

# Keystone Exams: Algebra I

## Assessment Anchors and Eligible Content



*Pennsylvania Department of Education*

[www.education.state.pa.us](http://www.education.state.pa.us)

January 2013

## General Introduction to the Keystone Exam Assessment Anchors

### Introduction

Since the introduction of the Keystone Exams, the Pennsylvania Department of Education (PDE) has been working to create a set of tools designed to help educators improve instructional practices and better understand the Keystone Exams. The Assessment Anchors, as defined by the Eligible Content, are one of the many tools the Department believes will better align curriculum, instruction, and assessment practices throughout the Commonwealth. Without this alignment, it will not be possible to significantly improve student achievement across the Commonwealth.

### How were Keystone Exam Assessment Anchors developed?

Prior to the development of the Assessment Anchors, multiple groups of PA educators convened to create a set of standards for each of the Keystone Exams. Enhanced Standards, derived from a review of existing standards, focused on what students need to know and be able to do in order to be college and career ready. (Note: Since that time, PA Common Core Standards have replaced the Enhanced Standards and reflect the college- and career-ready focus.) Additionally, the Assessment Anchors and Eligible Content statements were created by other groups of educators charged with the task of clarifying the standards assessed on the Keystone Exams. The Assessment Anchors, as defined by the Eligible Content, have been designed to hold together, or *anchor*, the state assessment system and the curriculum/instructional practices in schools.

Assessment Anchors, as defined by the Eligible Content, were created with the following design parameters:

- **Clear:** The Assessment Anchors are easy to read and are user friendly; they clearly detail which standards are assessed on the Keystone Exams.
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### How can teachers, administrators, schools, and districts use these Assessment Anchors?

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The Assessment Anchors, as defined by the Eligible Content, are organized into cohesive blueprints, each structured with a common labeling system that can be read like an outline. This framework is organized first by module, then by Assessment Anchor, followed by Anchor Descriptor, and then finally, at the greatest level of detail, by an Eligible Content statement. The common format of this outline is followed across the Keystone Exams.

Here is a description of each level in the labeling system for the Keystone Exams:

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## MODULE 1—Operations and Linear Equations &amp; Inequalities

FINAL—January 2013

## ASSESSMENT ANCHOR

## A1.1.1 Operations with Real Numbers and Expressions

Anchor Descriptor	Eligible Content	PA Common Core Standards
A1.1.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, and exponents).	A1.1.1.1.1 Compare and/or order any real numbers. <u>Note:</u> Rational and irrational may be mixed.	<b>CC.2.1.8.E.1</b> Distinguish between rational and irrational numbers using their properties. <b>CC.2.1.8.E.4</b> Estimate irrational numbers by comparing them to rational numbers. <b>CC.2.1.HS.F.1</b> Apply and extend the properties of exponents to solve problems with rational exponents. <b>CC.2.1.HS.F.2</b> Apply properties of rational and irrational numbers to solve real-world or mathematical problems.
	A1.1.1.1.2 Simplify square roots (e.g., $\sqrt{24} = 2\sqrt{6}$ ).	
Anchor Descriptor	Eligible Content	PA Common Core Standards
A1.1.1.2 Apply number theory concepts to show relationships between real numbers in problem-solving settings.	A1.1.1.2.1 Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.	<b>CC.2.1.6.E.3</b> Develop and/or apply number theory concepts to find common factors and multiples. <b>CC.2.1.HS.F.2</b> Apply properties of rational and irrational numbers to solve real-world or mathematical problems.

Eligible Content may be assessed using problem-solving situations.

## MODULE 1—Operations and Linear Equations &amp; Inequalities

FINAL—January 2013

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.1.1.3</b> Use exponents, roots, and/or absolute values to solve problems.	<b>A1.1.1.3.1</b> Simplify/evaluate expressions involving properties/laws of exponents, roots, and/or absolute values to solve problems. <u>Note</u> : Exponents should be integers from $-10$ to $10$ .	<b>CC.2.1.HS.F.1</b> Apply and extend the properties of exponents to solve problems with rational exponents. <b>CC.2.1.HS.F.2</b> Apply properties of rational and irrational numbers to solve real-world or mathematical problems. <b>CC.2.2.8.B.1</b> Apply concepts of radicals and integer exponents to generate equivalent expressions.
Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.1.1.4</b> Use estimation strategies in problem-solving situations.	<b>A1.1.1.4.1</b> Use estimation to solve problems.	<b>CC.2.2.7.B.3</b> Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations and justify the solution method.
Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.1.1.5</b> Simplify expressions involving polynomials.	<b>A1.1.1.5.1</b> Add, subtract, and/or multiply polynomial expressions (express answers in simplest form). <u>Note</u> : Nothing larger than a binomial multiplied by a trinomial.	<b>CC.2.2.HS.D.1</b> Interpret the structure of expressions to represent a quantity in terms of its context. <b>CC.2.2.HS.D.2</b> Write expressions in equivalent forms to solve problems. <b>CC.2.2.HS.D.3</b> Extend the knowledge of arithmetic operations and apply to polynomials. <b>CC.2.2.HS.D.5</b> Use polynomial identities to solve problems. <b>CC.2.2.HS.D.6</b> Extend the knowledge of rational functions to rewrite in equivalent forms.
	<b>A1.1.1.5.2</b> Factor algebraic expressions, including difference of squares and trinomials. <u>Note</u> : Trinomials are limited to the form $ax^2 + bx + c$ where $a$ is equal to 1 after factoring out all monomial factors.	
	<b>A1.1.1.5.3</b> Simplify/reduce a rational algebraic expression.	

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## MODULE 1—Operations and Linear Equations &amp; Inequalities

FINAL—January 2013

## ASSESSMENT ANCHOR

## A1.1.2 Linear Equations

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.1.2.1</b> Write, solve, and/or graph linear equations using various methods.	<b>A1.1.2.1.1</b> Write, solve, and/or apply a linear equation (including problem situations).	<b>CC.2.1.HS.F.3</b> Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.
	<b>A1.1.2.1.2</b> Use and/or identify an algebraic property to justify any step in an equation-solving process. <u>Note:</u> Linear equations only.	<b>CC.2.1.HS.F.4</b> Use units as a way to understand problems and to guide the solution of multi-step problems. <b>CC.2.1.HS.F.5</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
	<b>A1.1.2.1.3</b> Interpret solutions to problems in the context of the problem situation. <u>Note:</u> Linear equations only.	<b>CC.2.2.8.B.3</b> Analyze and solve linear equations and pairs of simultaneous linear equations. <b>CC.2.2.8.C.1</b> Define, evaluate, and compare functions. <b>CC.2.2.8.C.2</b> Use concepts of functions to model relationships between quantities. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.8</b> Apply inverse operations to solve equations or formulas for a given variable. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations and justify the solution method. <b>CC.2.2.HS.D.10</b> Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

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## MODULE 1—Operations and Linear Equations &amp; Inequalities

FINAL—January 2013

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.1.2.2</b> Write, solve, and/or graph systems of linear equations using various methods.	<b>A1.1.2.2.1</b> Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination. <u>Note:</u> Limit systems to two linear equations.	<b>CC.2.1.HS.F.5</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <b>CC.2.2.8.B.3</b>
	<b>A1.1.2.2.2</b> Interpret solutions to problems in the context of the problem situation. <u>Note:</u> Limit systems to two linear equations.	<b>CC.2.2.HS.D.7</b> Analyze and solve linear equations and pairs of simultaneous linear equations. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations and justify the solution method. <b>CC.2.2.HS.D.10</b> Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

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## MODULE 1—Operations and Linear Equations &amp; Inequalities

FINAL—January 2013

ASSESSMENT ANCHOR		
A1.1.3 Linear Inequalities		
Anchor Descriptor	Eligible Content	PA Common Core Standards
A1.1.3.1 Write, solve, and/or graph linear inequalities using various methods.	A1.1.3.1.1 Write or solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).	<b>CC.2.1.HS.F.5</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations and justify the solution method. <b>CC.2.2.HS.D.10</b> Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
	A1.1.3.1.2 Identify or graph the solution set to a linear inequality on a number line.	
	A1.1.3.1.3 Interpret solutions to problems in the context of the problem situation. <u>Note:</u> Linear inequalities only.	
Anchor Descriptor	Eligible Content	PA Common Core Standards
A1.1.3.2 Write, solve, and/or graph systems of linear inequalities using various methods.	A1.1.3.2.1 Write and/or solve a system of linear inequalities using graphing. <u>Note:</u> Limit systems to two linear inequalities.	<b>CC.2.1.HS.F.5</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.10</b> Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
	A1.1.3.2.2 Interpret solutions to problems in the context of the problem situation. <u>Note:</u> Limit systems to two linear inequalities.	

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## MODULE 2—Linear Functions and Data Organizations

FINAL—January 2013

<b>ASSESSMENT ANCHOR</b>		
<b>A1.2.1 Functions</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A1.2.1.1</b> Analyze and/or use patterns or relations.	<b>A1.2.1.1.1</b> Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.	<b>CC.2.2.8.C.1</b> Define, evaluate, and compare functions.
	<b>A1.2.1.1.2</b> Determine whether a relation is a function, given a set of points or a graph.	<b>CC.2.2.8.C.2</b> Use concepts of functions to model relationships between quantities.
	<b>A1.2.1.1.3</b> Identify the domain or range of a relation (may be presented as ordered pairs, a graph, or a table).	<b>CC.2.2.HS.C.1</b> Use the concept and notation of functions to interpret and apply them in terms of their context. <b>CC.2.2.HS.C.2</b> Graph and analyze functions and use their properties to make connections between the different representations. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.4.HS.B.2</b> Summarize, represent, and interpret data on two categorical and quantitative variables.

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## MODULE 2—Linear Functions and Data Organizations

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Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.2.1.2</b> Interpret and/or use linear functions and their equations, graphs, or tables.	<b>A1.2.1.2.1</b> Create, interpret, and/or use the equation, graph, or table of a linear function.	<b>CC.2.1.HS.F.3</b> Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. <b>CC.2.1.HS.F.4</b> Use units as a way to understand problems and to guide the solution of multi-step problems. <b>CC.2.2.8.B.2</b> Understand the connections between proportional relationships, lines, and linear equations. <b>CC.2.2.8.C.1</b> Define, evaluate, and compare functions. <b>CC.2.2.8.C.2</b> Use concepts of functions to model relationships between quantities. <b>CC.2.2.HS.C.2</b> Graph and analyze functions and use their properties to make connections between the different representations. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.C.4</b> Interpret the effects transformations have on functions and find the inverses of functions. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.4.HS.B.2</b> Summarize, represent, and interpret data on two categorical and quantitative variables.
	<b>A1.2.1.2.2</b> Translate from one representation of a linear function to another (i.e., graph, table, and equation).	

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## MODULE 2—Linear Functions and Data Organizations

FINAL—January 2013

ASSESSMENT ANCHOR		
A1.2.2 Coordinate Geometry		
Anchor Descriptor	Eligible Content	PA Common Core Standards
A1.2.2.1 Describe, compute, and/or use the rate of change (slope) of a line.	A1.2.2.1.1 Identify, describe, and/or use constant rates of change.	<b>CC.2.2.8.C.2</b> Use concepts of functions to model relationships between quantities. <b>CC.2.2.HS.C.1</b> Use the concept and notation of functions to interpret and apply them in terms of their context. <b>CC.2.2.HS.C.2</b> Graph and analyze functions and use their properties to make connections between the different representations. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.C.5</b> Construct and compare linear, quadratic, and exponential models to solve problems. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.4.HS.B.1</b> Summarize, represent, and interpret data on a single count or measurement variable.
	A1.2.2.1.2 Apply the concept of linear rate of change (slope) to solve problems.	
	A1.2.2.1.3 Write or identify a linear equation when given <ul style="list-style-type: none"> <li>• the graph of the line,</li> <li>• two points on the line, or</li> <li>• the slope and a point on the line.</li> </ul> Note: Linear equation may be in point-slope, standard, and/or slope-intercept form.	
	A1.2.2.1.4 Determine the slope and/or y-intercept represented by a linear equation or graph.	

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## MODULE 2—Linear Functions and Data Organizations

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Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A1.2.2.2</b> Analyze and/or interpret data on a scatter plot.	<b>A1.2.2.2.1</b> Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.	<b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.4.8.B.1</b> Analyze and/or interpret bivariate data displayed in multiple representations. <b>CC.2.4.HS.B.2</b> Summarize, represent, and interpret data on two categorical and quantitative variables. <b>CC.2.4.HS.B.3</b> Analyze linear models to make interpretations based on the data.

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<b>ASSESSMENT ANCHOR</b>		
<b>A1.2.3 Data Analysis</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A1.2.3.1</b> Use measures of dispersion to describe a set of data.	<b>A1.2.3.1.1</b> Calculate and/or interpret the range, quartiles, and interquartile range of data.	<b>CC.2.4.HS.B.1</b> Summarize, represent, and interpret data on a single count or measurement variable. <b>CC.2.4.HS.B.3</b> Analyze linear models to make interpretations based on the data.
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A1.2.3.2</b> Use data displays in problem-solving settings and/or to make predictions.	<b>A1.2.3.2.1</b> Estimate or calculate to make predictions based on a circle, line, bar graph, measure of central tendency, or other representation.	<b>CC.2.4.HS.B.1</b> Summarize, represent, and interpret data on a single count or measurement variable. <b>CC.2.4.HS.B.3</b> Analyze linear models to make interpretations based on the data.
	<b>A1.2.3.2.2</b> Analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations).	<b>CC.2.4.HS.B.5</b> Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
	<b>A1.2.3.2.3</b> Make predictions using the equations or graphs of best-fit lines of scatter plots.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A1.2.3.3</b> Apply probability to practical situations.	<b>A1.2.3.3.1</b> Find probabilities for compound events (e.g., find probability of red and blue, find probability of red or blue) and represent as a fraction, decimal, or percent.	<b>CC.2.4.7.B.3</b> Investigate chance processes and develop, use, and evaluate probability models. <b>CC.2.4.HS.B.4</b> Recognize and evaluate random processes underlying statistical experiments. <b>CC.2.4.HS.B.7</b> Apply the rules of probability to compute probabilities of compound events in a uniform probability model.

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# Keystone Exams: Algebra II

## Assessment Anchors and Eligible Content



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## MODULE 1—Number Systems and Non-Linear Expressions &amp; Equations

FINAL—January 2013

**ASSESSMENT ANCHOR****A2.1.1 Operations with Complex Numbers**

<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.1.1.1</b> Represent and/or use imaginary numbers in equivalent forms (e.g., square roots and exponents).	<b>A2.1.1.1.1</b> Simplify/write square roots in terms of $i$ (e.g., $\sqrt{-24} = 2i\sqrt{6}$ ).	<b>CC.2.1.HS.F.6</b> Extend the knowledge of arithmetic operations and apply to complex numbers.
	<b>A2.1.1.1.2</b> Simplify/evaluate expressions involving powers of $i$ (e.g., $i^6 + i^3 = -1 - i$ ).	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.1.1.2</b> Apply the order of operations in computation and in problem-solving situations.	<b>A2.1.1.2.1</b> Add and subtract complex numbers (e.g., $(7 - 3i) - (2 + i) = 5 - 4i$ ).	<b>CC.2.1.HS.F.6</b> Extend the knowledge of arithmetic operations and apply to complex numbers.
	<b>A2.1.1.2.2</b> Multiply and divide complex numbers (e.g., $(7 - 3i)(2 + i) = 17 + i$ ).	

**Eligible Content may be assessed using problem-solving situations.**

## MODULE 1—Number Systems and Non-Linear Expressions &amp; Equations

FINAL—January 2013

## ASSESSMENT ANCHOR

## A2.1.2 Non-Linear Expressions

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A2.1.2.1</b> Use exponents, roots, and/or absolute values to represent equivalent forms or to solve problems.	<b>A2.1.2.1.1</b> Use exponential expressions to represent rational numbers.	<b>CC.2.1.HS.F.1</b> Apply and extend the properties of exponents to solve problems with rational exponents. <b>CC.2.2.HS.D.2</b> Write expressions in equivalent forms to solve problems.
	<b>A2.1.2.1.2</b> Simplify/evaluate expressions involving positive and negative exponents and/or roots (may contain all types of real numbers—exponents should not exceed power of 10).	
	<b>A2.1.2.1.3</b> Simplify/evaluate expressions involving multiplying with exponents (e.g., $x^6 \cdot x^7 = x^{13}$ ), powers of powers (e.g., $(x^6)^7 = x^{42}$ ), and powers of products (e.g., $(2x^2)^3 = 8x^6$ ). <u>Note:</u> Limit to rational exponents.	
	<b>A2.1.2.1.4</b> Simplify or evaluate expressions involving logarithms and exponents (e.g., $\log_2 8 = 3$ or $\log_4 2 = \frac{1}{2}$ ).	

Eligible Content may be assessed using problem-solving situations.

## MODULE 1—Number Systems and Non-Linear Expressions &amp; Equations

FINAL—January 2013

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A2.1.2.2</b> Simplify expressions involving polynomials.	<b>A2.1.2.2.1</b> Factor algebraic expressions, including difference of squares and trinomials. <u>Note:</u> Trinomials limited to the form $ax^2+bx+c$ where $a$ is not equal to 0.	<b>CC.2.2.HS.D.1</b> Interpret the structure of expressions to represent a quantity in terms of its context. <b>CC.2.2.HS.D.2</b> Write expressions in equivalent forms to solve problems. <b>CC.2.2.HS.D.3</b> Extend the knowledge of arithmetic operations and apply to polynomials. <b>CC.2.2.HS.D.4</b> Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs. <b>CC.2.2.HS.D.5</b> Use polynomial identities to solve problems.
	<b>A2.1.2.2.2</b> Simplify rational algebraic expressions.	

**Eligible Content may be assessed using problem-solving situations.**

## MODULE 1—Number Systems and Non-Linear Expressions &amp; Equations

FINAL—January 2013

## ASSESSMENT ANCHOR

## A2.1.3 Non-Linear Equations

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A2.1.3.1</b> Write and/or solve non-linear equations using various methods.	<b>A2.1.3.1.1</b> Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).	<b>CC.2.2.HS.C.2</b> Graph and analyze functions, and use their properties to make connections between the different representations. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.C.4</b> Interpret the effects transformations have on functions, and find the inverses of functions. <b>CC.2.2.HS.C.5</b> Construct and compare linear, quadratic, and exponential models to solve problems. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.2.HS.D.5</b> Use polynomial identities to solve problems. <b>CC.2.2.HS.D.6</b> Extend the knowledge of rational functions to rewrite in equivalent forms. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.8</b> Apply inverse operations to solve equations or formulas for a given variable. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations, and justify the solution method. <b>CC.2.2.HS.D.10</b> Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
	<b>A2.1.3.1.2</b> Solve equations involving rational and/or radical expressions (e.g., $10/(x + 3) + 12/(x - 2) = 1$ or $\sqrt{x^2 + 21x} = 14$ ).	
	<b>A2.1.3.1.3</b> Write and/or solve a simple exponential or logarithmic equation (including common and natural logarithms).	
	<b>A2.1.3.1.4</b> Write, solve, and/or apply linear or exponential growth or decay (including problem situations).	

**Eligible Content may be assessed using problem-solving situations.**

## MODULE 1—Number Systems and Non-Linear Expressions &amp; Equations

FINAL—January 2013

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A2.1.3.2</b> Describe and/or determine change.	<b>A2.1.3.2.1</b> Determine how a change in one variable relates to a change in a second variable (e.g., $y = 4/x$ ; if $x$ doubles, what happens to $y$ ?).	<b>CC.2.2.HS.C.2</b> Graph and analyze functions, and use their properties to make connections between the different representations. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.C.4</b> Interpret the effects transformations have on functions, and find the inverses of functions. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.2.HS.D.8</b> Apply inverse operations to solve equations or formulas for a given variable. <b>CC.2.2.HS.D.9</b> Use reasoning to solve equations, and justify the solution method.
	<b>A2.1.3.2.2</b> Use algebraic processes to solve a formula for a given variable (e.g., solve $d = rt$ for $r$ ).	

Eligible Content may be assessed using problem-solving situations.

**ASSESSMENT ANCHOR****A2.2.1 Patterns, Relations, and Functions**

<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.2.1.1</b> Analyze and/or use patterns or relations.	<b>A2.2.1.1.1</b> Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.	<b>CC.2.1.HS.F.7</b> Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
	<b>A2.2.1.1.2</b> Identify and/or extend a pattern as either an arithmetic or geometric sequence (e.g., given a geometric sequence, find the 20th term).	<b>CC.2.2.HS.C.1</b> Use the concept and notation of functions to interpret and apply them in terms of their context.
	<b>A2.2.1.1.3</b> Determine the domain, range, or inverse of a relation.	<b>CC.2.2.HS.C.2</b> Graph and analyze functions, and use their properties to make connections between the different representations.
	<b>A2.2.1.1.4</b> Identify and/or determine the characteristics of an exponential, quadratic, or polynomial function (e.g., intervals of increase/decrease, intercepts, zeros, and asymptotes).	<b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities. <b>CC.2.2.HS.C.5</b> Construct and compare linear, quadratic, and exponential models to solve problems. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.3.HS.A.10</b> Translate between the geometric description and the equation for a conic section. <b>CC.2.4.HS.B.2</b> Summarize, represent, and interpret data on two categorical and quantitative variables.

**Eligible Content may be assessed using problem-solving situations.**

<b>ASSESSMENT ANCHOR</b>		
<b>A2.2.2 Applications of Functions</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.2.2.1</b> Create, interpret, and/or use polynomial, exponential, and/or logarithmic functions and their equations, graphs, or tables.	<b>A2.2.2.1.1</b> Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).	<b>CC.2.1.HS.F.3</b> Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.
	<b>A2.2.2.1.2</b> Create, interpret, and/or use the equation, graph, or table of an exponential or logarithmic function (including common and natural logarithms).	<b>CC.2.1.HS.F.4</b> Use units as a way to understand problems and to guide the solution of multi-step problems. <b>CC.2.2.HS.C.3</b> Write functions or sequences that model relationships between two quantities.
	<b>A2.2.2.1.3</b> Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.	<b>CC.2.2.HS.C.4</b> Interpret the effects transformations have on functions, and find the inverses of functions.
	<b>A2.2.2.1.4</b> Translate a polynomial, exponential, or logarithmic function from one representation of a function to another (graph, table, and equation).	<b>CC.2.2.HS.C.5</b> Construct and compare linear, quadratic, and exponential models to solve problems. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model. <b>CC.2.2.HS.D.7</b> Create and graph equations or inequalities to describe numbers or relationships. <b>CC.2.3.HS.A.10</b> Translate between the geometric description and the equation for a conic section.

**Eligible Content may be assessed using problem-solving situations.**

Anchor Descriptor	Eligible Content	PA Common Core Standards
<b>A2.2.2.2</b> Describe and/or determine families of functions.	<b>A2.2.2.2.1</b> Identify or describe the effect of changing parameters within a family of functions (e.g., $y = x^2$ and $y = x^2 + 3$ , or $y = x^2$ and $y = 3x^2$ ).	<b>CC.2.2.HS.C.4</b> Interpret the effects transformations have on functions, and find the inverses of functions. <b>CC.2.2.HS.C.5</b> Construct and compare linear, quadratic, and exponential models to solve problems. <b>CC.2.2.HS.C.6</b> Interpret functions in terms of the situations they model.

Eligible Content may be assessed using problem-solving situations.



<b>ASSESSMENT ANCHOR</b>		
<b>A2.2.3 Data Analysis</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.2.3.1</b> Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.	<b>A2.2.3.1.1</b> Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot.	<b>CC.2.1.HS.F.3</b> Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. <b>CC.2.1.HS.F.5</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <b>CC.2.4.HS.B.2</b> Summarize, represent, and interpret data on two categorical and quantitative variables. <b>CC.2.4.HS.B.3</b> Analyze linear models to make interpretations based on the data.
	<b>A2.2.3.1.2</b> Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>A2.2.3.2</b> Apply probability to practical situations.	<b>A2.2.3.2.1</b> Use combinations, permutations, and the fundamental counting principle to solve problems involving probability.	<b>CC.2.4.HS.B.4</b> Recognize and evaluate random processes underlying statistical experiments. <b>CC.2.4.HS.B.5</b> Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. <b>CC.2.4.HS.B.6</b> Use the concepts of independence and conditional probability to interpret data. <b>CC.2.4.HS.B.7</b> Apply the rules of probability to compute probabilities of compound events in a uniform probability model.
	<b>A2.2.3.2.2</b> Use odds to find probability and/or use probability to find odds.	
	<b>A2.2.3.2.3</b> Use probability for independent, dependent, or compound events to predict outcomes.	

**Eligible Content may be assessed using problem-solving situations.**

# Keystone Exams: Geometry

## Assessment Anchors and Eligible Content



*Pennsylvania Department of Education*

[www.education.state.pa.us](http://www.education.state.pa.us)

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# PENNSYLVANIA DEPARTMENT OF EDUCATION

## General Introduction to the Keystone Exam Assessment Anchors

### Introduction

Since the introduction of the Keystone Exams, the Pennsylvania Department of Education (PDE) has been working to create a set of tools designed to help educators improve instructional practices and better understand the Keystone Exams. The Assessment Anchors, as defined by the Eligible Content, are one of the many tools the Department believes will better align curriculum, instruction, and assessment practices throughout the Commonwealth. Without this alignment, it will not be possible to significantly improve student achievement across the Commonwealth.

### How were Keystone Exam Assessment Anchors developed?

Prior to the development of the Assessment Anchors, multiple groups of PA educators convened to create a set of standards for each of the Keystone Exams. Enhanced Standards, derived from a review of existing standards, focused on what students need to know and be able to do in order to be college and career ready. (Note: Since that time, PA Common Core Standards have replaced the Enhanced Standards and reflect the college- and career-ready focus.) Additionally, the Assessment Anchors and Eligible Content statements were created by other groups of educators charged with the task of clarifying the standards assessed on the Keystone Exams. The Assessment Anchors, as defined by the Eligible Content, have been designed to hold together, or *anchor*, the state assessment system and the curriculum/instructional practices in schools.

Assessment Anchors, as defined by the Eligible Content, were created with the following design parameters:

- **Clear:** The Assessment Anchors are easy to read and are user friendly; they clearly detail which standards are assessed on the Keystone Exams.
- **Focused:** The Assessment Anchors identify a core set of standards that could be reasonably assessed on a large-scale assessment; this will keep educators from having to guess which standards are critical.
- **Rigorous:** The Assessment Anchors support the rigor of the state standards by assessing higher-order and reasoning skills.
- **Manageable:** The Assessment Anchors define the standards in a way that can be easily incorporated into a course to prepare students for success.

### How can teachers, administrators, schools, and districts use these Assessment Anchors?

The Assessment Anchors, as defined by the Eligible Content, can help focus teaching and learning because they are clear, manageable, and closely aligned with the Keystone Exams. Teachers and administrators will be better informed about which standards will be assessed. The Assessment Anchors and Eligible Content should be used along with the Standards and the Curriculum Framework of the Standards Aligned System (SAS) to build curriculum, design lessons, and support student achievement.

The Assessment Anchors and Eligible Content are designed to enable educators to determine when they feel students are prepared to be successful in the Keystone Exams. An evaluation of current course offerings, through the lens of what is assessed on those particular Keystone Exams, may provide an opportunity for an alignment to ensure student preparedness.

## How are the Assessment Anchors organized?

The Assessment Anchors, as defined by the Eligible Content, are organized into cohesive blueprints, each structured with a common labeling system that can be read like an outline. This framework is organized first by module, then by Assessment Anchor, followed by Anchor Descriptor, and then finally, at the greatest level of detail, by an Eligible Content statement. The common format of this outline is followed across the Keystone Exams.

Here is a description of each level in the labeling system for the Keystone Exams:

- **Module:** The Assessment Anchors are organized into two thematic modules for each of the Keystone Exams. The module title appears at the top of each page. The module level is important because the Keystone Exams are built using a module format, with each of the Keystone Exams divided into two equal-size test modules. Each module is made up of two or more Assessment Anchors.
- **Assessment Anchor:** The Assessment Anchor appears in the shaded bar across the top of each Assessment Anchor table. The Assessment Anchors represent categories of subject matter that anchor the content of the Keystone Exams. Each Assessment Anchor is part of a module and has one or more Anchor Descriptors unified under it.
- **Anchor Descriptor:** Below each Assessment Anchor is a specific Anchor Descriptor. The Anchor Descriptor level provides further details that delineate the scope of content covered by the Assessment Anchor. Each Anchor Descriptor is part of an Assessment Anchor and has one or more Eligible Content statements unified under it.
- **Eligible Content:** The column to the right of the Anchor Descriptor contains the Eligible Content statements. The Eligible Content is the most specific description of the content that is assessed on the Keystone Exams. This level is considered the assessment limit and helps educators identify the range of the content covered on the Keystone Exams.
- **PA Common Core Standards:** In the column to the right of each Eligible Content statement is a code representing one or more Pennsylvania Common Core Standard that correlate to the Eligible Content statement. Some Eligible Content statements include annotations that indicate certain clarifications about the scope of an Eligible Content.
  - “e.g.” (“for example”)—sample approach, but not a limit to the Eligible Content.

## How do the K–12 Pennsylvania Common Core Standards affect this document?

Assessment Anchors and Eligible Content statements are aligned to the PA Common Core Standards; thus, the former enhanced standards are no longer necessary. Within this document, all standard references reflect the PA Common Core Standards.

Standards Aligned System — <http://www.pdesas.org/>

Pennsylvania Department of Education — [www.education.state.pa.us](http://www.education.state.pa.us)

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**ASSESSMENT ANCHOR****G.1.1 Properties of Circles, Spheres, and Cylinders**

<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.1.1.1</b> Identify and/or use parts of circles and segments associated with circles, spheres, and cylinders.	<b>G.1.1.1.1</b> Identify, determine, and/or use the radius, diameter, segment, and/or tangent of a circle.	<b>CC.2.3.HS.A.8</b> Apply geometric theorems to verify properties of circles. <b>CC.2.3.HS.A.9</b> Extend the concept of similarity to determine arc lengths and areas of sectors of circles. <b>CC.2.3.HS.A.13</b> Analyze relationships between two-dimensional and three-dimensional objects.
	<b>G.1.1.1.2</b> Identify, determine, and/or use the arcs, semicircles, sectors, and/or angles of a circle.	
	<b>G.1.1.1.3</b> Use chords, tangents, and secants to find missing arc measures or missing segment measures.	
	<b>G.1.1.1.4</b> Identify and/or use the properties of a sphere or cylinder.	

**Eligible Content may be assessed using problem-solving situations.**

<b>ASSESSMENT ANCHOR</b>		
<b>G.1.2 Properties of Polygons and Polyhedra</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.1.2.1</b> Recognize and/or apply properties of angles, polygons, and polyhedra.	<b>G.1.2.1.1</b> Identify and/or use properties of triangles.	<b>CC.2.3.8.A.2</b> Understand and apply congruence, similarity, and geometric transformations using various tools. <b>CC.2.3.HS.A.3</b> Verify and apply geometric theorems as they relate to geometric figures. <b>CC.2.3.HS.A.13</b> Analyze relationships between two-dimensional and three-dimensional objects.
	<b>G.1.2.1.2</b> Identify and/or use properties of quadrilaterals.	
	<b>G.1.2.1.3</b> Identify and/or use properties of isosceles and equilateral triangles.	
	<b>G.1.2.1.4</b> Identify and/or use properties of regular polygons.	
	<b>G.1.2.1.5</b> Identify and/or use properties of pyramids and prisms.	

**Eligible Content may be assessed using problem-solving situations.**

MODULE 1—Geometric Properties and Reasoning

FINAL—January 2013

<b>ASSESSMENT ANCHOR</b>		
<b>G.1.3 Congruence, Similarity, and Proofs</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.1.3.1</b> Use properties of congruence, correspondence, and similarity in problem-solving settings involving two- and three-dimensional figures.	<b>G.1.3.1.1</b> Identify and/or use properties of congruent and similar polygons or solids.	<b>CC.2.3.HS.A.1</b> Use geometric figures and their properties to represent transformations in the plane. <b>CC.2.3.HS.A.2</b> Apply rigid transformations to determine and explain congruence. <b>CC.2.3.HS.A.5</b> Create justifications based on transformations to establish similarity of plane figures. <b>CC.2.3.HS.A.6</b> Verify and apply theorems involving similarity as they relate to plane figures.
	<b>G.1.3.1.2</b> Identify and/or use proportional relationships in similar figures.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.1.3.2</b> Write formal proofs and/or use logic statements to construct or validate arguments.	<b>G.1.3.2.1</b> Write, analyze, complete, or identify formal proofs (e.g., direct and/or indirect proofs/proofs by contradiction).	<b>CC.2.2.HS.C.9</b> Prove the Pythagorean identity and use it to calculate trigonometric ratios. <b>CC.2.3.HS.A.3</b> Verify and apply geometric theorems as they relate to geometric figures. <b>CC.2.3.HS.A.6</b> Verify and apply theorems involving similarity as they relate to plane figures. <b>CC.2.3.HS.A.8</b> Apply geometric theorems to verify properties of circles.

Eligible Content may be assessed using problem-solving situations.

MODULE 2—Coordinate Geometry and Measurement

FINAL—January 2013

<b>ASSESSMENT ANCHOR</b>		
<b>G.2.1 Coordinate Geometry and Right Triangles</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.1.1</b> Solve problems involving right triangles.	<b>G.2.1.1.1</b> Use the Pythagorean theorem to write and/or solve problems involving right triangles.	<b>CC.2.2.HS.C.9</b> Prove the Pythagorean identity and use it to calculate trigonometric ratios. <b>CC.2.3.HS.A.7</b> Apply trigonometric ratios to solve problems involving right triangles.
	<b>G.2.1.1.2</b> Use trigonometric ratios to write and/or solve problems involving right triangles.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.1.2</b> Solve problems using analytic geometry.	<b>G.2.1.2.1</b> Calculate the distance and/or midpoint between two points on a number line or on a coordinate plane.	<b>CC.2.3.8.A.3</b> Understand and apply the Pythagorean theorem to solve problems. <b>CC.2.3.HS.A.11</b> Apply coordinate geometry to prove simple geometric theorems algebraically.
	<b>G.2.1.2.2</b> Relate slope to perpendicularity and/or parallelism (limit to linear algebraic equations).	
	<b>G.2.1.2.3</b> Use slope, distance, and/or midpoint between two points on a coordinate plane to establish properties of a two-dimensional shape.	

Eligible Content may be assessed using problem-solving situations.



## MODULE 2—Coordinate Geometry and Measurement

FINAL—January 2013

<b>ASSESSMENT ANCHOR</b>		
<b>G.2.2 Measurements of Two-Dimensional Shapes and Figures</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.2.1</b> Use and/or compare measurements of angles.	<b>G.2.2.1.1</b> Use properties of angles formed by intersecting lines to find the measures of missing angles.	<b>CC.2.3.8.A.2</b> Understand and apply congruence, similarity, and geometric transformations using various tools. <b>CC.2.3.HS.A.3</b> Verify and apply geometric theorems as they relate to geometric figures.
	<b>G.2.2.1.2</b> Use properties of angles formed when two parallel lines are cut by a transversal to find the measures of missing angles.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.2.2</b> Use and/or develop procedures to determine or describe measures of perimeter, circumference, and/or area. (May require conversions within the same system.)	<b>G.2.2.2.1</b> Estimate area, perimeter, or circumference of an irregular figure.	<b>CC.2.2.HS.C.1</b> Use the concept and notation of functions to interpret and apply them in terms of their context. <b>CC.2.3.HS.A.3</b> Verify and apply geometric theorems as they relate to geometric figures. <b>CC.2.3.HS.A.9</b> Extend the concept of similarity to determine arc lengths and areas of sectors of circles.
	<b>G.2.2.2.2</b> Find the measurement of a missing length, given the perimeter, circumference, or area.	
	<b>G.2.2.2.3</b> Find the side lengths of a polygon with a given perimeter to maximize the area of the polygon.	
	<b>G.2.2.2.4</b> Develop and/or use strategies to estimate the area of a compound/composite figure.	
	<b>G.2.2.2.5</b> Find the area of a sector of a circle.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.2.3</b> Describe how a change in one dimension of a two-dimensional figure affects other measurements of that figure.	<b>G.2.2.3.1</b> Describe how a change in the linear dimension of a figure affects its perimeter, circumference, and area (e.g., How does changing the length of the radius of a circle affect the circumference of the circle?).	<b>CC.2.3.HS.A.8</b> Apply geometric theorems to verify properties of circles. <b>CC.2.3.HS.A.9</b> Extend the concept of similarity to determine arc lengths and areas of sectors of circles.
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.2.4</b> Apply probability to practical situations.	<b>G.2.2.4.1</b> Use area models to find probabilities.	<b>CC.2.3.HS.A.14</b> Apply geometric concepts to model and solve real-world problems.

**Eligible Content may be assessed using problem-solving situations.**

<b>ASSESSMENT ANCHOR</b>		
<b>G.2.3 Measurements of Three-Dimensional Shapes and Figures</b>		
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.3.1</b> Use and/or develop procedures to determine or describe measures of surface area and/or volume. (May require conversions within the same system.)	<b>G.2.3.1.1</b> Calculate the surface area of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.	<b>CC.2.3.8.A.1</b> Apply the concepts of volume of cylinders, cones, and spheres to solve real-world and mathematical problems. <b>CC.2.3.HS.A.12</b> Explain volume formulas and use them to solve problems. <b>CC.2.3.HS.A.14</b> Apply geometric concepts to model and solve real-world problems.
	<b>G.2.3.1.2</b> Calculate the volume of prisms, cylinders, cones, pyramids, and/or spheres. Formulas are provided on a reference sheet.	
	<b>G.2.3.1.3</b> Find the measurement of a missing length given the surface area or volume.	
<b>Anchor Descriptor</b>	<b>Eligible Content</b>	<b>PA Common Core Standards</b>
<b>G.2.3.2</b> Describe how a change in one dimension of a three-dimensional figure affects other measurements of that figure.	<b>G.2.3.2.1</b> Describe how a change in the linear dimension of a figure affects its surface area or volume (e.g., How does changing the length of the edge of a cube affect the volume of the cube?).	<b>CC.2.3.HS.A.13</b> Analyze relationships between two-dimensional and three-dimensional objects.

**Eligible Content may be assessed using problem-solving situations.**