Keystone Exams: Algebra II

Assessment Anchors and Eligible Content

Pennsylvania Department of Education

www.education.state.pa.us

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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 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 Core Standards:** In the column to the right of each Eligible Content statement is a code representing one or more Pennsylvania 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.
    - "Note" —content exclusions or definable range of the Eligible Content.

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

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

Standards Aligned System — http://www.pdesas.org/ **Pennsylvania Department of Education —** www.education.state.pa.us

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ASSESSMENT ANCHOR
A2.1.1 Operations with Complex Numbers

Anchor Descriptor		Eligible Content		PA Core Standards
A2.1.1.1	Represent and/or use imaginary numbers in equivalent forms (e.g., square roots and exponents).	**A2.1.1.1.1**	Simplify/write square roots in terms of *i* (e.g., $\sqrt{-24} = 2i\sqrt{6}$).	**CC.2.1.HS.F.6** Extend the knowledge of arithmetic operations and apply to complex numbers.
		A2.1.1.1.2	Simplify/evaluate expressions involving powers of *i* (e.g., $i^6 + i^3 = -1 - i$).	

Anchor Descriptor		Eligible Content		PA Core Standards
A2.1.1.2	Apply the order of operations in computation and in problem-solving situations.	**A2.1.1.2.1**	Add and subtract complex numbers (e.g., $(7 - 3i) - (2 + i) = 5 - 4i$).	**CC.2.1.HS.F.6** Extend the knowledge of arithmetic operations and apply to complex numbers.
		A2.1.1.2.2	Multiply and divide complex numbers (e.g., $(7 - 3i)(2 + i) = 17 + i$).	

Eligible Content may be assessed using problem-solving situations.

ASSESSMENT ANCHOR
A2.1.2 Non-Linear Expressions

Anchor Descriptor	Eligible Content	PA Core Standards
A2.1.2.1 Use exponents, roots, and/or absolute values to represent equivalent forms or to solve problems.	**A2.1.2.1.1** Use exponential expressions to represent rational numbers.	**CC.2.1.HS.F.1** Apply and extend the properties of exponents to solve problems with rational exponents. **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.
	A2.1.2.1.2 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).	
	A2.1.2.1.3 Simplify/evaluate expressions involving multiplying with exponents (e.g., $x^6 \bullet x^7 = x^{13}$), powers of powers (e.g., $(x^6)^7 = x^{42}$), and powers of products (e.g., $(2x^2)^3 = 8x^6$). Note: Limit to rational exponents.	
	A2.1.2.1.4 Simplify or evaluate expressions involving logarithms and exponents (e.g., $\log_2 8 = 3$ or $\log_4 2 = ½$).	

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

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ASSESSMENT ANCHOR
A2.1.3 Non-Linear Equations

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

Eligible Content may be assessed using problem-solving situations.

Anchor Descriptor	Eligible Content	PA Core Standards
A2.1.3.2 Describe and/or determine change.	**A2.1.3.2.1** 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?).	**CC.2.2.HS.C.2** Graph and analyze functions, and use their properties to make connections between the different representations. **CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities. **CC.2.2.HS.C.4** Interpret the effects transformations have on functions, and find the inverses of functions. **CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships. **CC.2.2.HS.D.8** Apply inverse operations to solve equations or formulas for a given variable. **CC.2.2.HS.D.9** Use reasoning to solve equations, and justify the solution method.
	A2.1.3.2.2 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

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

Eligible Content may be assessed using problem-solving situations.

ASSESSMENT ANCHOR
A2.2.2 Applications of Functions

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

Eligible Content may be assessed using problem-solving situations.

Anchor Descriptor	Eligible Content	PA Core Standards
A2.2.2.2 Describe and/or determine families of functions.	**A2.2.2.2.1** 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 $y = 3x^2$).	**CC.2.2.HS.C.4** Interpret the effects transformations have on functions, and find the inverses of functions. **CC.2.2.HS.C.5** Construct and compare linear, quadratic, and exponential models to solve problems. **CC.2.2.HS.C.6** Interpret functions in terms of the situations they model.

Eligible Content may be assessed using problem-solving situations.

ASSESSMENT ANCHOR
A2.2.3 Data Analysis

Anchor Descriptor	Eligible Content	PA Core Standards
A2.2.3.1 Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.	**A2.2.3.1.1** Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot. **A2.2.3.1.2** Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.	**CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.2.1.HS.F.5** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **CC.2.4.HS.B.2** Summarize, represent, and interpret data on two categorical and quantitative variables. **CC.2.4.HS.B.3** Analyze linear models to make interpretations based on the data.

Anchor Descriptor	Eligible Content	PA Core Standards
A2.2.3.2 Apply probability to practical situations.	**A2.2.3.2.1** Use combinations, permutations, and the fundamental counting principle to solve problems involving probability. **A2.2.3.2.2** Use odds to find probability and/or use probability to find odds. **A2.2.3.2.3** Use probability for independent, dependent, or compound events to predict outcomes.	**CC.2.4.HS.B.4** Recognize and evaluate random processes underlying statistical experiments. **CC.2.4.HS.B.5** Make inferences and justify conclusions based on sample surveys, experiments, and observational studies. **CC.2.4.HS.B.6** Use the concepts of independence and conditional probability to interpret data. **CC.2.4.HS.B.7** Apply the rules of probability to compute probabilities of compound events in a uniform probability model.

Eligible Content may be assessed using problem-solving situations.