Graphs of Non-Linear Functions

Analyze graphs of quadratic functions (11.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Graph and identify key features of quadratic functions (F.IF.7a, F.IF.8a)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use factoring and completing the square in a quadratic function to determine • the vertex • axis of symmetry, • direction of opening, • zeros/roots **in context of the situation** Graph quadratic functions expressed in vertex form and standard form and show key features of the graph **in context of a situation.**	**Use factoring and completing the square** in a quadratic function to determine • the vertex • axis of symmetry, • direction of opening, • zeros/roots Graph quadratic functions expressed in vertex form **and** standard form, and show key features of the graph	**Given a quadratic function** in • vertex form find the vertex; • factored form find the zeros/roots; • standard form find the direction of opening Graph quadratic functions expressed in vertex form **or** standard form, and show key features of the graph	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Interpret key features (F.IF.4*, F.IF.5)		Identify and interpret **all** key features in a table **and** graph in terms of the quantities. • intercepts • intervals where functions are increasing or decreasing • intervals where the function is positive or negative • local minimums and maximums • whether or not a graph has symmetries • end behavior • domain Translate a verbal description of a **relationship** to sketch a quadratic graph.	**Identify all** key features **and interpret at least 4** key features from a table or graph in terms of the quantities. • intercepts • intervals where functions are increasing or decreasing • intervals where the function is positive or negative • local minimums and maximums • whether or not a graph has symmetries • end behavior • domain Translate a verbal description of a graph's key features to **sketch** a quadratic graph.	**Identify at least 6** key features from a table **or** graph • intercepts • intervals where functions are increasing or decreasing • intervals where the function is positive or negative • local minimums and maximums • whether or not a graph has symmetries • end behavior • domain Translate a verbal description of a graph's key features to **identify** a quadratic graph.	
Compare key features (F.IF.9*)		Compare key features of two functions represented • algebraically • graphically • numerically in tables • verbal descriptions Key features include: • intercepts • minimums and maximums • rate of change • increasing or decreasing • **positive or negative** • **symmetries** • **end behavior**	Compare key features of two functions represented • algebraically • graphically • numerically in tables • verbal descriptions Key features include: • intercepts • minimum and maximums • **rate of change** • **increasing and decreasing**	Compare key features of two functions represented • algebraically • graphically • numerically in tables • verbal descriptions Key features include: • intercepts • minimum and maximums	

Graphs of Non-Linear Functions

Analyze graphs of quadratic functions (11.1) (Continued)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify transformations (F.BF.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Identify the effect on a graph by replacing f(x) with a single transformation: ● f(x) + k ● k f(x), ● f(kx) ● f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(for all listed above),** find the value of the constant or coefficient	Identify the effect on a graph by replacing f(x) with a single transformation **(3 of the 4):** ● f(x) + k ● k f(x), ● f(kx) ● f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(3 of the 4 listed above),** find the value of the constant or coefficient	Identify the effect on a graph by replacing f(x) with a single transformation **(2 of the 4):** ● f(x) + k ● k f(x), ● f(kx) ● f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(2 of the 4 listed above),** find the value of the constant or coefficient	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Create quadratic equations (A.CED.1*)		Create quadratic equations in vertex **and** standard form and use them in a contextual situation and solve problems.	**Create** quadratic equations in vertex or standard form and use them in a contextual situation and solve problems.	**Identify** quadratic equations in vertex **or** standard form to represent a contextual situation and use them to solve problems.	
Combine functions (F.BF.1)		Combine linear, exponential, and quadratic functions **to model real world situations.**	Combine linear, exponential, **and** quadratic functions	Combine linear, exponential, **or** quadratic functions	

F.IF.4 For a ~~linear, exponential, or~~ quadratic 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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior. *

F.IF.5 Relate the domain of a ~~linear, exponential, or~~ quadratic function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. *

F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
a. Use the process of factoring and completing the square in a quadratic functions to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

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.★
a. Graph ~~linear and~~ quadratic functions and show intercepts, maxima, and minima.

A.CED.1* Create equations and inequalities in one variable and use them to solve problems

F.BF.1 Write a function that describes a relationship between two quantities.
a. Determine an explicit expression, a recursive process or steps for calculation from a context.
b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to decaying exponential and relate these functions to the model

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 negative and positive); 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

Graphs of Non-Linear Functions

Create and analyze non-linear functions (7.1/7.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Graph functions and identify key features (F.IF.7b)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Graph all of the following functions: ● piecewise ● step ● absolute value ● square root ● cube root **and identify key features**	Graph **all** of the following functions: ● piecewise ● step ● absolute value ● square root ● cube root	Graph **at least 3** of the following functions: ● piecewise ● step ● absolute value ● square root ● cube root	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Create and graph equations (A.CED.2*)		Create equations in two or more variables to represent relationships in contextual situations, and graph the equation **with labels and scales**	**Create** equations in two or more variables to represent relationships in contextual situations, and graph the equation	**Identify** equations in two or more variables to represent relationships in contextual situations, and graph the equation	

F.IF.7b Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

A.CED.2* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Graphs of Non-Linear Functions

Transformations of non-linear functions (7.1/7.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify transformations (F.BF.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Identify the effect on a graph by replacing f(x) with a single transformation: • f(x) + k • k f(x), • f(kx) • f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(for all listed above)**, find the value of the constant or coefficient	Identify the effect on a graph by replacing f(x) with a single transformation **(3 of the 4)**: • f(x) + k • k f(x), • f(kx) • f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(3 of the 4 listed above)**, find the value of the constant or coefficient	Identify the effect on a graph by replacing f(x) with a single transformation **(2 of the 4)**: • f(x) + k • k f(x), • f(kx) • f(x + k) for specific positive and negative values of k Given the graph of a function and a single transformation **(2 of the 4 listed above)**, find the value of the constant or coefficient	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1

F.IF.7b Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value 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 negative and positive); 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.~~