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New York State Regents Examination in Algebra II (Common Core)

Performance Level Descriptions

July 2016

Algebra II Performance Level Descriptions

Policy-Level Performance Level Definitions

For each subject area, there are students performing along a proficiency continuum with regard to the skills and knowledge necessary to meet the demands of the Learning Standards for Mathematics. There are students who are exceed the expectations of the standards, students meet the expectations, students who partially meet the expectations, and students who do not demonstrate sufficient knowledge or skills required for any performance level. New York State assessments are designed to classify students into one of four proficiency categories; these proficiency categories are defined as:

NYS Level 5
Students performing at this level exceed the expectations of the standards**.**

NYS Level 4
Students performing at this level meet the expectations of the standards.

NYS Level 3
Students performing at this level partially meet the expectations of the standards (sufficient for current Regents Diploma purposes).

NYS Level 2 (Safety Net)
Students performing at this level partially meet the expectations of the standards (sufficient for Local Diploma purposes).

NYS Level 1
Students performing at this level do not demonstrate the knowledge and skills required for NYS Level 2.

Performance Level Descriptions

Performance Level Descriptions (PLDs) describe the range of knowledge and skills students should demonstrate at a given performance level.

How were the PLDs developed?

The New York State Education Department convened a small group of NYS mathematics educators to develop the initial draft PLDs for Algebra II. The draft PLDs then went through additional rounds of review and edit from a number of NYS-certified educators, content specialists, and assessment experts as well as the Department's Mathematics Content Advisory Panel. In developing PLDs, participants considered policy-level definitions of the performance levels (see above) and the expectations for each grade level in the Learning Standards for Mathematics.

How are the PLDs used in Assessment?

PLDs are essential in setting standards for the New York State Regents Examinations. Standard setting panelists use PLDs to determine the threshold expectations for students to demonstrate the knowledge and skills necessary to attain just barely a Level 2, Level 3, Level 4, or Level 5 on the assessment. These discussions then influence the panelists in establishing the cut scores on the assessment. PLDs are also used to inform item development, as each test needs questions that distinguish performance all along the continuum.

How can the PLDs be used in Instruction?

PLDs help communicate to students, families, educators and the public the specific knowledge and skills expected of students to demonstrate proficiency and can serve a number of purposes in classroom instruction. They are the foundation of rich discussion around what students need to do to perform at higher levels and to explain the progression of learning within a subject area. We encourage the use of the PLDs for a variety of purposes, such as differentiating instruction to maximize individual student outcomes, creating classroom assessments and rubrics to help in identifying target performance levels for individual or groups of students, and tracking student growth along the proficiency continuum as described by the PLDs. In order to facilitate the use of the PLDs in instruction, the skills differentiating performance levels have been identified using bold text.

Algebra II Performance Level Descriptions

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
The Real Number System (N-RN)	**Generalize/explain the equivalence of rational exponents and radicals using abstract representations.** **Justify conjectures using concrete examples.**	Rewrite **multivariable** expressions involving radicals and/or rational exponents where the exponent may contain a variable.	Rewrite **single variable** expressions involving radicals and/or rational exponents where the exponent may contain a variable.	Rewrite **numerical** and variable expressions containing radicals and/or rational exponents.	Rewrite numerical expressions containing radicals and/or rational exponents.
	Compare and interpret complex expressions involving radicals and/or rational exponents where the exponent may contain a variable.	**Perform operations** on expressions involving radicals and/or rational exponents.	Simplify expressions containing radicals **and** rational exponents.	Simplify **expressions** containing radicals **or rational exponents.**	Simplify numerical radicals.
	Explain why two algebraic expressions containing radicals and rational exponents are equal.	Explain why two numerical expressions containing radicals and rational exponents are equal.			

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Quantities (N-Q)	**Identify and interpret** the most relevant quantity in a modeling context that contains more than one possible quantity.	**Determine** the most relevant quantity in a modeling context that contains more than one possible quantity.	Given the **most relevant** quantity in a modeling situation **justify its importance.**	Identify **quantities** in a modeling context.	Identify a quantity in a modeling context.

Algebra II Performance Level Descriptions

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
The Complex Number System (N-CN)	Calculate expressions containing both sums and products of complex numbers **with any power greater than 2**, providing an answer in a + bi form.	Calculate expressions containing both sums and products of complex numbers **providing an answer in a + bi form.**	Calculate expressions containing both **sums and products of** complex numbers. Simplify expressions containing powers of i **greater than 2**.	Calculate **products** of complex numbers. Simplify expressions containing i^2.	Calculate sums of complex numbers.
	Justify the equivalence of negative radicands and their complex equivalents using concrete examples.	Solve a quadratic equation to find the complex solutions **providing an answer in a + bi form. Justify the existence of non-real solutions graphically.**	Solve a quadratic equation **to find** the complex solutions.	Determine the existence of non-real solutions in a quadratic equation.	
	Explain the connection between the type of algebraic solutions and the graph of the quadratic equation.	**Identify the connection** between the type of algebraic solutions and the graph of the quadratic equation.			

Algebra II Performance Level Descriptions

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Seeing Structure in Expressions (A-SSE)	Rewrite polynomial, rational and exponential expressions **in different but equivalent forms**.	Rewrite polynomial, **rational** and exponential expressions in a different but equivalent form.	Rewrite polynomial **and** exponential expressions in a different but equivalent form.	**Rewrite** polynomial or exponential expressions in a different but equivalent form.	Provide evidence that two expressions are equivalent by substituting numerical values for variables or graphing each expression.
	Find **the most appropriate** form of an exponential function to solve real-world or mathematical problems **and explain multiple interpretations** of expressions in terms of its context.	In a real-world context, use the properties of exponents to write an equivalent form of an exponential function and interpret the parts of the expression to reveal information about the situation.	In a real-world context, use the properties of exponents to write an equivalent form of an exponential function.	Identify the parts of an exponential function **in a real-world context**.	Identify the parts of an exponential function.
		Apply the geometric series formula to solve a real world problem.	Apply the geometric series formula to **a geometric sequence of numbers.**	Given a geometric series in summation notation, list the terms of the geometric sequence.	Identify the first term in a geometric sequence and its common ratio.

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Arithmetic with Polynomials & Rational Expressions (A-APR)	Apply the remainder theorem to determine the remainder on division by (bx – a) and if (bx – a) is a factor of P(x).	Apply the remainder theorem to determine the remainder on division by (x – a) and if (x – a) is a factor of P(x).	Apply the remainder theorem to determine if (x – a) is a factor of P(x).	Determine the remainder of P(x) by evaluating P(a).	
	Identify zeros of quadratic, cubic, and quartic polynomials and polynomials for which factors are not provided, and use the factors to graph the function in context.	Identify zeros of quadratic, cubic, and quartic polynomials and polynomials for which factors are not provided, and use the factors to graph the function.	Identify zeros of quadratic, cubic, and quartic polynomials and use the factors to graph the function.	Identify zeros of quadratic, cubic, and quartic polynomials.	Identify the zeros of a polynomial function given in factored form.
	Derive a polynomial identity and use the identity to **describe** numerical relationships in context.	Prove that a polynomial equation is an identity and use the identity to **describe** numerical relationships.	Prove that a polynomial equation is an identity.	Provide justification for a step of a given identity proof.	Provide evidence that an equation is an identity by substituting numerical values for the variables.
	Determine equivalent forms of a rational expression and **describe** the algebraic significance of the remainder.	Determine equivalent forms of a rational expression **using long division.**	Determine equivalent forms of a rational expression **by inspection**.	Determine equivalent forms of a rational expression for factorable expressions (no remainder).	**Identify equivalent** forms of a rational expression for factored expressions (no remainder).

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Creating Equations (A-CED)	Create an equation in one variable and use it to solve problems (i.e., exponential with rational or real exponents, and rational equations) **in a real-world context.**	Create an equation in one variable and use it to solve problems (i.e., exponential with rational or real exponents, and rational equations).	Create an equation in one variable and use it **to solve problems** (i.e., linear, quadratic, exponential equations).	**Create an equation in one variable** (i.e., linear, quadratic, exponential equations).	Determine if an equation can be used to describe a given situation.

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Reasoning with Equations & Inequalities (A-REI)	**Predict, without solving,** when a radical or rational equation will have no real solutions and explain reasoning using mathematical evidence.	Solve radical and rational equations in one variable and **identify extraneous solutions**.	Solve radical **and** rational equations in one variable**.**	**Solve** a radical or a rational equation in one variable.	Verify that a number is a solution to a radical or rational equation.
	Solve quadratic equations in one variable that result in complex solutions and **construct a viable argument** to justify the advantages of one particular method over another.	Solve quadratic equations in one variable that result in complex solutions, **providing an answer in a + bi form.**	**Solve quadratic equations** in one variable that result in real or complex solutions.	Solve quadratic equations in one variable that results in a pure imaginary solution. (e.g., x = 0 +/- 2i).	Verify a solution to a quadratic equation in one variable.
	Solve a system of 3 equations in 3 variables and solve a linear-quadratic system and **construct a viable argument** to justify the advantages of one particular method over another.	Solve a system of 3 equations in 3 variables **and** solve a linear-quadratic system.	**Solve** a system of 3 equations in 3 variables or solve a linear-quadratic system.	**Select a solution** strategy for solving system of 3 equations in 3 variables or solve a linear-quadratic system.	Given a system of 3 equations in 3 variables or a linear-quadratic system, verify the solution algebraically.
	Recognize when an equation of the form f(x)=g(x) cannot be solved algebraically, and solve it graphically**.** Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$.	**Explain why** the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$. (Functions are limited to linear, polynomial, rational, or absolute value, exponential and logarithmic)	Find the exact or approximate **solutions to the equation *f(x) = g(x).*** (Functions are limited to linear, polynomial, rational, or absolute value, exponential and logarithmic)	Find the **exact or approximate solutions** to the system $y = f(x)$ and $y = g(x)$. (Functions are limited to linear, polynomial, rational, or absolute value, exponential and logarithmic)	Given a graph of $y = g(x)$ and $y = f(x)$, use integer-valued coordinates to name a point of intersection. (Functions are limited to linear, polynomial, rational, or absolute value, exponential and logarithmic)

Algebra II Performance Level Descriptions

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Interpreting Functions (F-IF)		**Generate the recursive formula** given a sequence.	**Identify** a recursively-defined sequence as a function and determine a specific term.	Identify a recursively-defined sequence as a function.	Determine the n^{th} value of an explicitly defined sequence.
	Generate an equation and sketch a graph of a function **given the key features**. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Accurately sketch and create graphs using technology and **interpret** key features of graphs and tables **in a real-world context.** (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Accurately sketch and create graphs using technology and **identify** key features of graphs and tables. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	**Create graphs using technology** and identify key features visible **within the "standard zoom"** (-10 to 10 calculator window) by hand or technology. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Identify key features on a given graph. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)
	Compare and explain the relationship between the average rates of change of two different functions over a specified interval**.** (Functions are limited to polynomial, exponential, trigonometric and logarithmic). **Generate** a function that illustrates given properties.	**Estimate, calculate, and interpret** the average rate of change over a specified interval from a graph or table. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	**Calculate** the average rate of change over a specified interval from a graph or table. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Calculate the average rate of change over a specified interval from a graph or table. (Functions are limited to **polynomial and exponential)**	Estimate the average rate of change from a polynomial or exponential graph.
	Rewrite function(s) in an equivalent form **in order to compare the** properties of two functions. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Rewrite a function in an equivalent form to **interpret** properties of the function.	Rewrite a function in an equivalent form to **identify** properties of the function.	Identify different but equivalent forms of the same function.	

(F-IF continued)		Compare properties of two functions with each represented in a different way (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions). (Functions are limited to polynomial, exponential, **trigonometric** and logarithmic)	Compare properties of two functions with each represented in a different way (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions). (Functions are limited to polynomial, exponential and **logarithmic**)	Compare properties of two functions with each represented in a different way (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions). (Functions are limited to **polynomial and exponential)**	Compare properties of two functions represented in the **same way** (i.e., algebraically, graphically, or numerically in tables). (Functions are limited to polynomial and exponential)

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Building Functions (F-BF)		**Determine** and write the function that generates an arithmetic or geometric sequence in a real world context.	**Write the function** that generates an arithmetic or geometric sequence.	**Write a qualitative or narrative description of** an arithmetic or geometric sequence.	Identify the descriptive characteristics of an arithmetic versus geometric pattern.
	Justify that a specific recursively-defined and explicit formula represent the same sequence.	Write sequences **both recursively and** as an explicit formula.	**Write sequences** as an explicit formula.	Identify a sequence as **represented recursively.**	Identify a sequence as represented by an explicit formula.
	Combine **and interpret** functions using arithmetic operations in context.	Combine functions using arithmetic operations **in context**.	Combine functions using **arithmetic operations**.	Combine functions using **addition and subtraction.**	Combine functions of the same function family, using addition and subtraction.
	Justify algebraically whether a function is even or odd.	Identify the effect on a graph of replacing $f(x)$ with $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$. Find the value of k given the graphs. Identify even and odd functions from their graphs **and algebraic expressions.** (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Identify the effect on a graph of replacing $f(x)$ with $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$. Find the value of k given the graphs. **Identify even and odd functions from their graphs.** (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Identify the effect on a graph of replacing $f(x)$ with $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$. **Find the value of k given the graphs.** (Functions are limited to polynomial, exponential, trigonometric and logarithmic)	Identify the effect on a graph of replacing $f(x)$ with $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$. (Functions are limited to polynomial, exponential, trigonometric and logarithmic)
	Justify algebraically that two functions are inverses.	Find the **inverse of a** function (other than linear) algebraically.	Find the inverse of a linear function algebraically.	Recognize that an inverse of a linear function is formed by interchanging the domain and range.	

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Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Linear, Quadratic, & Exponential Models (F-LE)	**Construct and apply** a linear and exponential function that models a **real world context**, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	**Construct and identify** linear and exponential functions that model a **real-world context**, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	Construct and identify linear and exponential functions, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	**Identify** linear and exponential functions, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	Identify linear and exponential functions, given a graph, or two input-output pairs (include reading these from a table).
	Explain the solution to an exponential equation using the relationship between exponents and logarithms. Solve exponential equations with **rational bases** or base *e*.	Solve an exponential equation and evaluate logarithms using technology. (Bases are limited to 2, 10, and ***e***)	Solve an exponential equation and evaluate logarithms using technology. (Bases are limited to **2**, 10)	**Solve an exponential equation** and evaluate logarithms using technology. (Bases are limited to 10)	Evaluate logarithms using technology (Base 10 and *e*)
	Interpret **changes in parameters** based on the comparison of two functions in terms of a real-world context.	Interpret the parameters (i.e., growth or decay factor) in an exponential function **in terms of a real-world context.**	**Interpret** the parameters (i.e., growth or decay factor) in an exponential function.	Determine if an exponential function of the form $A = Pe^{rt}$ represents growth or decay.	Determine if an exponential function of the form $f(x) = a(b)^x$ represents growth or decay.

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Trigonometric Functions (F-TF)	Explain how the **graphs** of trigonometric functions are generated from the unit circle.	Explain how the unit circle enables the extension of the six trigonometric functions to all real numbers.	Determine angle measures, in degrees/radians, and the six trigonometric ratios using the unit circle or the Pythagorean identity. Convert angle/arc measures from radians to degrees and degrees to radians.	Determine angle measures, in degrees/radians**,** and the **three basic** trigonometric ratios (sin Θ, cos Θ, and tan Θ) using the unit circle or the Pythagorean identity.	Calculate angle measures, in degrees, and three basic trigonometric ratios (sin Θ, cos Θ, and tan Θ) **using the unit circle.**
	Create appropriate trigonometric functions to model periodic phenomena **based on a verbal description of the amplitude, frequency, and midline.**	Construct an appropriate trigonometric function to model periodic phenomena by correctly interpreting **amplitude, frequency and midline**.	**Choose** an appropriate trigonometric function to model periodic phenomena by correctly interpreting amplitude, frequency, or midline.	Given a situation, determine the appropriate trigonometric function that best represents the model.	Given a graph, identify which trigonometric function is being modeled. Identify amplitude, frequency or midline of a given trigonometric model.

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Expressing Geometric Properties with Equations (G-GPE)	Derive **equivalent equations** for a parabola given its focus and its directrix.	Derive the equation of a parabola given its focus and its directrix, for a parabola of **either orientation** where the focus and the directrix are located anywhere in the coordinate plane.	**Derive the equation** of a parabola given its focus and its directrix, for a **vertically oriented** parabola where the focus is on the vertical axis or the directrix is on the horizontal axis.	**Identify the orientation** of the parabola given its focus and its directrix.	Identify the vertex for a parabola of either orientation.
	Identify the focus **and** directrix of a parabola given the equation in any form.	Identify the focus **or** directrix of a parabola given the equation in **standard form**.	Identify the focus **and** directrix of a parabola given the **graph of the parabola.**	Identify the focus **or** directrix of a parabola given the graph of the parabola.	Identify the vertex of a parabola given the equation in vertex form.
	Explain the relationship between the focus and directrix and how the parabola is formed.	Justify the relationship between the focus and directrix.	Given the graph of a parabola, show the relationship between the focus and the directrix.		

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Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Interpreting Categorical & Quantitative Data (S-ID)	**Generate and explain** why scenarios may fit a normal distribution. **Generalize** how the normal distribution relates to the mean and standard deviation.	Interpret the mean and standard deviation of the normal distribution in the context of appropriate real-world scenarios. Use the normal distribution to estimate population percentages in real-world scenarios.	**Sketch** a normal distribution model given the mean and standard deviation of a set of data.	Identify the mean and standard deviation **given a normal distribution and** calculate a z-score for a given set of data.	Identify whether data sets are approximately normal or skewed.
	Choose and justify the most appropriate model for a set of data. Generate and interpret models, and make predictions in a context.	Generate and apply an exponential or trigonometric model to a set of data. Interpret the model and predictions in a context.	Generate and **use** the exponential or trigonometric model to make predictions.	Generate exponential and trigonometric equations to model a set of data.	Generate exponential equations to model a set of data.

Algebra II Performance Level Descriptions

Domain	NYS Level 5	NYS Level 4	NYS Level 3	NYS Level 2	NYS Level 1
Making Inferences & Justifying Conclusions (S-IC)	**Compare and contrast** the purposes and differences among sample surveys, experiments, and observational studies. Make inferences and justify conclusions based on appropriate data collection methods.	**Explain how randomization is accomplished in** sample surveys, experiments, and observational studies and describe the purpose of each.	**Explain the purpose** of a sample survey, experiments, and observational study.	**Identify which method** of data collection is appropriate to a given context.	Describe how randomization affects a sample.
	Create and **interpret** an interval of plausible values containing the middle 95% of data.	**Develop a margin of error** based on the results of a sample when estimating a population mean or proportion.	**Estimate** a population mean or proportion using sample data.	**Calculate** sample means and proportions.	Identify sample means and sample proportions.
	Explain how a simulation could be used to justify conclusions from a statistical study.	**Interpret the results of simulations** in the context of a data collection method.	Understand the purpose of a simulation and **determine** if a given model is consistent with the results of a simulation involving proportions.		
	Use a rerandomization simulation to decide if the difference in means is significant and **explain** the conclusion in the context of the problem.	Use a rerandomization simulation to decide if the difference in means is significant.	**Calculate and interpret** the difference of the means in a controlled experiment.	Compare two treatments in a controlled experiment.	Calculate the difference of means in a controlled experiment.
	Construct a viable argument and/or critique the reasoning of a claim based on statistical evidence, **using statistical language**.	Identify the evidence needed and **evaluate** a claim based on statistical evidence.	**Identify the statistical evidence** needed to evaluate a claim.	Given the statistical evidence, determine if a claim is likely to be true or not true.	

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Conditional Probability & the Rules of Probability (S-CP)	**Construct and interpret** a two-way table given a verbal description.	**Calculate conditional probabilities** given a two-way table.	**Calculate probabilities** given a two-way table.	Calculate **relative frequencies** given a two-way table.	
	Create, explain and interpret two independent events using concepts of conditional probability in verbal descriptions or two-way tables.	**Explain why** two events are independent using concepts of conditional probability in verbal descriptions or two-way tables.	**Determine if** two events are independent using concepts of conditional probability in verbal descriptions or two-way tables.		
		Calculate the conditional probability of A given B as the fraction of B's outcomes that also belong to A and **interpret** the answer in terms of the model.	Calculate the conditional probability of A given B given P(A and B) and P(B).	Identify P(A), P(A and B), and P(B).	
	Choose and apply appropriate subsets of a sample space in order to compute probabilities of events and interpret the results in the given context**.**	**Apply** subsets of a sample space in order to compute probabilities of events and interpret the results in the given context**.**	Apply subsets of a sample space in order to compute probabilities of events in the given context.	Identify subsets of a sample space.	List the sample space of a probability experiment.