	Pre-Alg +	Algebra	Geometry	Algebra II	Fourth Course
Standard 9	Functions				
Benchmark 1 (Part 1)	Define, evaluate, and compare functions.	Interpret functions that arise in applications in terms of the context. (Linear, exponential, and quadratic)		Interpret functions that arise in applications in terms of the context. (Emphasize selection of appropriate models)	
	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.		For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.	
	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.		Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	
	Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★		Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★	
	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.				
Benchmark 1 (Part 2)		Understand the concept of a function and use function notation.			

		Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).			
		Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.			
		Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.			
Benchmark 1 (Part 3)		Use functions to model relationships between quantities.			
		Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.			

Benchmark 1 (Part 4)		Analyze functions using different representations. (Linear, exponential, quadratic, absolute value, step, piecewise-defined)		Analyze functions using different representations. (Focus on using key features to guide selection of appropriate type of model function)	Analyze functions using different representations. (Logarithmic and trigonometric functions)
		Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.⋆		Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.⋆	(+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
		Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.		Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	
		Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).		Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	
Benchmark 2 (Part 1)		Build a function that models a relationship between two quantities.(Linear, exponential, and quadratic)		Build a function that models a relationship between two quantities. (Include all types of functions studied)	Build a function that models a relationship between two quantities. (Include all types of functions studied)
		Write a function that describes a relationship between two quantities. ⋆		Write a function that describes a relationship between two quantities. ⋆	Write a function that describes a relationship between two quantities. ⋆
		Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.⋆			
Benchmark 2 (Part 2)		Build new functions from existing functions. (Quadratic, and absolute value; for F.BF.4a, linear only)		Build new functions from existing functions.(Include simple radical, rational, and exponential functions; emphasize common effect of each transformation across function types)	Build new functions from existing functions.

		Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.		Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.	
		Find inverse functions.		Find inverse functions.	Find inverse functions.
					(+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
Benchmark 3 (Part 1)		Construct and compare linear, quadratic, and exponential models and solve problems.		Construct and compare linear, quadratic, and exponential models and solve problems. (Logarithms as solutions for exponentials)	
		Distinguish between situations that can be modeled with linear functions and with exponential functions.		For exponential models, express as a logarithm the solution to abct =dwherea,c,anddarenumber sandthebasebis2,10,ore; evaluate the logarithm using technology.	
		Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs.			
		Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.			

Benchmark 3 (Part 2)		Interpret expressions for functions in terms of the situation they model. (Linear and exponential of form f(x) = bx + k)			
		Interpret the parameters in a linear or exponential function in terms of a context.			
Benchmark 4 (Part 1)				Extend the domain of trigonometric functions using the unit circle.	Extend the domain of trigonometric functions using the unit circle.
				Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	(+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–x, π+x, and 2π–x in terms of their values for x, where x is any real number.
				Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	(+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
Benchmark 4 (Part 2)				Model periodic phenomena with trigonometric functions.	Model periodic phenomena with trigonometric functions.
				Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.⋆	(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

					(+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.⋆
Benchmark 4 (Part 3)				Prove and apply trigonometric identities.	Prove and apply trigonometric identities.
				Prove the Pythagorean identity sin2(θ) + cos2(θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.	(+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.