

EXPONENTIAL FUNCTIONS (CONT.)

REVIEW:

- ① WRITE $3x + 2y = 13$ IN SLOPE-INTERCEPT FORM.

$$\begin{array}{r} 3x + 2y = 13 \\ -3x \quad -3x \\ \hline 2y = -3x + 13 \\ \frac{2y}{2} = \frac{-3x + 13}{2} \end{array}$$

$$y = -\frac{3}{2}x + \frac{13}{2}$$

- ② WHAT IS THE SLOPE OF ANY LINE PERPENDICULAR TO

$$3x - 4y = 12? \quad m = -\frac{A}{B} = -\frac{-3}{-4}$$

$$m = \frac{3}{4} \Rightarrow m_{\perp} = -\frac{4}{3}$$

$$m = -\frac{4}{3}$$

- ③ THE TABLE BELOW GIVES POINTS FROM A LINEAR FUNCTION, $f(x)$. WRITE THE EQUATION OF THE FUNCTION.

0	x	1	2	3	5
1	f(x)	3	5	7	11

$\xrightarrow{+1}$ $\xrightarrow{+1}$ $\xrightarrow{+2}$
 $\xleftarrow{-2}$ $\xrightarrow{+2}$ $\xrightarrow{+2}$ $\xrightarrow{+4}$

$$f(x) = 2x + 1$$

$$m = \frac{2}{1} = 2 \quad b = 1$$

GIVEN THE FUNCTION $f(x) = 3 \cdot 2^x$, COMPLETE THE TABLE:

x	0	1	2	3
f(x)	3	6	12	24

WHAT TYPE OF FUNCTION IS $f(x)$? EXPONENTIAL

DOES IT HAVE A CONSTANT RATE OF CHANGE?

NO. IT DOUBLES EACH TIME

APPLICATION. WRITE AN EQUATION FOR THE FUNCTION SHOWN IN THE TABLE.

x	0	1	2	3	4
g(x)	8	4	2	1	$\frac{1}{2}$

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

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

$$a = 8 \quad b = \frac{1}{2}$$

(23)

APPLICATION. FOR EACH OF THE FUNCTIONS BELOW, DETERMINE IF THE FUNCTION IS LINEAR OR EXPONENTIAL. THEN GIVE THE EQUATION OF THE FUNCTION.

①

x	0	1	2	3
f(x)	8	29	50	71

$\underbrace{29-8}_{+21}$ $\underbrace{50-29}_{+21}$ $\underbrace{71-50}_{+21}$ LINEAR
 $m=21$ $b=8$

$f(x) = 21x + 8$

②

x	0	1	2	3
g(x)	8	16	32	64

$\underbrace{16-8}_{\times 2}$ $\underbrace{32-16}_{\times 2}$ $\underbrace{64-32}_{\times 2}$ EXP
 $a=8$ $b=2$

$g(x) = 8(2)^x$

③

x	0	1	2	3
h(x)	-9	-17	-25	-33

$\underbrace{-17-(-9)}_{-8}$ $\underbrace{-25-(-17)}_{-8}$ $\underbrace{-33-(-25)}_{-8}$ LINEAR
 $m = \frac{-8}{2} = -4$
 $b = -1$

$h(x) = -4x - 1$

④

x	1	2	3	4
k(x)	15	45	135	405

$\underbrace{45-15}_{\times 3}$ $\underbrace{135-45}_{\times 3}$ $\underbrace{405-135}_{\times 3}$ EXP
 $a=15$
 $b=3$

$k(x) = 15(3)^x$

RECAP:

* LINEAR FUNCTIONS HAVE A CONSTANT RATE OF CHANGE.

$$\text{RATE OF CHANGE} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y\text{-INTERCEPT} = (0, b)$$

* EXPONENTIAL FUNCTIONS DO NOT HAVE A CONSTANT RATE OF CHANGE.

$$\text{GROWTH/DECAY RATE} = \frac{\text{"NEXT Y-VALUE"}}{\text{"PREVIOUS Y-VALUE"}}$$

$$y\text{-INTERCEPT} = (0, b)$$

Skills Practice

Exponential Functions

Graph each function. Find the y-intercept, and state the domain and range. + ASD HA ALSO BEHAVIOR.

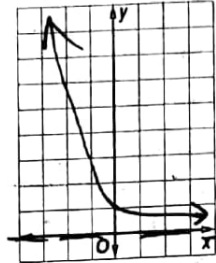
1. $y = 2^x$ $a = 1$ $b = 2$



Y-INT (0, 1)
 D: \mathbb{R}
 R: $y > 0$
 AS $x \rightarrow \infty$,
 $y \rightarrow \infty$
 AS $x \rightarrow -\infty$,
 $y \rightarrow 0$

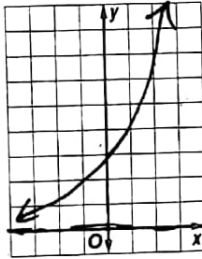
HA: $y = 0$

2. $y = \left(\frac{1}{3}\right)^x$ $a = 1$ $b = \frac{1}{2}$



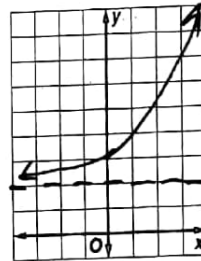
Y-INT (0, 1)
 D: \mathbb{R}
 R: $y > 0$
 AS $x \rightarrow \infty$,
 $y \rightarrow 0$
 AS $x \rightarrow -\infty$,
 $y \rightarrow \infty$

HA: $y = 0$



$a = 3$ $b = 2$
 Y-INT (0, 3)
 D: \mathbb{R}
 R: $y > 0$
 AS $x \rightarrow \infty$, $y \rightarrow \infty$
 AS $x \rightarrow -\infty$, $y \rightarrow 0$

3. $y = 3(2^x)$ HA: $y = 0$



4. $y = 3^x + 2$

$a = 3$ SHIFT $\uparrow 2$
 Y-INT (0, 3)
 $b = 3$
 D: \mathbb{R}
 R: $y > 2$
 AS $x \rightarrow \infty$, $y \rightarrow \infty$
 AS $x \rightarrow -\infty$, $y \rightarrow 2$
 HA: $y = 2$

Determine whether the set of data shown below displays exponential behavior. Write yes or no. Explain why or why not. (WRITE EQ.)

5.

-3	-2	-1	0
9	12	15	18

LINEAR CONSTANT RATE OF Δ .

$y = 3x + 18$

6.

0	5	10	15
20	10	5	2.5

EXP. DECAT RATE. $\times \frac{1}{2}$

$y = 20\left(\frac{1}{2}\right)^x$

7.

4	8	12	16
20	40	80	160

EXP. GROWTH $\times 2$

8.

50	30	10	-10
90	70	50	30

$m = \frac{-20}{-20} = 1$ $b = 40$

$y = x + 40$

Practice

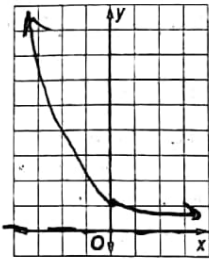
Exponential Functions

HA ALSO

Graph each function. Find the y-intercept and state the domain and range. + **END BEHAVIOR**

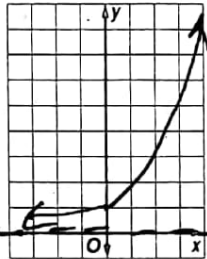
1. $y = (\frac{1}{10})^x$ $a = \frac{1}{10}$
 $b = \frac{1}{10}$

D: \mathbb{R}
R: $y > 0$



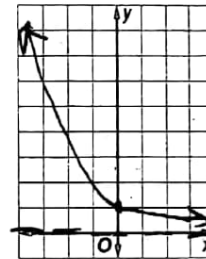
DECAY
Y-INT (0, 1)
AS $x \rightarrow \infty$
 $y \rightarrow 0$
AS $x \rightarrow -\infty$
 $y \rightarrow \infty$
HA: $y = 0$

2. $y = 3^x$ $a = 1$
 $b = 3$



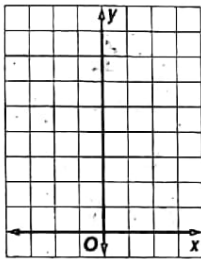
GROWTH
Y-INT (0, 1)
D: \mathbb{R}
R: $y > 0$
AS $x \rightarrow \infty$
 $y \rightarrow \infty$
AS $x \rightarrow -\infty$
 $y \rightarrow 0$
HA: $y = 0$

3. $y = (\frac{1}{4})^x$ $a = \frac{1}{4}$
 $b = \frac{1}{4}$

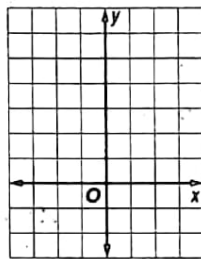


DECAY
Y-INT (0, 1)
D: \mathbb{R}
R: $y > 0$
AS $x \rightarrow \infty$
 $y \rightarrow 0$; AS
 $x \rightarrow -\infty$, $y \rightarrow \infty$
HA: $y = 0$

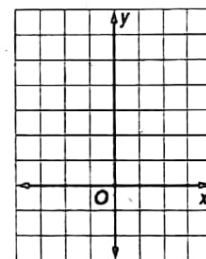
4. $y = 4(2^x) + 1$



5. $y = 2(2^x - 1)$



6. $y = 0.5(3^x - 3)$



Determine whether the set of data shown below displays exponential behavior. Write yes or no. Explain why or why not.

7.

	2	5	8	11
	480	120	30	7.5

$\frac{+3}{4} \quad \frac{+3}{4} \quad \frac{+3}{4}$

EXP. DECAY RATE

8.

	21	18	15	12
	30	23	16	9

$\frac{-3}{-7} \quad \frac{-3}{-7} \quad \frac{-3}{-7}$

$m = \frac{-7}{-3} = \frac{7}{3}$
LINEAR.

9. **LEARNING** Ms. Klemperer told her English class that each week students tend to forget one sixth of the vocabulary words they learned the previous week. Suppose a student learns 60 words. The number of words remembered can be described by the function $W(x) = 60(\frac{5}{6})^x$, where x is the number of weeks that pass. How many words will the student remember after 3 weeks?

$60(\frac{5}{6})^3 = \frac{60 \cdot 125}{216} = \frac{10 \cdot 125}{36} = 37 \frac{1}{3} \approx 38$

10. **BIOLOGY** Suppose a certain cell reproduces itself in four hours. If a lab researcher begins with 50 cells, how many cells will there be after one day, two days, and three days? (Hint: Use the exponential function $y = 50(2^x)$.)

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