MCAP Maryland Comprehensive Assessment Program

Geometry

Performance Level Descriptors

Maryland State Department of Education

August 2021

MARYLAND STATE DEPARTMENT OF EDUCATION
EQUITY AND EXCELLENCE

MCAP Geometry Performance Level Descriptors

Domain: Congruence (G.CO)

Cluster A: Experiment with transformations in the plane

Evidence Statements:

- **G-CO.A.1:** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
- **G-CO.A.2:** Identify transformations that preserve distance and angle measure to those that do not (e.g. translation versus horizontal stretch).
- **G-CO.A.3:** Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
- **G-CO.A.5:** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
	use precise definitions of geometric terms.	identify a geometric term given a precise definition.	identify the precise definition of a given geometric term.
apply knowledge of rigid transformations to solve problems.	draw or identify a transformed figure given a mapping statement or determine the sequence of rigid transformations needed to carry a figure onto itself or another figure.	draw or identify a transformed figure given a single rigid transformation or determine a single rigid transformation needed to carry a figure onto itself or another figure.	identify a rigid transformation that was applied to a figure to map it onto another figure.
identify when a sequence of transformations preserves congruence.	identify when a single transformation preserves congruence.		

MCAP Geometry Performance Level Descriptors

Domain: Congruence (G.CO)

Cluster B: Understand congruence in terms of rigid motions

Evidence Statements:

- **G-CO.B.6:** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **G-CO.B.7:** Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
- **G-CO.B.8:** Explain how the criteria for triangle congruence (ASA, SAS, SSS, AAS and HL) follow from the definition of congruence in terms of rigid motions.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
use the definition of congruence to explain or prove relationships among geometric figures.	describe the effect of a sequence of rigid transformations on a given figure or use the definition of congruence to determine relationships among geometric figures. describe how the criteria for triangle congruence follows from the definition of congruence in terms of rigid motion.	describe the effect of a rigid transformation on a given figure. identify the corresponding parts of congruent triangles under a transformation.	identify transformations that preserve lengths and angle measures. identify the criteria for triangle congruence that proves two given triangles are congruent.

MCAP Geometry Performance Level Descriptors

Domain: Congruence (G.CO)

Cluster C: Prove geometric theorems

Evidence Statements:

- **G-CO.C.9:** Prove and/or apply theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
- **G-CO.C.10:** Prove and/or apply theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
- **G-CO.C.11:** Prove and/or apply theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
prove and/or apply line, angle, triangle and parallelogram theorems.	prove line, angle, triangle and parallelogram theorems with supports or apply these theorems to solve a problem.	identify a missing statement or reason to complete a proof involving lines, angles, triangles or parallelograms.	solve a one-step problem involving theorems about lines, angles, triangles, or parallelograms with all pertinent information explicitly given.

MCAP Geometry Performance Level Descriptors

Domain: Congruence (G.CO)

Cluster D: Make geometric constructions

Evidence Statements:

- **G-CO.D.12:** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
- **G-CO.D.13:** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
represent or produce a geometric construction to solve a problem. justify the steps or results of a geometric construction.	Produce or complete a geometric construction that requires three or more steps or describe a geometric construction given a set of steps or a marked up image.	Complete a geometric construction that requires one or two steps or identify a geometric construction given a set of steps or a marked up image.	identify the correct tools needed for a geometric construction.

MCAP Geometry Performance Level Descriptors

Domain: Similarity, Right Triangles and Trigonometry (G.SRT)

Cluster A and B: Understand similarity in terms of similarity transformations and prove theorems involving similarity

Evidence Statements:

- **G-SRT.A.1a**: A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
- **G-SRT.A.1b:** The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
- **G-SRT.A.2:** Given two figures, determine if they are similar and provide support for the determination.
- **G-SRT.A.3:** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
- **G-SRT.B.4:** Prove and/or apply theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity
- **G-SRT.B.5:** Use given information to determine if two triangles are similar or congruent and then find either a missing side or a missing angle.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
apply properties of dilations to justify conclusions. use congruence and similarity criteria for triangles to prove statements or generalize about triangles.	apply properties of dilations to solve problems. use congruence and similarity criteria for triangles to solve problems or prove statements with supports.	describe the effect of a dilation on a given figure and/or calculate relevant measures. identify the corresponding parts of similar triangles or determine the missing measure of a side or angle of given similar triangles.	recognize that dilation does not preserve congruence. identify if two triangles are similar or congruent based only on appearances.

MCAP Geometry Performance Level Descriptors

Domain: Similarity, Right Triangles and Trigonometry (G.SRT)

Cluster C: Define trigonometric ratios and solve problems involving right triangles

Evidence Statements:

- **G-SRT.C.6:** Use trigonometric ratios to find missing sides and angles of right triangles given other sides and angles.
- **G-SRT.C.7:** Use the relationship between the sine and cosine of complementary angles to solve problems.
- **G-SRT.C.8:** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
justify right triangle relationships or the relationship between the sine and cosine of complimentary angles to solve problems.	apply right triangle relationships to determine unknown angle measures and side lengths of a right triangle. apply the relationship between the sine and cosine of complimentary angles to solve problems.	apply right triangle relationships to determine unknown angle measures of a right triangle.	apply right triangle relationships to determine unknown side lengths of a right triangle.

MCAP Geometry Performance Level Descriptors

Domain: Circles (G.C) and Expressing Geometric Properties (G.GPE)

Cluster A and B: Understand and apply theorems about circles, find arc lengths and areas of sectors and circles and translate between the geometric description and the equation for a conic section

Cluster A: Translate between the geometric descriptions and the equation for a conic section

Evidence Statements:

- **G-C.A.2:** Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
- **G-C.A.3:** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
- **G-C.B.5:** Find arc length and areas of sectors
- **G-GPE.A.1:** Given the center-radius form of the equation of a circle, identify the coordinates of the center of the circle and the radius. Items could ask students to use the distance formula to find the radius of a circle.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
solve problems or prove statements by combining multiple attributes and relationships of circles.	solve problems by applying attributes and relationships of circles.	solve problems by applying attributes and relationships of circles, with all pertinent information explicitly given.	identify attributes and relationships of circles.

MCAP Geometry Performance Level Descriptors

Domain: Expressing Geometric Properties (G.GPE)

Cluster B: Use coordinates to prove simple geometric theorems algebraically

Evidence Statements:

- **G-GPE.B.4:** Use coordinates to prove simple geometric theorems algebraically.
- **G-GPE.B.5:** Use the relationships between the slopes for parallel and perpendicular lines to solve problems.
- **G-GPE.B.6:** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
- **G-GPE.B.7:** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
prove theorems or solve problems using unknown coordinates or by combining multiple relationships.	prove theorems or solve problems using coordinates.	solve problems involving parallel or perpendicular lines or the perimeter of polygons on a coordinate plane.	determine the slope of a line that is parallel or perpendicular to a given line, the distance between two points in the coordinate plane, or the coordinates of the midpoint of a line segment.

MCAP Geometry Performance Level Descriptors

Domain: Geometric Measurement and Dimension (G.GMD)

Cluster A and B: Explain volume formulas and use them to solve problems and visualize relationships between two-dimensional and three-dimensional objects

Evidence Statements:

- **G-GMD.A.1:** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
- **G-GMD.A.3:** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- **G-GMD.B.4-1:** Identify the shape of a two-dimensional cross-sections of three-dimensional objects.
- **G-GMD.B.4-2:** Identify the three-dimensional object generated by a rotation of a two-dimensional object.

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
compose an informal argument for circumference, area or volume formulas.	complete an informal argument for circumference, area, or volume formulas with supports.		
	solve real-world problems involving volume.	solve real-world problems involving volumes with all pertinent information explicitly provided.	solve real-world problems involving a single volume formula with all pertinent information explicitly provided.
	identify the two-dimensional cross-section of a three dimensional object or identify the three dimensional object generated by a rotation of a two-dimensional object.		

MCAP Geometry Performance Level Descriptors

Domain: Modeling with Geometry (G.MG)

Cluster A: Apply geometric concepts in modeling situations

Evidence Statements:

- **G-MG.A.1:** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- **G-MG.A.2:** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
- **G-MG.A.3:** Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Note: *'Modeling with Geometry' is a domain of the content standards but is not the same as the Modeling Subclaim, which can include every content standard in geometry.*

Level 4 *A student performing at this level should be able to:*	**Level 3** *A student performing at this level should be able to:*	**Level 2** *A student performing at this level should be able to:*	**Level 1** *A student performing at this level should be able to:*
apply geometric concepts in modeling situations to solve problems with multiple constraints and/or that require connecting multiple grade level concepts. calculate a missing measure in modeling situations involving density.	apply geometric concepts in modeling situations to solve problems. calculate density in modeling situations involving area and volume.	deconstruct a composite geometric figure and describe the measurements of the components of the figure in a modeling situation. calculate density in modeling situations given an area or volume.	identify a single geometric shape in a modeling situation and describe it's measurements. identify the correct units in modeling situations involving density.

MCAP Geometry Performance Level Descriptors

Reasoning Subclaim

All Reasoning Assessment Items connect to the content knowledge, skills, and abilities described in the Algebra I Content Evidence Statements.

Students must provide evidence of their ability to reason mathematically by responding to:

- one-point items that require the application of reasoning skills aligned to the Content PLDS.
- four-point items that require communicating their reasoning via a written response

Evidence Statements:

G.R.1: Identify a counterexample to refute a conjecture/claim.
G.R.2: Identify a correct method and justification given two or more chains of reasoning.
G.R.3: Determine cases where a given proposition is true or false.
G.R.4: Identify an unstated assumption that makes a problem well-posed or makes a particular method viable.
G.R.5: Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures.
G.R.6: Apply geometric reasoning in a coordinate setting, and/or use coordinates to draw geometric conclusions.
G.R.7: Present solutions to multi-step problems in the form of valid chains of reasoning or describe errors in solutions to multi-step problems and present corrected solutions.
G.R.8: Use a combination of algebraic and geometric reasoning to justify or refute propositions or conjectures about geometric figures.

Reasoning PLDs

The Reasoning PLDs describe a student's written response to a four-point reasoning item at each performance level.

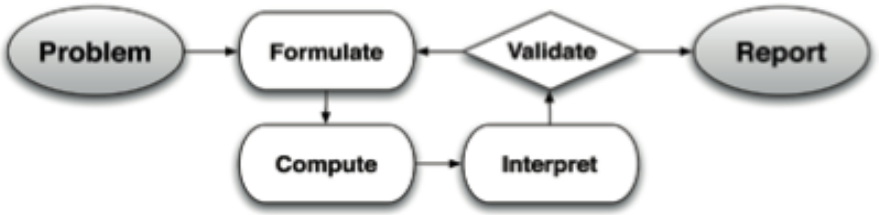
Level 4 *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 3** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 2** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*	**Level 1** *A student performing at this level should be able to provide evidence of mathematical reasoning by communicating:*
a sophisticated chain of reasoning.	a well-developed chain of reasoning.	a partially developed, valid chain of reasoning.	the beginning of a chain of reasoning.
a precise, logical solution pathway.	a logical solution pathway that may contain minor flaws.	a solution pathway that contains some correct processes yielding an incorrect solution.	an attempted solution pathway.
an extensive command of mathematical representations and vocabulary.	a proficient command of mathematical representations and vocabulary.	an understanding of some mathematical representations and vocabulary.	a developing understanding of some mathematical representations and vocabulary.

MCAP Geometry Performance Level Descriptors

Modeling Subclaim

All Modeling Assessment Items require a student to employ one or more steps of the modeling cycle when determining a response and are connected to the content knowledge, skills, and abilities described in the Algebra I Content Evidence Statements.

Students must provide evidence of their ability to use the modeling cycle by responding to one-point machine scored items and four-point items that require communicating a written response.



Modeling PLDs

Evidence Statements:

G.M.1: Choose an appropriate mathematical model to solve a real-world problem.
G.M.2: Construct a mathematical model to solve a real-world problem.
G.M.3: Validate a given model and/ or make improvements to a given model.
G.M.4: Interpret the solution to a real-world problem in terms of context.
G.M.5: Use and/or provide a reasonable estimate of a quantity needed to solve a problem.
G.M.6: Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in the standards.
G.M.7: Solve multi-step contextual word problems with degree of difficulty appropriate to the course, involving perimeter, area, or volume that require the use 8th grade algebra skills.
G.M.8: Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills involving right triangles in an applied setting.
G.M.9: Identify information or assumptions needed to solve a problem.

MCAP Geometry Performance Level Descriptors

Modeling PLDs

The Modeling PLDs describe a student's written response to a four-point modeling item at each performance level. For one-point modeling items, refer to the content PLD for the associated standard.

Level 4 *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 3** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 2** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*	**Level 1** *A student performing at this level should be able to provide evidence of the ability to use the modeling cycle by:*
determining the information or mathematics needed to solve a problem that requires connecting multiple grade-level concepts.	determining needed information or mathematics.	identifying needed information or mathematics.	identifying some needed information or mathematics.
communicating an accurate, organized solution path aligned to the problem using appropriate, effective, and precise representations.	communicating an accurate, organized solution path aligned to the problem using appropriate, effective, and precise representations that may contain minor flaws.	communicating a partial solution path that may contain mathematical errors.	communicating the beginning of a solution path, containing mathematical errors.
evaluating or validating a solution path or showing how to improve a model or correct a given solution.	evaluating or validating a solution path or showing how to improve a model, but work may include minor flaws.	partially validating a solution path or incorrectly improving the model.	attempting to validate a solution path.