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10.1. Advanced Algebra

Solving Systems of Equations by Graphing

DATE: 11/26

Target 4A. Understand the relationships between exponential functions and their graphs



Exponential Functions: a function in the form $y = ab^x$, where $a \neq 0$, $b > 0$, and $b \neq 1$
important to definition

Asymptote: a line that a graph approaches but never crosses.

Graph an Exponential Function

1. Sketch the graph of $y = 2^x$. Then state the function's domain and range.

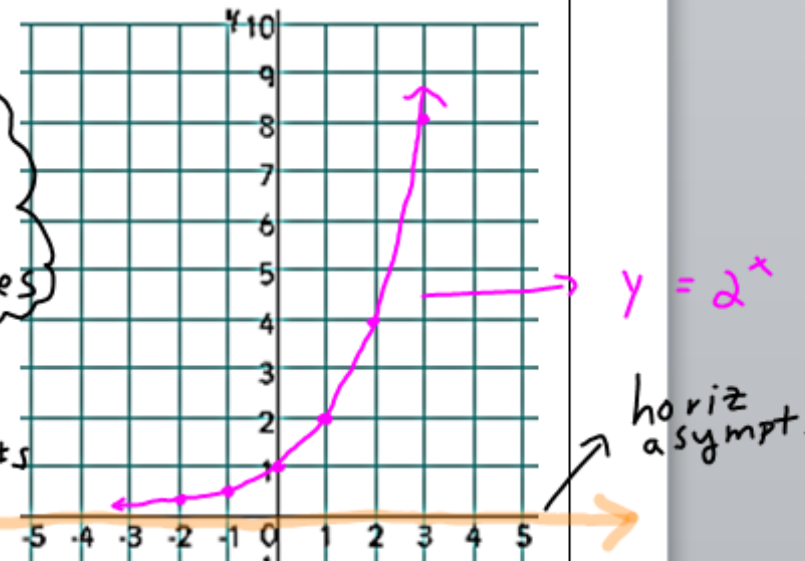
X	Y
-2	0.25 ✓
-1	0.5 ✓
0	1 ✓
1	2 ✓
2	4 ✓
3	8 ✓

Domain:
the set of all x-values.

Range:
the set of y-values

Domain: \mathbb{R}
All real #s

Range: $\{y | y > 0\}$
"All positive y-values"



10-1 Exponential Functions - Microsoft Word

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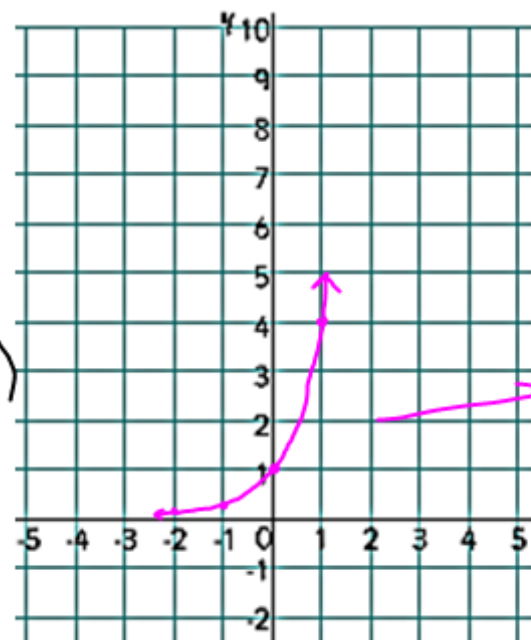
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2. Sketch the graph of $y = 4^x$. Then state the function's domain and range.

X	Y
-2	0.0625 ✓
-1	0.25 ✓
0	1 ✓
1	4 ✓

Domain:
 \mathbb{R} (All reals)

Range:
 $\{y \mid y > 0\}$
 All pos. y #'s



In general, an equation of the form $y = ab^x$, where $a \neq 0$, $b > 0$, and $b \neq 1$, is called an exponential function with base b .

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In general, an equation of the form $y = ab^x$, where $a \neq 0$, $b > 0$, and $b \neq 1$, is called an *exponential function* with base b .

Exponential Functions have the following characteristics:

1. *The function is continuous and one-to-one* ✓
2. *The domain is the set of all real numbers* ✓
3. *The x-axis is an asymptote of the graph* ✓
4. *The range is the set of all positive numbers if $a > 0$ and all negative numbers if $a < 0$.* ✓
5. *The y-intercept is a .* ✓
6. *The graphs of $y = ab^x$ and $y = a\left(\frac{1}{b}\right)^x$ are reflections across the y-axis.*

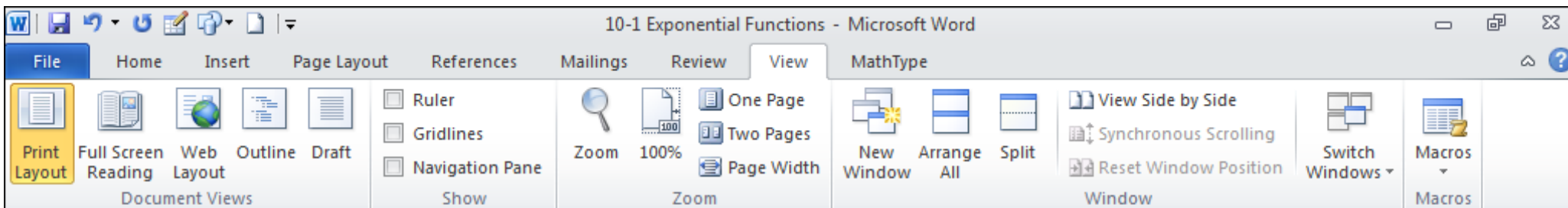
Exponential Growth: exponential growth occurs when a quantity increases exponentially over time.

- If $a > 0$ and $b > 1$, the function $y = ab^x$ represents exponential growth.

Exponential Decay: exponential decay occurs when a quantity decreases exponentially over time.

- If $a > 0$ and $0 < b < 1$, the function $y = ab^x$ represents exponential decay.

Determine whether each function represents growth or decay.



time.

- If $a > 0$ and $b > 1$, the function $y = ab^x$ represents exponential growth.

Left → Right

Exponential Decay: exponential decay occurs when a quantity decreases exponentially over time.

- If $a > 0$ and $0 < b < 1$, the function $y = ab^x$ represents exponential decay.

Left - Right

↳ A # less than 1

Determine whether each function represents growth or decay.

1. $y = \left(\frac{1}{5}\right)^x$ $\frac{1}{5} = 0.2$

Decay

2. $y = 3(4)^x$

Growth

3. $y = 7(1.2)^x$

Growth

4. $y = (0.7)^x$

Decay

5. $y = \frac{1}{2}(3)^x$

Growth

6. $y = 10\left(\frac{4}{3}\right)^x$ $\frac{4}{3} = 1.\bar{3}$

Growth

Property of Equality for Exponential Functions: If b is a positive number other than 1, then $b^x = b^y$ if and only if $x = y$.

Example: If $2^x = 2^8$, then $x = \underline{8}$

If b matches, then ready to equate exponents.

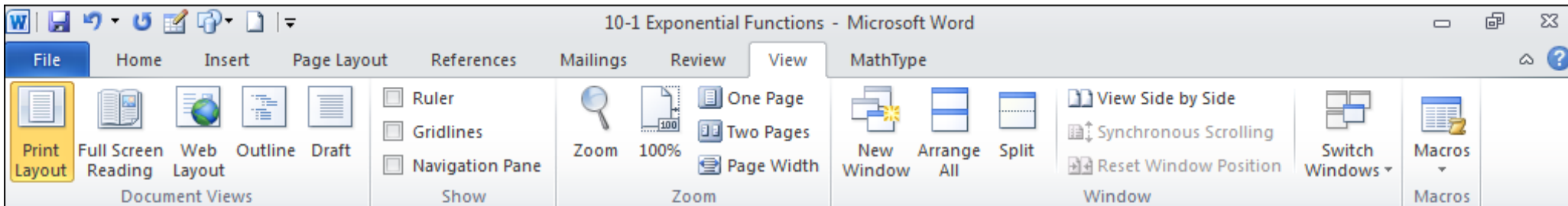
Solve each exponential equation.

1. $3^{2n+1} = 81$

2. $4^{2x} = 8^{x-1}$

3. $4^{9n-2} = 256$

4. $3^{5x} = 9^{2x-1}$



Determine whether each function represents growth or decay.

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

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Property of Equality for Exponential Functions: If b is a positive number other than 1, then

$b^x = b^y$ if and only if $x = y$.

Example: If $2^x = 2^8$, then $x = \underline{\hspace{2cm}}$

Solve each exponential equation.

1. $3^{2n+1} = 81$

$$\begin{aligned} 3^{2n+1} &= 3^4 \\ 2n+1 &= 4 \\ -1 \quad -1 & \\ \hline 2n &= 3 \\ \frac{2}{2} \quad \frac{2}{2} & \\ \hline n &= 1.5 \end{aligned}$$

2. $4^{2x} = 8^{x-1}$

$$\begin{aligned} (2^2)^{2x} &= (2^3)^{(x-1)} \\ 2^{4x} &= 2^{3(x-1)} \\ 4x &= 3(x-1) \\ 4x &= 3x-3 \\ -3x \quad -3x & \\ \hline x &= -3 \end{aligned}$$

3. $4^{9n-2} = 256$

$$\begin{aligned} 4^{9n-2} &= 4^4 \\ 9n-2 &= 4 \\ +2 \quad +2 & \\ \hline 9n &= 6 \\ \frac{9}{9} \quad \frac{6}{9} & \\ \hline n &= \frac{6 \div 3}{9 \div 3} = \frac{2}{3} \\ n &= \frac{2}{3} \end{aligned}$$

4. $3^{5x} = 9^{2x-1}$

$$\begin{aligned} 3^{5x} &= (3^2)^{2x-1} \\ 3^{5x} &= 3^{2(2x-1)} \\ 5x &= 2(2x-1) \\ 5x &= 4x-2 \\ -4x \quad -4x & \\ \hline x &= -2 \end{aligned}$$