

AP[®] PRECALCULUS CONCEPT OUTLINE

The table below extends over the next several pages. It shows the alignment of *Precalculus: Graphical, Numerical, Algebraic* to the AP[®] Precalculus Course Framework. This AP[®] framework includes four units, which are divided into topics, learning objectives, and essential knowledge. The table provides a complete list of the textbook sections where each element of essential knowledge is located.

UNIT 1: Polynomial and Rational Functions

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>	Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Change in Tandem			Rational Functions and End Behavior		
1.1.A	1.1.A.1	1.2, 1.3	1.7.A	1.7.A.1	2.6
	1.1.A.2	1.2, 1.5, 1.7		1.7.A.2	1.2, 2.6, 2.7
	1.1.A.3	1.2, 1.3		1.7.A.3	2.6
	1.1.A.4	1.2, 1.3		1.7.A.4	1.2, 2.6
1.1.B	1.1.B.1	1.2, 1.3, 1.7		1.7.A.5	1.2, 2.6
	1.1.B.2	1.3, 1.7		1.7.A.6	1.2, 1.3, 2.6
	1.1.B.3	1.2, 2.3	Rational Functions and Zeros		
	1.1.B.4	1.2, 2.3	1.8.A	1.8.A.1	2.6, 2.7
	1.1.B.5	1.1, 2.3, 2.4, 2.5		1.8.A.2	2.6, 2.7
Rates of Change			Rational Functions and Vertical Asymptotes		
1.2.A	1.2.A.1	2.1, 2.2, 3.3	1.9.A	1.9.A.1	1.2, 1.3, 2.6, 2.7
	1.2.A.2	2.2, 2.6, 3.3		1.9.A.2	1.2, 2.6, 2.7
	1.2.A.3	2.1, 2.2	Rational Functions and Holes		
1.2.B	1.2.B.1	1.2, 2.2, 2.6, 3.3, 3.7, 4.1, 6.2	1.10.A	1.10.A.1	2.6, 2.7
	1.2.B.2	1.2, 1.7, 2.2, 6.2		1.10.A.2	1.2, 2.6
	1.2.B.3	1.2, 1.7, 2.2, 6.2	Equivalent Representations of Polynomial and Rational Expressions		
Rates of Change in Linear and Quadratic Functions			1.11.A	1.11.A.1	2.4, 2.6
1.3.A	1.3.A.1	1.7, 2.1, 2.3		1.11.A.2	2.3, 2.4, 2.6
	1.3.A.2	2.1, 2.2, 2.3		1.11.A.3	2.7
	1.3.A.3	2.2	1.11.B	1.11.B.1	2.4
1.3.B	1.3.B.1	2.2		1.11.B.2	2.6
	1.3.B.2	2.2	1.11.C	1.11.C.1	2.4
	1.3.B.3	2.2, 2.3	Transformations of Functions		
Polynomial Functions and Rates of Change			1.12.A	1.12.A.1	1.6, 2.1, 2.2, 2.6, 4.4, 7.3
1.4.A	1.4.A.1	2.1, 2.3		1.12.A.2	1.6, 2.1, 2.2, 2.6, 4.4, 4.5, 7.3
	1.4.A.2	1.2, 2.3, 2.4		1.12.A.3	1.6, 2.1, 2.2, 2.6, 4.4, 4.5, 7.3
	1.4.A.3	2.3, 2.4		1.12.A.4	1.6, 2.1, 2.2, 2.6, 4.4, 4.5, 7.3
	1.4.A.4	2.3, 2.4		1.12.A.5	1.6, 2.1, 2.2, 4.4, 4.5, 7.3
	1.4.A.5	2.3, 2.4		1.12.A.6	1.6, 2.1, 2.2, 4.4, 7.3
Polynomial Functions and Complex Zeros			Function Model Selection and Assumption Articulation		
1.5.A	1.5.A.1	2.4, 2.5	1.13.A	1.13.A.1	1.1, 1.7
	1.5.A.2	2.3, 2.4, 2.5		1.13.A.2	1.7
	1.5.A.3	2.3, 2.4, 2.7		1.13.A.3	1.7
	1.5.A.4	2.5		1.13.A.4	2.3
	1.5.A.5	2.4		1.13.A.5	2.2, 2.3
	1.5.A.6	2.3		1.13.A.6	2.3
1.5.B	1.5.B.1	1.2, 1.3, 2.1		1.13.A.7	1.4, 1.7
	1.5.B.2	1.2, 1.3, 2.1	1.13.B	1.13.B.1	1.1, 1.7, 3.2, 3.3
Polynomial Functions and End Behavior				1.13.B.2	1.7, 3.2, 3.3
1.6.A	1.6.A.1	1.2, 1.3, 2.3		1.13.B.3	1.1, 1.7, 2.7, 3.2, 3.3
	1.6.A.2	1.2, 1.3, 2.3		1.13.B.4	1.1, 1.7, 2.7, 3.2, 3.3
	1.6.A.3	2.3			

TG-2 CONCEPT OUTLINE

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Function Model Construction and Application		
1.14.A	1.14.A.1	1.1, 1.7, 2.3
	1.14.A.2	2.3

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
	1.14.A.3	1.1, 1.2, 2.1, 2.2, 2.3
	1.14.A.4	1.7
1.14.B	1.14.B.1	2.7
1.14.C	1.14.C.1	1.1, 1.7, 2.3, 2.6, 2.7

UNIT 2: Exponential and Logarithmic Functions

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Change in Arithmetic and Geometric Sequences		
2.1.A	2.1.A.1	3.1
	2.1.A.2	3.1
	2.1.A.3	3.1
2.1.B	2.1.B.1	3.1
	2.1.B.2	3.1
	2.1.B.3	3.1

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Competing Function Model Validation		
2.6.A	2.6.A.1	1.7, 3.2, 3.3, 3.7
	2.6.A.2	1.7, 3.3
2.6.B	2.6.B.1	2.2, 3.3
	2.6.B.2	2.2, 3.3, 3.7

Change in Linear and Exponential Functions		
2.2.A	2.2.A.1	3.1
	2.2.A.2	3.1
	2.2.A.3	3.1, 3.2, 3.3
	2.2.A.4	3.3
	2.2.A.5	3.1, 3.3
2.2.B	2.2.B.1	3.1, 3.3
	2.2.B.2	3.1, 3.3
	2.2.B.3	3.1, 3.3

Composition of Functions		
2.7.A	2.7.A.1	1.4
	2.7.A.2	1.4
	2.7.A.3	1.4
	2.7.A.4	1.3, 1.4
2.7.B	2.7.B.1	1.4
	2.7.B.2	1.4
	2.7.B.3	1.4
2.7.C	2.7.C.1	1.4, 1.6
	2.7.C.2	1.6
	2.7.C.3	1.6

Exponential Functions		
2.3.A	2.3.A.1	3.2, 3.3
	2.3.A.2	3.2, 3.3
	2.3.A.3	3.2, 3.3
	2.3.A.4	3.3
	2.3.A.5	3.2, 3.3

Inverse Functions		
2.8.A	2.8.A.1	1.5, 3.4, 4.7
	2.8.A.2	1.5, 3.4, 4.7
2.8.B	2.8.B.1	1.5, 3.4, 4.7
	2.8.B.2	1.5, 3.4, 4.7
	2.8.B.3	1.5, 3.4, 4.7
	2.8.B.4	1.5, 3.4, 4.7
	2.8.B.5	1.5, 3.4, 4.7

Exponential Function Manipulation		
2.4.A	2.4.A.1	3.2
	2.4.A.2	3.2
	2.4.A.3	3.2
	2.4.A.4	3.2

Logarithmic Expressions		
2.9.A	2.9.A.1	3.4
	2.9.A.2	3.4, 3.5
	2.9.A.3	3.6

Exponential Function Context and Data Modeling		
2.5.A	2.5.A.1	3.3
	2.5.A.2	3.3
	2.5.A.3	3.3
	2.5.A.4	3.3
	2.5.A.5	3.2, 3.3
	2.5.A.6	3.2
2.5.B	2.5.B.1	3.2, 3.3, 3.7
	2.5.B.2	3.3
	2.5.B.3	3.2, 3.3, 3.7

Inverses of Exponential Functions		
2.10.A	2.10.A.1	3.4
	2.10.A.2	3.5, 3.6
	2.10.A.3	3.4
	2.10.A.4	3.4, 3.5
	2.10.A.5	3.4, 3.5

Logarithmic Functions		
2.11.A	2.11.A.1	3.4, 3.5
	2.11.A.2	3.4, 3.5
	2.11.A.3	3.6, 3.7
	2.11.A.4	3.4, 3.5

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Logarithmic Function Manipulation		
2.12.A	2.12.A.1	3.5
	2.12.A.2	3.5
	2.12.A.3	3.5
	2.12.A.4	3.4
Exponential and Logarithmic Equations and Inequalities		
2.13.A	2.13.A.1	3.7
	2.13.A.2	3.7
	2.13.A.3	3.7
2.13.B	2.13.B.1	3.4, 3.7
	2.13.B.2	3.4, 3.7

UNIT 3: Trigonometric and Polar Functions

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Periodic Phenomena		
3.1.A	3.1.A.1	4.3, 4.6
	3.1.A.2	4.3, 4.4, 4.6
3.1.B	3.1.B.1	4.3, 4.4
	3.1.B.2	4.3, 4.4
	3.1.B.3	4.3, 4.4, 4.6
Sine, Cosine, and Tangent		
3.2.A	3.2.A.1	4.1
	3.2.A.2	4.1
	3.2.A.3	4.2, 4.3
	3.2.A.4	4.2, 4.3
	3.2.A.5	4.2, 4.3, 4.5
Sine and Cosine Function Values		
3.3.A	3.3.A.1	4.2, 4.3
	3.3.A.2	4.2, 4.3
Sine and Cosine Function Graphs		
3.4.A	3.4.A.1	1.3, 4.2, 4.3, 4.4
	3.4.A.2	1.3, 4.2, 4.3
	3.4.A.3	1.3, 4.2, 4.3
	3.4.A.4	1.3, 4.2, 4.3, 4.4
Sinusoidal Functions		
3.5.A	3.5.A.1	4.4
	3.5.A.2	4.4
	3.5.A.3	4.4
	3.5.A.4	4.4
	3.5.A.5	1.3, 4.4
	3.5.A.6	1.3, 4.3, 4.4, 5.1
Sinusoidal Function Transformations		
3.6.A	3.6.A.1	4.4, 4.6
	3.6.A.2	4.4
	3.6.A.3	4.4
	3.6.A.4	4.4
	3.6.A.5	4.4
	3.6.A.6	4.4
Sinusoidal Function Context and Data Modeling		
3.7.A	3.7.A.1	4.4
	3.7.A.2	4.4

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Logarithmic Function Context and Data Modeling		
2.14.A	2.14.A.1	3.4, 3.7
	2.14.A.2	3.7
	2.14.A.3	3.7
	2.14.A.4	3.7
	2.14.A.5	3.7
	2.14.A.6	3.7
Semi-log Plots		
2.15.A	2.15.A.1	3.6
	2.15.A.2	3.6
2.15.B	2.15.B.1	3.6
	2.15.B.2	3.6

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
	3.7.A.3	4.4
	3.7.A.4	4.4
	3.7.A.5	4.4
The Tangent Function		
3.8.A	3.8.A.1	4.2, 4.3, 4.5
	3.8.A.2	4.2, 4.3, 4.5
3.8.B	3.8.B.1	4.5
	3.8.B.2	4.5
	3.8.B.3	4.5
3.8.C	3.8.C.1	4.5
	3.8.C.2	4.5
	3.8.C.3	4.5
	3.8.C.4	4.5
	3.8.C.5	4.5
Inverse Trigonometric Functions		
3.9.A	3.9.A.1	4.7
	3.9.A.2	4.7
	3.9.A.3	4.7
Trigonometric Equations and Inequalities		
3.10.A	3.10.A.1	4.7, 5.1
	3.10.A.2	4.7, 5.1
	3.10.A.3	4.7, 5.1
The Secant, Cosecant, and Cotangent Functions		
3.11.A	3.11.A.1	4.2, 4.3, 4.5
	3.11.A.2	4.2, 4.3, 4.5
	3.11.A.3	4.5
	3.11.A.4	4.2, 4.3, 4.5
	3.11.A.5	4.5
Equivalent Representations of Trigonometric Functions		
3.12.A	3.12.A.1	5.1, 5.2
	3.12.A.2	5.1, 5.4
3.12.B	3.12.B.1	5.3
	3.12.B.2	5.3
	3.12.B.3	5.3
	3.12.B.4	5.2, 5.3
3.12.C	3.12.C.1	5.2, 5.3
	3.12.C.2	5.1, 5.2, 5.3

TG-4 CONCEPT OUTLINE

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Trigonometry and Polar Coordinates		
3.13.A	3.13.A.1	5.5
	3.13.A.2	5.5
	3.13.A.3	5.5
	3.13.A.4	2.5, 5.5
Polar Function Graphs		
3.14.A	3.14.A.1	5.6
	3.14.A.2	5.6
	3.14.A.3	5.6

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Rates of Change in Polar Functions		
3.15.A	3.15.A.1	5.6
	3.15.A.2	5.6
	3.15.A.3	5.6
	3.15.A.4	5.6
	3.15.A.5	5.6

UNIT 4: Functions Involving Parameters, Vectors, and Matrices

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
Parametric Functions		
4.1.A	4.1.A.1	1.5, 6.2
	4.1.A.2	1.5, 6.2
	4.1.A.3	6.2
	4.1.A.4	6.2
	4.1.A.5	6.2
Parametric Functions Modeling Planar Motion		
4.2.A	4.2.A.1	6.2
	4.2.A.2	6.2
	4.2.A.3	6.2
Parametric Functions and Rates of Change		
4.3.A	4.3.A.1	6.2
	4.3.A.2	6.2
	4.3.A.3	6.2, 6.3, 6.4
	4.3.A.4	6.2
Parametrically Defined Circles and Lines		
4.4.A	4.4.A.1	6.4
	4.4.A.2	6.4
	4.4.A.3	6.2
Implicitly Defined Functions		
4.5.A	4.5.A.1	1.4, 6.2, 6.4
	4.5.A.2	6.2
	4.5.A.3	6.2, 6.3, 6.4
4.5.B	4.5.B.1	6.2
	4.5.B.2	6.2
Conic Sections		
4.6.A	4.6.A.1	6.3
	4.6.A.2	6.4
	4.6.A.3	6.5
Parametrization of Implicitly Defined Functions		
4.7.A	4.7.A.1	6.2, 6.3, 6.4, 6.5
	4.7.A.2	1.5, 6.2
4.7.B	4.7.B.1	6.2, 6.3
	4.7.B.2	6.4
	4.7.B.3	6.5
Vectors		
4.8.A	4.8.A.1	6.1
	4.8.A.2	6.1
	4.8.A.3	6.1
	4.8.A.4	6.1

Learning Objective	Essential Knowledge	Sections in <i>Precalculus: Graphical, Numerical, Algebraic</i>
4.8.B	4.8.B.1	6.1
	4.8.B.2	6.1
	4.8.B.3	6.1
4.8.C	4.8.C.1	6.1
	4.8.C.2	6.1
4.8.D	4.8.D.1	6.1
	4.8.D.2	5.4, 6.1
Vector-Valued Functions		
4.9.A	4.9.A.1	6.2
	4.9.A.2	6.2
Matrices		
4.10.A	4.10.A.1	7.1
	4.10.A.2	7.1
The Inverse and Determinant of a Matrix		
4.11.A	4.11.A.1	7.1
	4.11.A.2	7.1
	4.11.A.3	7.1
	4.11.A.4	7.1
4.11.B	4.11.B.1	7.1
	4.11.B.2	7.1
	4.11.B.3	7.1
Linear Transformations and Matrices		
4.12.A	4.12.A.1	7.2
	4.12.A.2	7.2
	4.12.A.3	7.2, 7.3
	4.12.A.4	7.2, 7.3
	4.12.A.5	7.2, 7.3
Matrices as Functions		
4.13.A	4.13.A.1	7.3
	4.13.A.2	7.3
	4.13.A.3	7.3
	4.13.A.4	7.3
4.13.B	4.13.B.1	7.3
	4.13.B.2	7.3
4.13.C	4.13.C.1	7.3
	4.13.C.2	7.3
Matrices Modeling Contexts		
4.14.A	4.14.A.1	7.4
4.14.B	4.14.B.1	7.4
	4.14.B.2	7.4
	4.14.B.3	7.4