Algebra 1

Our Goal: To learn to compare the growth rates of linear, exponential, and quadratic functions

Warm Up: Check and discuss homework

Today's Homework
8.6 Exercises, p.465-467: 6-30 (evens)

Previous Homework
8.5 Exercises, p.455-456: 6-72 (multiples of 6)
that's 6,12,18,24,30,36,42,48,54,60,66,72
(graph paper online, if helpful)

$y = ax^2 + bx + c$

$\frac{-b}{2a} = 4$

$-b = 8a$

$x < 4$, incr.

$x > 4$ decr

$y = a(x-h)^2 + k$

$y = a(x-b)(x-c)$

$(4, 1)$

$y = (x-4)^2 + 1$

$= x^2 - 8x + 16 + 1$

$= x^2 - 8x + 17$

$(x-4)(x-4)$

Write a system of linear equations that has the ordered pair as its solution.

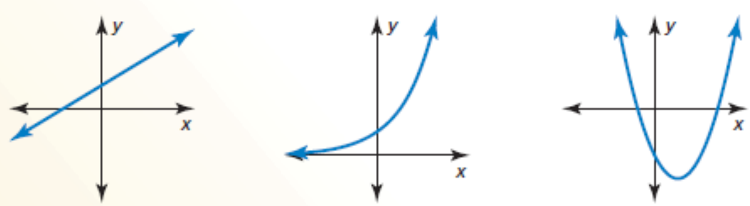
1. (4, 4) **2.** (−3 −13) **3.** (−1, 7)

4. (16, −26) **5.** (1, 3) **6.** (−3, 2)

Core Concept

Linear, Exponential, and Quadratic Functions

Linear Function	Exponential Function	Quadratic Function
$y = mx + b$	$y = ab^x$	$y = ax^2 + bx + c$



Core Concept

Differences and Ratios of Functions

You can use patterns between consecutive data pairs to determine which type of function models the data. The differences of consecutive y-values are called *first differences*. The differences of consecutive first differences are called *second differences*.

- **Linear Function** The first differences are constant.
- **Exponential Function** Consecutive y-values have a common *ratio*.
- **Quadratic Function** The second differences are constant.

In all cases, the differences of consecutive x-values need to be constant.

Tell whether each table of values represents a *linear*, an *exponential*, or a *quadratic* function.

+1

a.

x	−3	−2	−1	0	1
y	11	8	5	2	−1

−3

lin.

+1

b.

x	−2	−1	0	1	2
y	1	2	4	8	16

×2

expon.

+1

c.

x	−2	−1	0	1	2
y	−1	−2	−1	2	7

−1 +1 +3 +5

+2 +2 +2

4. Tell whether the table of values represents a *linear*, an *exponential*, or a *quadratic* function. +1

x	−1	0	1	2	3
y	1	3	9	27	81

×3

vertex

Tell whether the table of values represents a *linear*, an *exponential*, or a *quadratic* function. Then write the function.

x	2	4	6	8	10
y	12	0	−4	0	12

−12 −4 4 12

+8 +8 +8

$y = a(x-h)^2 + k$

$y = a(x-6)^2 - 4$

$12 = a(10-6)^2 - 4$

$12 = 16a - 4$

$16 = 16a$

$a = 1$

$y = a(x-4)(x-8)$

$-4 = a(6-4)(6-8)$

$-4 = a \cdot 2(-2)$

$a = 1$

$y = (x-4)(x-8)$

5. Tell whether the table of values represents a *linear*, an *exponential*, or a *quadratic* function. Then write the function.

x	−1	0	1	2	3
y	16	8	4	2	1

expon.

$\times \frac{1}{2}$

$$y = a(b)^x$$

$$y = a\left(\frac{1}{2}\right)^x$$

$$y = 8\left(\frac{1}{2}\right)^x$$

Core Concept

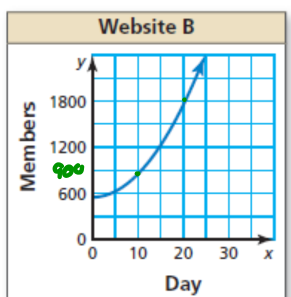
Comparing Functions Using Average Rates of Change

- Over the same interval, the average rate of change of a function increasing quadratically eventually exceeds the average rate of change of a function increasing linearly. So, the value of the quadratic function eventually exceeds the value of the linear function.
- Over the same interval, the average rate of change of a function increasing exponentially eventually exceeds the average rate of change of a function increasing linearly or quadratically. So, the value of the exponential function eventually exceeds the value of the linear or quadratic function.

x	y
1	4
3	7
0	2

Two social media websites open their memberships to the public.
(a) Compare the websites by calculating and interpreting the average rates of change from Day 10 to Day 20. (b) Predict which website will have more members after 50 days. Explain.

Website A	
Day, x	Members, y
0	650
5	1025
10	1400
15	1775
20	2150
25	2525



$$m=\frac{y_2-y_1}{x_2-x_1}=\frac{2150-1400}{20-10}$$

$$=\frac{750}{10}=75$$

$(10, \cancel{890}\ 900)$ $(20, 1800)$

$$m=\frac{1800-900}{20-10}$$

$$=\frac{900}{10}=90$$

In 1900, Littleton had a population of 1000 people. Littleton's population increased by 50 people each year. In 1900, Tinyville had a population of 500 people. Tinyville's population increased by 5% each year.

a. In what year were the populations about equal?

b. Suppose Littleton's initial population doubled to 2000 and maintained a constant rate of increase of 50 people each year. Did Tinyville's population still catch up to Littleton's population? If so, in which year?

c. Suppose Littleton's rate of increase doubled to 100 people each year, in addition to doubling the initial population. Did Tinyville's population still catch up to Littleton's population? Explain.

Write a linear, an exponential, and a quadratic function that each has a *y*-intercept of 2.