

AP Calculus

Chapter 1

Section 1-3

May 13-10:02 PM

Exponential Functions

Let a be a positive real number ^{$\neq 1$} other than 1. The function

$$f(x) = a^x$$

is the **exponential function with base a .**

\uparrow constant

May 13-10:44 PM

Rules for Exponents

$$\frac{1}{a^y} = a^{-y}$$

If $a > 0$ and $b > 0$, the following hold for all real numbers x and y .

1. $a^x \cdot a^y = a^{x+y}$

2. $\frac{a^x}{a^y} = a^{x-y}$

3. $(a^x)^y = (a^y)^x = a^{xy}$

4. $a^x \cdot b^x = (ab)^x$

5. $\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$

May 13-10:44 PM

Exponential Bases

- Rewrite the expressions to have the indicated base

(5^{2x}) , base: 25

$$25^x$$

(16^{6y}) , base: 4

$$(4^2)^{6y} = 4^{12y}$$

$\left(\frac{1}{32}\right)^x$, base: 2

$$2^{-5x}$$

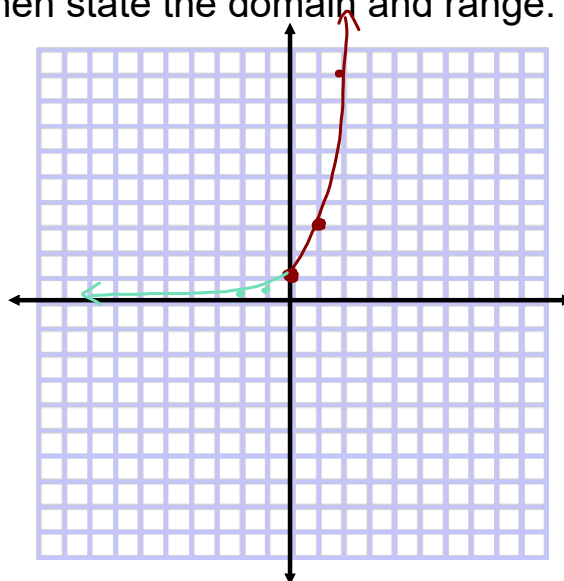
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Exponential Functions

- Graph the function. Then state the domain and range.

$$f(x) = 3^x$$

x	y
-2	$\frac{1}{9}$
-1	$\frac{1}{3}$
0	1
1	3
2	9



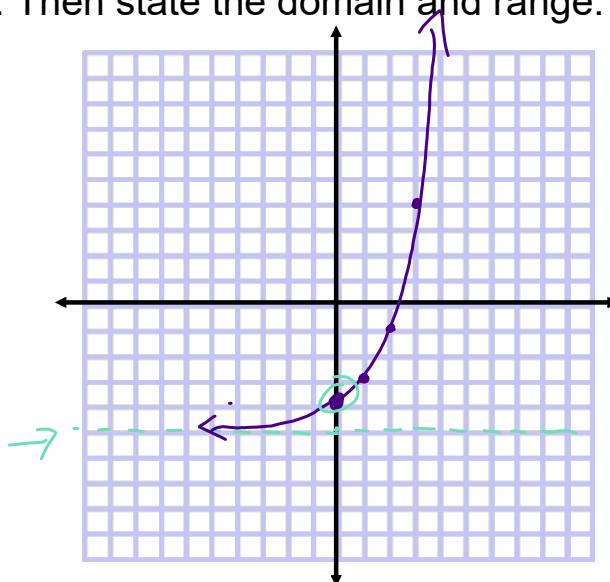
D: all real
 R: $(0, \infty)$ $y > 0$

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Exponential Functions

- Graph the function. Then state the domain and range.

$$f(x) = 2^x - 5$$



May 13-10:44 PM

Function Zeroes

$$f(x) = 3^x - 4$$

$$0 = 3^x - 4$$

$$\log_3 4 = \cancel{\log_3} 3^x$$

$$\log_3 4 = x$$

May 13-10:44 PM

Exponential Growth and Decay

$$y = k \cdot a^x, k > 0$$

$k \rightarrow$ initial value

@ time $x=0$, $y=k$

$a \rightarrow$ growth/decay rate

May 13-10:44 PM

If you invest \$1200 at an annual interest rate of 9.5%.
How long will it take for your investment to double?

$$k = 1200$$

$$a = 1.095$$

$$Y = 1200 \cdot 1.095^x$$

$$2400 = 1200 \cdot 1.095^x$$

$$2 = 1.095^x$$

$$\log_{1.095} 2 = x$$

$$\frac{\ln 2 \text{ or } \log 2}{\ln 1.095 \text{ or } \log 1.095} \approx 8 \text{ years}$$

Aug 20-8:56 AM

Half-life

The half-life for a certain isotope is 17 days. A laboratory has a sample that includes 500g of the isotope. What will the mass of the sample be after 51 days?

$$y = 500 \cdot \left(\frac{1}{2}\right)^{x/17} \quad \begin{array}{l} y \rightarrow g \\ x \rightarrow \# \text{ days} \end{array}$$

Estimate the time that it will take for there to be less than 8g in the sample.

$$8 = 500 \left(\frac{1}{2}\right)^{x/17}$$

$$\frac{8}{500} = \left(\frac{1}{2}\right)^{x/17}$$

$$17 \cdot \log_{1/2} \frac{8}{500} = \frac{x}{17} \cdot 17$$

$$\approx 10 \text{ days}$$

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Homework

Page 26-27

1 - 25 odd, 29 - 32 all

May 13-10:02 PM