# CMAS Integrated Math II Performance Level Descriptors
## (Based on PARCC)

In 2018, Colorado will continue to use the performance level descriptors (PLDs) that were developed in collaboration with the Partnership for Assessment of Readiness for College and Careers (PARCC) consortium to describe performance on the CMAS assessments.

| | Math II: Sub-Claim A | | | |
|---|---|---|---|---|
| | The student solves problems involving the Major Content for the grade/course with connections to the Standards for Mathematical Practice. | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| **Quadratics and Exponential Expressions**<br><br>A.SSE.1-2<br>A.SSE.2-2<br>A.SSE.2-5<br>A.SSE.3a<br>A.SSE.3b | Interprets the structure of equivalent quadratic and exponential expression that contain **real** exponents.<br><br>**Writes** equivalent expressions to reveal information by viewing one or more of their parts as a single entity, **including factoring and completing the square for quadratics.** | **Interprets the structure of equivalent quadratic and exponential expressions (with rational exponents) to reveal information by viewing at least one of their parts as a single entity.** | Identifies equivalent **quadratic and** exponential expressions with integer exponents. | Identifies equivalent exponential expressions with integer exponents. |
| **Quadratic Equations**<br><br>A.REI.4a-1<br>A.REI.4b-1<br>A.REI.4b-2<br>A.CED.4-2<br>HS.Int.2 | Solves quadratic equations in one variable with **real** coefficients, **using methods appropriate to the initial form,** including completing the square, inspection, taking square roots, the quadratic formula and factoring.<br>**Recognizes when the quadratic formula give complex solutions** | **Solves** quadratic equation in one variable with rational coefficients, **using method including completing the square, inspection, taking square roots, the quadratic formula or factoring.** | Identifies solutions to quadratic equations in one variable with integer **or rational** coefficients. | Identifies solutions to quadratic equations in one variable with integer coefficients. |
| **Graphing Exponential and Quadratic Functions**<br>F.IF.4-4<br>F.IF.5-2 HS.Int-1 | **Writes** quadratic and exponential functions, determines key features, graphs functions and solves problems in contextual situations.<br><br>Determines domains **and relates them to the quantitative relationship described** for quadratic functions. | **For quadratic and exponential functions that model contextual relationships, determines** key features **and sketches graphs of functions.**<br><br>**Determines domains of quadratic functions.** | Identifies key features of quadratic and exponential functions. | **Given a graph**, identifies key features of quadratic and exponential functions. |
| **Rate of Change**<br>F.IF.6-4<br>F.IF.6-9 | Calculates **and interprets** the average rate of change of exponential and quadratic (presented symbolically or as a table) over a specified interval, and estimates the rate of change from a graph.<br>**Compares rates of change associated with different intervals.** | Calculates the average rate of change of exponential and quadratic functions (presented symbolically or as a table) over a specified interval **and estimate the rate of change from a graph.** | Calculates the average rate of change of exponential and quadratic functions (presented **symbolically** or as a table) over a specified interval. | Calculates the average rate of change of exponential and quadratic functions (presented as a table) over a specified interval. |

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| **Polynomial, Rational and Radical Expressions** N.RN.2 A.APR.1-1 | Adds, subtracts and multiplies **three or more** polynomials. Using the properties of exponents, rewrites expressions containing **radicals and** rational exponents. | **Adds, subtracts and multiplies two polynomials.** **Using the properties of exponents, rewrites expressions** containing **rational exponents.** | Identifies equivalent expressions when adding, subtracting and **multiplying** polynomials and expressions containing integer exponents. | Identifies equivalent expressions when adding and subtracting polynomials and expressions containing integer exponents. |
| **Similarity** G.SRT.1a G.SRT.1b G.SRT.2 G.SRT.5 | Uses transformations **and congruence and similarity criteria for triangles to prove** relationships among geometric figures and to solve problems. | **Uses** transformations to **determine** relationships **among simple** geometric figures **and to solve problems.** | Identifies transformation relationships in simple geometric figures. | Identifies transformation relationships in simple geometric figures in cases where an image is provided. |
| **Similarity in Trigonometry** G.SRT.6 G.SRT.7-2 G.SRT.8 | Uses trigonometric ratios, the Pythagorean Theorem and the relationship between sine and cosine to solve right triangles in applied problems. **Uses similarity transformations with right triangles to define trigonometric ratios for acute angles.** | Uses trigonometric ratios, the Pythagorean Theorem **and the relationship between sine and cosine to solve right triangles in applied problems.** | Uses trigonometric ratios and the Pythagorean Theorem to determine the unknown side lengths and **angle measurements** of a right triangle. | Uses trigonometric ratios and the Pythagorean Theorem to determine the unknown side lengths of a right triangle. |

| | Math II: Sub-Claim B | | | |
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| | The student solves problems involving the Additional and Supporting Content for the grade/course with connections to the Standards for Mathematical Practice. | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| **Probability** S.CP.Int.1 | Recognizes, determines and uses conditional probability and independence in **multi- step contextual** problems, using appropriate set language and appropriate representations, including two-way frequency tables. **Applies the Addition Rule of probability.** | Recognizes, determines **and uses** conditional probability and independence in contextual problems, **using appropriate set language and appropriate representations, including two-way frequency tables.** | Recognizes and determines **conditional probability** and independence in contextual problems. | Recognizes and determines independence in contextual problems. |
| **Statistics** S.ID.6a-1 S.ID.Int.2 | Represents data on scatter plots and describes how the variables are related. Fits quadratic functions to data to solve problems in the context of the data **and informally assesses the fit of functions by plotting and analyzing residuals.** | Represents data on scatter plots **and describes how the variables are related.** Informally, determines whether quadratic models are a good fit. **Fits quadratic functions to data to solve** | Represents data on scatter plots. Informally, determines whether quadratic models are a good fit. **Uses fitted quadratic functions to solve contextual problems.** | Represents data on scatter plots. Informally, determines whether quadratic models are a good fit. |

| | Math II: Sub-Claim B<br>The student solves problems involving the Additional and Supporting Content for the grade/course with connections to the Standards for Mathematical Practice. | | | |
|---|---|---|---|---|
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| | | **problems in the context of the data.** | | |
| **Geometric Formulas**<br>G.GMD.1<br>G.GMD.3 | **Uses volume formulas to solve mathematical and contextual problems that involve cylinders, pyramids, cones and spheres.**<br><br>Uses dissection arguments, **Cavalieri's principle and informal limit arguments to support** the formula for the circumference of a circle, area of a circle, **volume of a cylinder**, **pyramid, and cone.** | Using formulas, determines the volume of cylinders, pyramids, cones and spheres.<br><br>**Gives an informal argument for the formula for the circumference of a circle and area of a circle, including dissection arguments.** | Using formulas, determines the volume of cylinders, pyramids, cones and spheres. | Using formulas, determines the volume of cylinders, pyramids, cones and spheres. |
| **Graphs**<br>F.IF.7a-2 F.IF.7b<br>F.IF.7e-1<br>F.BF.3-1<br>F.BF.3-4 HS-Int.2 | Graphs **and compares** exponential, quadratic, **square root, cube root, piece-wise-defined functions (including step functions and absolute value functions),** identifying intercepts, maxima and minima, end behavior and zeros.<br><br>Identifies and illustrates the effect on linear and quadratic graphs of replacing f($x$) by f($x$)+k, kf($x$), f(kx), and f($x$+k) for specific values of $k$.  Finds the values of $k$ given the graphs. | **Graphs exponential and quadratic functions,** identifying intercepts, maxima and minima, end behavior and zeros**.**<br><br>Identifies and illustrates the effect on linear and quadratic graphs of replacing f($x$) by one of the following: f($x$)+k, kf($x$), f(kx), and f($x$+k) for specific values of $k$. **Finds the values of $k$ given the graphs.** | Identifies intercepts, maxima and minima, **end behavior** and zeros from graphs<br><br>Identifies the effect on linear and quadratic graphs of replacing f($x$) by one of the following f($x$)+k, **kf($x$), f(kx), and f($x$+k)** for specific values of $k$. | Identifies intercepts, maxima and minima and zeros from graphs.<br><br>Identifies the effect on linear and quadratic graphs of replacing f($x$) by f($x$)+k for specific values of $k$. |
| **Multiple Representations of Functions**<br>A.REI.7 F.Int.1-4<br>F.BF.1b-1 F.IF.8a<br>F.IF.8b F.IF.9-4<br>HS.Int.1 | Writes quadratic or exponential functions defined by expressions in different but equivalent forms to reveal and explain different properties of the functions, including zeros, extreme values, symmetry and percent rate of change.<br><br>Within a context, compares properties of two functions represented in different ways (algebraically, graphically, numerically or verbally).<br><br>**Solves a simple system of linear and quadratic equations algebraically or** | **Writes quadratic or exponential functions defined by expressions in different but equivalent forms to reveal and explain different properties of the functions,** including zeros, extreme values, **symmetry** and percent rate of change.<br><br>**Within a routine context,** compares properties of two functions **represented in different ways (algebraically, graphically, numerically or verbally).**<br><br>**Given a graph, solves a system of a linear** | Given equivalent expressions, identifies features of **quadratic or** exponential functions, including zeros, extreme values and percent rate of change.<br><br>**Compares properties of two functions within the same representation.** | Given equivalent expressions, identifies features of exponential functions, including zeros, extreme values and percent rate of change. |

| | Math II: Sub-Claim B | | | |
|---|---|---|---|---|
| | The student solves problems involving the Additional and Supporting Content for the grade/course with connections to the Standards for Mathematical Practice. | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| | **graphically.**<br><br>**Combines standard functions using arithmetic operations.** | **and quadratic equations.** | | |
| **Number Systems** N.RN.B-1 N.CN.1 N.CN.2 N.CN.7 | Identifies rational, irrational and complex numbers.<br><br>Uses commutative, associative and distributive properties to **perform operations with complex numbers.**<br><br>Calculates sums and products of two rational and/or irrational numbers **and determines whether and generalizes when the sums and products are rational or irrational.** | Identifies rational, irrational and complex numbers.<br><br>Uses commutative, associative and **distributive** properties to perform operation with complex numbers.<br><br>**Calculates sums and products of two rational and/or irrational numbers.** | Identifies rational, irrational and complex numbers.<br><br>Uses commutative and associative properties to add and subtract complex numbers **and to multiply a complex number by a real number.** | Identifies rational, irrational and complex numbers.<br><br>Uses commutative and associative properties to add and subtract complex numbers. |

| | Math II: Sub-Claim C | | | |
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| | In connection with content, the student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others and/or attending to precision when making mathematical statements | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| **Reasoning** HS.C.2.1 HS.C.3.1 HS.C.3.2 HS.C.5.5 HS.C.8.1 HS.C.9.1 HS.C.12.1 HS.C.12.2 HS.C.14.5 HS.C.14.6 HS.C.15.14 HS.C.16.2 HS.C.18.3 | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, the student clearly constructs and communicates a **complete response** based on:<br>• the principle that the graph of an equation in two variables is the set of all its solutions<br>• reasoning about linear and exponential growth<br>• properties of rational numbers or irrational numbers<br>• transformations of functions<br>• a chain of reasoning to justify or refute algebraic, function- related, or linear equation propositions or conjectures | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, the student clearly constructs and communicates a response based on:<br>• the principle that the graph of an equation in two variables is the set of all its solutions<br>• reasoning about linear and exponential growth<br>• properties of rational numbers or irrational numbers<br>• transformations of functions<br>• a chain of reasoning to justify or refute algebraic, function- related, or linear equation propositions or conjectures | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, the student constructs and communicates a **partial response** based on:<br>• the principle that the graph of an equation in two variables is the set of all its solutions<br>• reasoning about linear and exponential growth<br>• properties of rational numbers or irrational numbers<br>• transformations of functions<br>• a chain of reasoning to justify or refute algebraic, function- related, or linear equation propositions or conjectures | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, the student constructs and communicates an incomplete response based on:<br>• the principle that the graph of an equation in two variables is the set of all its solutions<br>• reasoning about linear and exponential growth<br>• properties of rational numbers or irrational numbers<br>• transformations of functions<br>• a chain of reasoning to justify or refute algebraic, function- related, or linear equation propositions or |

| | Math II: Sub-Claim C | | | |
|---|---|---|---|---|
| | In connection with content, the student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others and/or attending to precision when making mathematical statements | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| | • a given equation or system of equations by: | • a given equation or system of equations by: | • a given equation or system of equations by: | conjectures<br>• a given equation or system of equations by: |
| | • using a logical approach based on a conjecture and/or stated assumptions, utilizing mathematical connections (when appropriate)<br>• providing an **efficient and** logical progression of steps or chain of reasoning with appropriate justification<br>• performing precise calculations<br>• using correct grade- level vocabulary, symbols and labels<br>• providing a justification of a conclusion<br>• determining whether an argument or conclusion is generalizable.<br>• evaluating, interpreting and critiquing the validity of others' responses, approaches and reasoning – utilizing mathematical connections (when appropriate) – and **providing a counter-example where applicable** | • using a logical approach based on a conjecture and/or stated assumptions, **utilizing mathematical connections (when appropriate)**<br>• providing a **logical** progression of steps or chain of reasoning **with appropriate justification**<br>• **performing precise calculations**<br>• using **correct** grade-level vocabulary, symbols and labels<br>• providing a **justification** of a conclusion<br><br>• **evaluating, interpreting and critiquing the validity of others' responses, approaches and reasoning – utilizing mathematical connections (when appropriate).** | • **using a logical approach based on a conjecture and/or stated assumptions**<br>• **providing a logical, but incomplete, progression of steps or chain of reasoning**<br><br>• **performing minor calculation errors**<br>• using **some** grade-level vocabulary, symbols and labels<br>• providing a partial justification of a conclusion based on own calculations<br><br>• **evaluating the validity of others' approaches and conclusions** | • using an approach based on a conjecture and/or stated or faulty assumptions<br>• providing an incomplete or illogical progression of steps or chain of reasoning<br>• making an intrusive calculation error<br>• using limited grade-level vocabulary, symbols and labels<br>• providing a partial justification of a conclusion based on own calculations |

| | Math II: Sub-Claim D | | | |
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| | In connection with content, the student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice, and where helpful making sense of problems and persevering to solve them, reasoning abstractly, and quantitatively, using appropriate tools strategically, looking for the making use of structure and/or looking for and expressing regularity in repeated reasoning. | | | |
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| **Modeling**<br>HS.D.1-2<br>HS.D.2-1<br>HS.D.2-2<br>HS.D.2-6<br>HS.D.2-9<br>HS.D.2-11 | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, devises and enacts a plan to apply mathematics in solving problems arising in everyday life, society and the workplace by:<br>• using stated assumptions and making | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, devises and enacts a plan to apply mathematics in solving problems arising in everyday life, society and the workplace by:<br>• using stated assumptions **and making** | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, devises and enacts a plan to apply mathematics in solving problems arising in everyday life, society and the workplace by:<br>• using stated assumptions and | In connection with the content knowledge, skills, and abilities described in Sub-claims A and B, devises a plan to apply mathematics in solving problems arising in everyday life, society and the workplace by:<br>• using stated assumptions and |

| | | Math II: Sub-Claim D<br>In connection with content, the student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice, and where helpful making sense of problems and persevering to solve them, reasoning abstractly, and quantitatively, using appropriate tools strategically, looking for the making use of structure and/or looking for and expressing regularity in repeated reasoning. | | |
|---|---|---|---|---|
| | **Level 5: Exceeded Expectations** | **Level 4: Met Expectations** | **Level 3: Approached Expectations** | **Level 2: Partially Met Expectations** |
| HS.D.3-2b<br>HS.D.3-4b | assumptions and approximations to simplify a real-world situation (includes micro-models)<br>• mapping relationships between important quantities<br>• selecting appropriate tools to create models<br>• analyzing relationships mathematically between important quantities to draw conclusion<br>• **analyzing and/or creating constraints, relationships and goals**<br>• interpreting mathematical results in the context of the situation | **assumptions** and approximations to simplify a real-world situation **(includes micro-models)**<br>• **mapping relationships between** important quantities<br>• **selecting appropriate** tools to create models<br>• analyzing relationships mathematically between important quantities to draw conclusions<br>• interpreting mathematical results **in the context of the situation** | approximations to simplify a real-world situation<br>• **illustrating relationships between** important quantities<br>• using provided tools to create models<br>• analyzing relationships mathematically **between important quantities** to draw conclusions<br>• **interpreting mathematical results in a simplified context** | approximations to simplify a real-world situation<br>• identifying important quantities<br>• using provided tools to create models<br>• analyzing relationships mathematically to draw conclusions |