**Common Core Learning Standards for Geometry**

Tuesday, December 18, 2018

Standards

Modeling (defined by a \* in the CCSS) is defined as both a conceptual category for high school mathematics and a mathematical practice and is an important avenue for motivating students to study mathematics, for building their understanding of mathematics, and for preparing them for future success.

All college and career ready standards (those without a +) are found in each pathway. A few (+) standards are included to increase coherence but are not necessarily expected to be addressed on high stakes assessments.

Geometry Overview

**Congruence (G-CO) 30% of points**

Experiment with transformations in the plane

Understand congruence in terms of rigid motions

Prove geometric theorems

Make geometric constructions

G.CO.A *Experiment with transformations in the plane* *6%* Q25 June 2016, Q4 June 2015

As of December 2018 5.6% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.CO.A.1](http://www.corestandards.org/Math/Content/HSG/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.

[CCSS.MATH.CONTENT.HSG.CO.A.2](http://www.corestandards.org/Math/Content/HSG/CO/A/2/)
Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

[CCSS.MATH.CONTENT.HSG.CO.A.3](http://www.corestandards.org/Math/Content/HSG/CO/A/3/)
Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

[CCSS.MATH.CONTENT.HSG.CO.A.4](http://www.corestandards.org/Math/Content/HSG/CO/A/4/)
Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

[CCSS.MATH.CONTENT.HSG.CO.A.5](http://www.corestandards.org/Math/Content/HSG/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.

G.CO.B *Understand congruence in terms of rigid motions* *6.5%* Q30 Aug 2015, Q28 Jan 2016

As of December 2018 6.5% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.CO.B.6](http://www.corestandards.org/Math/Content/HSG/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.

[CCSS.MATH.CONTENT.HSG.CO.B.7](http://www.corestandards.org/Math/Content/HSG/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.

[CCSS.MATH.CONTENT.HSG.CO.B.8](http://www.corestandards.org/Math/Content/HSG/CO/B/8/)
Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

G.CO.C *Prove geometric theorems* *15.3%* Q35 Aug 2015, Q35 June 2016

As of December 2018 15.3% of total available points involved this cluster

Note: 3 of the 4 Regents exams have a 6 point question from this cluster.

 [CCSS.MATH.CONTENT.HSG.CO.C.9](http://www.corestandards.org/Math/Content/HSG/CO/C/9/)
Prove 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*.

[CCSS.MATH.CONTENT.HSG.CO.C.10](http://www.corestandards.org/Math/Content/HSG/CO/C/10/)
Prove 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*.

[CCSS.MATH.CONTENT.HSG.CO.C.11](http://www.corestandards.org/Math/Content/HSG/CO/C/11/)
Prove 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*.

G.CO.D *Make Geometric Constructions 3.0%* Q34 Jan 2016

As of December 2018 3.0% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.CO.D.12](http://www.corestandards.org/Math/Content/HSG/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*.

[CCSS.MATH.CONTENT.HSG.CO.D.13](http://www.corestandards.org/Math/Content/HSG/CO/D/13/)
Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

**Similarity, Right Triangles, and Trigonometry (G-SRT) 31% of points**

Understand similarity in terms of similarity transformations

Prove theorems involving similarity

Define trigonometric ratios and solve problems involving right triangles

G.SRT.A *Understand similarity in terms of similarity transformations 8.4%* Q34 June 2016, Q29 Aug 2015

As of December 2018 8.4% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.SRT.A.1](http://www.corestandards.org/Math/Content/HSG/SRT/A/1/)
Verify experimentally the properties of dilations given by a center and a scale factor:

[CCSS.MATH.CONTENT.HSG.SRT.A.1.A](http://www.corestandards.org/Math/Content/HSG/SRT/A/1/a/)
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.

[CCSS.MATH.CONTENT.HSG.SRT.A.1.B](http://www.corestandards.org/Math/Content/HSG/SRT/A/1/b/)
The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

[CCSS.MATH.CONTENT.HSG.SRT.A.2](http://www.corestandards.org/Math/Content/HSG/SRT/A/2/)
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

[CCSS.MATH.CONTENT.HSG.SRT.A.3](http://www.corestandards.org/Math/Content/HSG/SRT/A/3/)
Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

G.SRT.B *Prove theorems involving similarity 10.6%* Q33 June 2016, Q31 June 2015.

As of December 2018 10.6% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.SRT.B.4](http://www.corestandards.org/Math/Content/HSG/SRT/B/4/)
Prove 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.*

*[CCSS.MATH.CONTENT.HSG.SRT.B.5](http://www.corestandards.org/Math/Content/HSG/SRT/B/5/)*Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

G.SRT.C *Define trigonometric ratios and solve problems involving right triangles 12.3*% Q34 June 2015, Q32 Aug 2015

As of December 2018 12.3% of total available points involved this cluster

CCSS.MATH.CONTENT.HSG.SRT.C.6
Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

[CCSS.MATH.CONTENT.HSG.SRT.C.7](http://www.corestandards.org/Math/Content/HSG/SRT/C/7/)
Explain and use the relationship between the sine and cosine of complementary angles.

[CCSS.MATH.CONTENT.HSG.SRT.C.8](http://www.corestandards.org/Math/Content/HSG/SRT/C/8/)
Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.\*

G.SRT.D *Apply trigonometry to general triangles*

[CCSS.MATH.CONTENT.HSG.SRT.D.9](http://www.corestandards.org/Math/Content/HSG/SRT/D/9/)
(+) Derive the formula *A* = 1/2 *ab* sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

[CCSS.MATH.CONTENT.HSG.SRT.D.10](http://www.corestandards.org/Math/Content/HSG/SRT/D/10/)
(+) Prove the Laws of Sines and Cosines and use them to solve problems.

[CCSS.MATH.CONTENT.HSG.SRT.D.11](http://www.corestandards.org/Math/Content/HSG/SRT/D/11/)
(+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

**Circles (G-C) 7% of points**

Understand and apply theorems about circles

Find arc lengths and areas of sectors of circles

G.C.A *Understand and apply theorems about circles 4.3%* Q12 Aug 2015, Q20 June 2016

As of December 2018 4.3% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.C.A.1](http://www.corestandards.org/Math/Content/HSG/C/A/1/)
Prove that all circles are similar.

[CCSS.MATH.CONTENT.HSG.C.A.2](http://www.corestandards.org/Math/Content/HSG/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.*

*[CCSS.MATH.CONTENT.HSG.C.A.3](http://www.corestandards.org/Math/Content/HSG/C/A/3/)*Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

[CCSS.MATH.CONTENT.HSG.C.A.4](http://www.corestandards.org/Math/Content/HSG/C/A/4/)
(+) Construct a tangent line from a point outside a given circle to the circle.

Note – all questions in the cluster so far have been MC

G.C.B *Find arc lengths and areas of sectors of circles 2.6%* Q29 June 2015, Q29 June 2016

As of December 2018 2.6% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.C.B.5](http://www.corestandards.org/Math/Content/HSG/C/B/5/)
Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector

**Expressing Geometric Properties with Equations (G-GPE) 14% of points**

Translate between the geometric description and the equation for a conic section

Use coordinates to prove simple geometric theorems algebraically

G.GPE.A *Translate between geometric description and the equation for a conic section 2.8%* Q14 June 15

As of December 2018 2.8% of total available points involved this cluster

Note – all questions in this cluster so far have been multiple choice

 [CCSS.MATH.CONTENT.HSG.GPE.A.1](http://www.corestandards.org/Math/Content/HSG/GPE/A/1/)
Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

[CCSS.MATH.CONTENT.HSG.GPE.A.2](http://www.corestandards.org/Math/Content/HSG/GPE/A/2/)
Derive the equation of a parabola given a focus and directrix.

[CCSS.MATH.CONTENT.HSG.GPE.A.3](http://www.corestandards.org/Math/Content/HSG/GPE/A/3/)
(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

G.GPE.B *Use coordinates to prove simple geometric theorems algebraically 11.6%* Q36 Jun 15, Q33 Aug 15

As of December 2018 11.6% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.GPE.B.4](http://www.corestandards.org/Math/Content/HSG/GPE/B/4/)
Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*

*[CCSS.MATH.CONTENT.HSG.GPE.B.5](http://www.corestandards.org/Math/Content/HSG/GPE/B/5/)*Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

[CCSS.MATH.CONTENT.HSG.GPE.B.6](http://www.corestandards.org/Math/Content/HSG/GPE/B/6/)
Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

[CCSS.MATH.CONTENT.HSG.GPE.B.7](http://www.corestandards.org/Math/Content/HSG/GPE/B/7/)
Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.\*

**Geometric Measurement and Dimension (G-GMD) 6% of points**

Explain volume formulas and use them to solve problems

Visualize relationships between two-dimensional and three-dimensional objects

G.MD.A *Explain volume formulas and use them to solve problems 2.8%* Q23 June 2015, Q4 Jan 2016

As of December 2018 2.8% of total available points involved this cluster

Note – all questions in this cluster so far have been multiple choice.

 [CCSS.MATH.CONTENT.HSG.GMD.A.1](http://www.corestandards.org/Math/Content/HSG/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*.

[CCSS.MATH.CONTENT.HSG.GMD.A.2](http://www.corestandards.org/Math/Content/HSG/GMD/A/2/)
(+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

[CCSS.MATH.CONTENT.HSG.GMD.A.3](http://www.corestandards.org/Math/Content/HSG/GMD/A/3/)
Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.\*

G.MD.B *Visualize relationships between two-dimensional and three-dimensional objects 3.4%* Q1June 2015, Q1 June 2016. Note – all questions in this cluster so far have been multiple choice.

As of December 2018 3.4% of total available points involved this cluster

 [CCSS.MATH.CONTENT.HSG.GMD.B.4](http://www.corestandards.org/Math/Content/HSG/GMD/B/4/)
Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

**Modeling with Geometry (G-MG) 11% of points**

G.MG.A *Apply geometric concepts in modeling situations 10.8%* Q35 June 2015, Q25 Aug 2015

As of December 2018 10.8% of total available points involved this cluster

*This cluster receives only a small reference in the standards document – however, it is a significant part of the course and in the last 4 Regents exams it accounts for an average of 12% of the points including a 6 point question in 3 out of the 4 exams*.

 [CCSS.MATH.CONTENT.HSG.MG.A.1](http://www.corestandards.org/Math/Content/HSG/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).\*

[CCSS.MATH.CONTENT.HSG.MG.A.2](http://www.corestandards.org/Math/Content/HSG/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).\*

[CCSS.MATH.CONTENT.HSG.MG.A.3](http://www.corestandards.org/Math/Content/HSG/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).\*