*Ch. 7.5

Algebra 1 9.6

Identify linear, quadratic, and exponential* functions from data

Write equations that model data

linear $y = mx + B$

quadratic $y = x^2$

exponential $y = 3^x$

difference

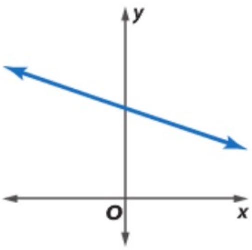
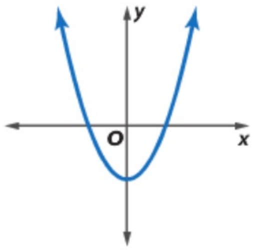
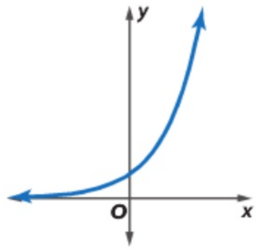
subtract

$1 + ? = 5$

$\underbrace{1, 5}_{4}, \underbrace{9}_{4}, \underbrace{13}_{4}, \underbrace{17}_{4} \ldots$

d = common difference $= 4$

ConceptSummary Linear and Nonlinear Functions

Linear Function	Quadratic Function	Exponential Function
$y = mx + b$	$y = ax^2 + bx + c$	$y = ab^x$, when $b > 0$
		

Example 1 Choose a Model Using Graphs

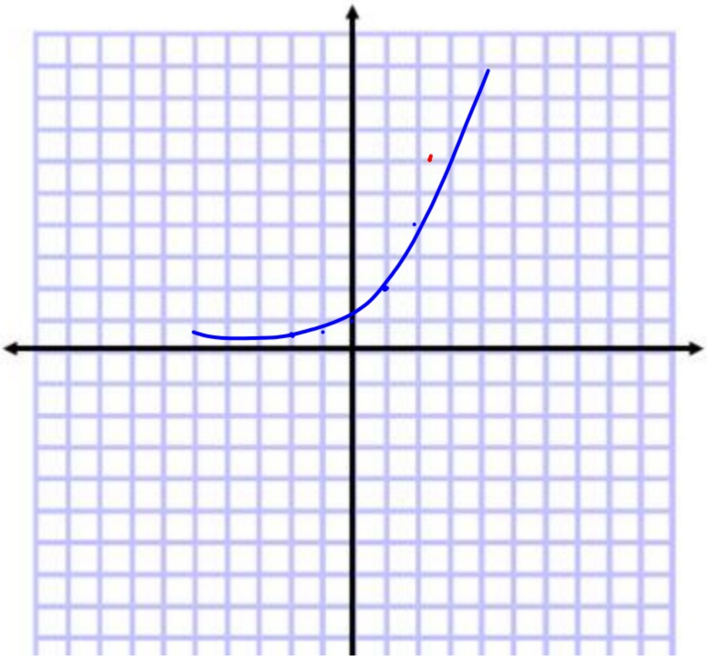
Graph each set of ordered pairs. Determine whether the ordered pairs represent a *linear* function, a *quadratic* function, or an *exponential* function.

a. $\{(-2, 5), (-1, 2), (0, 1), (1, 2), (2, 5)\}$

b. $\left\{\left(-2, \frac{1}{4}\right), \left(-1, \frac{1}{2}\right), (0, 1), (1, 2), (2, 4)\right\}$

$y = x^2 + 1$

$y = (\quad)^x$

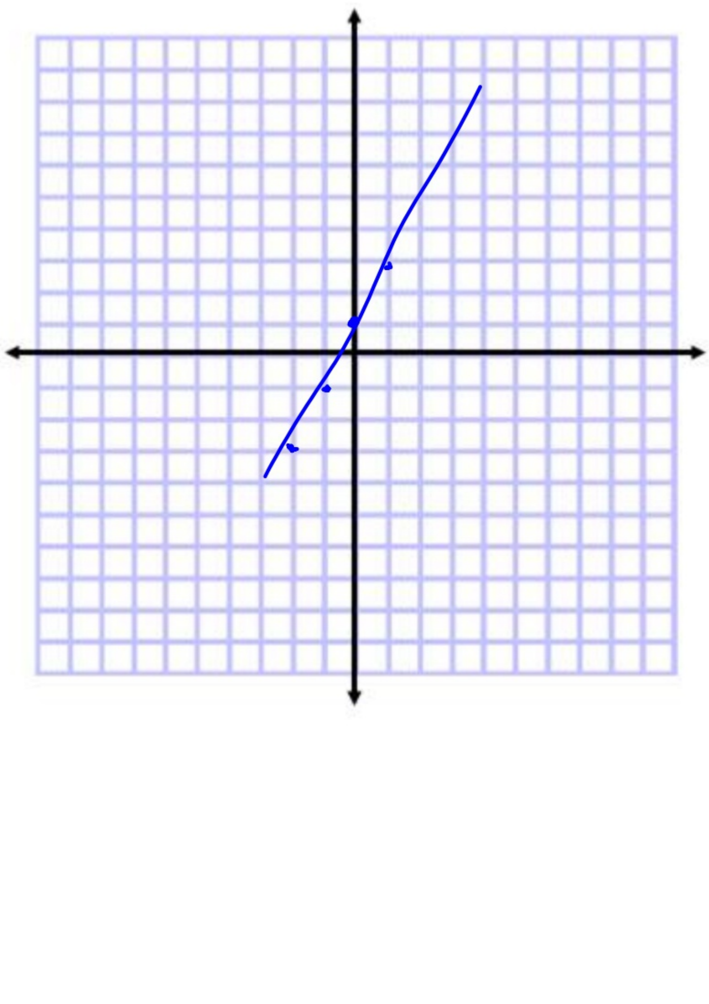


GuidedPractice

1A. $(-2, -3), (-1, -1), (0, 1), (1, 3)$

1B. $(-1, 0.25), (0, 1), (1, 4), (2, 16)$

$y = 2x + 1$



p. 591

Another way to determine which model best describes data is to use patterns. The differences of successive y-values are called *first differences*. The differences of successive first differences are called *second differences*.

- If the differences of successive y-values are all equal, the data represent a linear function. L 1^{st} diff = $y = mx + B$ — $y=mx+b$
- If the second differences are all equal, but the first differences are not equal, the data represent a quadratic function. Q 2^{nd} = $y = ax^2$ — $y=ax^2$
- If the ratios of successive y-values are all equal and $r \neq 1$, the data represent an exponential function. ratio $\neq$ $y = a(b)^x$ — $y=a(b)^x$ (constant ratio = b)

WatchOut!

x-Values Before you check for successive differences or ratios, make sure the *x*-values are increasing by the same amount.

Linear

Example 2 Choose a Model Using Differences or Ratios

Look for a pattern in each table of values to determine which kind of model best describes the data.

a.

x	−2	−1	0	1	2
y	−8	−3	2	7	12

5 5 5 5

b.

x	−1	0	1	2	3
y	8	4	2	1	0.5

−4   −2   −1   −0.5

2   1   0.5

$\boxed{\frac{0.5}{1} \quad \frac{1}{2} \quad \frac{2}{4} \quad \frac{4}{8}}$

−0.5 ++ 1

−1 ++ 2

−2 ++ 4

Guided Practice

2A.

x	−3	−2	−1	0	1
y	−3	−7	−9	−9	−7

2

−3

−4 −2 0 2

2 2 2

$0 \neq 2$

$-2 \neq 4$

2B.

x	−2	−1	0	1	2
y	−18	−13	−8	−3	2

5 5 5 5

$2 + 3$

$-3 + 8$

$-8 + 13$

$-13 + 18$

Example 3 Write an Equation

Determine which kind of model best describes the data. Then write an equation for the function that models the data.

x	-4	-3	-2	-1	0
y	32	18	8	2	0

$-14 \quad -10 \quad -6 \quad -2$

$4 \quad 4 \quad 4$

$-2+6$

$-6+-10$

$-10+14$

Step 1 Determine which model fits the data.

Quadratic

$y=2x^2$

$\boxed{y=ax^2}$

$2=a(-1)(-1)$

$2=1\cdot a$

Step 2 Write an equation for the function that models the data.

$2=a$

Avoid using 0 if possible

GuidedPractice

3A.

x	−2	−1	0	1	2
y	11	7	3	−1	−5

−4 −4 −4 −4

Linear

$y = mx + B$

(1, −1)
(2, −5)

$\frac{-4}{1}$

−5 + 1
−1 − 3
3 − 7
7 − 11

$y = -4x + 3$

$-5 = -4 \cdot 2 + B$

$-5 = -8 + B$

$+8 \quad +8$

$3 = B$

3B.

x	−3	−2	−1	0	1
y	0.375	0.75	1.5	3	6

$\times 2 \quad \times 2 \quad \times 2 \quad \times 2$

$y = a(b)^x$

$y = 3(2)^x$

$y = a(2)^x$

$6 = a(2)^1$

$\frac{6}{2} = \frac{2a}{2}$

$a = 3$

-2	-1	0	1	2
.008	0.04	0.2	1	5

5

$$y = a(5)^x$$

$$5 = a(5)^2$$

$$\frac{5}{25} = \frac{a \cdot 25}{25}$$

$$a = \frac{5}{25} = \frac{1}{5}$$

$$y = \frac{1}{5}(5)^x$$

9.6 p593

15-25 o

54-59 all