Unit 5 Notes 5/10/2021

Algebra 1 Unit 5: Comparing Linear, Quadratic, and Exponential Functions Notes

Distinguishing Between Linear, Quadratic, & Exponential Functions

Standard(s):
MGSE9-12.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

MGSE9-12.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

In this unit, we will review and compare Linear, Quadratic, and Exponential Functions.

Identifying Types of Functions from an Equation

Classify each equation as linear, quadratic, or exponential:

a. $f(x) = 3x + 2$ b. $y = 5^x$ c. $f(x) = 2$ d. $f(x) = 4(2)^x + 1$ e. $y = 4x^2 + 2x - 1$

Linear Exponential Linear Exponential Quadratic

Identifying Types of Functions from a Table

- Linear Functions have **constant** (same) **first differences** (add/subtract same number over and over).
- Quadratic Functions have **constant second differences**.
- Exponential functions have **constant ratios** (multiply by same number over and over).

Linear Function

x	y
2	4
5	3
8	2
11	1

(+3, +3, +3; −1, −1, −1)

Quadratic Function

x	y
0	3
1	2
2	3
3	6
4	11

(−1, +1, +3, +5; +2, +2, +2)

Exponential Function

x	$f(x) = 2(3)^x$
1	6
2	18
3	54
4	162

(+1, +1, +1; ×3, ×3, ×3)

Determine if the following tables represent linear, quadratic, exponential, or neither and explain why.

a.

x	y
−2	7
−1	4
0	1
1	−2
2	−5

(−3, −3, −3, −3)

Linear

b.

x	y
−1	1.5
0	3
1	6
2	12

(×2, ×2, ×2)

Exponential

c.

x	y
−2	6
−1	3
0	2
1	3
2	6

(−3, −1, 1, 3; 2, 2, 2)

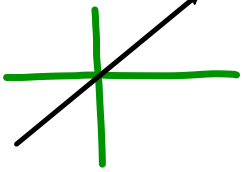
Quadratic

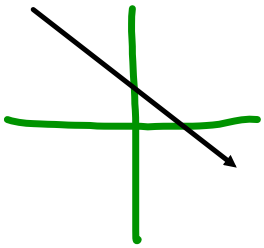
Linear

$y = 2x + 5$

$y = 3x$

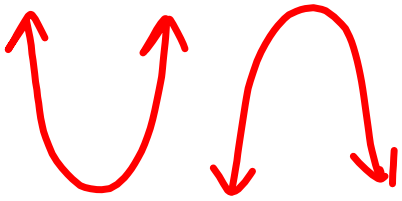
$y = 7$





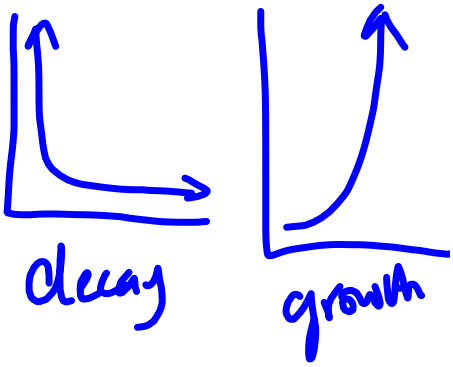
Quadratic

$y = x^2 + 5$



Exponential

$y = 3^x + 2$



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Day 1 – Characteristics of Functions

Standard(s):
MGSE9-12.F.IF.4 Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Which of these characteristics do you already know?

Characteristic	Definition	Notation
Y-Intercept	Where the graph crosses the y - axis (x = 0)	(0, y)
X-Intercept/ Root/ Zero/ Solution	Where the graph crosses the x - axis (y = 0)	(x, 0)
Domain	All the possible x-values or inputs of a function	All real numbers, ℝ (-∞, ∞) or -∞≤ x ≤∞
Range	All the possible y-values or outputs of a function	y ≤ # or y ≥ #
Vertex	Middle point of the parabola	(x, y)
Axis of Symmetry Quadratic Quadratic	vertical line that divides the graph into two mirror-images	x = # (x-coordinate of vertex)
Extrema: Maximum/Minimum Quadratic	Min: lowest point of a graph Max: highest point of a graph	Only for Quadratic Functions
Maximum/Minimum Value	y-value of the maximum or minimum (vertex)	y = # (y-coordinate of vertex)
Intervals of Increase/ Decrease/Constant	Increase: Graph goes up Decrease: Graph goes down Constant: Graph is constant	x > # or x < #
Positive/Negative Intervals	Positive: above the x-axis Negative: below the x-axis	# < x < #or x > # or x < #
End Behavior	Where the graph "goes" on the left and right	As x increases... → ∞ and as x decreases... → -∞
Rate of Change	Change in y over change in x Rise over run	$\frac{y_2 - y_1}{x_2 - x_1}$

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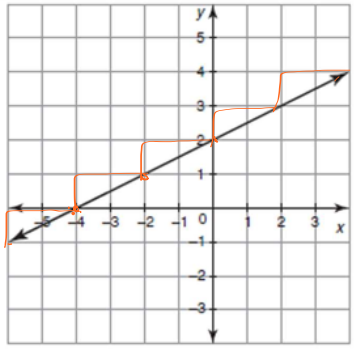


Domain: $(-\infty,\infty)$, $\mathbb{R}$ Range: All real #s

X-intercept: $(-4,0)$ Y-intercept: $(0,2)$

Zero: $x=-4$ Interval of Constant: none

Interval of Increase: $(-\infty,\infty)$ Interval of Decrease: none

Maximum(s): none Minimum(s): none

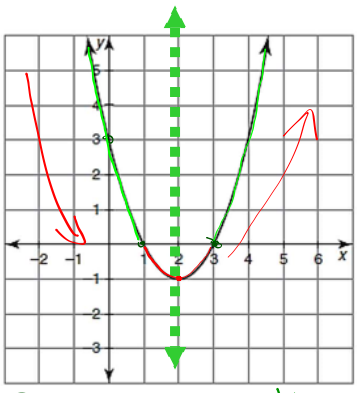
Positive: $x>-4$ Negative: $x<-4$

End Behavior: L as $x \to -\infty$, $f(x) \to -\infty$

R as $x \to \infty$, $f(x) \to \infty$

Rate of Change: Constant $ROC = \frac{1}{2}$

Linear



Domain: $(-\infty,\infty)$ or $\mathbb{R}$ Range: $[-1,\infty)$ or $y \geq -1$

X-intercept: $(1,0)$, $(3,0)$ Y-intercept: $(0,3)$

Zero: $x=1$, $x=3$ Interval of Constant: none

Interval of Increase: $x>2$ Interval of Decrease: $x<2$

Maximum(s): none Minimum(s): $y=-1$

Positive: $x<1$; $x>3$ Negative: $1<x<3$

End Behavior: as $x \to -\infty$, $f(x) \to \infty$

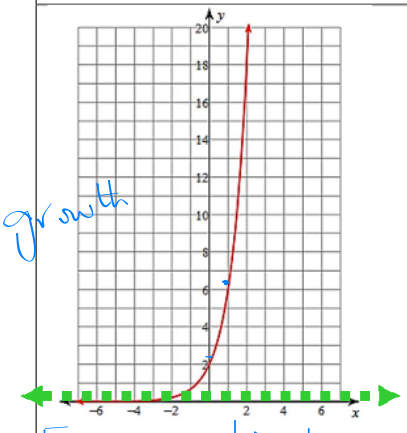
as $x \to \infty$, $f(x) \to \infty$

Rate of Change from $1 \leq x \leq 4$: $ROC = \frac{3-0}{4-1} = \frac{3}{3} = 1$

Quadratic $\frac{y_2-y_1}{x_2-x_1}$

$(1,0)$ $(4,3)$

x_1 y_1 x_2 y_2



Domain: $(-\infty,\infty)$, $\mathbb{R}$ Range: $(0,\infty)$ or $y>0$

X-intercept: none Y-intercept: $(0,2)$

Interval of Increase: $(-\infty,\infty)$ Interval of Decrease: none

Maximum(s): none Minimum(s): none

Positive: $x>0$ Negative: none

Asymptote: $y=0$

End Behavior: L as $x \to -\infty$, $f(x) \to 0$

R as $x \to \infty$, $f(x) \to \infty$

Rate of Change [0, 1]: $ROC = \frac{6-2}{1-0} = 4$

x_1 x_2

Exponential

growth

$(0,2)$ $(1,6)$

x_1 y_1 x_2 y_2

Formative Assessment Quick Check

1. Which function has an end behavior of

as $x \to -\infty$, $f(x) \to$ ∞

as $x \to \infty$, $f(x) \to$ ∞

Quadratic

2. Which function has an end behavior of

as $x \to -\infty$, $f(x) \to$ $+\infty$

as $x \to \infty$, $f(x) \to$ $-\infty$

Linear

3. What is the only function that has an asymptote when graphed? Exponential

4. What function is this?

$$2(x^2 - 4x + 5)$$ Quadratic

5. What function is this?

$$3(2 + 5x)$$ Linear

$6 + 15x$

6. Which function has an end behavior of

as $x \to -\infty$, $f(x) \to$ 3 — asymptote

as $x \to \infty$, $f(x) \to$ ∞ Exponential