

Exponents & Logarithms

2.1/2.2 Represent and model exponential functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Create and solve exponential functions (A.CED.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: <ul style="list-style-type: none"> • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving 	Create exponential equations and use them in a contextual situations to solve problems.	Create exponential equations to model a contextual situation.	Identify exponential equations to model a contextual situation.	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Rewrite and solve exponential functions (F.IF.8)		Write an exponential function in equivalent forms to reveal key features (ie. rate of change, decay, growth) and use them in a contextual situation to solve problems.	Identify key features (ie. rate of change, decay, growth) from a function and interpret the features in context of the situation.	Identify key features (ie. rate of change, decay, growth) from a function	
Graph, interpret exponential functions (F.IF.7e, F.LE.5) <small>*Can use technology for more complex cases*</small>		Graph exponential functions and interpret all key features of the graph in the context of a situation	Graph exponential functions and interpret some key features of the graph in the context of a situation	Graph exponential and logarithmic functions and identify key features of the graph	
Identify transformations (F.BF.3)		Identify the effect on a graph by replacing $f(x)$ with more than two transformations: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k	Identify the effect on a graph by replacing $f(x)$ with two transformations: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k	Identify the effect on a graph by replacing $f(x)$ with a single transformation: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k	
Find intersection points involving exponential functions (A.REI.11)		Write a function given more than two transformations.	Write a function given two transformations.	Write a function given a transformation.	
		For exponential functions, find intersection points using technology, graphs, and tables and explain in the context of a situation	For exponential functions, find intersection points using technology, graphs, and tables	For exponential functions, find intersection points using technology, graphs or tables	

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
 b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

A.REI.11 Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

F.BF.3 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. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

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2.3/2.4 Discover and apply logarithms

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Solve exponential and logarithmic equations (F.BF.4, F.BF.5, F.LE.4)	Can extend thinking beyond the standard, including tasks that may involve one of the following:	Use the inverse relationship of logarithmic and exponential functions to solve problems <u>in contextual situations.</u>	Use the inverse relationship of logarithmic and exponential functions to <u>solve problems.</u>	<u>Rewrite logarithmic and exponential functions as inverses</u>	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Graph and interpret log functions (F.IF.7e) <small>*Can use technology for more complex cases*</small>	<ul style="list-style-type: none"> Designing Connecting Synthesizing Applying Justifying 	Graph logarithmic functions and <u>interpret all key features</u> of the graph in the context of a situation	Graph logarithmic functions and <u>interpret some key features</u> of the graph in the context of a situation	Graph logarithmic functions and <u>identify key features</u> of the graph	
Identify transformations (F.BF.3)	<ul style="list-style-type: none"> Critiquing Analyzing Creating Proving 	Identify the effect on a graph by replacing $f(x)$ with <u>more than two</u> transformations: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k Write a function given <u>more than two transformations.</u>	Identify the effect on a graph by replacing $f(x)$ with <u>two</u> transformations: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k Write a function given <u>two transformations.</u>	Identify the effect on a graph by replacing $f(x)$ with a <u>single</u> transformation: $f(x) + k$, $a f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a , b , h , and k Write a function given <u>a transformation.</u>	

F.IF.7e Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases
e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.LE.4. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.

F.BF.4 Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.

F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

F.BF.3 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. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.