



COLORADO
Content Standards Mathematics Grades 9-12
Advanced Mathematical Concepts
Precalculus with Applications © 2004

OBJECTIVES	PAGE REFERENCES
STANDARD 1: Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems. In order to meet this standard, a student will	
<ul style="list-style-type: none"> construct and interpret number meanings through real-world experiences* and the use of hands-on materials; 	SE: 206
<ul style="list-style-type: none"> represent and use numbers in a variety of equivalent forms (<i>for example, fractions, decimals, percents, exponents*, scientific notation*</i>); 	SE: 64 #2, 65 #8, 273 #2, 282 #62, 695-703, 732 #67 TWE: AIN 698 OEA 703
<ul style="list-style-type: none"> know the structure and properties of the real number system* (<i>for example, primes*, factors, multiples, relationships among sets of numbers</i>); and 	SE: 13-19, 64 #1, 65 #1-#2, 152-158 <i>Graphing Calculator Exploration 86</i> TWE: OEA 703
<ul style="list-style-type: none"> use number sense, including estimation and mental arithmetic, to determine the reasonableness of solutions. 	SE: 272 ex 2, 744 #6c, 745 #14c, 747 #21d, 974 #45
GRADES 9-12 As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> demonstrating meanings for real numbers, absolute value*, and scientific notation using physical materials and technology in problem-solving situations; 	SE: 206
<ul style="list-style-type: none"> developing, testing, and explaining conjectures about properties of number systems and sets of numbers; and 	SE: <i>Graphing Calculator Exploration 86</i> TWE:
<ul style="list-style-type: none"> using number sense to estimate and justify the reasonableness of solutions to problems involving real numbers. 	SE: 272 ex 2, 744 #6c, 745 #14c, 747 #21d, 974 #45
For students continuing their mathematics education beyond these standards, what they will know and are able to do may include	
<ul style="list-style-type: none"> investigating limiting processes by examining infinite sequences and series; and 	SE: 774-783, 786-793, 794-800, 805 #40 TWE: AIN 789 FTC 775 MTL 775 OEA 783, 793 TT 798
<ul style="list-style-type: none"> explaining relationships among real numbers, complex numbers*, and vectors* using models. 	SE: 206, 209 #3

OBJECTIVES	PAGE REFERENCES
STANDARD 2	
Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.	
In order to meet this standard, a student will	
<ul style="list-style-type: none"> identify, describe, analyze, extend, and create a wide variety of patterns in numbers, shapes, and data; 	SE: 759-765, 766-773, 774-783, 793 #37-#38, 800 #53, 830 #11-#13, 845 #54 TWE: AIN 761 EC 764, 773
<ul style="list-style-type: none"> describe patterns using mathematical language; 	SE: 762 #1, 771 #1, 780 #1b, 791 #3c-#3d, 797 #1-#3, 819 #1 TWE: EC 793 OEA 773, 793, 800
<ul style="list-style-type: none"> solve problems and model real-world situations using patterns and functions; 	SE: 762 ex 6, 763 #16, 764 #52, 768 ex 3, 770 ex 6, 772 #41, 773 #47, 779 ex 5, 781 #13, 782 #42, 790 ex 6
<ul style="list-style-type: none"> compare and contrast different types of functions; and 	SE: 5-12, 17 #3, 18 #29, 50 #30, 142 #2 TWE: AIN 47, 141 OEA 12, 19, 51
<ul style="list-style-type: none"> describe the connections among representations of patterns and functions, including words, tables, graphs, and symbols. 	SE: 20-25, 29 #4, 30 #27, 44 #19, 46 ex 1-ex 2, 49 #23, 50 #29, 59 #31-#38 TWE: EC 25
GRADES 9-12	
As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> modeling real-world phenomena (<i>for example, distance-versus-time relationships, compound interest, amortization tables, mortality rates</i>) using functions, equations, inequalities, and matrices*; 	SE: 762 ex 6, 763 #16, 764 #52, 768 ex 3, 770 ex 6, 772 #41, 773 #47, 779 ex 5, 781 #13, 782 #42, 790 ex 6
<ul style="list-style-type: none"> representing functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations; 	SE: 20-25, 29 #4, 30 #27, 44 #19, 46 ex 1-ex 2, 49 #23, 50 #29, 59 #31-#38 TWE: EC 25
<ul style="list-style-type: none"> solving problems involving functional relationships using graphing calculators and/or computers as well as appropriate paper-and-pencil techniques; 	SE: <i>Graphing Calculator Exploration</i> 13, 26, 69, 133, 232, 369, 378, 458, 526 TWE: FTC 117
<ul style="list-style-type: none"> analyzing and explaining the behaviors, transformations*, and general properties of types of equations and functions (<i>for example, linear, quadratic*, exponential*</i>); and 	SE: 88-96, 137-145 TWE: EC 96 MTL 88 OEA 96
<ul style="list-style-type: none"> interpreting algebraic equations and inequalities geometrically and describing geometric relationships algebraically. 	SE: 67-72, 73-77, 86 #55, 96 #36, 104 #55, 107-111, 118 #28, 120 #11-#16 TWE: EC 72, 76
For students continuing their mathematics education beyond these standards, what they know and are able to do may include	
<ul style="list-style-type: none"> using rational, polynomial, trigonometric, and inverse functions to model real-world phenomena; 	SE: 154 ex 4, 156 #14, 157 #42, 183 ex 3, 186 #13, 209 ex 5, 211 #51, 239 ex 4, 240 #11, 241 #33

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> representing and solving problems using linear programming and difference equations; 	SE: 112-118, 122 #51, 123 #54 TWE: AIN 114 EC 118 FTC 117 OEA 118
<ul style="list-style-type: none"> solving systems of linear equations using matrices and vectors; 	SE: 98-105, 122 #45-#48, 123 #54 TWE: OEA 105
<ul style="list-style-type: none"> describing the concept of continuity of a function; 	SE: 159-168, 179 #41, 199 #35-#37 <i>Graphing Calculator Exploration</i> 169 TWE: OEA 168, 170
<ul style="list-style-type: none"> performing operations on and between functions; and 	SE: 13-19, 25 #42, 31 #32-#33, 37 #38, 44 #17, 51 #34-#35, 58 #18-#23 TWE: AIN 16 EC 19 OEA 19
<ul style="list-style-type: none"> making the connections between trigonometric functions and polar coordinates, complex numbers, and series. 	SE: 553-560, 561-567, 568-573, 586-591, 593-598 TWE: EC 560, 591, 597 OEA 591
STANDARD 3: Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems. In order to meet this standard, a student will	
<ul style="list-style-type: none"> solve problems by systematically collecting, organizing, describing, and analyzing data using surveys, tables, charts, and graphs; 	SE: 84 #49, 740-748, 889-896, 934 #11-#13 <i>Graphing Calculator Exploration</i> 265-266 <i>InterNet Project</i> 937
<ul style="list-style-type: none"> make valid inferences, decisions, and arguments based on data analysis; and 	SE: 927 <i>Graphing Calculator Exploration</i> 877 <i>InterNet Project</i> 885, 937
<ul style="list-style-type: none"> use counting techniques, experimental probability, or theoretical probability, as appropriate, to represent and solve problems involving uncertainty. 	SE: 837-845, 846-851, 852-858, 859-867, 868-874, 875-880, 883 #27-#34, 884 #37-#40 TWE: MTL 846
GRADES 9-12 As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology (<i>for example, graphing calculators, computer software</i>); 	TWE: AIN 854, 877 FTC 876 OEA 880
<ul style="list-style-type: none"> analyzing statistical claims for erroneous conclusions or distortions; 	SE: 927-932, 936 #36-#39 <i>Graphing Calculator Exploration</i> 877 TWE: AIN 929
<ul style="list-style-type: none"> fitting curves to scatter plots, using informal methods or appropriate technology, to determine the strength of the relationship between two data sets and to make predictions; 	SE: 38-44, 51 #31, 60 #53, 61 #69, 145 #49, 151 #51, 258-264 TWE: AIN 40, 260 EC 44

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> drawing conclusions about distributions of data based on analysis of statistical summaries (<i>for example, the combination of mean and standard deviation, and differences between the mean and median</i>); 	SE: 111 #33, 150 #43, 897-907, 908-917, 925 #23, 934 #14-#18, 935 #19-#22, 937 #41, 939 #9
<ul style="list-style-type: none"> using experimental and theoretical probability to represent and solve problems involving uncertainty (<i>for example, the chance of playing professional sports if a student is a successful high school athlete</i>); and 	SE: 837-845, 846-851, 852-858, 859-867, 868-874, 875-880, 883 #27-#34, 884 #37-#40 TWE: MTL 846
<ul style="list-style-type: none"> solving real-world problems with informal use of combinations and permutations* (<i>for example, determining the number of possible meals at a restaurant featuring a given number of side dishes</i>). 	SE: 837-845, 846-851, 857 #45 TWE: AIN 841, 848 EC 845, 850 FTC 838 MTL 837 OEA 845
For students continuing their mathematics education beyond these standards, what they know and are able to do may include	
<ul style="list-style-type: none"> creating and interpreting discrete and continuous probability distributions, and understanding their application to real-world situations (<i>for example, insurance</i>); 	SE: 852 ex 1, 856 #12
<ul style="list-style-type: none"> testing hypotheses using appropriate statistics; 	SE: 111 #33, 150 #43, 897-907, 908-917, 925 #23, 934 #14-#18, 935 #19-#22, 937 #41, 939 #9
<ul style="list-style-type: none"> exploring the effect of sample size on the results of statistical surveys using experiments and simulations; and 	SE: 928
<ul style="list-style-type: none"> solving real-world problems with formal use of combinations and permutations. 	SE: 837-845, 846-851, 857 #45 TWE: AIN 841, 848 EC 845, 850 FTC 838 MTL 837 OEA 845
STANDARD 4: Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems. In order to meet this standard, a student will	
<ul style="list-style-type: none"> connect various physical objects with their geometric representation; 	SE: 616 ex 2, 629 #48, 632 ex 1, 639 #47 TWE: AIN 618
<ul style="list-style-type: none"> connect mathematical concepts from across the standards with their geometric representations; 	SE: 135 #40, 272-273, 617 ex 3, 618 ex 5, 619 #4, 620 #8-#9, 621 #33, 640 #55, 652 #51, 945 #57
<ul style="list-style-type: none"> recognize, draw, describe, and analyze geometric shapes in one, two, and three dimensions; 	SE: 36 #11, 273 #3, 483 #3, 613 #3, 617 ex 3, 620 #23-#27, 640 #55, 652 #51, 887 #2 TWE: EC 621
<ul style="list-style-type: none"> make, investigate, and test conjectures about geometric ideas; and 	SE: 36 #11, 110 #23, 144 #41, 429 #58, 436 #45, 764 #54, 947 #39

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> solve problems and model real-world situations using geometric concepts. 	SE: 168 #46, 178 #35, 187 #44, 192-193 ex 5, 226 #13, 229, 318 #42, 358 #51, 510 #38, 701 #68
GRADES 9-12	
As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> finding and analyzing relationships among geometric figures using transformations (<i>for example, reflections, translations, rotations, dilations*</i>) in coordinate systems*; 	SE: 88-96, 104 #53, 121 #28-#33, 138 ex 1, 149 #1, 228 #49, 535-542, 670-677 TWE: EC 96, 677
<ul style="list-style-type: none"> deriving and using methods to measure perimeter, area, and volume of regular and irregular geometric figures; 	SE: 168 #46, 178 #35, 187 #44, 192-193 ex 5, 226 #13, 229, 318 #42, 510 #38, 612, 701 #68
<ul style="list-style-type: none"> making and testing conjectures about geometric shapes and their properties, incorporating technology where appropriate; and 	SE: 36 #11, 110 #23, 144 #41, 429 #58, 436 #45, 764 #54, 947 #39
<ul style="list-style-type: none"> using trigonometric ratios* in problem-solving situations (<i>for example, finding the height of a building from a given point, if the distance to the building and the angle of elevation are known</i>). 	SE: 284-290, 291-298, 305-312 TWE: AIN 286, 295 EC 290, 298 OEA 290, 298, 312
For students continuing their mathematics education beyond these standards, what they know and are able to do may include	
<ul style="list-style-type: none"> deducing properties of figures using vectors*; 	SE: 487 ex 3, 490 #13, 491 #40, 492 #41, 495 ex 3, 497 #13, 498 #45, 503 #11, 504 #41-#42, 508 ex 4
<ul style="list-style-type: none"> applying transformations, coordinates, and vectors in problem-solving situations; and 	SE: 88-96, 535-542, 670-677 TWE: EC 96, 677
<ul style="list-style-type: none"> describing, analyzing, and extending patterns produced by processes of geometric change (<i>for example, limits and fractals</i>). 	SE: 586, 599, 605 #11, 817-818, 941-948
STANDARD 5: Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.	
In order to meet this standard, a student will	
<ul style="list-style-type: none"> understand and apply the attributes of length, capacity*, weight, mass, time, temperature, perimeter, area, volume, and angle measurement in problem-solving situations; 	SE: 168 #46, 178 #35, 187 #44, 192-193 ex 5, 226 #13, 229, 318 #42, 358 #51, 510 #38, 612, 701 #68
<ul style="list-style-type: none"> make and use direct and indirect measurements to describe and compare real-world phenomena; 	SE: 77 #28, 188 #56, 192 ex 5, 358 #51, 476 #40, 598 #38, 701 #68, 828 #35, 833 #56, 968 #41
<ul style="list-style-type: none"> understand the structure and use of systems of measurement; 	SE: 23 #11, 24 #35, 28 ex 3 TWE: OEA 25
<ul style="list-style-type: none"> describe and use rates of change (<i>for example, temperature as it changes throughout the day, or speed as the rate of change of distance over time</i>) and other derived measures; and 	SE: 299 ex 2, 301 ex 4, 302 #9, 303 #23, 304 #29, 307 ex 4, 309 #14, 317 #31, 332 #34, 961-968

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> select appropriate units, including metric and U.S. customary, and tools (<i>for example, rulers, protractors, compasses, thermometers</i>) to measure to the degree of accuracy required to solve a given problem. 	This objective can be found in Glencoe's <i>Mathematics: Applications and Concepts Course 3</i> © 2004 pages 358-362.
GRADES 9-12	
As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> measuring quantities indirectly using techniques of algebra, geometry, or trigonometry*; 	SE: 299 ex 2, 301 ex 4, 302 #9, 303 #23, 304 #29, 307 ex 4, 309 #14, 317 #31, 332 #34, 961-968
<ul style="list-style-type: none"> selecting and using appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements; and 	SE: 927-928
<ul style="list-style-type: none"> determining the degree of accuracy of a measurement (<i>for example, by understanding and using significant digits</i>). 	SE: 927-928
For students continuing their mathematics education beyond these standards, what they know and are able to do may include	
<ul style="list-style-type: none"> demonstrating the meanings of area under a curve and length of an arc. 	SE: 961-968, 980 #39-#42 TWE: AIN 965
STANDARD 6: Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems. In order to meet this standard, a student will	
<ul style="list-style-type: none"> model, explain, and use the four basic operations - addition, subtraction, multiplication, and division - in problem-solving situations; 	SE: 12 #57, 51 #37, 56 #32, 64 ex 2, 65 #3, 125 #2, 136 #50, 695-703
<ul style="list-style-type: none"> develop, use, and analyze algorithms*; and 	SE: 70 #3, 76 #3, 115 #3, 233 #4, 240 #2 TWE: OEA 77, 188, 228, 257
<ul style="list-style-type: none"> select and apply appropriate computational techniques to solve a variety of problems and determine whether the results are reasonable. 	SE: 12 #57, 51 #37, 56 #32, 64 ex 2, 65 #3, 125 #2, 136 #50, 695-703
GRADES 9-12	
As students in grades 9-12 extend their knowledge, what they know and are able to do includes	
<ul style="list-style-type: none"> using ratios, proportions, and percents in problem-solving situations; 	SE: 189-196, 200 #56-#58, 248 #35, 283 #72, 284-290, 298 #54, 692 ex 1, 693 #4 TWE: EC 196 OEA 196
<ul style="list-style-type: none"> selecting and using appropriate methods for computing with real numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable; and 	SE: 64 ex 1, 65 #3, 125 #2, 341 #3, 549 #7, 613 #5, 695-703

OBJECTIVES	PAGE REFERENCES
<ul style="list-style-type: none"> describing the limitations of estimation, and assessing the amount of error resulting from estimation within acceptable limits. 	SE: 927-928
For students continuing their mathematics education beyond these standards, what they know and are able to do may include	
<ul style="list-style-type: none"> analyzing and solving optimization problems*; 	SE: 171, 175 ex 4, 176 #12, 178 #35-#37, 201 #61 TWE: OEA 179
<ul style="list-style-type: none"> analyzing different algorithms (<i>for example, sorting</i>) for efficiency; 	SE: 171, 175 ex 4, 176 #12, 178 #35-#37, 201 #61 TWE: OEA 179
<ul style="list-style-type: none"> analyzing and using critical path algorithms (<i>for example, determining in which order to perform a set of tasks in a large project</i>); and 	SE: 504 #39, 606 #38
<ul style="list-style-type: none"> investigating problem situations that arise in connection with computer validation and the application of algorithms. 	SE: 504 #39, 606 #38

Codes Used for TWE Pages

AIN	Addressing Individual Needs
EC	Extra Credit
FTC	From the Classroom of...
MTL	Motivating the Lesson
OEA	Open-Ended Assessment
TT	Teaching Tip