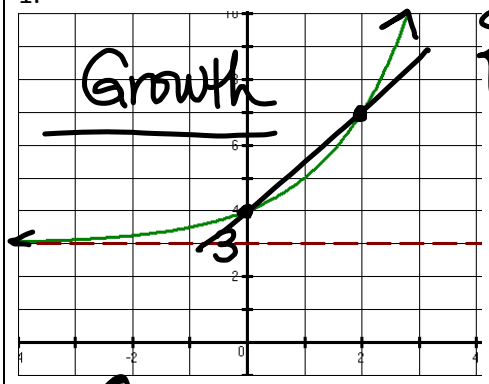
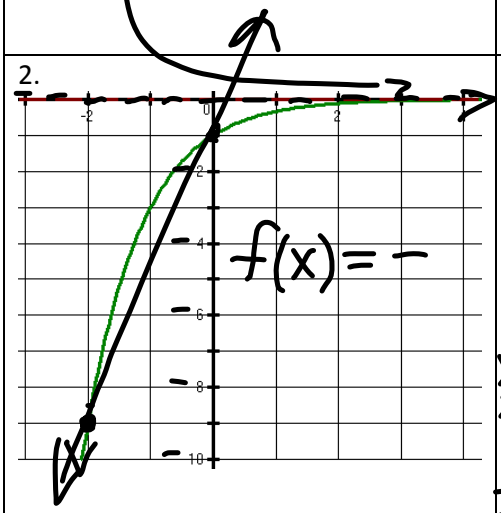
GSE Algebra I **Unit 4: Modeling and Analyzing Exponential Functions** **Name:**

Study Guide

What you need to know and be able to do	Things to remember	Problem	Problem
Describe Characteristics of Exponential Functions	• *Interval of Inc/Dec* • *Domain* • *Range* • *Asymptote* • *B ____ 1* • *Growth/Decay* • *X-int* • *Y-int* • *End behaviors* • *Rate of Change* $\frac{y_2 - y_1}{x_2 - x_1}$	1.  	Domain: $\mathbb{R}$ Range: $y > 3$ Asymptote: $y = 3$ X-int: none Y-int: $(0,4)$ Int. of Increase or Decrease B $>$ 1 Growth or Decay End Behaviors: $x \to -\infty$ $y \to 3$ $x \to +\infty$ $y \to \pm\infty$ Rate of Change from 0 < x < 2 Slope $(0,4)$ $(2,7)$ $\frac{7-4}{2-0} = \frac{3}{2}$
		2.  	Domain: $\mathbb{R}$ Range: $y < 0$ Asymptote: $y = 0$ X-int: none Y-int: $(0,-1)$ Int. of Increase or Decrease B $<$ 1 Growth or Decay End Behaviors: $x \to -\infty$ $y \to -\infty$ $x \to +\infty$ $y \to 0^-$ Rate of Change from -2 < x < 0 $(-2,-9)$ 4 Slope $(0,-1)$
Identify Transformations of Exponential Functions	• *Describe the transformations on the parent function $y = 2^x$*	3. $y = -2(2)^{x-3}$ reflects over x-axis Stretch by 2 right 3	4. $y = \frac{1}{3}(2)^x + 8$ Shrink by 1/3 up 8
	• *Write the equation for the function $y = 3^x$ with given transformations*	5. Vertically compress by a factor of 1/3, shift left 3, and shift down 8 $y = \frac{1}{3}(3)^{x+3} - 8$	6. Reflect across the x-axis, vertically stretch by a factor 5, and shift up 7 $y = -5(3)^x + 7$

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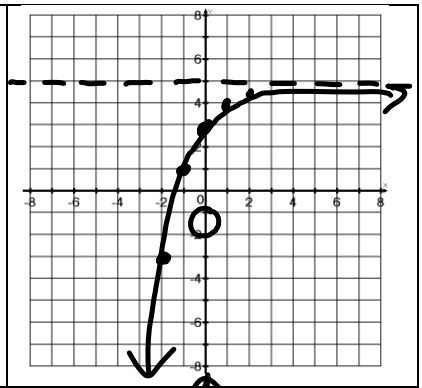
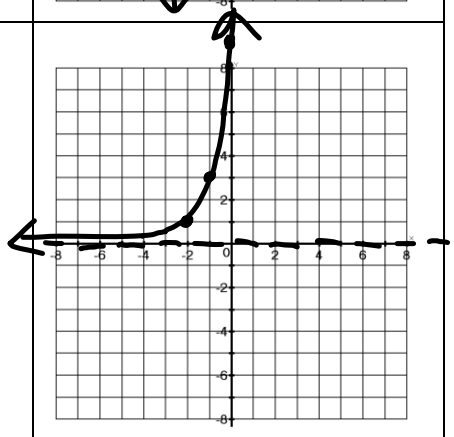
<table>
<tr>
<td rowspan="2">Graph Exponential Functions</td>
<td rowspan="2">• Use -2, -1, 0, 1, 2 for the x-values
• Graph the asymptote</td>
<td>7. $f(x) = -2\left(\frac{1}{2}\right)^x + 5$
<table><tr><th>x</th><th>f(x)</th></tr><tr><td>-2</td><td>-3</td></tr><tr><td>-1</td><td>1</td></tr><tr><td>0</td><td>3</td></tr><tr><td>1</td><td>4</td></tr><tr><td>2</td><td>9/2=4.5</td></tr></table></td>
<td>  </td>
</tr>
<tr>
<td>8. $g(x) = (3)^{x+2}$ left 2
<table><tr><th>x</th><th>f(x)</th></tr><tr><td>-4</td><td>.11</td></tr><tr><td>-3</td><td>1/3 = .33</td></tr><tr><td>-2</td><td>1</td></tr><tr><td>-1</td><td>3</td></tr><tr><td>0</td><td>9</td></tr><tr><td>2</td><td>81</td></tr></table></td>
<td>  </td>
</tr>
<tr>
<td>Comparing exponential characteristics</td>
<td>• Compare y-intercepts
• Compare rates of change</td>
<td colspan="2"><u>Use the graphs from Problems 7 and 8</u></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. Which function has a greater rate of change from $0 \leq x \leq 2$? Why?
#8 = 36 #7 = .75
Why because 36 > .75!</td>
<td>10. Which function has a lower y-intercept? Why?
#7 (0, 3)
#8 (0, 9)</td>
</tr>
<tr>
<td rowspan="2">Solve Exponential Functions</td>
<td rowspan="2">• Isolate the base
• Create like bases</td>
<td>11. $7^{x-9} = 49^{2x-3}$</td>
<td>12. $64^{3x+5} = 1024^x$</td>
</tr>
<tr>
<td>13. $6^{x-3} + 5 = 41$</td>
<td>14. $8^{3x-1} - 3 < 13$</td>
</tr>
</table>

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Create and Use Exponential Functions from word problems and tables

- *Find your initial value 'a' (x = 0)*
- *Calculate your rate 'b'*
- *If there are percentages, it is either (1 +r) or (1 – r)*

$y = a(b)^x$

$b = 2$ doubles

$b = \frac{1}{2}$ cut by half.

15. The population of Marietta in 2003 was estimated to be 35,000 people with an annual rate of increase of about 24%.

a. Write an equation to represent the population of Marietta.

$y = 35{,}000(1+.24)^x$

$y = 35{,}000(1.24)^x$

b. Use your equation to estimate the population in 2015 to the nearest hundred people.

$= 35{,}000(1.24)^{12}$

462,500 people

16. A certain bacteria that is growing on your kitchen counter doubles every 5 minutes. Assuming that there was only 1 bacteria in the beginning, how many bacteria would there be after 2 hours?

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

$y = 1(2)^{\frac{120}{5}}$

$= 16{,}777{,}216$ bacteria

17. Chyna invests $300 at a bank that offers a rate of 5% compounded quarterly.

$r = 5\%$

$r = .05$

a. Write an equation to model the amount of money in Chyna's bank account.

$A = P(1+\frac{r}{n})^{nt} = 300(1+\frac{.05}{4})^{4 \cdot t}$

b. How much money will Chyna have in 4 years?

$= 300(1+\frac{.05}{4})^{4 \cdot 4} =$

$365.97

18. Caleb bought a new car at a cost of $25,000. The value of the car decreases about 25% every 2 years.

$25{,}000(.75)^{\frac{x}{2}}$

a. How much will his car be worth about 2 years?

$25{,}000(.75)^{\frac{2}{2}} =$

$18750

b. How much will his car be worth after 10 years?

.96

$25{,}000(.75)^{\frac{10}{2}} =$

$5932.62

19. Tina and her friends are having a party. The amount of people that know about the party throughout the week is shown in the table below.

Number of Days	Number of People
0	6
1	18
2	54
3	162

a. Write the equation of the amount of people that know about the party.

$y = 6(3)^x$

b. How many people will know about the party in a week?

$y = 6(3)^7 =$

13,122 people

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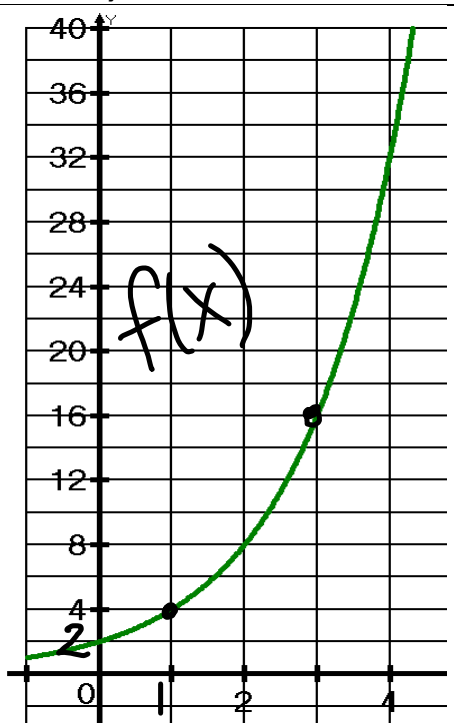
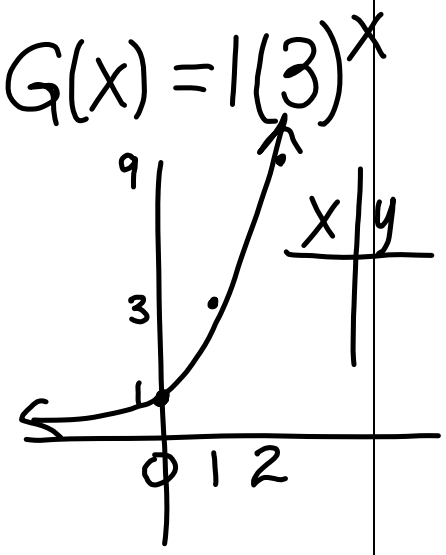
Create and Use Geometric Sequences	• *Recursive Rule:* $a_n = r * a_{n-1}$ • *Explicit/Closed Rule:* $a_n = a_1(r)^{n-1}$	20. Given the sequence below: 152, 76, 38, … $a_n = a_1(r)^{n-1}$ a. Use the recursive rule to find the 5th term explicit b. Create the closed formula for the sequence. $a_n = 152\left(\frac{1}{2}\right)^{n-1}$ c. Use the explicit formula to find the 8h term $a_8 = 152\left(\frac{1}{2}\right)^{8-1} = 1.1875$	21. Given $a_1 = -2$ $r = 2$ ~~$a_n = 2a_{n-1}$~~ a. Find the first 5 terms of the sequence. $a_1 = -2$ $a_2 = -4$ $a_3 = -8$ $a_4 = -16$ $a_5 = -32$ b. Create the explicit formula. $a_n = -2(2)^{n-1}$ c. Calculate the 8th and 10th terms. $a_8 = -256$ $a_{10} = -1024$
Compare Exponential functions in different forms	• *Find the characteristics of each function in its own form. Use those characteristics to compare* • *Y-intercepts occur where x = 0* • *Rate of change requires 2 points to plug into the slope formula* • *Greater rate of change is the magnitude of*	**F(x) is represented by the graph below**	What is the y-intercept of f(x)? (0, 2) What is the y-intercept of g(x)? (0, 1) Which function has a lower y-intercept? G(x) What is the rate of change of f(x) for 0 ≤ x ≤ 3? (0, 2) (3, 16) $\frac{16-2}{3-0} = \frac{14}{3} = 4\frac{2}{3}$ What is the rate of change for G(x) for 0 ≤ x ≤ 3? (0, 1) (3, 27) $\frac{27-1}{3-0}$ $26/3 = 8\frac{2}{3}$

	the number, not the sign	 **G(x) is represented by the equation** $G(x) = 1(3)^x$	G(x) Which function has the greater rate of increase for $0 \le x \le 3$?