



Precalculus

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STANDARDS

PAGE REFERENCES

CONTENT EXPECTATIONS FOR PRECALCULUS

P1 Functions

P1.1 Know and use a definition of a function to decide if a given relation is a function.

Student Edition:

6 ex 3, 9 #15-#28, 10 #54-#57, 44 #1-#4, 77 #11-#14

Key Concept 5, 6

Teacher Edition:

AE 6; TWT 6

P1.2 Perform algebraic operations (including compositions) on functions and apply transformations (translations, reflections, and rescalings).

Student Edition:

45-55, 57-64, 75 #93-#95, 79 #38-#43

Teacher Edition:

A 64; AE 47, 48, 49, 51, 58, 59, 60; DI 48, 59, 60, 62; F 48, 59; TWT 47, 59

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<p>P1.3 Write an expression for the composition of one given function with another and find the domain, range, and graph of the composite function. Recognize components when a function is composed of two or more elementary functions.</p>	<p>Student Edition: 58 ex 2, 59 ex 3, 60 ex 5, 61 #15-#20, 62 #53-#56, 73 #90-#92 <i>Key Concept</i> 58 <i>Study Tip</i> 59 <i>Watch Out</i> 58</p> <p>Teacher Edition: AE 59; DI 59; F 59; TWT 59</p>
<p>P1.4 Determine whether a function (given symbolically or graphically) has an inverse and express the inverse (symbolically, if the function is given symbolically, or graphically, if given graphically) if it exists. Know and interpret the function notation for inverses.</p>	<p>Student Edition: 66 ex 1, 67 ex 2, 68 ex 4, 69 ex 5, 70 #1-#12, 71 #50-#53, 80 #53-#60, 81 #22-#25 <i>Graphing Technology Lab</i> 74-75 <i>Key Concept</i> 65</p> <p>Teacher Edition: AW 66, 67, 68; TWT 67</p>
<p>P1.5 Determine whether two given functions are inverses, using composition.</p>	<p>Student Edition: 68 ex 3, 70 #27-#36 <i>Key Concept</i> 68</p> <p>Teacher Edition: AE 68</p>
<p>P1.6 Identify and describe discontinuities of a function (e.g., greatest integer function, $1/x$) and how these relate to the graph.</p>	<p>Student Edition: 25 ex 1, 26 ex 2, 30 #1-#10, 31 #42-#43, 32 #58-#59, 43 #77-#79, 44 #17, 78 #27-#31 <i>Key Concept</i> 24 <i>Study Tip</i> 136</p> <p>Teacher Edition: AE 25, 26; DI 29; F 26</p>
<p>P1.7 Understand the concept of limit of a function as x approaches a number or infinity. Use the idea of limit to analyze a graph as it approaches an asymptote. Compute limits of simple functions (e.g., find the limit as x approaches 0 of $f(x) = 1/x$) informally.</p>	<p>Student Edition: 131 ex 1, 134 ex 3, 135 ex 4, 136 ex 5, 138 #9-#10, 147 #70-#72, 149 #11-#16, 151 #50-#53, 153 #9-#10 <i>Graphing Technology Lab</i> 96, 108 <i>Key Concept</i> 98, 131, 132 <i>Study Tip</i> 135</p> <p>Teacher Edition: AE 132, 133, 134, 136; F 131; TNT 136; TWT 132; WO 90</p>

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<p>P1.8 Explain how the rates of change of functions in different families (e.g., linear functions, exponential functions, etc.) differ, referring to graphical representations.</p>	<p>Student Edition: 39 ex 5, 41 #34-#35, 42 #73, 44 #20, 78 #36-#37, 81 #12-#13, 759 ex 1, 762 #1-#6, 765 #22, 774 #82 <i>Connect to AP Calculus</i> 82-83 <i>Key Concept</i> 38, 758</p> <p>Teacher Edition: A 83; AE 39, 759; F 38, 759; TWT 760</p>
<p>P2 Exponential and Logarithmic Functions</p>	
<p>P2.1 Use the inverse relationship between exponential and logarithmic functions to solve equations and problems.</p>	<p>Student Edition: 172-180, 181-188, 189 #10-#13, 190-199, 210 #40-#45, 212 #21-#28, 213 #32-#38, 215 #6-#9</p> <p>Teacher Edition: A 180, 188, 199; AE 173, 174, 182, 183, 191, 192, 194, 195; DI 175, 194; TWT 193</p>
<p>P2.2 Graph logarithmic functions. Graph translations and reflections of these functions.</p>	<p>Student Edition: 175 ex 5, 176 ex 6, 178 #28-#33, 188 #21-#23, 189 #9, 212 #29-#31, 215 #1-#2</p> <p>Teacher Edition: AE 175, 176</p>
<p>P2.3 Compare the large-scale behavior of exponential and logarithmic functions with different bases and recognize that different growth rates are visible in the graphs of the functions.</p>	<p>Student Edition: 160 ex 2, 166 #11-#20, 168 #56-#57, 188 #121-#123, 212 #11-#14, 215 #1-#2 <i>Connect to AP Calculus</i> 216-217</p> <p>Teacher Edition: AE 160</p>
<p>P2.4 Solve exponential and logarithmic equations when possible, (e.g. $5^x = 3^{(x+1)}$). For those that cannot be solved analytically, use graphical methods to find approximate solutions.</p>	<p>Student Edition: 190-199, 210 #40-#45, 213 #39-#44, 215 #18-#21</p> <p>Teacher Edition: A 199; AE 191, 192, 194, 195; DI 194; F 192</p>

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<p>P2.5 Explain how the parameters of an exponential or logarithmic model relate to the data set or situation being modeled. Find an exponential or logarithmic function to model a given data set or situation. Solve problems involving exponential growth and decay.</p>	<p>Student Edition: 161, 163 ex 5, 164 ex 6, 165 ex 7, 166 #25-#26, 167 #34-#42, 168 #44 <i>Graphing Technology Lab</i> 170-171 <i>Key Concept</i> 162, 164 <i>Study Tip</i> 162</p> <p>Teacher Edition: AE 162, 163, 164, 167; DI 163, 169; TNT 162; TWT 160</p>
P3 Quadratic Functions	
<p>P3.1 Solve quadratic-type equations (e.g. $e^{2x} - 4e^{x+4} = 0$) by substitution.</p>	<p>Student Edition: 101 ex 4, 104 #27-#28, 118 #12 <i>Key Concept</i> 100</p> <p>Teacher Edition: AE 101</p>
<p>P3.2 Apply quadratic functions and their graphs in the context of motion under gravity and simple optimization problems.</p>	<p>Student Edition: 468 ex 6, 469 #32, 470 #49-#51 <i>Key Concept</i> 467</p> <p>Teacher Edition: AE 468; DI 468</p>
<p>P3.3 Explain how the parameters of an exponential or logarithmic model relate to the data set or situation being modeled. Find a quadratic function to model a given data set or situation.</p>	<p>Student Edition: 200-210, 213 #45-#46, 214 #54, 215 #25, 230 #92, 241 #84</p> <p>Teacher Edition: A 210; AE 201, 202, 203; DI 204, 210; F 202, 203; TNT 203</p>
P4 Polynomial Functions	
<p>P4.1 Given a polynomial function whose roots are known or can be calculated, find the intervals on which the function's values are positive and those where it is negative.</p>	<p>Student Edition: 102 ex 6, 104 #33-#42, 106 #81-#84 <i>Key Concept</i> 98</p> <p>Teacher Edition: AE 102; TNT 102</p>

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<p>P4.2 Solve polynomial equations and inequalities of degree greater than or equal to three. Graph polynomial functions given in factored form using zeros and their multiplicities, testing the sign-on intervals and analyzing the function's large-scale behavior.</p>	<p>Student Edition: P11 ex 4, P13 #23-#28, 100 ex 3, 104 #23-#42, 106 #85-#88, 118 #10-#12, 149 #25-#28, 153 #11-#12 <i>Key Concept</i> P11</p> <p>Teacher Edition: AE P11, 100</p>
<p>P4.3 Know and apply fundamental facts about polynomials: the Remainder Theorem, the Factor Theorem, and the Fundamental Theorem of Algebra.</p>	<p>Student Edition: 109-117, 118 #23-#24, 124 ex 6, 149 #29-#30, 153 #17-#18 <i>Key Concept</i> 123</p> <p>Teacher Edition: A 117; AE 110, 113, 124; DI 113, 124; TNT 113</p>
P5 Rational Functions and Difference Quotients	
<p>P5.1 Solve equations and inequalities involving rational functions. Graph rational functions given in factored form using zeros, identifying asymptotes, analyzing their behavior for large x values, and testing intervals.</p>	<p>Student Edition: 130-140, 147 #70-#72, 151 #50-#53</p> <p>Teacher Edition: AE 132, 133, 134, 135, 136, 137; DI 136; F 131</p>
<p>P5.2 Given vertical and horizontal asymptotes, find an expression for a rational function with these features.</p>	<p>Student Edition: 139 #56, 153 #25-#26</p> <p>Teacher Edition: AE 133, 134; DI 132; F 131; TWT 132</p>
<p>P5.3 Know and apply the definition and geometric interpretation of difference quotient. Simplify difference quotients and interpret difference quotients as rates of change and slopes of secant lines.</p>	<p>Student Edition: 83 #7-#9, 216, 217 #3-#6, 759 ex 1-ex 2, 761 ex 3-ex 4, 762 #1-#6, 765 #27-#30, 766 ex 1, 772 #1-#6, 773 #64, 794 #23-#24, 797 #17-#19 <i>Key Concept</i> 758, 760</p> <p>Teacher Edition: AE 759, 767; TT 216</p>
P6 Trigonometric Functions	
<p>P6.1 Define (using the unit circle), graph, and use all trigonometric functions of any angle. Convert between radian and degree measure. Calculate arc lengths in given circles.</p>	<p>Student Edition: 256-266, 268 #21-#22, 269-279 <i>Graphing Technology Lab</i> 254-255, 267</p> <p>Teacher Edition: AE 257, 258, 259, 261, 262, 270, 271, 272, 274, 275; DI 261, 271; F 259; TNT 250, 264, 271</p>

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<p>P6.2 Graph transformations of the sine and cosine functions (involving changes in amplitude, period, midline, and phase) and explain the relationship between constants in the formula and transformed graph.</p>	<p>Student Edition: 256-266, 268 #21-#22, 279 #63-#65, 290 #74-#76, 304 #37-#44, 307 #14-#15 <i>Graphing Technology Lab</i> 254-255, 267 <i>Technology Tip</i> 262</p> <p>Teacher Edition: A 255; AE 257, 258, 261, 262, 263; DI 261; F 259; TNT 262, 264</p>
<p>P6.3 Know basic properties of the inverse trigonometric functions $\sin^{-1} x$, $\cos^{-1} x$, $\tan^{-1} x$, including their domains and ranges. Recognize their graphs.</p>	<p>Student Edition: 280-290, 301 #73-#76, 305 #53-#60, 307 #23-#24</p> <p>Teacher Edition: AE 281, 282, 283, 284, 285, 286, 287; DI 282; F 282, 286; T 280; TWT 281; WO 288</p>
<p>P6.4 Know the basic trigonometric identities for sine, cosine, and tangent (e.g., the Pythagorean identities, sum and difference formulas, co-functions relationships, double-angle and half-angle formulas).</p>	<p>Student Edition: 312-319, 326 #66-#71, 333 #67-#69, 335 #4-#7, 336-343</p> <p>Teacher Edition: A 319; AE 313, 314, 315, 316, 337, 338; DI 314, 315, 319; F 313, 339; T 312; TWT 314; WO 317, 319</p>
<p>P6.5 Solve trigonometric equations using basic identities and inverse trigonometric functions.</p>	<p>Student Edition: 327-333, 335 #21-#24, 340 ex 7, 342 #40-#45, 348 ex 4, 349 ex 6, 351 ex 9, 352 #31-#36</p> <p>Teacher Edition: A 333; AE 328, 329, 330, 340, 348, 349, 351; DI 329, 333; TWT 329; WO 331</p>
<p>P6.6 Prove trigonometric identities and derive some of the basic ones (e.g., double-angle formula from sum and difference formulas, half-angle formula from double-angle formula, etc.).</p>	<p>Student Edition: 320-326, 333 #64-#66, 335 #10-#15, 339 ex 5, 340 ex 6, 342 #46-#49, 343 #70-#71, 356 #23-#32, 357 #55-#58, 359 #6-#10</p> <p>Teacher Edition: A 326; AE 321, 322, 323, 340; DI 323, 326; F 322; T 320; TNT 322, 324; TWT 322</p>
<p>P6.7 Find a sinusoidal function to model a given data set or situation and explain how the parameters of the model relate to the data set or situation.</p>	<p>Student Edition: 263 ex 7, 264 #21-#22, 265 #30</p> <p>Teacher Edition: AE 263; DI 263</p>

STANDARDS	PAGE REFERENCES
P7 Vectors, Matrices, and Systems of Equations	
<p>P7.1 Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors.</p>	<p>Student Edition: 485 ex 4, 488 #27-#34, 493 ex 3, 497 #11-#18, 508 #75-#77, 509 #6, 513 ex 5, 514 #36-#47, 526 #23-#26, 529 #8-#10</p> <p><i>Key Concept</i> 493, 513</p> <p><i>Study Tip</i> 513</p> <p>Teacher Edition: AE 485, 493, 513; DI 493</p>
<p>P7.2 Know and apply the algebraic and geometric definitions of the dot product of vectors.</p>	<p>Student Edition: 501 ex 1, 506 #1-#8, 507 #42-#45, 509 #21, 522 #1-#8, 523 #45-#47, 524 #69-#71, 527 #31-#34, 529 #13-#14</p> <p><i>Key Concept</i> 500, 518</p> <p>Teacher Edition: AE 501, 519; TNT 501, 521</p>
<p>P7.3 Know the definitions of matrix addition and multiplication. Add, subtract, and multiply matrices. Multiply a vector by a matrix.</p>	<p>Student Edition: P23-P27, P38 #39-#41, 375, 376 ex 1, 377 ex 2, 383 #1-#8, 385 #57-#60, 394 #54-#55, 387 #9-#10, 412 #54, 414 #23-#26, 417 #6-#7</p> <p><i>Technology Tip</i> 376</p> <p>Teacher Edition: A P27; AE P23, P24, P25, 376; F 377; TWT P24</p>
<p>P7.4 Represent rotations of the plane as matrices and apply to find the equations of rotated conics.</p>	<p>Student Edition: 454-461, 471 #58-#59, 475 #41-#49, 476 #59, 477 #9-#10, 491 #72</p> <p>Teacher Edition: A 461; AE 455, 456, 457, 458; DI 461; F 457; TNT 458; TWT 456</p>
<p>P7.5 Define the inverse of a matrix and compute the inverse of two-by-two and three-by-three matrices when they exist.</p>	<p>Student Edition: 378-379, 380 ex 5, 381 ex 6, 383 #19-#34, 385 #66, 397 #11-#14, 414 #27-#30, 417 #9-#10</p> <p><i>Reading Math</i> 378, 379</p> <p><i>Study Tip</i> 379</p> <p><i>Technology Tip</i> 380</p> <p>Teacher Edition: AE 379, 380, 382; TWT 381</p>

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<p>P7.6 Explain the role of determinants in solving systems of linear equations using matrices and compute determinants of two-by-two and three-by-three matrices.</p>	<p>Student Edition: 381 ex 6, 382 ex 7, 384 #35-#44, 385 #65, 390 ex 3, 392 #11-#18, 397 #11-#14, 404 #56-#58, 415 #37-#42 <i>Graphing Technology Lab</i> 387</p> <p>Teacher Edition: AE 381, 382, 390, 391; DI 381, 382, 391, 394; TWT 381, 391</p>
<p>P7.7 Write systems of two and three linear equations in matrix form. Solve such systems using Gaussian elimination or inverse matrices.</p>	<p>Student Edition: 378 ex 3, 383 #11-#18, 386 #79-#81, 388-394, 397 #19-#20, 404 #56-#58, 412 #54, 415 #31-#36, 417 #13-#14</p> <p>Teacher Edition: A 386; AE 378, 389, 390, 391; DI 382, 391, 394; F 389; TNT 378</p>
<p>P7.8 Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.</p>	<p>Student Edition: 405-412, 416 #53-#58, 417 #17-#18, 431 #84-#86</p> <p>Teacher Edition: A 412; AE 406, 407, 408, 409; DI 409; F 407; TNT 406, 410</p>
<p>P8 Sequences, Series, and Mathematical Induction</p>	
<p>P8.1 Know, explain, and use sigma and factorial notation.</p>	<p>Student Edition: P28, 594 ex 6, 595 #36-#45, 596 #57-#60, 597 #85-#86, 618 #115-#117, 646 #15-#16 <i>Key Concept</i> 594 <i>Watch Out</i> 594</p> <p>Teacher Edition: AE 594; TNT 594</p>
<p>P8.2 Given an arithmetic, geometric, or recursively defined sequence, write an expression for the nth term when possible. Write a particular term of a sequence when given the nth term.</p>	<p>Student Edition: 599-607, 608-617, 620 #15-#18, 646 #17-#28 <i>Study Tip</i> 603 <i>Watch Out</i> 609</p> <p>Teacher Edition: A 618; F 600</p>

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<p>P8.3 Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.</p>	<p>Student Edition: 603 ex 6, 605 #40-#45, 612 ex 6, 613 ex 7, 615 #40-#47, 616 #48-#55, 618 #13, 620 #10-#13, 644 #77, 646 #21-#22, 649 #3-#4</p> <p><i>Key Concept</i> 612</p> <p><i>Study Tip</i> 612</p> <p>Teacher Edition: AE 603, 610, 612, 613; TWT 601</p>
<p>P8.4 Compute the sums of infinite geometric series. Understand and apply the convergence criterion for geometric series.</p>	<p>Student Edition: 614 ex 8, 616 #57-#64, 617 #105-#106, 637 ex 1, 642 #1-#6, 648 #42- #43, 649 #21-#22</p> <p><i>Key Concept</i> 613, 636</p> <p><i>Study Tip</i> 613</p> <p>Teacher Edition: AE 614, 637</p>
<p>P8.5 Understand and explain the principle of mathematical induction and prove statements using mathematical induction.</p>	<p>Student Edition: 621-627, 635 #75-#76, 644 #64, 647 #29-#35, 649 #12-#15</p> <p>Teacher Edition: A 627; AE 622, 623, 624; DI 625, 627; F 623; TWT 625; WO 625</p>
<p>P8.6 Prove the binomial theorem using mathematical induction. Show its relationships to Pascal's triangle and to combinations. Use the binomial theorem to find terms in the expansion of a binomial to a power greater than 3.</p>	<p>Student Edition: 628-635, 644 #61-#63, 647 #36-#41, 649 #19-#20, 663 #31-#33</p> <p><i>Study Tip</i> 629</p> <p>Teacher Edition: A 635; AE 629, 630, 631, 632; DI 632, 635; F 629, 630; T 628; TWT 630</p>
<p>P9 Polar Coordinates, Parameterizations, and Conic Sections</p>	
<p>P9.1 Convert between polar and rectangular coordinates. Graph functions given in polar coordinates.</p>	<p>Student Edition: 534-540, 550 #69-#71, 551 ex 1, 553 ex 2, 554 ex 3, 557 #1-#12</p> <p><i>Key Concept</i> 551, 553</p> <p>Teacher Edition: A 540; AE 535, 536, 537, 552, 553, 554; DI 537, 553, 559; F 537; TWT 537, 553</p>

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<p>P9.2 Write complex numbers in polar form. Know and use De Moivre’s Theorem.</p>	<p>Student Edition: 569-579, 583 #51-#71, 585 #22-#25, 607 #92-#93</p> <p>Teacher Edition: A 579; AE 571, 572, 573, 574, 575, 576; DI 572, 579; F 572</p>
<p>P9.3 Evaluate parametric equations for given values of the parameter.</p>	<p>Student Edition: 465 ex 1, 466 ex 4, 467 ex 5, 469 #1-#8, 470 #45-#48, 476 #50-#51</p> <p>Teacher Edition: AE 465, 466, 467; TNT 467</p>
<p>P9.4 Convert between parametric and rectangular forms of equations.</p>	<p>Student Edition: 465 ex 2, 466 ex 3-ex 4, 469 #9-#16, 476 #52-#55</p> <p><i>Study Tip</i> 465, 467</p> <p>Teacher Edition: A 471; AE 465, 466; F 466</p>
<p>P9.5 Graph curves described by parametric equations and find parametric equations for a given graph.</p>	<p>Student Edition: 464-471, 476 #50-#55, 477 #4-#5, 499 #75-#77</p> <p><i>Graphing Technology Lab</i> 472</p> <p>Teacher Edition: A 471; AE 465, 466, 467; DI 471; F 466; TNT 467; TWT 468</p>
<p>P9.6 Use parametric equations in applied contexts (e.g., orbits and projectiles) to model situations and solve problems.</p>	<p>Student Edition: 468 ex 6, 469 #32, 470 #49-#51, 477 #18</p> <p><i>Graphing Technology Lab</i> 472</p> <p><i>Key Concept</i> 467</p> <p>Teacher Edition: AE 468; DI 468</p>
<p>P9.7 Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations.</p>	<p>Student Edition: 424 ex 1, 428 #1-#10, 430 #77, 436 ex 3, 438 #14-#21, 439 #44-#47, 440 #70, 446 ex 4, 449 #34-#43, 453 #12, 461 #70-#72, 474 #11-#14</p> <p>Teacher Edition: A 431; AE 424, 436, 446; DI 423; F 433; TWT 423, 424</p>

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<p>P9.8 Identify parabolas, ellipses, and hyperbolas from equations, write the equations in standard form, and sketch an appropriate graph of the conic section.</p>	<p>Student Edition: 422-431, 432-441, 442-452, 453 #5-#6, 461 #67-#69</p> <p>Teacher Edition: A 441; AE 424, 425, 426, 427, 434, 435, 437, 444; DI 423, 433; F 423, 433, 443; TWT 434</p>
<p>P9.9 Derive the equation for a conic section from given geometric information (e.g., find the equation of an ellipse given its two axes). Identify key characteristics (e.g. foci and asymptotes) of a conic section from its equation or graph.</p>	<p>Student Edition: 425 ex 3, 426 ex 4, 428 #15-#24, 429 #60-#63, 430 #77, 435 ex 2, 437 ex 5, 438 #7-#13, 439 #39-#42, 446 ex 3, 449 #23-#30, 451 #67-#68, 453 #7-#10</p> <p><i>Key Concept</i> 423, 433, 443</p> <p>Teacher Edition: A 441; AE 425, 426, 435, 437, 446; DI 426</p>
<p>P9.10 Identify conic sections whose equations are in polar or parametric form.</p>	<p>Student Edition: 437 ex 5, 447 ex 5</p> <p>Teacher Edition: A 452; AE 437, 447; DI 444; TNT 447</p>