Exponential and Logarithmic Function Review Guide

Name:_____

On Test Day you will Pick ONLY one box to complete in the row below, the maximum amount of points that can be earned for it is written in each box, the max for this section is 6 points.

Level 1 4 points

$f(x) = 6^{x-4}$
$g(x) = 2(4)^x + 7$

Evaluate and write out ALL steps

f(4)
$f(4) = 6^{4-4}$
$= 6^0$
$f(4) = 1$

g(3)
$g(3) = 2(4)^3 + 7$
$g(3) = 2(64) + 7$
$= 128 + 7$
$g(3) = 135$

Level 2 6 points

$f(x) = \left(\frac{7}{3}\right)^{x+6}$
$g(x) = -10\left(\frac{1}{5}\right)^x - 8$

negative exponent → Flip Fraction

Evaluate and write out ALL steps

f(-4)
$f(-4) = \left(\frac{7}{3}\right)^{-4+6}$
$= \left(\frac{7}{3}\right)^2$
$f(-4) = \frac{49}{9}$

g(-3)
$g(-3) = -10\left(\frac{1}{5}\right)^{-3} - 8$
$= -10\left(\frac{5}{1}\right)^3 - 8$
$= -10(125) - 8$
$= -1250 - 8$
$g(-3) = -1,258$

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Level 3 5 points

Decay
Bases are less than 1

Jets were purchased by the Southwest Airline company in 2021. Their values in millions of dollars are modeled by the functions $f(x) = 76(0.81)^x$ and $g(x) = 66(0.88)^x$ where x is the number of years since 2021. Which function models the jet that is worth the most after 10 years?

Plug x = 10 into both and plug into calculator

$f(10) = 76(0.81)^{10} = 9.239825$
$9,239,825.75$

$g(10) = 66(0.88)^{10} = 18.381064$
$18,381,064.42$

g(x) is models the jet worth more

Level 4 6 points

When Cole went to buy a house, he got a mortgage loan for $240,000 with an interest rate of 7% compounded monthly.

P, n = 12

$A = P\left(1 + \frac{r}{n}\right)^{nt}$

7% → r = 0.07

Write the formula that represents his situation:

$A = 240{,}000\left(1 + \frac{0.07}{12}\right)^{12t}$

Explain why this is growth or decay:

Growth, base is bigger than 1

Base $= 1 + \frac{0.07}{12} = 1.0058 > 1$

He got a 30-year loan. How much interest will he have paid by the end of the 30 years, if he does not pay more of it off each month?

t = 30

$A = 240{,}000\left(1 + \frac{0.07}{12}\right)^{(12 \cdot 30)}$
$A = \$1,947,959.39$
$-240,000$
Subtract house cost $\$1,707,959.39$

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Name: x−h right, x+h left

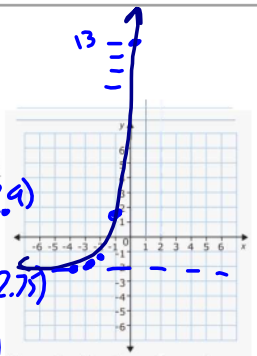
On Test Day you will Pick ONLY one box to complete in the row below, the maximum number of points that can be earned for it is written in each box, the max for this section is 7 points.

$a(b)^{x-h}+k$; $|a|>1$ stretch, $|a|<1$ shrink, a is neg Reflect; +k up, −k down

Level 1 — 5 points

Graph: $f(x) = 4^{x+1} - 3$

x	$f(x) = 4^{(x+1)} - 3$	(x, y)
-3	$4^{-3+1}-3 = 4^{-2}-3 = -2.9$	(-3, -2.9)
-2	$4^{-2+1}-3 = 4^{-1}-3 = -2.75$	(-2, -2.75)
-1	$4^{-1+1}-3 = 4^{0}-3 = 1-3 = -2$	(-1, -2)
0	$4^{0+1}-3 = 4^{1}-3 = 1$	(0, 1)
1	$4^{1+1}-3 = 4^{2}-3 = 16-3 = 13$	(1, 13)



Describe the Transformations

x+1 → left 1

−3 → down 3

Where is the Asymptote?

y = −3

Where is the y-Intercept?

(0, 1)

Level 2 — 7 points

$G(x) = -0.25(5)^{x-3} + 2$

Sketch the graph below clearly plot 3 points and the asymptote.

Is the parent function Growth or Decay?

base = 5 > 1

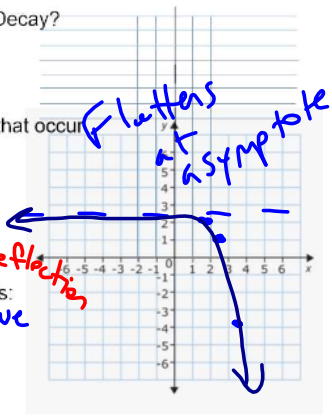
growth

What are all the transformations that occur compared to it's parent function?

+2 shift up 2

x−3 right 3

−0.25 shrink and reflection



Point 1 — Asymptote is: y = 2 (K value)

$f(3) = -0.25(5)^{3-3} + 2 = 1.75$

Point 2

$f(4) = -0.25(5)^{4-3} + 2 = 0.75$

Point 3

$f(5) = -0.25(5)^{5-3} + 2 = -4.25$

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Level 3 — 5 points

Write the Equation for the graph

$y = a \cdot b^{x-h} + k$

$y = 2\left(\frac{1}{4}\right)^{x-0} + 2$

Find a and b

y int (0, 4)

$4 = a \cdot b^{0-0} + 2$

$4 = a \cdot b^{0} + 2$

$-2 \quad -2$

$2 = a \cdot 1$

$a = 2$

another point (−1, 10)

$10 = 2b^{-1-0} + 2$

$-2 \quad -2$

$\frac{8}{2} = \frac{2b^{-1}}{2}$

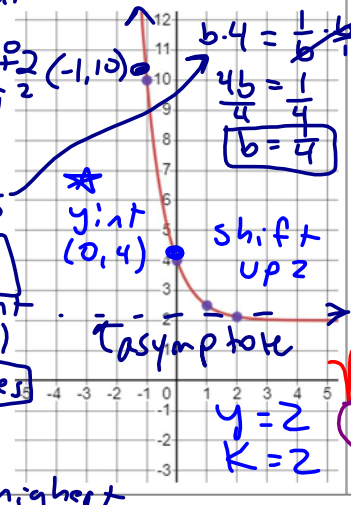
$4 = b^{-1}$

$4 = \frac{1}{b}$

$b \cdot 4 = \frac{1}{b} \cdot b$

$\frac{4b}{4} = \frac{1}{4}$

$b = \frac{1}{4}$



What is the Domain?

x values left to right

$x \in (-\infty, \infty)$

What is the Range?

y values lowest to highest

$y \in (2, \infty)$

Level 4 — 6 points

$y = ab^x$

You have become a bunny person. Your bunnies populate ~~exponentially~~. After the ~~first year~~, you now have ~~6 bunnies~~. After ~~3 years you have 86~~ bunnies. If you never give any away and none dies or runs off, how many bunnies will you have after 7 years? Round down to the nearest whole bunny.

$f(1) = 6$ (x, y) $\quad f(3) = 86$ (x, y) $\quad f(7) = ?$

$6 = ab^1$ $\quad 86 = ab^3$

divide to cancel 'a' → $6 = a(3.786)^1$

$\frac{86}{6} = \frac{ab^3}{ab^1}$

$\sqrt{14.3} = \sqrt{b^2}$

$3.786 = b$

$3.786 \quad 3.786$

$a = 1.585$

$y = 1.585(3.786)^x$

$f(7) = 1.585(3.786)^7$

$f(7) = 17{,}670$ bunnies

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Name:_____

On Test Day you will Complete as many as you want or can in each box in the row below, the maximum number of points that can be earned for this section is 13 points if you complete all the problems correctly.

Level 1 — 2 point each	Level 2 — 3 points	Level 2 — 4 points
Evaluate these:	Condense:	Expand:
$\log_5(125)$	$28\log x - 7\log x$	$\ln\left(\frac{e^3 \cdot y^4}{x^7}\right)$
$\log_4(20)$		
$10^{\log(7.5)}$		

Base goes in basement

$\log_5(125) = 3$

ASK $5^? = 125$

$5^3 = 125$

$\log_4(20) = \frac{\log(20)}{\log(4)} = 2.161$

needs change of base formula

$10^{\log(7.5)}$ — $\log_{10}(7.5)$ match

$= 7.5$

bases and logs cancel if bases match

$28\log x - 7\log x$

$\log(x^{28}) - \log(x^7)$

$\log\left(\frac{x^{28}}{x^7}\right)$

$\frac{x^{28}}{x^7} = x^{28-7}$

$\log(x^{21})$

ln is $\log_e$

log is $\log_{10}$

$\ln(e^3) + \ln(y^4) - \ln(x^7)$

$\ln(e) = 1$ because $e^? = e$

$3\ln(e) + 4\ln(y) - 7\ln(x)$

$3 + 4\ln(y) - 7\ln(x)$

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Level 1 — 3 points	Level 2 — 4 points
$32^n = 1034$	$6^{v+9} - 5 = 211$
Level 3 — 5 points	Level 4 — 6 points
The population of bacteria follows this growth $A = 34(3.3)^x$ where x is in hours. When will there be 2000 bacteria?	$21e^{4p-6} + 9 = 156$

exponent

base

bases hold up exponents

$\log_{32}(1034) = n$

$\frac{\log(1034)}{\log(32)} = n$

$n = 2.0028$

$\log_{base}(\ ) = exponent$

must get base alone 1st

$6^{v+9} - 5 = 211$

$+5 \quad +5$

$6^{v+9} = 216$

$\log_6(6^{v+9}) = \log_6(216)$

$v+9 = \frac{\log(216)}{\log(6)}$

$v+9 = 3$

$-9 \quad -9$

$v = -6$

$A = 2000$ get base alone

$\frac{2000}{34} = \frac{34(3.3)^x}{34}$

$58.82 = 3.3^x$ exponent base

$\log_{3.3}(58.82) = x$

$\frac{\log(58.82)}{\log(3.3)} = x$

$x = 3.413$ hours

$21e^{4p-6} + 9 = 156$

$-9 \quad -9$

$\frac{21e^{4p-6}}{21} = \frac{147}{21}$

$\ln(e^{4p-6}) = \ln(7)$

$4p-6 = \ln(7)$

$+6 \quad +6$

$\frac{4p}{4} = \frac{7.946}{4}$

$p = 1.986$

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Level 1 3 points	Level 2 4 points
$\log(8x) = \log(55-3x)$ ignore logs because matches $8x = 55-3x$ $+3x \quad +3x$ $\frac{11x}{11} = \frac{55}{11}$ $x = 5$	$-8\log_5(x+20) = -24$ $\frac{-8}{-8} \quad \frac{-24}{-8}$ $\log_5(x+20) = 3$ making both sides exponents for the base that matches the logs, cancels the log $x+20 = 5^3$ $x+20 = 125$ $-20 \quad -20$ $x = 105$
Level 3 5 points	**Level 4 6 points**
$\log(8x) + \log(2) = 3$ $\log(8x \cdot 2) = 3$ $\log(16x) = 3$ $10 \quad 10$ making both sides exponents for the base that matches the logs, cancels the log $16x = 10^3$ $\frac{16x}{16} = \frac{10^3}{16}$ $x = 62.5$	Condense 1st $\ln(8x) + \ln(6x+5) - \ln(4x) = 5$ $\ln\left(\frac{8x(6x+5)}{4x}\right) = 5$ $\ln\left(\frac{2(6x+5)}{1}\right) = 5$ $\ln(12x+10) = 5$ ln is $\log_e$ $e \quad e$ $12x+10 = e^5$ $-10 \quad -10$ $\frac{12x}{12} = \frac{138.413}{12}$ $x = 11.534$

Basic Exponential Function $y = ab^x$

What is the growth and decay model formula? ending amount = starting amount, rate as a decimal, time

$$A = P(1+r)^t$$

% → Decimal move point 2x

What is the Compound Interest model formula?

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

n = # of times compounded per year

What is the Compound Continuous Interest model formula?

$$A = Pe^{rt}$$

What is the Product Rule for Logs?

$\log(12x) + \log(4y) = \log(48xy)$ add → multiply

What is the Quotient Rule for Logs?

$\log(12x) - \log(4y) = \log\left(\frac{12x}{4y}\right)$ subtract → divide

What is the Power Rule for Logs?

$4 \cdot \log(3x) = \log(3x)^4 = \log(3^4 x^4)$ coefficient → exponent

$\log\left(\frac{3x}{4}\right)^4$

Condense and simplify the expression: $\log(12x) + 2 - \log(3x)$

$\log(12x) + 2 \cdot \log(10) - \log(3x)$

$\log(12x) + \log(10^2) - \log(3x)$

$\log\left(\frac{12x \cdot 100}{3x}\right)$

$\log(4 \cdot 100)$

$\log(400) = 2.602$