Algebra 1

ELG HS.F.3: Analyze functions using different representations.

Vertical Progression:

7th Grade	**7.RP.A Analyze proportional relationships and use them to solve real-world and mathematical problems** ○ **7.RP.A.2** Recognize and represent proportional relationships between quantities.
8th Grade	**8.F.A Define, Evaluate, and compare functions.** ○ **8.F.A.2** Compare properties of two functions each represented in a different way. **8.F.B Use functions to model relationships between quantities.** ○ **8.F.B.5** 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.
Algebra 1	**ELG.MA.HS.F.3: Analyze functions using different representations** ○ **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.★ ○ **F-IF.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima. ○ **F-IF.7b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ○ **F-IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. ○ **F-IF.8a** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. ○ **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.* Note: Functions may include linear, quadratic, exponential, polynomial (quadratic or cubic), square root, cube root, and piecewise-defined functions (including step and absolute value).
Algebra 2	**ELG.MA.HS.F.3: Analyze functions using different representations** ○ **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.★ ○ **F-IF.7c** Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. ○ **F-IF.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. ○ **F-IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. ○ **F-IF.8b** Use the properties of exponents to interpret expressions for exponential functions. ○ **F-IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Note: Functions may include linear, quadratic, exponential, polynomial, square root, cube root, piecewise defined (including step and absolute value), **rational, trigonometric, and logarithmic.**

Students will demonstrate command of the ELG by:

- Graphing linear, exponential, quadratic, square root, cube root, and piecewise-defined functions expressed symbolically and showing key features of the graph.
- Identifying and describing key features and characteristics of graphs (i.e., slope, intercepts, maxima, minima, end behavior, domain, range).
- Comparing the properties of two functions having different parent functions represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Vocabulary:

- cube root function
- decreasing
- domain
- end behavior
- exponential function
- increasing
- linear function
- maxima
- minima
- piecewise function
- quadratic function
- range
- slope-intercept form
- square root function
- step function
- zeroes of functions

Sample Instructional/Assessment Tasks:

1) **Standard(s): HSF-IF.C.7.b**

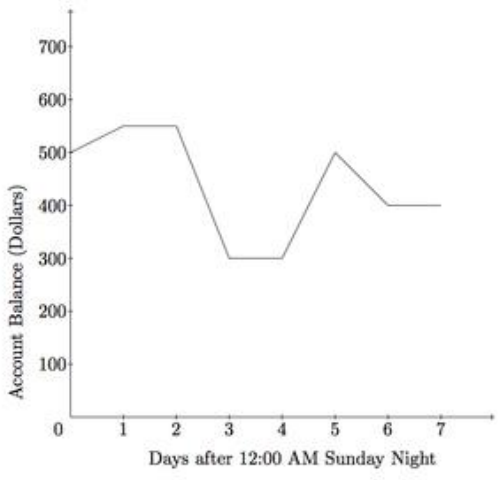
Bank Account Balance

Source: Illustrative Mathematics
https://www.illustrativemathematics.org/content-standards/HSF/IF/C/7/tasks/1840

Item Prompt:

At the beginning of the week, Jessie had $500 in her bank account. She deposited a check for $50 on Tuesday and then paid $250 in rent on Wednesday. On Friday, Jessie deposited $200 in the account and then on Saturday she paid $50 for groceries from her bank account. Jessie made the following graph for the balance in her bank account during this week:

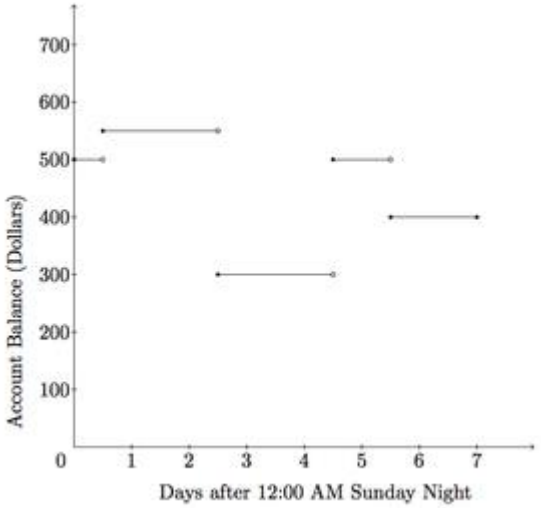
A. Is the depiction of how the account balance varies over the week accurate? Explain.
B. How can Jessie graphically represent the bank account balance in a way that better shows how it changes?



Correct Answer:

A. According to Jessie's graph, her bank account had $500 at the beginning of Monday and steadily went up to about $550 on Tuesday. There was no activity on Tuesday but on Wednesday the account went down to $300. On Thursday the account remained at $300 and then went up to about $500 on Friday. On Saturday the account went back down to about $400 where it stayed on Sunday. On each day where the balance changed, Jessie's graph shoes the balance changing continuously over that period. This is not realistic. When we make a withdrawal or deposit to a bank account, that amount is either deducted or added *all at once* rather than continuously over a period of time. Though not realistic, Jessie's graph does capture the overall up and down behavior of her bank balance.

B. According to the analysis in part (a), we could better capture the behavior of the bank balance by showing it changing (up or down) in jumps and then maintaining a stable value until the next transaction:



This graph shows a deposit on Monday, a withdrawal on Wednesday, a deposit on Friday, and a withdrawal on Saturday. Notice also the closed and open points at the end of the intervals: for example, the closed point on Monday at about $550 and the corresponding open point at$500 indicate that this is the moment when the deposit was made so that the account balance has changed at this instant on Monday.

2) Standard(s): F.IF.4, F.IF.7, F.IF.8

Source:
http://www.insidemathematics.org/assets/common-core-math-tasks/sorting%20functions.pdf

Item Prompt:

Below are four graphs, four equations, four tables, and four rules. Your task is to match each graph with an equation, a table and a rule.

Write your answers in the following table.

Graph	Equation	Table	Rule
A			
B			
C			
D			

Explain how you matched each of the four graphs to its equation.

Graph A _____

_____

Graph B _____

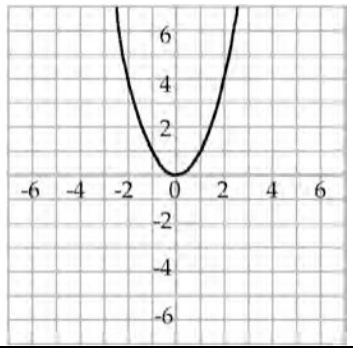
_____

Graph C _____

_____

Graph D _____

_____

Graph A  	Equation A $xy = 2$	Table A 	x	-2	-1	0	1	2	3
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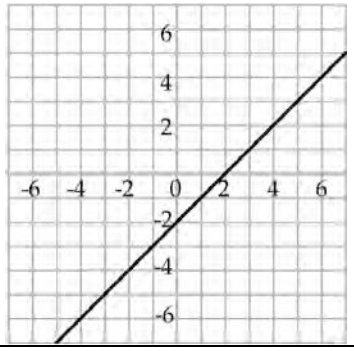
y	-4	-3	-2	-1	0	1			Rule A y is the same as x multiplied by x
Graph B  	Equation B $y^2 = x$	Table B 	x	-2	-1	0	1	2	3
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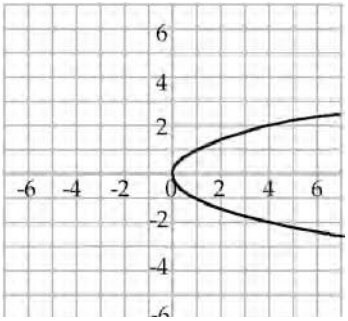
y	4	1	0	1	4	9			Rule B x multiplied by y is equal to 2
Graph C  	Equation C $y = x^2$	Table C 	x	0	1	4	9	16
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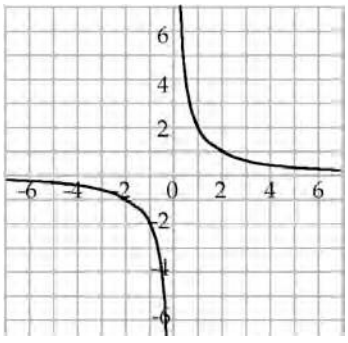
y	0	±1	±2	±3	±4			Rule C y is 2 less than x
Graph D  	Equation D $y = x - 2$	Table D 	x	-2	-1	0	1	2	4
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y	-1	-2	±∞	2	1	0.5			Rule D x is thesame as y multipliedby y

Correct Answer:

Graph	Equation	Table	Rule
A	C	B	A
B	D	A	C
C	B	C	D
D	A	D	B

Note: sample reasoning and student responses are available via the link.