



# ADVANCED Mathematical Concepts

Precalculus  
with Applications  
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STANDARDS	PAGE REFERENCES
<b>CONTENT EXPECTATIONS FOR PRECALCULUS</b>	
<b>P1 Functions</b>	
<p><b>P1.1</b> Know and use a definition of a function to decide if a given relation is a function.</p>	<p><b>Student Edition:</b> 6 ex 4, 7 ex 5, 8 #3, 9 #10-#11, 10 #32-#37, 11 #52, 19 #36, 25 #44, 31 #1, 37 #39, 44 #18, 51 #36, 61 #67, 72 #44, 105 #61, 111 #32</p> <p><b>Teacher Wraparound Edition:</b> A 12; AIN 7; ICE 6, 7</p>
<p><b>P1.2</b> Perform algebraic operations (including compositions) on functions and apply transformations (translations, reflections, and rescalings).</p>	<p><b>Student Edition:</b> 13-19, 25 #42, 31 #32, 137-145, 709 #23 <i>Graphing Calculator Exploration 26</i></p> <p><b>Teacher Wraparound Edition:</b> A 19, 145; AIN 16, 141; EC 19; F 146; FTC 139; ICE 14, 15, 16, 138, 139, 140; MTL 138</p>
<p><b>P1.3</b> 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><b>Student Edition:</b> 13-19, 25 #42, 31 #32, 37 #38, 44 #17, 58 #24-#30, 61 #1, 72 #43, 104 #60 <i>Extra Practice Lesson 1-2 A26</i></p> <p><b>Teacher Wraparound Edition:</b> A 19; AIN 16; EA 17; F 20; ICE 15, 16</p>

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<p><b>P1.4</b> 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><b>Student Edition:</b> 152-158, 168 #40, 188 #49, 196 #43, 198 #29-#34, 201 #60</p> <p><b>Teacher Wraparound Edition:</b> A 158; AIN 154; EA 155; F 159; FTC 155; ICE 153, 154, 155; MTL 152; TT 154</p>
<p><b>P1.5</b> Determine whether two given functions are inverses, using composition.</p>	<p><b>Student Edition:</b> 155 ex 5, 156 #13</p> <p><b>Teacher Wraparound Edition:</b> A 158; ICE 155</p>
<p><b>P1.6</b> Identify and describe discontinuities of a function (e.g., greatest integer function, <math>1/x</math>) and how these relate to the graph.</p>	<p><b>Student Edition:</b> 159-168, 179 #41, 180-188, 196 #42, 199 #35-#37, 200 #52-#55</p> <p><i>Graphing Calculator Exploration</i> 169-170</p> <p><b>Teacher Wraparound Edition:</b> A 168, 170, 188; EA 165; ICE 160, 162, 181, 182, 183, 184; MTL 169; TT 160, 162, 163, 182</p>
<p><b>P1.7</b> Understand the concept of limit of a function as <math>x</math> 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 <math>x</math> approaches 0 of <math>f(x) = 1/x</math>) informally.</p>	<p><b>Student Edition:</b> 774-783, 793 #36, 814 #45, 831 #22-#26, 833 #56, 941-948</p> <p><b>Teacher Wraparound Edition:</b> FTC 775; ICE 775, 776, 777, 779, 944, 945; MTL 181, 775; TT 775, 776, 777, 778, 942, 943</p>
<p><b>P1.8</b> 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><b>Student Edition:</b> 137-145, 151 #46, 178 #38</p> <p><i>Graphing Calculator Exploration</i> 26</p> <p><b>Teacher Wraparound Edition:</b> A 26, 145; AIN 141; FTC 139; MTL 26, 138</p>
<p><b>P2 Exponential and Logarithmic Functions</b></p>	
<p><b>P2.1</b> Use the inverse relationship between exponential and logarithmic functions to solve equations and problems.</p>	<p><b>Student Edition:</b> 719 ex 1, 721 ex 5, 729 ex 7, 731 #45, 751 #30-#31, 752 #64-#67</p> <p><b>Teacher Wraparound Edition:</b> A 725; F 726; ICE 719, 721; MTL 719</p>
<p><b>P2.2</b> Graph logarithmic functions. Graph translations and reflections of these functions.</p>	<p><b>Student Edition:</b> 718-725, 731 #52-#54, 751 #57</p> <p><b>Teacher Wraparound Edition:</b> ICE 721; MTL 719</p>

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<p><b>P2.3</b> 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><b>Student Edition:</b> 705 ex 1, 708 #2, 709 #22, 710 #30</p> <p><b>Teacher Wraparound Edition:</b> ICE 705; GCE 704</p>
<p><b>P2.4</b> Solve exponential and logarithmic equations when possible, (e.g. <math>5^x = 3^{(x+1)}</math>). For those that cannot be solved analytically, use graphical methods to find approximate solutions.</p>	<p><b>Student Edition:</b> 721 ex 5, 723 #13-#16, 729 ex 7 – ex 8, 731 #40-#45, 734 ex 3 – ex 4, 735 #11-#12, 736 #48-#49, 748 #26, 751 #42-#47, 752 #64-#67</p> <p><b>Teacher Wraparound Edition:</b> A 725; F 726; ICE 721, 734; TT 721</p>
<p><b>P2.5</b> 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><b>Student Edition:</b> 707 ex 3 – ex 4, 708 #8, 709 #27, 710 #31, 716 #17, 717 #10, 725 #68, 740-748, 752 #72-#74</p> <p><b>Teacher Wraparound Edition:</b> A 711, 748; AIN 707; EC 711, 748; FTC 742; ICE 707, 741, 743; MTL 740; TT 743</p>
<p><b>P3 Quadratic Functions</b></p>	
<p><b>P3.1</b> Solve quadratic-type equations (e.g. <math>e^{2x} - 4e^{x+4} = 0</math>) by substitution.</p>	<p><i>U-substitution</i> can be covered during teacher/class discussion.</p>
<p><b>P3.2</b> Apply quadratic functions and their graphs in the context of motion under gravity and simple optimization problems.</p>	<p><b>Student Edition:</b> 215 ex 3, 219 #11, 220 #37, 242 #40</p> <p><b>Teacher Wraparound Edition:</b> ICE 215; TT 215</p>
<p><b>P3.3</b> 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><b>Student Edition:</b> 258-264</p> <p><i>Graphing Calculator Exploration</i> 265-266</p> <p><b>Teacher Wraparound Edition:</b> AIN 260; ICE 260; TT 260</p>
<p><b>P4 Polynomial Functions</b></p>	
<p><b>P4.1</b> 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><b>Student Edition:</b> 229-235, 236-242, 250 #47, 257 #47, 269 #26-#43</p> <p><b>Teacher Wraparound Edition:</b> A 235, 242; EA 233; F 236; ICE 230, 231, 239; TT 230, 231, 237</p>

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<p><b>P4.2</b> 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><b>Student Edition:</b> 222-228, 235 #29, 250 #48, 268 #22-#25</p> <p><b>Teacher Wraparound Edition:</b> A 228; F 229; ICE 223, 224, 225</p>
<p><b>P4.3</b> Know and apply fundamental facts about polynomials: the Remainder Theorem, the Factor Theorem, and the Fundamental Theorem of Algebra.</p>	<p><b>Student Edition:</b> 207, 208 ex 3 – ex 4, 210 #11-#13, 211 #39-#47, 212 #56, 222-228, 235 #6, 250 #48, 268 #22-#25, 283 #70</p> <p><b>Teacher Wraparound Edition:</b> A 212; AIN 208; EX 228; F 229; ICE 208, 224, 225; MTL 222; TT 223</p>
<p><b>P5 Rational Functions and Difference Quotients</b></p>	
<p><b>P5.1</b> Solve equations and inequalities involving rational functions. Graph rational functions given in factored form using zeros, identifying asymptotes, analyzing their behavior for large <math>x</math> values, and testing intervals.</p>	<p><b>Student Edition:</b> 180-188, 196 #42, 200 #50-#51</p> <p><b>Teacher Wraparound Edition:</b> A 188; AIN 184; EC 188; ICE 181, 182, 183, 184, 185; TT 181, 182</p>
<p><b>P5.2</b> Given vertical and horizontal asymptotes, find an expression for a rational function with these features.</p>	<p><b>Student Edition:</b> 185 #1, 186 #21-#23, 187 #43, 200 #48-#49, 201 #2, 212 #57</p>
<p><b>P5.3</b> 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><b>Student Edition:</b> 951, 952 ex 1, 957 #4-#5, 958 #14-#19, 959 #47, 960 #4, 979 #22-#24</p> <p><i>Graphing Calculator Exploration</i> 949-950</p> <p><b>Teacher Wraparound Edition:</b> AIN 956; ICE 952; TT 952</p>
<p><b>P6 Trigonometric Functions</b></p>	
<p><b>P6.1</b> 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><b>Student Edition:</b> 284-290, 291-298, 304 #31, 311 #53, 318 #37, 336 #23-#26, 337 #27-#36</p> <p><b>Teacher Wraparound Edition:</b> A 290, 298; AIN 286; EC 290, 298; F 291; ICE 285, 286, 292, 293, 294, 295; TT 292</p>
<p><b>P6.2</b> 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><b>Student Edition:</b> 359-366, 368-376, 378-386</p> <p><b>Teacher Wraparound Edition:</b> A 366, 376; EC 376, 386; ICE 361, 362, 369, 370, 371, 379, 380, 381, 382; MTL 368; T 369; TT 361, 381</p>

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<p><b>P6.3</b> Know basic properties of the inverse trigonometric functions <math>\sin^{-1} x</math>, <math>\cos^{-1} x</math>, <math>\tan^{-1} x</math>, including their domains and ranges. Recognize their graphs.</p>	<p><b>Student Edition:</b> 305, 306 ex 1 – ex 2, 309 #5-#8, 310 #45, 337 #40-#44</p> <p><b>Teacher Wraparound Edition:</b> EC 365; ICE 306, 307; TT 305, 306</p>
<p><b>P6.4</b> 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><b>Student Edition:</b> 421-430, 436 #46, 437-445, 448-455 <i>Graphing Calculator Exploration</i> 446-447</p> <p><b>Teacher Wraparound Edition:</b> A 430, 445; AIN 426; EC 429; F 437; ICE 422, 423, 425, 426, 439, 440, 441, 451; TT 423, 425</p>
<p><b>P6.5</b> Solve trigonometric equations using basic identities and inverse trigonometric functions.</p>	<p><b>Student Edition:</b> 456-461, 469 #38, 479 #34-#39</p> <p><b>Teacher Wraparound Edition:</b> AIN 457; EC 461; F 463; ICE 457, 458</p>
<p><b>P6.6</b> 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><b>Student Edition:</b> 431-436, 437, 438 ex 1, 445 #6-#7, 452 ex 4, 453 #10-#12, 454 #28-#35, 478 #16-#19, 481 #58, 492 #46</p> <p><b>Teacher Wraparound Edition:</b> A 436; EC 436, 445; F 437, 448, 455; ICE 432, 433, 438, 452; TT 432</p>
<p><b>P6.7</b> 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><b>Student Edition:</b> 387-394, 402 #49, 416 #39-#40, 417 #50, 444 #53</p> <p><b>Teacher Wraparound Edition:</b> AIN 390; FTC 389; ICE 388, 389; MTL 388</p>
<p><b>P7 Vectors, Matrices, and Systems of Equations</b></p>	
<p><b>P7.1</b> Perform operations (addition, subtraction, and multiplication by scalars) on vectors in the plane. Solve applied problems using vectors.</p>	<p><b>Student Edition:</b> 493-499, 501 ex 4, 502 ex 5, 503 #22-#27, 504 #40, 544 #13-#16</p> <p><b>Teacher Wraparound Edition:</b> A 499; AIN 495; EC 498; F 500, 505; ICE 493, 494, 496, 501, 502</p>
<p><b>P7.2</b> Know and apply the algebraic and geometric definitions of the dot product of vectors.</p>	<p><b>Student Edition:</b> 505-511, 519 #33, 525 #41, 545 #33-#37</p> <p><b>Teacher Wraparound Edition:</b> A 499, 511; EA 508; ICE 506, 507; TT 506</p>

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<p><b>P7.3</b> Know the definitions of matrix addition and multiplication. Add, subtract, and multiply matrices. Multiply a vector by a matrix.</p>	<p><b>Student Edition:</b> 80 ex 3 – ex 4, 81 ex 5, 83 #8-#13, 84 #47-#48, 96 #35, 104 #54, 120 #20-#27, 136 #44, 151 #49, 158 #52, 179 #46, 188 #51 <i>Graphing Calculator Exploration</i> 86 <b>Teacher Wraparound Edition:</b> A 86; ICE 80, 81; TT 80, 81, 536, 537</p>
<p><b>P7.4</b> Represent rotations of the plane as matrices and apply to find the equations of rotated conics.</p>	<p><b>Student Edition:</b> 535-542, 546 #53-#54 <b>Teacher Wraparound Edition:</b> A 542; AIN 539; EX 542; ICE 536, 538; MTL 535</p>
<p><b>P7.5</b> Define the inverse of a matrix and compute the inverse of two-by-two and three-by-three matrices when they exist.</p>	<p><b>Student Edition:</b> 98-105, 111 #29, 121 #39-#44, 151 #48 <b>Teacher Wraparound Edition:</b> F 107; ICE 100</p>
<p><b>P7.6</b> 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><b>Student Edition:</b> 98-105, 121 #34-#38 <b>Teacher Wraparound Edition:</b> AIN 101; EC 104; F 107; ICE 99; TT 99, 100</p>
<p><b>P7.7</b> Write systems of two and three linear equations in matrix form. Solve such systems using Gaussian elimination or inverse matrices.</p>	<p><b>Student Edition:</b> 100 ex 4, 101 ex 5, 102 #11-#12, 103 #44-#45, 158 #51 <i>Graphing Calculator Exploration</i> 106 <b>Teacher Wraparound Edition:</b> A 105; F 107; ICE 100</p>
<p><b>P7.8</b> Represent and solve systems of inequalities in two variables and apply these methods in linear programming situations to solve problems.</p>	<p><b>Student Edition:</b> 107-111, 112-118, 122 #49-#51, 123 #54, 135 #43, 145 #45, 158 #50 <b>Teacher Wraparound Edition:</b> A 111, 118; AIN 109, 114; EC 111, 118; F 112; FTC 108; ICE 108, 109, 113, 114; MTL 107</p>
<p><b>P8 Sequences, Series, and Mathematical Induction</b></p>	
<p><b>P8.1</b> Know, explain, and use sigma and factorial notation.</p>	<p><b>Student Edition:</b> 794-800, 805 #38, 814 #44, 831 #31-#34 <b>Teacher Wraparound Edition:</b> A 800; AIN 796; EC 799; F 801; ICE 795, 796, 797; TT 795, 796, 798</p>

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<p><b>P8.2</b> Given an arithmetic, geometric, or recursively defined sequence, write an expression for the <math>n</math>th term when possible. Write a particular term of a sequence when given the <math>n</math>th term.</p>	<p><b>Student Edition:</b> 759-765, 766-773, 783 #47, 793 #1, 800 #53, 830 #11-#13</p> <p><b>Teacher Wraparound Edition:</b> A 765; F 766, 774; ICE 760, 762, 767, 768; TT 761</p>
<p><b>P8.3</b> Understand, explain, and use the formulas for the sums of finite arithmetic and geometric sequences.</p>	<p><b>Student Edition:</b> 761 ex 5, 762 ex 6, 763 #14, 764 #44-#45, 765 #55, 769 ex 5, 771 #14, 772 #37-#40, 793 #2, 830 #14-#15, 845 #55</p> <p><b>Teacher Wraparound Edition:</b> A 773; F 774; ICE 761, 762, 769, 770</p>
<p><b>P8.4</b> Compute the sums of infinite geometric series. Understand and apply the convergence criterion for geometric series.</p>	<p><b>Student Edition:</b> 774-783, 786-793, 805 #40, 831 #22-#27</p> <p><b>Teacher Wraparound Edition:</b> A 783; AIN 789; EA 780; F 786; ICE 775, 776, 779, 787</p>
<p><b>P8.5</b> Understand and explain the principle of mathematical induction and prove statements using mathematical induction.</p>	<p><b>Student Edition:</b> 822-825, 832 #51-#53</p> <p><b>Teacher Wraparound Edition:</b> A 828; AIN 825; EC 828; ICE 823, 824, 825; MTL 822; TT 823, 827</p>
<p><b>P8.6</b> 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><b>Student Edition:</b> 801-805, 814 #43, 821 #37, 832 #35-#40, 851 #40</p> <p><b>Teacher Wraparound Edition:</b> A 805; AIN 803; EC 805; F 806; ICE 802, 803; TT 802</p>
<p><b>P9 Polar Coordinates, Parameterizations, and Conic Sections</b></p>	
<p><b>P9.1</b> Convert between polar and rectangular coordinates. Graph functions given in polar coordinates.</p>	<p><b>Student Edition:</b> 568-573, 579 #5-#6, 584 #42, 591 #52, 609 #24-#31, 611 #66, 711 #33</p> <p><b>Teacher Wraparound Edition:</b> A 573, 579; AIN 570, 576; EC 572; F 574; ICE 569, 571, 575, 576, 577; MTL 568, 574</p>
<p><b>P9.2</b> Write complex numbers in polar form. Know and use De Moivre's Theorem.</p>	<p><b>Student Edition:</b> 599-606, 610 #59-#62, 827 #23</p> <p><b>Teacher Wraparound Edition:</b> A 606; AIN 603; ICE 600</p>

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<p><b>P9.3</b> Evaluate parametric equations for given values of the parameter.</p>	<p><b>Student Edition:</b> 522 ex 4, 524 #31, 546 #45-#49</p> <p><b>Teacher Wraparound Edition:</b> F 527, ICE 666</p>
<p><b>P9.4</b> Convert between parametric and rectangular forms of equations.</p>	<p><b>Student Edition:</b> 662-669, 684 #44, 690 #42-#49</p> <p><b>Teacher Wraparound Edition:</b> AIN 665; ICE 664, 665, 666</p>
<p><b>P9.5</b> Graph curves described by parametric equations and find parametric equations for a given graph.</p>	<p><b>Student Edition:</b> 663 ex 1, 677 #49</p> <p><b>Teacher Wraparound Edition:</b> AIN 665; EC 669; ICE 663, 664</p>
<p><b>P9.6</b> Use parametric equations in applied contexts (e.g., orbits and projectiles) to model situations and solve problems.</p>	<p><b>Student Edition:</b> 527-533, 542 #26, 546 #50-#52, 547 #56 <i>Graphing Calculator Exploration</i> 526</p> <p><b>Teacher Wraparound Edition:</b> A 533, 669; AIN 530; EC 533; F 535; ICE 528, 529, 530; TT 530</p>
<p><b>P9.7</b> Know, explain, and apply the locus definitions of parabolas, ellipses, and hyperbolas and recognize these conic sections in applied situations.</p>	<p><b>Student Edition:</b> 632 ex 1, 658, 663 ex 1, 667 #23, 677 #49, 689 #38-#41</p> <p><b>Teacher Wraparound Edition:</b> A 669; AIN 681; F 670, 678; ICE 632, 663</p>
<p><b>P9.8</b> Identify parabolas, ellipses, and hyperbolas from equations, write the equations in standard form, and sketch an appropriate graph of the conic section.</p>	<p><b>Student Edition:</b> 634 ex 2, 644 ex 1, 646 ex 4, 649 ex 6, 650 #10-#13, 651 #31-#42, 652 #49</p> <p><b>Teacher Wraparound Edition:</b> A 641, 652; F 642; ICE 634, 635, 637, 644, 645, 646, 649, 656; MTL 653; TT 645, 655</p>
<p><b>P9.9</b> 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><b>Student Edition:</b> 634 ex 2, 644 ex 1, 646 ex 4, 649 ex 6, 650 #10-#13, 651 #31-#42, 652 #49</p> <p><b>Teacher Wraparound Edition:</b> A 641, 652; F 642; ICE 634, 635, 637, 644, 645, 646, 649, 656; MTL 653; TT 645, 655</p>

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<p><b>P9.10</b> Identify conic sections whose equations are in polar or parametric form.</p>	<p><b>Student Edition:</b> 632 ex 1, 658, 663 ex 1, 667 #23, 677 #49, 689 #38-#41</p> <p><b>Teacher Wraparound Edition:</b> A 669; AIN 665, 681; EC 669; F 670, 678; ICE 632, 663, 664; TT 663</p>