

Summative Mathematics Crosswalk

The chart below includes the California Content Standards assessed on the Summative Mathematics California Standards Test, the ELM Topics (taken from *Focus on Mathematics*), the ELM Specifications for the EAP, the Competencies in Mathematics from the Intersegmental Committee of the Academic Senate (ICAS), and the American Diploma Project (ADP) Benchmarks in Mathematics. The standards highlighted in purple are the standards assessed on the EAP subset of CST items. The standards highlighted in green are additional standards assessed by the augmentation items. Some of the augmentation items also address standards already assessed by the CST subset (highlighted in purple). Taken together, the purple and green highlighted standards constitute the full range of California Content Standards measured on the EAP. The standards not highlighted are the standards assessed on the full CST but are not selected for inclusion on the EAP. The purpose of this crosswalk is to show if there is any alignment between the ELM Topics, ELM Specifications, ICAS Competencies, and ADP Benchmarks to the California Content Standards. It is intended to be read left-to-right. Differences in the varying levels of purpose and specificity among these sets of standards should be considered when drawing conclusions.

California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
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**Red font indicates a passage that is not addressed in the compared sets of standards.**

**ALGEBRA I CONTENT STANDARDS**

<p><b>2.0</b> Students understand and use such operations as taking the opposite, finding the reciprocal, taking a root, and raising to a fractional power. They understand and use the rules of exponents.</p>	<p><b>A.01</b> Evaluate and interpret algebraic expressions  <b>A.04</b> Use properties of exponents  <b>N.08</b> Evaluate and estimate square roots</p>	<p><b>4.1</b> Evaluate &amp; interpret algebraic expressions (including function notation, rational exponents, and radicals).  <b>4.4</b> Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; <u>powers and roots</u>; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.  <b>3.3.2.</b> Functions: Logarithmic functions, their graphs, and applications; trigonometric functions of real variables, their graphs, properties including periodicity, and applications; basic trigonometric identities; operations on functions, including addition, subtraction, multiplication, <u>reciprocals</u>, division, composition, and iteration; inverse functions and their graphs; domain and range.  <b>A.7.</b> Apply laws of exponents.</p>	<p><b>J2.2.</b> Determine the relative position on the number line of numbers and the relative magnitude of numbers expressed in fractional form, in decimal form, <u>as roots</u> or in scientific notation.  <b>J1.1.</b> Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions. [ADP Core]  <b>J1.2.*</b> Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.  <b>J2.3.</b> Understand functional notation and evaluate a function at a specified point in its domain.</p>	<p>This CA standard generally addresses "operations" but includes a "such as" list of 5 specific skills. The ELM Topics only address 2 of them, ICAS 3, and ADP 3. Finding a reciprocal is not included in either ELM Topics or Specs. Missing from all four is taking an opposite.</p>
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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>3.0</b> Students solve equations and inequalities involving absolute values.</p>	<p><b>A.13</b> Solve equations involving absolute value (in one variable) <b>A.14</b> Solve inequalities involving absolute value (in one variable)</p>	<p><b>4.6</b> Solve simple equations &amp; inequalities in one variable involving absolute value.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; <u>solutions of linear equations and inequalities</u>; <u>absolute value</u>; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.</p>	<p><b>J3.1.</b> Solve linear equations and inequalities in one variable including those <u>involving the absolute value</u> of a linear function. [ADP Core]</p>	
<p><b>4.0*</b> Students simplify expressions prior to solving linear equations and inequalities in one variable, such as <math>3(2x-5) + 4(x-2) = 12</math>.</p>	<p><b>A.02</b> Simplify algebraic expressions <b>A.07</b> Solve linear equations (with both numerical and literal coefficients) <b>A.09</b> Solve linear inequalities</p>	<p><b>4.6</b> Solve simple equations &amp; inequalities in one variable involving absolute value.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; <u>solutions of linear equations and inequalities</u>; <u>absolute value</u>; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and <u>as a means for solving problems</u>, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols. <b>A.2.</b> Combine like terms in algebraic expressions.</p>		<p>This concept is covered well in ELM Topics but does not address the concept of simplifying linear expressions as a step in the equation solution process. The ELM Spec seems to be specifically restricted to absolute value linear equations while the CA standard and ELM Topics do not have that restriction. It is included in lower grade benchmarks in ADP. The ICAS requirement actually appear to be counter to that of the CA standard, since it calls for decreased emphasis on manipulation of symbols.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>5.0*</b> Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.</p>	<p><b>A.07</b> Solve linear equations (with both numerical and literal coefficients)  <b>A.09</b> Solve linear inequalities  <b>A.10</b> Solve problems in context that are modeled by linear equations</p>		<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; <u>solutions of linear equations and inequalities</u>; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and <u>as a means for solving problems</u>, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.</p>	<p><b>J3.1.</b> Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function. [ADP Core]  <b>J5.1.</b> Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage increase or decrease problems, and ratio and proportion problems. [ADP Core]  <b>J5.2.</b> Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.  <b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.</p>	<p>Justification for the steps of the algebraic solution is not addressed in ELM and ICAS. Contextual problems in the ELM Specs are only required for quadratic equations (See 4.5).</p>

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<p><b>6.0*</b> Students graph a linear equation and compute the x- and y- intercepts (e.g., graph <math>2x + 6y = 4</math>). They are also able to sketch the region defined by linear inequality (e.g., they sketch the region defined by <math>2x + 6y &lt; 4</math>).</p>	<p><b>A.09</b> Solve linear inequalities  <b>A.15</b> Find and use slopes and intercepts of lines  <b>G.10</b> Graph linear functions in one variable  <b>G.09</b> Plot points on the graph of a function determined by an algebraic expression</p>	<p><b>7.3</b> Graph linear and simple quadratic functions in one variable.  <b>7.4</b> Relate basic information about a function to features of its graphs (e.g. linearity, positivity or negativity, increasing or decreasing).</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.  <b>3.1.2.</b> Families of Functions and Their Graphs: Applications; <u>linear functions</u>; quadratic and power functions; exponential functions; roots; operations on functions and the corresponding effects on their graphs; <u>interpretation of graphs</u>; function notation; functions in context, as models for data. Increased emphasis should be placed on various representations of functions-using graphs, tables, variables, words -and on the interplay among the graphical and other representations, while decreased emphasis should be placed on repeated manipulations of algebraic expressions.</p>	<p><b>J4.1.</b> Graph a linear equation and demonstrate that it has a constant rate of change. [ADP Core]  <b>J4.2.</b> Understand the relationship between the coefficients of a linear equation and the slope and x- and y- intercepts of its graph.  <b>J4.4.</b> Graph the solution set of a linear inequality and identify whether the solution set is an open or a closed half-plane; graph the solution set of a system of two or three linear inequalities.</p>	<p>The ELM and ICAS standards are missing the graph of an inequality, while ADP matches but goes beyond the CA standard by including the relationship between the equation and the graph. ELM Spec 7.4 generally addresses computation of x- and y- intercepts as basic information about the function gathered from the graph.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>7.0*</b> Students verify that a point lies on a line, given an equation of the line. Students are able to derive linear equations using the point-slope formula.</p>	<p><b>A.01</b> Evaluate and interpret algebraic expressions  <b>G.09</b> Plot points on the graph of a function determined by an algebraic expression  <b>A.8.</b> Plot points that are on the graph of a function.</p>	<p><b>4.1</b> Evaluate &amp; interpret algebraic expressions (including function notation, rational exponents, and radicals).</p>		<p><b>J4.2.</b> Understand the relationship between the coefficients of a linear equation and the slope and x- and y-intercepts of its graph.  <b>K10.2.</b> Describe a line by a linear equation.</p>	<p>Neither ELM nor ICAS addresses the use of coordinates to derive the equation of a line. The ADP Benchmark does not address verification that a given point is on a line and its focus is on slope-intercept while the CA standard focuses on point-slope</p>
<p><b>8.0</b> Students understand the concepts of parallel lines and perpendicular lines and how those slopes are related. Students are able to find the equation of a line perpendicular to a given line that passes through a given point.</p>		<p><b>6.3</b> Determine angles in the plane <u>using properties of intersecting lines, parallel lines, and perpendicular lines.</u></p>		<p><b>K10.1.</b> Express the intuitive concept of the “slant” of a line in terms of the precise concept of slope, use the coordinates of two points on a line to define its slope, and use slope to express the parallelism and perpendicularity of lines.  <b>K10.2.</b> Describe a line by a linear equation.</p>	<p>In ICAS Data standards, students are required to write an equation of a line of good fit in examples. No other requirements exist in ICAS or ELM in this regard. This is another example of an ELM Spec that aligns with the CA standard where there is no comparable ELM Topic.</p>
<p><b>10.0*</b> Students add, subtract, multiply, and divide monomials and polynomials. Students solve multistep problems, including word problems, by using these techniques.</p>	<p><b>A.05</b> Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)</p>	<p><b>4.2</b> Divide and factor polynomials (with emphasis on quadratic polynomials).</p>	<p><b>A.2.</b> Combine like terms in algebraic expressions.  <b>A.3.</b> Use the distributive law for monomials and binomials.  <b>A.4.</b> Factor monomials out of algebraic expressions.</p>	<p><b>J1.3.</b> Add, subtract and multiply polynomials; divide a polynomial by a low degree polynomial.  <b>J2.4.*</b> Combine functions by composition, as well as by <u>addition, subtraction, multiplication and division.</u></p>	<p>ELM Specs do not include all operations with polynomials - just division. In ICAS there is no clear reference to addition, subtraction, multiplication, and division. However addition and subtraction would be implied by the combining of like terms, multiplication by distribution, and division by both distribution and factoring.</p>

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<p><b>11.0</b> Students apply basic factoring techniques to second-and simple third-degree polynomials. These techniques include finding a common factor for all terms in a polynomial, recognizing the difference of two squares, and recognizing perfect squares of binomials.</p>	<p>A.05 Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)</p>	<p><b>4.2</b> Divide and factor polynomials (with emphasis on quadratic polynomials).</p>	<p><b>A.3.</b> Use the distributive law for monomials and binomials. <b>A.4.</b> Factor monomials out of algebraic expressions.</p>	<p>J1.4. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.</p>	<p>The specific techniques for factoring are not addressed in ELM, ICAS, or ADP.</p>
<p><b>12.0*</b> Students simplify fractions with polynomials in the numerator and denominator by factoring both and reducing them to the lowest terms.</p>	<p><b>A.02</b> Simplify algebraic expressions <b>A.05</b> Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)</p>	<p><b>4.2</b> Divide and factor polynomials (with emphasis on quadratic polynomials).</p>	<p><b>A.3.</b> Use the distributive law for monomials and binomials. <b>A.4.</b> Factor monomials out of algebraic expressions.</p>	<p><b>J1.4.</b> Factor polynomials by removing the greatest common factor; factor quadratic polynomials. <b>J1.5.</b> Add, subtract, multiply, divide and <u>simplify rational expressions.</u></p>	<p>Both ICAS and ELM Topics address simplifying algebraic expressions in general, especially those containing polynomials, but both are missing an important reference to simplification of rational expressions in particular. The ELM Spec specifically addresses polynomials but relates to rational expressions made up of polynomials through division.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>14.0*</b> Students solve a quadratic equation by factoring or completing the square.</p>	<p><b>A.11</b> Solve quadratic and rational equations (with both numerical and literal coefficients; real solutions only)</p>	<p><b>4.4</b> Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients. <b>4.2</b> Divide and factor polynomials (with emphasis on quadratic polynomials).</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.</p>	<p><b>J3.5.</b> Solve quadratic equations in one variable. [ADP Core] <b>J1.4.</b> Factor polynomials by removing the greatest common factor; factor quadratic polynomials.</p>	<p>Solving rational equations is not required in the CA standard but is in ELM. Specific methods for finding solutions of quadratic equations is not included in other standards but is in the CA standard.</p>
<p><b>15.0*</b> Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems.</p>	<p><b>N.02</b> Understand and use percent in context <b>N.05</b> Interpret and use ratio and proportion in context <b>A.10</b> Solve problems in context that are modeled by linear equations <b>A.16</b> Use constant and average rates to solve problems in context (using appropriate units)</p>	<p><b>4.4</b> Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols. <b>A.1.</b> Perform arithmetic with signed numbers, including fractions and percentages.</p>	<p><b>I1.2.</b> Calculate and apply ratios, proportions, rates and percentages to solve problems. <b>J5.1.</b> Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage increase or decrease problems, and ratio and proportion problems. [ADP Core]</p>	<p>ELM Specs do not include applications with any other than quadratic functions (See 4.5). ICAS does not specifically mention ratio-based problem solving in its statements. However the examples for 3.1.1 are proportion problems. In addition examples following 3.1.5 (in Data) include percentage and mixture.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>20.0*</b> Students use the quadratic formula to find the roots of a second-degree polynomial and to solve quadratic equations.</p>	<p><b>A.11</b> Solve quadratic and rational equations (with both numerical and literal coefficients; real solutions only)</p>	<p>4.4 Find real solutions to simple equations (including <u>quadratic</u> and rational), with both numerical and literal coefficients.</p>	<p><b>A.6.</b> Solve quadratic equations of one variable.</p>	<p><b>J3.5.</b> Solve quadratic equations in one variable. [ADP Core]  <b>J4.5.</b> Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph. [ADP Core]</p>	<p>Neither ADP, ICAS, nor ELM specifically require use of the quadratic formula.</p>
<p><b>22.0</b> Students use the quadratic formula or factoring techniques or both to determine whether the graph of a quadratic function will intersect the x-axis in zero, one, or two points.</p>	<p><b>G.11</b> Graph quadratic functions in one variable</p>	<p>4.4 Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients.            4.2 Divide and factor polynomials (with emphasis on quadratic polynomials).            7.4 Relate basic information about a function to features of its graphs (e.g. linearity, positivity or negativity, increasing or decreasing).</p>		<p><b>J4.5.</b> Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph. [ADP Core]  <b>J4.8.</b> Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem. [ADP Core]</p>	<p>Only ADP and ELM require graphing quadratic functions. Only ADP requires analysis of the graph and the connection between the solutions and the zeros. Neither ELM Topics or Specs specifically address the number of x-intercepts but ELM Specs include the general statement regarding the features of a graph.</p>
<p><b>23.0*</b> Students apply quadratic equations to physical problems, such as the motion of an object under the force of gravity.</p>	<p><b>A.12</b> Solve problems in context that are modeled by quadratic equations</p>	<p>4.5 Solve problems in context that are modeled by quadratic equations.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; <u>solutions of quadratic equations</u>; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and <u>as a means for solving problems</u>, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.</p>	<p><b>J5.3.</b> Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity. [ADP Core]</p>	

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<b>GEOMETRY CONTENT STANDARDS</b>					
<p><b>3.0</b> Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.</p>			<p><b>3.1.6.</b> Argumentation and Proof: Mathematical implication; hypotheses and conclusions; direct and indirect reasoning; inductive and deductive reasoning. Increased emphasis should be placed on constructing and <u>recognizing valid mathematical arguments</u>, while decreased emphasis should be placed on mathematical proofs as formal exercises.</p> <p><b>3.3.4.</b> Argumentation and Proof: Mathematical induction and <u>formal proof</u>. Attention should be paid to the distinction between plausible, informal reasoning and complete, rigorous demonstration.</p>	<p><b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.</p> <p><b>MR3.</b> Understanding the role of definitions, proofs and <u>counterexamples</u> in mathematical reasoning; constructing simple proofs. [ADP Core]</p>	<p>ICAS does not specifically require counterexamples as a method of disproving a statement.</p>
<p><b>4.0</b> Students prove basic theorems involving congruence and similarity.</p>	<p><b>G.04</b> Use properties of congruent or similar geometric objects</p>	<p><b>6.1</b> Recognize and use the properties of congruent or similar geometric objects.</p> <p><b>5.2</b> Calculate the ratio of corresponding geometric measurements of similar figures (e.g. if the perimeters are in a 3:2 ratio, the areas are in a 9:4 ratio).</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; <u>similarity</u>; <u>congruence</u>; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>3.3.4.</b> Argumentation and Proof: Mathematical induction and <u>formal proof</u>. Attention should be paid to the distinction between plausible, informal reasoning and complete, rigorous demonstration.</p>	<p><b>K3.</b> Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems. [ADP Core]</p> <p><b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.</p> <p><b>MR3.</b> Understanding the role of definitions, proofs and counterexamples in mathematical reasoning; constructing simple proofs. [ADP Core]</p>	<p>ELM requires use of the properties but not their proofs.</p>

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<p><b>5.0</b> Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles.</p>	<p><b>G.04</b> Use properties of congruent or similar geometric objects</p> <p><b>G.06</b> Determine angles in the plane (using properties of intersecting lines, parallel lines, and perpendicular lines)</p>	<p><b>5.2</b> Calculate the ratio of corresponding geometric measurements of similar figures (e.g. if the perimeters are in a 3:2 ratio, the areas are in a 9:4 ratio).</p> <p><b>6.1</b> Recognize and use the properties of congruent or similar geometric objects.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; <u>similarity</u>; <u>congruence</u>; lines, <u>triangles</u>, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>3.3.4.</b> Argumentation and Proof: Mathematical induction and <u>formal proof</u>. Attention should be paid to the distinction between plausible, informal reasoning and <u>complete, rigorous demonstration</u>.</p> <p><b>A.11.</b> Find and use ratios from similar triangles.</p>	<p><b>K3.</b> Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems. [ADP Core]</p> <p><b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.</p> <p><b>MR3.</b> Understanding the role of definitions, proofs and counterexamples in mathematical reasoning; <u>constructing simple proofs</u>. [ADP Core]</p>	<p>ELM requires knowledge of properties of similar and congruent figures, but proof is not required in either ELM Topics or Specs.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p>7.0* Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.</p>	<p>G.05 Solve geometric problems using the properties of basic geometric figures (including triangles, quadrilaterals, polygons, and circles)</p>	<p>6.3 Determine angles in the plane <u>using properties of intersecting lines, parallel lines, and perpendicular lines.</u></p> <p>6.2 Solve geometric problems using the properties of basic geometric figures (including triangles, quadrilaterals, polygons and circles)</p>	<p>3.1.3. Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p>3.3.4. Argumentation and Proof: Mathematical induction and <u>formal proof</u>. Attention should be paid to the distinction between plausible, informal reasoning and <u>complete, rigorous demonstration</u>.</p>	<p>K2.1. Identify and apply properties of and theorems about parallel lines and use them to prove theorems such as two lines parallel to a third are parallel to each other and to perform constructions such as a line parallel to a given line through a point not on the line.</p> <p>K2.3. Identify and apply properties of and theorems about angles and use them to prove theorems such as two lines are parallel exactly when the alternate interior angles they make with a transversal are equal and to perform constructions such as the bisector of an angle.</p>	<p>ICAS and ELM Topics do not address the properties of angles and lines formed when parallel lines are cut by a transversal. They do, however, reference the properties of circles. Proof is not required in either ELM Topics or Specs. ELM Spec 6.3 picks up on what is left out of the ELM Topics, where only finding angles formed by lines is addressed. (See G.06)</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>8.0*</b> Students know, derive, and solve problems involving perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.</p>	<p><b>G.01</b> Find the perimeter, area, or volume of geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, cylinders, and combinations of these figures)</p>	<p><b>4.4</b> Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients.</p> <p><b>4.5</b> Solve problems in context that are modeled by quadratic equations.</p> <p><b>5.1</b> Find the perimeter, area, or volume of simple geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, and cylinders).</p> <p><b>6.2</b> Solve geometric problems using the properties of basic geometric figures (including triangles, quadrilaterals, polygons, and circles).</p> <p><b>7.3</b> Graph linear and simple quadratic functions in one variable.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>A.10.</b> Find areas of a right triangles.</p>	<p><b>K8.2.</b> Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the surface area of a prism, a pyramid, a cone and a sphere; and the volume of a rectangular box, a prism, a pyramid, a cone and a sphere. [ADP Core]</p>	<p>Decomposition and combinations of figures is not specifically addressed in this CA standard but is in ELM and ADP. Both ELM Topics and Specs include a reference to compound or complex figures not in the CA standard.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>9.0</b> Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.</p>		<p><b>5.1</b> Find the perimeter, area, or volume of simple geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, and cylinders). <b>5.3</b> Use perimeters, areas, and volumes of simple geometric figures to find perimeters, areas and volumes of compound geometric figures.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, <u>areas</u>, and <u>volumes</u>, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to <b>coordinate geometry in three dimensions</b>; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p>	<p><b>K8.2.</b> Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the <u>surface area</u> of a prism, a pyramid, a cone and a sphere; and the <u>volume</u> of a rectangular box, a prism, a pyramid, a cone and a sphere. [ADP Core]</p>	<p>Three dimensional coordinate geometry is in ICAS only. This alignment shows an ELM Spec that aligns where there is no comparable ELM Topic. ELM Specs do not specify which types of 3-D figures are to be included.</p>
<p><b>10.0*</b> Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.</p>	<p><b>G.01</b> Find the perimeter, area, or volume of geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, cylinders, and combinations of these figures)</p>	<p><b>5.1</b> Find the perimeter, area, or volume of simple geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, and cylinders).</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, <u>areas</u>, and <u>volumes</u>, and their relationship with dimension; angle measurement; similarity; congruence; lines, <u>triangles</u>, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas. <b>A.10.</b> Find areas of a right triangles.</p>	<p><b>K8.2.</b> Determine the perimeter of a polygon and the circumference of a circle; the <u>area</u> of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the <u>surface area</u> of a prism, a pyramid, a cone and a sphere; and the <u>volume</u> of a rectangular box, a prism, a pyramid, a cone and a sphere. [ADP Core]</p>	<p>This ICAS statement does not include polygons other than triangles.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>11.0</b> Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.</p>	<p><b>G.02</b> Calculate the ratio of corresponding geometric measurements of similar figures (e.g., if the perimeters are in a 3:2 ratio, the areas are in a 9:4 ratio)</p>	<p><b>5.2</b> Calculate the ratio of corresponding geometric measurements of similar figures (e.g. if the perimeters are in a 3:2 ratio, the areas are in a 9:4 ratio). <b>6.1</b> Recognize and use the properties of congruent or similar geometric objects.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p>	<p><b>K8.3.</b> Know that the effect of a scale factor <math>k</math> on length, area and volume is to multiply each by <math>k</math>, <math>k^2</math> and <math>k^3</math>, respectively.</p>	<p>This ICAS statement does not address the relationship between the scale factor and the change in area and volume.</p>
<p><b>15.0</b> Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles.</p>	<p><b>G.03</b> Use the Pythagorean Theorem <b>G.08</b> Identify and plot points in the coordinate plane</p>	<p><b>5.4</b> Know and use the Pythagorean theorem. <b>7.5</b> Find the <u>length</u> or midpoint of a line segment in the coordinate plane.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; <u>Pythagorean Theorem</u>; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas. <b>A.12.</b> Given the lengths of two sides of a right triangle, find the length of the third side.</p>	<p><b>K5.</b> <u>Apply the Pythagorean theorem, its converse</u> and properties of special right triangles to solve problems. <b>K10.3.</b> Find the distance between two points using their coordinates and the Pythagorean theorem.</p>	

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>17.0</b> Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.</p>	<p><b>G.13</b> Find the length or midpoint of a line segment in the coordinate plane <b>G.08</b> Identify and plot points in the coordinate plane</p>	<p><b>7.5</b> Find the length or midpoint of a line segment in the coordinate plane.</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; <u>lines</u>, triangles, <u>circles</u>, and their properties; symmetry; Pythagorean Theorem; <u>coordinate geometry in the plane, including distance between points, midpoint, equation of a circle</u>; introduction to <b>coordinate geometry in three dimensions</b>; <u>right angle trigonometry</u>. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>3.3.3.</b> Geometric Concepts: Two- and <b>three-dimensional coordinate geometry</b>; locus problems; polar coordinates; vectors; parametric representations of curves.</p> <p><b>3.3.4.</b> Argumentation and Proof: Mathematical induction and <u>formal proof</u>. Attention should be paid to the distinction between plausible, informal reasoning and <u>complete, rigorous demonstration</u>.</p>	<p><b>K10.2.</b> Describe a line by a <u>linear equation</u>. <b>K10.3.</b> Find the distance between two points using their coordinates and the Pythagorean theorem. <b>K10.4.*</b> Find an <u>equation of a circle</u> given its center and radius and, given an equation of a circle, find its center and radius. <b>K1.2.</b> State and <u>prove key basic theorems</u> in geometry such as the Pythagorean theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length. [ADP Core]</p>	<p>ADP requires proof and use but does not specifically address proofs using coordinate geometry. Proof is not required in either ELM Topics or Specs.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>18.0</b> Students know the definitions of the basic trigonometric functions defined by the angles of a right triangle. They also know and are able to use elementary relationships between them. For example, <math>\tan(x) = \sin(x)/\cos(x)</math>, <math>(\sin(x))^2 + (\cos(x))^2 = 1</math>.</p>			<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; <u>right angle trigonometry</u>. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p>	<p><b>K11.1.</b> Understand how similarity of right triangles allows the trigonometric functions sine, cosine and tangent to be defined as ratios of sides and be able to use these functions to solve problems. <b>K12.2.*</b> Know and use the basic identities, such as <math>\sin^2(x) + \cos^2(x) = 1</math> and <math>\cos(\pi/2-x) = \sin(x)</math> and formulas for sine and cosine, such as addition and double angle formulas.</p>	<p>ICAS does not specify how right triangle trigonometry is to be applied.</p>
<p><b>19.0</b> Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.</p>			<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; <u>right angle trigonometry</u>. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas. <b>A.12.</b> Given the lengths of two sides of a right triangle, find the length of the third side.</p>	<p><b>K11.2.</b> Apply the trigonometric functions sine, cosine and tangent to solve for an unknown length of a side of a right triangle, given one of the acute angles and the length of another side. [ADP Core]</p>	<p>ELM Topics and Specs do not address right triangle trigonometry.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>21.0*</b> Students prove and solve problems regarding relationships among <b>chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.</b></p>		<p><b>6.2</b> Solve <u>geometric problems</u> using the properties of basic geometric figures (including triangles, quadrilaterals, <b>polygons and circles</b>)</p>	<p><b>3.1.3.</b> Geometric Concepts: Distances, areas, and volumes, and their relationship with dimension; angle measurement; similarity; congruence; lines, triangles, <b>circles, and their properties</b>; symmetry; Pythagorean Theorem; coordinate geometry in the plane, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; <b>right angle trigonometry</b>. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>3.3.4.</b> Argumentation and Proof: Mathematical induction and <b>formal proof</b>. Attention should be paid to the distinction between plausible, informal reasoning and <b>complete, rigorous demonstration</b>.</p>	<p><b>K4.</b> Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.  <b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.  <b>MR3.</b> Understanding the role of definitions, proofs and counterexamples in mathematical reasoning; constructing simple proofs. [ADP Core]</p>	<p>Only ADP and ICAS include the properties of circles. ICAS's proof statement is only in general terms. The language in the CA standard is more specific, listing the related parts of the circle. This alignment shows where an ELM Spec relates generally to the CA standard where there are no counterparts in the ELM Topics. Proof is not required in either ELM Topics or Specs.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>22.0</b> Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflections.</p>			<p><b>3.1.2.</b> Families of Functions and Their Graphs: Applications; linear functions; quadratic and power functions; exponential functions; roots; <u>operations on functions and the corresponding effects on their graphs</u>; <u>interpretation of graphs</u>; function notation; functions in context, as models for data. Increased emphasis should be placed on various representations of functions-using graphs, tables, variables, words -and on the interplay among the graphical and other representations, while decreased emphasis should be placed on repeated manipulations of algebraic expressions.</p> <p><b>3.1.3.</b> Geometric Concepts: <u>Distances, areas, and volumes, and their relationship with dimension</u>; angle measurement; similarity; congruence; lines, triangles, circles, and their properties; symmetry; Pythagorean Theorem; <u>coordinate geometry in the plane</u>, including distance between points, midpoint, equation of a circle; introduction to coordinate geometry in three dimensions; right angle trigonometry. Increased emphasis should be placed on developing an understanding of geometric concepts sufficient to solve unfamiliar problems and an understanding of the need for compelling geometric arguments, while decreased emphasis should be placed on memorization of terminology and formulas.</p> <p><b>3.2.3.</b> Geometry: Transformational geometry, including rotations, reflections, translations, and dilations; tessellations; solid geometry; three-dimensional coordinate geometry, including lines and planes.</p>	<p><b>K6.</b> Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.</p>	<p>Only ICAS and ADP include rigid motions. ADP does not specify that the coordinate plane should be used. ICAS requires use of three-dimensional coordinates.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<b>ALGEBRA II CONTENT STANDARDS</b>					
<p><b>1.0*</b> Students solve equations and inequalities involving absolute value.</p>	<p><b>A.13</b> Solve equations involving absolute value (in one variable) <b>A.14</b> Solve inequalities involving absolute value (in one variable)</p>	<p><b>4.6</b> Solve simple equations &amp; inequalities in one variable involving absolute value.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; <b>solutions of linear equations and inequalities; absolute value</b>; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.</p>	<p><b>J3.1.</b> Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function. [ADP Core]</p>	<p>The ELM Specs include the modifier "simple," which might be seen as a limitation that does not exist in the CA standard or in the ELM Topics.</p>
<p><b>2.0*</b> Students solve systems of linear equations and inequalities (in two or three variables) by substitution, with graphs, or with matrices.</p>	<p><b>A.08</b> Solve systems of linear equations in two unknowns</p>	<p><b>4.7</b> Solve simple systems of linear equations in two unknowns <b>7.3</b> Graph linear and simple quadratic functions in one variable.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols. <b>3.3.1.</b> Variables, Equations, and Algebraic Expressions: Solutions to systems of equations, and their geometrical interpretation; solutions to quadratic equations, both algebraic and graphical; the correspondence between roots and factors of polynomials; the binomial theorem.</p>	<p><b>J3.3.</b> Solve systems of two linear equations in two variables. [ADP Core] <b>J3.4.*</b> Solve systems of three linear equations in three variables. <b>J5.2.</b> Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems. <b>J3.3.</b> Solve systems of two linear equations in two variables. [ADP Core] <b>J3.4.*</b> Solve systems of three linear equations in three variables. <b>J5.2.</b> Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.</p>	<p>ICAS and ELM do not specify equations and inequalities in three variables. In addition ELM does not address systems of inequalities. And again the word "simple" is included in the ELM Spec, a limitation is not in the topics or CA standard. Matrices are not required in any of the comparative sets of standards.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
3.0* Students are adept at operations on polynomials, including long division.	A.05 Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)	4.2 Divide and factor polynomials (with emphasis on quadratic polynomials).	3.3.2. Functions: Logarithmic functions, their graphs, and applications; trigonometric functions of real variables, their graphs, properties including periodicity, and applications; basic trigonometric identities; operations on functions, including addition, subtraction, multiplication, reciprocals, division, composition, and iteration; inverse functions and their graphs; domain and range.	J1.3. Add, subtract and multiply polynomials; divide a polynomial by a low degree polynomial.	While long division is not specifically mentioned, division is clearly required. Polynomial operations in the ELM Specs only include division. (Factoring would be a form of division, as well.)
4.0* Students factor polynomials representing the difference of squares, perfect square trinomials, and the sum and difference of two cubes.	A.05 Perform polynomial arithmetic (add, subtract, multiply, divide, and <u>factor</u> )	4.2 Divide and <u>factor</u> polynomials (with emphasis on quadratic polynomials).	A.3. Use the distributive law for monomials and binomials.	J1.4. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.	While all comparative sets of standards address factoring polynomials, ELM, ICAS, and ADP do not specifically mention the difference of squares or the sum/difference of cubes.
6.0* Students add, subtract, multiply, and divide complex numbers.					None of the other sets of standards addresses operations with complex numbers.

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>7.0*</b> Students add, subtract, multiply, divide, reduce, and evaluate rational expressions with monomial and polynomial denominators and simplify complicated rational expressions, including those with negative exponents in the denominator.</p>	<p><b>A.01</b> Evaluate and interpret algebraic expressions  <b>A.02</b> Simplify algebraic expressions  <b>A.04</b> Use properties of exponents  <b>A.05</b> Perform polynomial arithmetic (add, subtract, multiply, divide, and factor)  <b>A.06</b> Perform arithmetic operations involving rational expressions</p>	<p><b>4.1</b> Evaluate &amp; interpret algebraic expressions (including function notation, rational exponents, and radicals).  <b>4.3</b> Perform simple arithmetic operations involving rational expressions (add, subtract, multiply, and divide).  <b>4.2</b> Divide and factor polynomials (with emphasis on quadratic polynomials).</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; <u>evaluation of expressions and formulas</u>; translation from words to symbols; solutions of linear equations and inequalities; absolute value; powers and roots; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and as a means for solving problems, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols.  <b>A.2.</b> Combine like terms in algebraic expressions.  <b>A.3.</b> Use the distributive law for monomials and binomials.  <b>A.4.</b> Factor monomials out of algebraic expressions.  <b>A.7.</b> Apply laws of exponents.</p>	<p><b>J1.3.</b> Add, subtract and multiply polynomials; <u>divide a polynomial by a low degree polynomial</u>.  <b>J1.5.</b> Add, subtract, multiply, divide and simplify rational expressions.  <b>J1.6.</b> <u>Evaluate</u> polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.  <b>J2.4.*</b> Combine functions by composition, as well as by addition, subtraction, multiplication and <u>division</u>.  <b>J1.1.</b> Understand the properties of <u>integer exponents</u> and roots and apply these properties to simplify algebraic expressions. [ADP Core]</p>	<p>ICAS does not clearly call for operations with rational numbers. However, the requirements in the appendix imply those operations with like terms using addition and subtraction; distribution implies multiplication; and factoring implies division. Negative exponents are also not specifically mentioned in ICAS.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>8.0*</b> Students solve and graph quadratic equations by factoring, completing the square, or using the quadratic formula. Students apply these techniques in solving word problems. They also solve quadratic equations in the complex number system.</p>	<p><b>A.11</b> Solve quadratic <b>and rational equations</b> (with both numerical and literal coefficients; real solutions only)  <b>A.12</b> Solve problems in context that are modeled by quadratic equations  <b>G.11</b> Graph quadratic functions in one variable</p>	<p><b>4.4</b> Find real solutions to simple equations (including quadratic and <b>rational</b>), with both numerical and literal coefficients.  <b>4.5</b> Solve problems in context that are modeled by quadratic equations.  <b>5.1</b> Find the perimeter, <u>area</u>, or volume of simple geometric figures (including triangles, quadrilaterals, rectangular parallelepipeds, circles, and cylinders).  <b>7.3</b> Graph linear and simple <u>quadratic functions</u> in one variable.</p>	<p><b>3.3.1.</b> Variables, Equations, and Algebraic Expressions: Solutions to systems of equations, and their geometrical interpretation; <u>solutions to quadratic equations, both algebraic and graphical</u>; the correspondence between roots and factors of polynomials; the binomial theorem.  <b>3.1.2.</b> Families of <u>Functions and Their Graphs</u>: Applications; linear functions; <u>quadratic</u> and power functions; exponential functions; roots; operations on functions and the corresponding effects on their graphs; interpretation of graphs; function notation; functions in context, as models for data. Increased emphasis should be placed on various representations of functions-using graphs, tables, variables, words -and on the interplay among the graphical and other representations, while decreased emphasis should be placed on repeated manipulations of algebraic expressions.</p>	<p><b>J3.5.</b> Solve quadratic equations in one variable. [ADP Core]  <b>J4.5.</b> Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph. [ADP Core]  <b>J5.3.</b> Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity. [ADP Core]</p>	<p>Solving rational equations is not required in this CA standard but is in ELM. Specific methods for finding solutions of quadratic equations is not included in other standards but is in this CA standard.</p>
<p><b>9.0*</b> Students demonstrate and explain the effect that changing a coefficient has on the graph of quadratic functions; that is, students can determine how the graph of a parabola changes as a, b, and c vary in the equation <math>y = a(x-b)^2 + c</math>.</p>		<p><b>7.4</b> Relate basic information about a function to features of its graphs (e.g. linearity, positivity or negativity, increasing or decreasing).</p>		<p><b>J4.5.</b> Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph. [ADP Core]</p>	<p>ADP is the only one that addresses the connection between a quadratic graph and the equation. ADP does not specifically require that students know how the graph of the parabola changes as coefficients are changed. ELM Specs includes a requirement for basic information about a graph of a function which may include how the function would be altered when parameters are changed.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>10.0*</b> Students graph quadratic functions and determine the maxima, minima, and zeros of the function.</p>		<p><b>7.3</b> Graph linear and simple quadratic functions in one variable.  <b>7.4</b> Relate basic information about a function to features of its graphs (e.g. linearity, positivity or negativity, increasing or decreasing).</p>		<p><b>J4.5.</b> Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph. [ADP Core]  <b>J4.8.</b> Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem. [ADP Core]</p>	<p>ELM Topics and ICAS do not address interpretation of a quadratic graph. This CA standard has no counterpart in ELM Topics but does in ELM Specs.</p>
<p><b>11.1*</b> Students understand the inverse relationship between exponents and logarithms, and use this relationship to solve problems involving logarithms and exponents.</p>	<p><b>A.04</b> Use properties of exponents</p>		<p><b>3.3.2.</b> Functions: <u>Logarithmic functions</u>, their graphs, and applications; trigonometric functions of real variables, their graphs, properties including periodicity, and applications; basic trigonometric identities; operations on functions, including addition, subtraction, multiplication, reciprocals, division, composition, and iteration; <u>inverse functions</u> and their graphs; domain and range.  <b>A.7.</b> Apply laws of exponents.</p>	<p><b>J2.6.*</b> Know the inverse of an exponential function is a logarithm, prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.  <b>J5.5.*</b> Recognize and solve problems that can be modeled using an exponential function but whose solution requires facility with logarithms, such as exponential growth and decay problems.</p>	<p>ELM Topics and Specs require use of exponent properties but does not specify that log properties are to be used at all. There are no references to the inverse relationship between exponential and logarithmic functions in ELM Specs. ICAS does not make the connection between exponents and logs.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>12.0*</b> Students know the laws of fractional exponents, understand exponential functions, and use these functions in problems involving exponential growth and decay.</p>	<p><b>A.04</b> Use properties of exponents</p>	<p><b>4.1</b> Evaluate &amp; interpret algebraic expressions (including function notation, rational exponents, and radicals). <b>4.4</b> Find real solutions to simple equations (including quadratic and rational), with both numerical and literal coefficients.</p>	<p><b>3.1.1.</b> Variables, Equations, and Algebraic Expressions: Algebraic symbols and expressions; evaluation of expressions and formulas; translation from words to symbols; solutions of linear equations and inequalities; absolute value; <u>powers and roots</u>; solutions of quadratic equations; solving two linear equations in two unknowns including the graphical interpretation of a simultaneous solution. Increased emphasis should be placed on algebra both as a language for describing mathematical relationships and <u>as a means for solving problems</u>, while decreased emphasis should be placed on interpreting algebra as merely a set of rules for manipulating symbols. <b>A.7.</b> Apply laws of exponents.</p>	<p><b>J1.2.*</b> Understand the properties of rational exponents and apply these properties to simplify algebraic expressions. <b>J4.7.</b> Graph exponential functions and identify their key characteristics. [ADP Core] <b>J5.4.</b> Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems. [ADP Core]</p>	<p>While properties of exponents are required in all of the comparative sets of standards, there is no clear reference to rational exponents in ELM Topics or ICAS and no requirement that addresses exponential function models in either the ELM Specs or Topics.</p>
<p><b>14.0</b> Students understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values.</p>				<p><b>J2.6.*</b> Know the inverse of an exponential function is a logarithm, prove <u>basic properties of a logarithm</u> using properties of its inverse and apply those properties to solve problems.</p>	<p>This CA standard is specifically aimed at the properties of logarithms. Only ADP addresses logarithms specifically. The ELM Topic is very general and only refers to the simplification part of the CA standard.</p>
<p><b>15.0*</b> Students determine whether a specific algebraic statement involving rational expressions, radical expressions, or logarithmic or exponential functions is sometimes true, always true, or never true.</p>		<p><b>4.1</b> Evaluate &amp; <u>interpret algebraic expressions</u> (including function notation, <u>rational exponents, and radicals</u>). <b>4.3</b> Perform simple arithmetic operations involving rational expressions (add, subtract, multiply, and divide).</p>		<p><b>MR1.</b> Using inductive and deductive reasoning to arrive at valid conclusions.</p>	<p>The ELM Specs used here reference interpretation of an expression, which may include determination of the possible degrees of truth. It is likely that the most common "algebraic statement" would be one involving operations.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<p><b>17.0</b> Given a quadratic equation of the form <math>ax^2 + by^2 + cx + dy + e = 0</math>, students can use the method for completing the square to put the equation into standard form and can recognize whether the graph of the equation is a circle, ellipse, parabola, or hyperbola. Students can then graph the equation.</p>		<p><b>4.5</b> Solve problems in context that are modeled by quadratic equations.</p>		<p><b>J4.6.*</b> Graph ellipses and hyperbolas whose axes are parallel to the x and y axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.  <b>J4.8.</b> Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.                      [ADP Core]  <b>K10.4.*</b> Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.</p>	<p>The graph analysis addressed in the CA standard is not clearly included in the ADP Benchmarks.</p>
<p><b>18.0*</b> Students use fundamental counting principles to compute combinations and permutations.</p>			<p><b>3.1.4</b> Probability: Counting (permutation and combinations, multiplication principle); sample spaces; expected value; conditional probability; area representation of probability.</p>	<p><b>L4.4</b> Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.</p>	<p>The ADP Benchmark subsumes this CA standard, although it does not specifically mention counting strategies.</p>
<p><b>19.0*</b> Students use combinations and permutations to compute probabilities.</p>				<p><b>L4.5.</b> Apply probability concepts to practical situations to make informed decisions. [ADP Core]</p>	<p>ADP addresses probability calculations.</p>
<p><b>22.0</b> Students find the general term and the sums of arithmetic series and of both finite and infinite geometric series.</p>			<p><b>3.2.2.</b> Sequences and Series: Geometric and arithmetic sequences and series; the Fibonacci sequence; recursion relations.</p>	<p><b>J1.7.*</b> Derive and use the formulas for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, <math>r</math>, is in the interval <math>(-1, 1)</math>.</p>	<p>While ICAS addresses geometric and arithmetic sequences and series, it is unclear whether their formulas are required.</p>

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
23.0* Students derive the summation formulas for arithmetic series and for both finite and infinite geometric series.			3.2.2. Sequences and Series: <u>Geometric and arithmetic sequences and series</u> ; the Fibonacci sequence; recursion relations.	J1.7.* <u>Derive and use the formulas</u> for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, $r$ , is in the interval $(-1, 1)$ .	While it is somewhat likely that ICAS will require using the formulas, it is less clear that deriving the formulas is required. CST Alg 2/HSM include this concept in addition to ADP.
24.0 Students solve problems involving functional concepts, such as composition, defining the inverse function and performing arithmetic operations on functions.		4.1 Evaluate & <u>interpret algebraic expressions</u> (including <u>function notation</u> , rational exponents, and radicals).	3.3.2. Functions: Logarithmic functions, their graphs, and applications; trigonometric functions of real variables, their graphs, properties including periodicity, and applications; basic trigonometric identities; <u>operations on functions, including addition, subtraction, multiplication, reciprocals, division, composition, and iteration</u> ; <u>inverse functions</u> and their graphs; domain and range.	J2.4.* Combine functions by composition, as well as by addition, subtraction, multiplication and division. J2.5.* Identify whether a function has an inverse and when functions are inverses of each other; explain why the graph of a function and its inverse are reflections of one another over the line $y = x$ .	Only ELM Topics and Specs does not address these function operations.

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California Content Standards	ELM Topics (taken from <i>Focus on Mathematics</i> )	ELM Specifications for EAP	ICAS	ADP	Comments
<b>PROBABILITY AND STATISTICS CONTENT STANDARDS</b>					
<p><b>1.0</b> Students know the definition of the notion of <i>independent events</i> and can use the rules for addition, multiplication, and complementation to solve for probabilities of particular events in finite sample spaces.</p>				<p><b>L4.4.</b> Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.  <b>L4.5.</b> Apply probability concepts to practical situations to make informed decisions. [ADP Core]</p>	<p>Complementation is not addressed specifically in ADP.</p>
<p><b>2.0</b> Students know the definition of <i>conditional probability</i> and use it to solve for probabilities in finite sample spaces.</p>			<p><b>3.1.4.</b> Probability: Counting (permutations and combinations, multiplication principle); <u>sample spaces</u>; <u>expected value</u>; <u>conditional probability</u>; <u>area representations of probability</u>. Increased emphasis should be placed on a conceptual understanding of discrete probability, while decreased emphasis should be placed on aspects of probability that involve memorization and rote application of formulas.</p>	<p><b>L4.4.</b> Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.</p>	<p>ELM does not address computation of conditional probabilities.</p>
<p><b>7.0</b> Students compute the variance and the standard deviation of a distribution of data.</p>				<p><b>L1.3.</b> Compute and explain summary statistics for distributions of data including measures of center (mean, median) and spread (range, percentiles, variance, standard deviation). [ADP Core]</p>	