to put 1-quart cans in the remaining space. How many 1-quart cans of paint can fit in the remaining space? Justify your answer using words, symbols, or pictures.

*The content standard for this item is **Geometry**. In problem-solving investigations, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional geometry, and justify their findings.*

Scoring Rubric:

Score	Description
4	The student's response earns 6 points.
3	The student's response earns 4 or 5 points.
2	The student's response earns 3 points.
1	The student's response earns 1 or 2 points.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Points assigned:

Part A (2 points):

- 2 points for correct procedure and correct number of cans ($18 \div 6\frac{1}{2} \approx 2$, $50 \div 6\frac{1}{2} \approx 7$, $2 \times 7 = \mathbf{14}$ or **14 cans**)

OR

- 1 point for correct procedure for calculating number of cans with arithmetic error(s) **OR** for correct answer with incorrect, incomplete, or no procedure, **OR** for correct answer with incorrect units

Part B (2 points):

- 2 points for correct procedure and correct number of cans ($18 \div 4 \approx 4$, $50 \div 4 \approx 12$, $4 \times 12 = \mathbf{48}$ or **48 cans**)

OR

- 1 point for correct procedure for calculating number of cans with arithmetic error(s) **OR** for correct answer with incorrect, incomplete, or no procedure, **OR** for correct answer with incorrect units

Part C (2 points):

- 2 points for correct answer based on part A and correct procedure for calculating number of cans. The following example is based on a correct answer to part A. Two rows of 7 one-gallon cans fit on the shelf, which takes up a space of 45.5 inches by 13 inches; this leaves 5 inches in the front, which is room for 1 row of 12 one-quart cans, and 4.5 inches on a side, which is room for 1 column of one-quart cans; $18 \div 4 \approx 4$, $50 \div 4 \approx 12$; $12 + 4 = 16$ cans, but the can at the corner gets counted twice, so $16 - 1 = 15$ cans

OR

- 1 point for correct procedure for calculating number of cans with arithmetic error(s) **OR** for correct answer with incorrect, incomplete, or no procedure

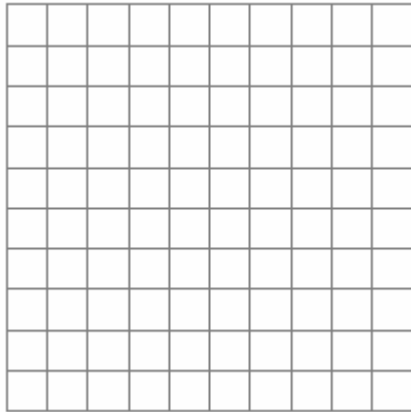
Write the answers to the question in the spaces below.

29. Barry the electrician charges \$50.00 for a service call and \$45.00 for every hour he spends on the job. Martin the electrician charges \$40.00 for a service call and \$50.00 for every hour he spends on the job.

A. How much will Martin charge for a 5-hour job?

Answer: \$ _____

B. Make a graph that shows how much each of the electricians will charge for calls of up to 8 hours. Make sure to label the axes and to give your graph a title.



C. Will Martin and Barry ever charge the same amount for a job? Explain your answer.

Answer: _____

Explanation: _____

*The content standard for this item is **Data Analysis, Probability, and Discrete Math**. In problem-solving investigations, students discover trends, formulate conjectures regarding cause-and-effect relationships, and demonstrate critical thinking skills in order to make informed decisions.*

Scoring Rubric:

Score	Description
4	The student's response earns 4 points.
3	The student's response earns 3 or 3½ points.
2	The student's response earns 2 or 2½ points.
1	The student's response earns ½ to 1½ points.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Points assigned:*Part A (1 point):*

- 1 point for the correct answer (\$290.00)

Part B (2 points):

- 2 points for graph drawn and all points plotted correctly, axes clearly labeled, appropriate scales used, and title

OR

- 1½ points for correct graph with a minor error in one of the following areas: axes not clearly labeled; scales chosen so that the relationship is not clear; points incorrectly plotted

OR

- 1 point for graph with minor errors in two of the following areas: axes not clearly labeled; scales chosen so the relationship is not clear; points incorrectly plotted

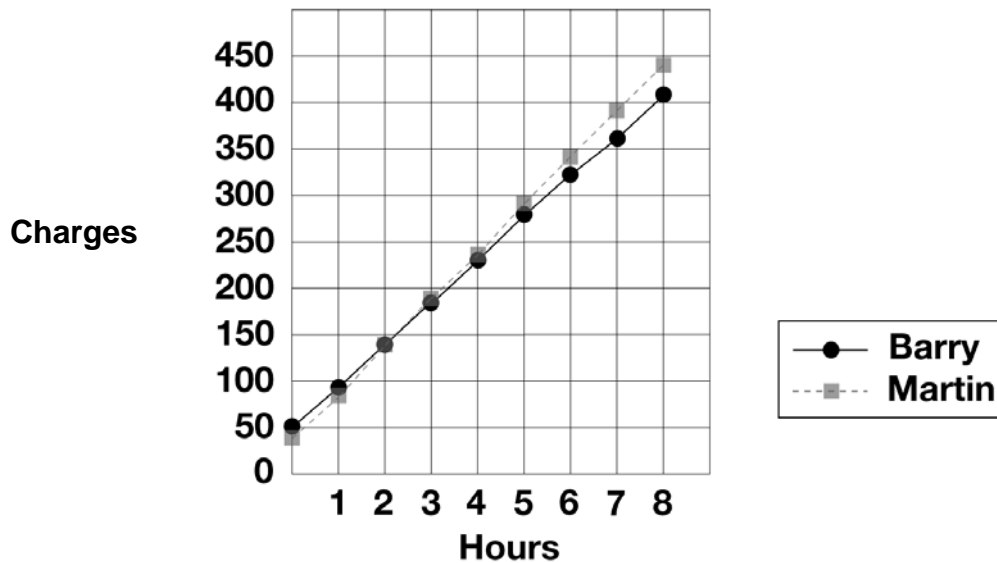
OR

- ½ point for graph with minor errors in three of the following areas: axes not clearly labeled; scales chosen so that the relationship is not clear; points incorrectly plotted

OR

- ½ point for graph with major errors in plotting points (more than half incorrect) where scale is correct

ELECTRICIAN SERVICE CALLS



Part C (1 point):

- 1 point for the correct answer (yes, Martin and Barry will both charge the same amount, \$140, for a two-hour job) and valid explanation (Barry charges a fee of \$50 plus \$90 for two hours, which equals \$140. Martin charges a \$40 fee plus \$100 for two hours, which also equals \$140) **OR** for correct explanation and incorrect answer resulting from use of an incorrect answer from part B

OR

- $\frac{1}{2}$ point for incorrect answer with valid explanation containing arithmetic error(s)

Use the figures below to answer question 30.



figure 1

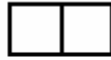


figure 2

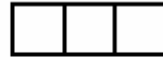


figure 3

30. The figures above are formed by placing squares side by side. Each side of the squares is 1 unit in length.

A. Complete the chart below.

Figure	Perimeter
1	4
2	6
3	
4	
5	

B. What is the perimeter of the figure with 100 squares? Explain your reasoning.

C. Write a mathematical sentence that shows how to calculate the perimeter of a figure with n squares.

*The content standard for this item is **Patterns, Relations, and Functions**. In problem-solving investigations, students demonstrate an understanding of patterns, relations, and functions that represent and explain real-world situations.*

Scoring Rubric:

Score	Description
4	The student's response earns 4 points.
3	The student's response earns 3 points.
2	The student's response earns 2 points.
1	The student's response earns 1 point. OR The student's response demonstrates minimal understanding of the pattern of perimeters.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, too brief to evaluate, or blank.

Correct responses:

Part A: 8, 10, 12 [1 point]

Part B: 202, 100 units on each of the top and bottom of the rectangle with an additional unit on each end [1 point for correct answer, 1 point for reasoning]

Part C: $P = 2n + 2$, $P = 4 + 2(n - 1)$; $P = 2(n + 1)$ [1 point]

Standards and Benchmark Statements, across Grades

Strand N: Number and Number Relations

Standard: In problem-solving investigations, students demonstrate an understanding of the real number system and communicate the relationships within that system using a variety of techniques and tools.

K–4	5–8	9–12
<p>N-1-E constructing number meaning and demonstrating that a number can be expressed in many different forms (for example, standard notation, number words, number lines, geometrical representation, fractions, and decimals)</p> <p>N-2-E demonstrating number sense and estimation skills, giving particular attention to common equivalent reference points (for example, $1/4 = 25\% = .25$; $1/2 = 50\% = .5$; $\\$1 = 100\%$, etc.)</p> <p>N-3-E reading, writing, representing, comparing, ordering, and using whole numbers in a variety of forms (for example, standard notation, number line, and geometrical representation)</p> <p>N-4-E demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply, and divide) and their relationships to each other</p> <p>N-5-E selecting appropriate operation(s) (add, subtract, multiply, and divide) for a given situation</p>	<p>N-1-M demonstrating that a rational number can be expressed in many forms, and selecting an appropriate form for a given situation (for example, fractions, decimals, and percents)</p> <p>N-2-M demonstrating number sense and estimation skills to describe, order, and compare rational numbers (for example, magnitude, integers, fractions, decimals, and percents)</p> <p>N-3-M reading, writing, representing, and using rational numbers in a variety of forms (for example, integers, mixed numbers, and improper fractions)</p> <p>N-4-M demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply, and divide) and their relationships to each other</p> <p>N-5-M applying an understanding of rational numbers and arithmetic operations to real-life situations</p>	<p>N-1-H demonstrating an understanding of the real number system</p> <p>N-2-H demonstrating that a number can be expressed in many forms, and selecting an appropriate form for a given situation (for example, fractions, decimals, percents, and scientific notation)</p> <p>N-3-H using number sense to estimate and determine if solutions are reasonable</p> <p>N-4-H determining whether an exact or approximate answer is necessary</p> <p>N-5-H selecting and using appropriate computational methods and tools for given situations (for example, estimation, or exact computation using mental arithmetic, calculator, symbolic manipulator, or paper and pencil)</p> <p>N-6-H applying ratios and proportional thinking in a variety of situations (for example, finding a missing term of a proportion)</p>

Strand N: Number and Number Relations (continued)

K–4	5–8	9–12
<p>N-6-E applying a knowledge of basic math facts and arithmetic operations to real-life situations</p> <p>N-7-E constructing, using, and explaining procedures to compute and estimate with whole numbers (for example, mental math strategies)</p> <p>N-8-E selecting and using appropriate computational methods and tools for given situations involving whole numbers (for example, estimation, mental arithmetic, calculator, or paper and pencil)</p> <p>N-9-E demonstrating the connection of number and number relations to the other strands and to real-life situations</p>	<p>N-6-M constructing, using, and explaining procedures to compute and estimate with rational numbers employing mental math strategies</p> <p>N-7-M selecting and using appropriate computational methods and tools for given situations involving rational numbers (for example, estimation, or exact computation using mental arithmetic, calculator, computer, or paper and pencil)</p> <p>N-8-M demonstrating a conceptual understanding and applications of proportional reasoning (for example, determining equivalent ratios, finding a missing term of a given proportion)</p>	<p>N-7-H justifying reasonableness of solutions and verifying results</p>

Strand A: Algebra

Standard: In problem-solving investigations, students demonstrate an understanding of concepts and processes that allows them to analyze, represent, and describe relationships among variable quantities and to apply algebraic methods to real-world situations.

K–4	5–8	9–12
<p>A-1-E demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (for example, use letters or boxes to represent values; understand =, ≠, <, and > symbols)</p> <p>A-2-E modeling and developing strategies for solving equations and inequalities</p> <p>A-3-E recognizing the connection of algebra to the other strands and to real-life situations (for example, number sentences or formulas to represent real-world problems)</p>	<p>A-1-M demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (for example, symbolically represent real-world problems as linear terms, equations, or inequalities)</p> <p>A-2-M modeling and developing methods for solving equations and inequalities (for example, using charts, graphs, manipulatives, and/or standard algebraic procedures)</p> <p>A-3-M representing situations and number patterns with tables, graphs, and verbal and written statements, while exploring the relationships among these representations (for example, multiple representations for the same situation)</p> <p>A-4-M analyzing tables and graphs to identify relationships exhibited by the data and making generalizations based upon these relationships</p> <p>A-5-M demonstrating the connection of algebra to the other strands and to real-life situations.</p>	<p>A-1-H demonstrating the ability to translate real-world situations (for example, distance-versus-time relationships, population growth, growth functions for diseases, growth of minimum wage, auto insurance tables) into algebraic expressions, equations, and inequalities and vice versa</p> <p>A-2-H recognizing the relationship between operations involving real numbers and operations involving algebraic expressions</p> <p>A-3-H using tables and graphs as tools to interpret algebraic expressions, equations, and inequalities</p> <p>A-4-H solving algebraic equations and inequalities using a variety of techniques with the appropriate tools (for example, handheld manipulatives, graphing calculator, symbolic manipulator, or pencil and paper)</p>

Strand M: Measurement

Standard: In problem-solving investigations, students demonstrate an understanding of the concepts, processes, and real-life applications of measurement.

K–4	5–8	9–12
<p>M-1-E applying (measure or solve measurement problem) the concepts of length (inches, feet, yards, miles, millimeters, centimeters, decimeters, meters, kilometers), area, volume, capacity (cups, liquid pints and quarts, gallons, milliliters, liters), weight (ounces, pounds, tons, grams, kilograms), mass, time (seconds, minutes, hours, days, weeks, months, years), money, and temperature (Celsius and Fahrenheit) to real-world experiences</p> <p>M-2-E selecting and using appropriate standard and non-standard units of measure (for example, paper clips and Cuisenaire rods) and tools for measuring length, area, capacity, weight/mass, and time for a given situation by considering the purpose and precision required for the task</p> <p>M-3-E using estimation skills to describe, order, and compare measures of length, capacity, weight/mass, time, and temperature</p>	<p>M-1-M applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences</p> <p>M-2-M demonstrating an intuitive sense of measurement (for example, estimating and determining reasonableness of measures)</p> <p>M-3-M selecting appropriate units and tools for tasks by considering the purpose for the measurement and the precision required for the task (for example, length of a room in feet rather than inches)</p> <p>M-4-M using intuition and estimation skills to describe, order, and compare formal and informal measures (for example, ordering cup, pint, quart, gallon; comparing a meter to a yard)</p> <p>M-5-M converting from one unit of measurement to another within the same system</p> <p>M-6-M demonstrating the connection of measurement to the other strands and to real-life situations</p>	<p>M-1-H selecting and using appropriate units, techniques, and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements</p> <p>M-2-H demonstrating an intuitive sense of measurement (for example, estimating and determining reasonableness of results as related to area, volume, mass, rate, and distance)</p> <p>M-3-H estimating, computing, and applying physical measurement using suitable units (for example, calculate perimeter and area of plane figures, surface area and volume of solids presented in real-world situations)</p> <p>M-4-H demonstrating the concept of measurement as it applies to real-world experiences</p>

Strand M: Measurement (continued)

K-4	5-8	9-12
<p>M-4-E converting from one unit of measurement to another within the same system (customary and metric); comparisons between systems should be based on intuitive reference points, not formal computations (for example, a meter is a little longer than a yard)</p> <p>M-5-E demonstrating the connection of measurement to the other strands and to real-life situations</p>		

Strand G: Geometry

Standard: In problem-solving investigations, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional geometry, and justify their findings.

K–4	5–8	9–12
<p>G-1-E determining the relationships among shapes</p> <p>G-2-E identifying, describing, comparing, constructing, and classifying two-dimensional and three-dimensional geometric shapes using a variety of materials</p> <p>G-3-E making predictions regarding combinations, subdivisions, and transformations (slides, flips, turns) of simple plane geometric shapes</p> <p>G-4-E drawing, constructing models, and comparing geometric shapes with special attention to developing spatial sense</p> <p>G-5-E identifying and drawing lines and angles and describing their relationships to each other and to the real world</p> <p>G-6-E demonstrating the connection of geometry to the other strands and to real-life situations</p>	<p>G-1-M using estimation skills to describe, order, and compare geometric measures</p> <p>G-2-M identifying, describing, comparing, constructing, and classifying geometric figures and concepts</p> <p>G-3-M making predictions regarding transformations of geometric figures (for example, make predictions regarding translations, reflections, and rotations of common figures)</p> <p>G-4-M constructing two- and three-dimensional models</p> <p>G-5-M making and testing conjectures about geometric shapes and their properties</p> <p>G-6-M demonstrating an understanding of the coordinate system (for example, locate points, identify coordinates, and graph points in a coordinate plane to represent real-world situations)</p>	<p>G-1-H identifying, describing, comparing, constructing, and classifying geometric figures in two and three dimensions using technology where appropriate to explore and make conjectures about geometric concepts and figures</p> <p>G-2-H representing and solving problems using geometric models and the properties of those models (for example, Pythagorean Theorem or formulas involving radius, diameter, and circumference)</p> <p>G-3-H solving problems using coordinate methods, as well as synthetic and transformational methods (for example, transform on a coordinate plane a design found in real-life situations)</p> <p>G-4-H using inductive reasoning to predict, discover, and apply geometric properties and relationships (for example, patty paper constructions, sum of the angles in a polygon)</p> <p>G-5-H classifying figures in terms of congruence and similarity and applying these relationships</p>

Strand G: Geometry (continued)

K-4	5-8	9-12
	G-7-M demonstrating the connection of geometry to the other strands and to real-life situations (for example, applications of the Pythagorean Theorem)	G-6-H demonstrating deductive reasoning and mathematical justification (for example, oral explanation, informal proof, and paragraph proof)

Strand D: Data Analysis, Probability, and Discrete Math

Standard: In problem-solving investigations, students discover trends, formulate conjectures regarding cause-and-effect relationships, and demonstrate critical thinking skills in order to make informed decisions.

K–4	5–8	9–12
<p>D-1-E collecting, organizing, and describing data based on real-life situations</p> <p>D-2-E constructing, reading, and interpreting data in charts, graphs, tables, etc.</p> <p>D-3-E formulating and solving problems that involve the use of data</p> <p>D-4-E exploring, formulating, and solving sequence-of-pattern problems involving selection and arrangement of objects/numerals</p> <p>D-5-E predicting outcomes based on probability (for example, make predictions of same chance, more likely, or less likely; determine fair and unfair games)</p> <p>D-6-E demonstrating the connection of data analysis, probability, and discrete math to other strands and real-life situations</p>	<p>D-1-M systematically collecting, organizing, describing, and displaying data in charts, tables, plots, graphs, and/or spreadsheets</p> <p>D-2-M analyzing, interpreting, evaluating, drawing inferences, and making estimations, predictions, decisions, and convincing arguments based on organized data (for example, analyze data using concepts of mean, median, mode, range, random samples, sample size, bias, and data extremes)</p> <p>D-3-M describing informal thinking procedures (for example, solving elementary logic problems using Venn diagrams, tables, charts, and/or elementary logic operatives to solve logic problems in real-life situations; reach valid conclusions in elementary logic problems involving “and, or, not, if/then”)</p> <p>D-4-M analyzing various counting and enumeration procedures with and without replacement (for example, find the total number of possible outcomes or possible choices in a given situation)</p>	<p>D-1-H designing and conducting statistical experiments that involve the collection, representation, and analysis of data in various forms</p> <p>D-2-H recognizing data that relate two variables as linear, exponential, or otherwise in nature (for example, match a data set, linear or non-linear, to a graph and vice versa)</p> <p>D-3-H using simulations to estimate probabilities (for example, lists and tree diagrams)</p> <p>D-4-H demonstrating an understanding of the calculation of finite probabilities using permutations, combinations, sample spaces, and geometric figures</p> <p>D-5-H recognizing events as dependent or independent in nature and demonstrating techniques for computing multiple-event probabilities</p> <p>D-6-H recognizing and answering questions about data that are normally or non-normally distributed</p>

Strand D: Data Analysis, Probability, and Discrete Math (continued)

K–4	5–8	9–12
	<p>D-5-M comparing experimental probability results with theoretical probability (for example, representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs)</p> <p>D-6-M demonstrating the connection of data analysis, probability, and discrete math to other strands and to real-life situations</p>	<p>D-7-H making inferences from data that are organized in charts, tables, and graphs (for example, pictograph; bar, line, or circle graph; stem-and-leaf plot or scatter plot)</p> <p>D-8-H using logical thinking procedures, such as flow charts, Venn diagrams, and truth tables</p> <p>D-9-H using discrete math to model real-life situations (for example, fair games or elections, map coloring)</p>

Strand P: Patterns, Relations, and Functions

Standard: In problem-solving investigations, students demonstrate an understanding of patterns, relations, and functions that represent and explain real-world situations.

K–4	5–8	9–12
<p>P-1-E recognizing, describing, extending, and creating a wide variety of numerical (for example, skip counting of whole numbers), geometrical, and statistical patterns</p> <p>P-2-E representing and describing mathematical relationships using tables, variables, open sentences, and graphs</p> <p>P-3-E recognizing the use of patterns, relations, and functions in other strands and in real-life situations</p>	<p>P-1-M describing, extending, analyzing, and creating a wide variety of numerical, geometrical, and statistical patterns (for example, skip counting of rational numbers, and simple exponential number patterns)</p> <p>P-2-M describing and representing relationships using tables, rules, simple equations, and graphs</p> <p>P-3-M analyzing relationships to explain how a change in one quantity results in a change in another (for example, change in the dimensions of a rectangular solid affects the volume)</p> <p>P-4-M demonstrating the pervasive use of patterns, relations, and functions in other strands and in real-life situations</p>	<p>P-1-H modeling the concepts of variables, functions, and relations as they occur in the real world, and using the appropriate notation and terminology</p> <p>P-2-H translating between tabular, symbolic, or graphic representations of functions</p> <p>P-3-H recognizing behavior of families of elementary functions, such as polynomial, trigonometric, and exponential functions, and, where appropriate, using graphing technologies to represent them</p> <p>P-4-H analyzing the effects of changes in parameters (for example, coefficients and constants) on the graphs of functions, using technology whenever possible</p> <p>P-5-H analyzing real-world relationships that can be modeled by elementary functions</p>

Louisiana Educational Assessment Program Mathematics Achievement Level Descriptors: Grade 8

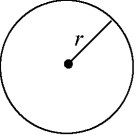
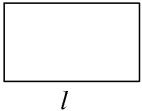
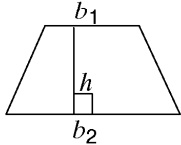
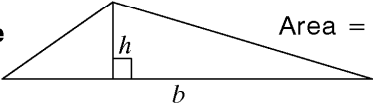
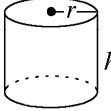
Note: These descriptors have been modified slightly from the 1999 publication to match the condensed descriptors on the updated 2006 Individual Student Reports.

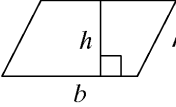
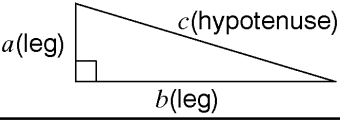
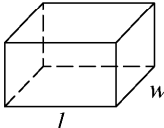
Achievement Level	Descriptors
Advanced	<p>Students scoring at this level generally exhibit the ability to</p> <ul style="list-style-type: none"> • probe examples and counterexamples in order to shape generalizations from which they can develop models; • use number sense and geometric awareness to consider the reasonableness of an answer; • use abstract thinking to create unique and/or alternative problem-solving techniques; and • explain the reasoning processes underlying their conclusions.
Mastery	<p>Students scoring at this level generally exhibit the ability to</p> <ul style="list-style-type: none"> • logically create and defend their ideas, as well as give supporting examples; • understand the connections between fractions, percents, decimals, and other mathematical topics such as algebra and functions; • thoroughly understand basic-level arithmetic operations in order to problem solve in practical situations; • use quantity and spatial relationships in problem solving and reasoning; • convey underlying reasoning skills beyond the level of arithmetic; • compare and contrast mathematical ideas and generate their own examples; • apply properties of informal geometry; • accurately use the tools of technology; and • understand the process of gathering and organizing data and be able to make inferences, calculate, evaluate, and communicate results within the domain of statistics and probability.
Basic	<p>Students scoring at this level generally exhibit the ability to</p> <ul style="list-style-type: none"> • complete problems correctly with the help of prompts such as diagrams, charts, and graphs; • solve routine, real-world problems through the appropriate selection and use of strategies and technological tools—including calculators and geometric shapes; • use fundamental algebraic and informal geometric concepts in problem solving; • determine which available data are necessary and sufficient for correct solutions and use them in problem solving; and • show limited skill in communicating mathematically.

Mathematics Achievement Level Descriptors: Grade 8 (continued)

Approaching Basic	<p>Students scoring at this level generally exhibit the ability to</p> <ul style="list-style-type: none">• complete problems correctly with the help of prompts such as diagrams, charts, and graphs;• solve one-step problems involving basic computation (+, −, ×, ÷) and follow procedural steps with instructional assistance;• recognize basic geometric figures;• recognize simple, obvious patterns;• use the tools of technology;• apply conceptual knowledge inconsistently; and• demonstrate difficulty in transferring knowledge and skills to problem-solving situations.
Unsatisfactory	<p>Students scoring at this level have not demonstrated the fundamental knowledge and skills needed for the next level of schooling. Students at this level generally have <i>not</i> exhibited the ability to</p> <ul style="list-style-type: none">• complete problems correctly with the help of prompts such as diagrams, charts, and graphs;• solve one-step problems involving basic computation (+, −, ×, ÷) and follow procedural steps with instructional assistance;• recognize basic geometric figures;• recognize simple, obvious patterns;• use the tools of technology;• apply conceptual knowledge on a limited basis; or• transfer knowledge and skills to problem-solving situations.

Use the information below to answer questions on the Mathematics test.

Circle  <p> $\pi \approx 3.14$ Area = $\pi \cdot r^2$ Circumference = $2\pi \cdot r$ </p>
Rectangle  <p> Area = $l \cdot w$ Perimeter = $2(l + w)$ </p>
Trapezoid  <p> Area = $\frac{1}{2} h(b_1 + b_2)$ </p>
Triangle  <p> Area = $\frac{1}{2} b \cdot h$ </p>
Cylinder  <p> Volume = $\pi \cdot r^2 \cdot h$ Surface Area = $2\pi \cdot r^2 + 2\pi \cdot r \cdot h$ </p>

Parallelogram  <p> Area = $b \cdot h$ </p>
Pythagorean Theorem: $a^2 + b^2 = c^2$ 
Rectangular Solid  <p> Volume = $l \cdot w \cdot h$ Surface Area = $2wl + 2lh + 2wh$ </p>

Metric Units of Length

- 1 kilometer = 1,000 meters
- 1 centimeter = 0.01 meter
- 1 millimeter = 0.001 meter

U.S. Unit Conversions

- 8 fluid ounces = 1 cup
- 2 cups = 1 pint
- 2 pints = 1 quart
- 4 quarts = 1 gallon
- 16 ounces = 1 pound
- 5,280 feet = 1 mile

Distance Formula: distance = rate • time

- Mean:** In a collection of data, the sum of all the data divided by the number of data
- Median:** The middle number or average of the two middle numbers in a collection of data when the data are arranged in order
- Mode:** The number or numbers that occur most often in a collection of data
- Range:** The difference between the greatest and the least numbers in a collection of data

Note: The Mathematics Reference Sheet has been reduced in size for this document. A version suitable for printing can be found on the Louisiana Department of Education Web site