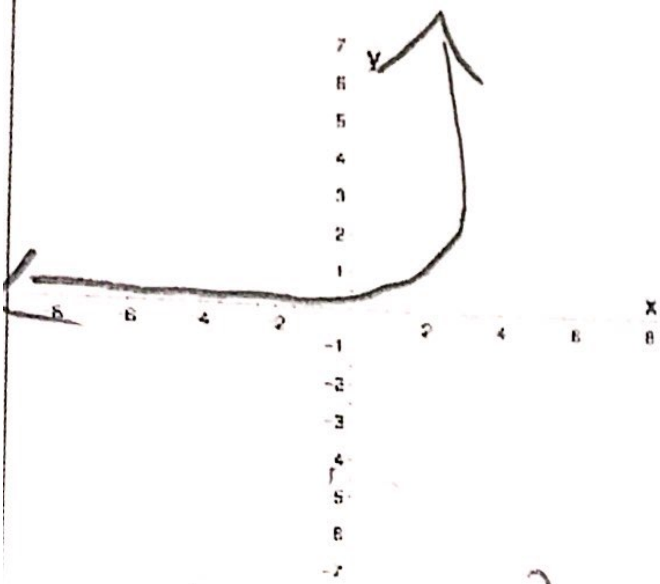
Solve the following (Round to the nearest hundredth :

1. $3^x + 1 = 5$ $3^x = 4$ $x\log 3 = \log 4$ $x = \frac{\log 4}{\log 3}$ $\boxed{x = 1.26}$	2. $\frac{6(e^{2x})}{6} = \frac{18}{6}$ $e^{2x} = 3$ $2x = \ln 3$ $\frac{\ln 3}{2} = x$ $\boxed{.55 = x}$
3. $\log(x + 9) = 3$ $10^3 = x + 9$ $1000 = x + 9$ $\boxed{991 = x}$	4. $\ln(x - 4) = 5$ $\log_e(x-4) = 5$ $e^5 = x - 4$ $e^5 + 4 = x$ $\boxed{152.41 = x}$
5. $\log_2 y + \log_2 8 = 5$ $\log_2 8y = 5$ $2^5 = 8y$ $32 = 8y$ $\boxed{y = 4}$	6. $\log_6 x - \log_6 4 = \log_6 7$ $\log_6 \frac{x}{4} = \log_6 7$ $\frac{x}{4} = 7$ $\boxed{x = 28}$
7. $3\ln(x - 2) = 12$ $\ln(x-3) = 4$ $e^4 = x - 3$ $e^4 + 3 = x$ $\boxed{x = 57.60}$	8. $\ln 4 + \ln 6x = \ln 8$ $\ln 24x = \ln 8$ $24x = 8$ $x = 8/24$ $\boxed{x = 1/3}$
9. $\log x = \log 14$ $\boxed{x = 14}$	10. $7^{x+3} = 240$ $x + 3\log 7 = \log 240$ $x + 3 = \frac{\log 240}{\log 7}$ $x = \frac{\log 240}{\log 7} - 3$ $\boxed{x = -.18}$

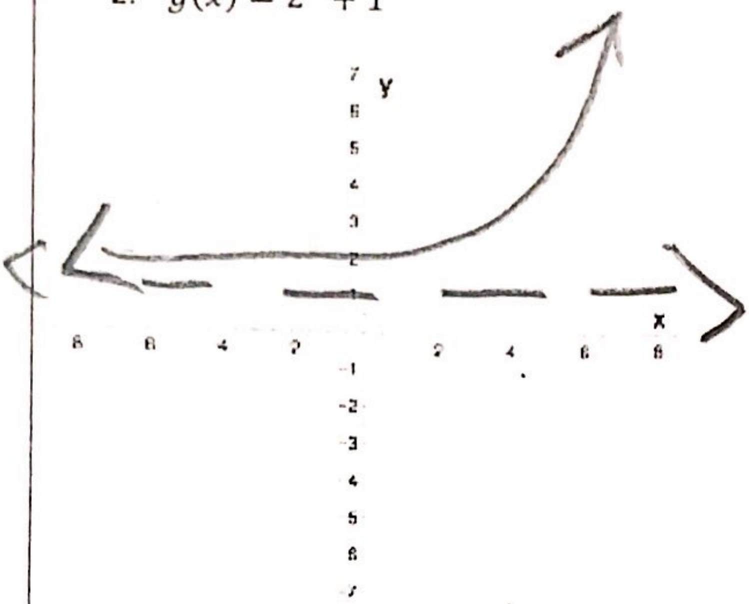
Graph the following

1. $g(x) = 3^{x-1}$



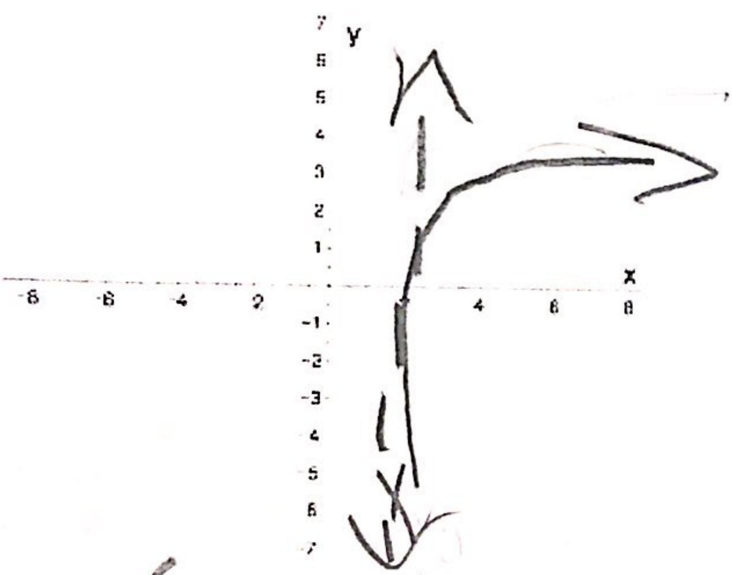
Domain: $(-\infty, \infty)$
Range: $(0, \infty)$
Asymptote: $y = 0$

2. $g(x) = 2^x + 1$



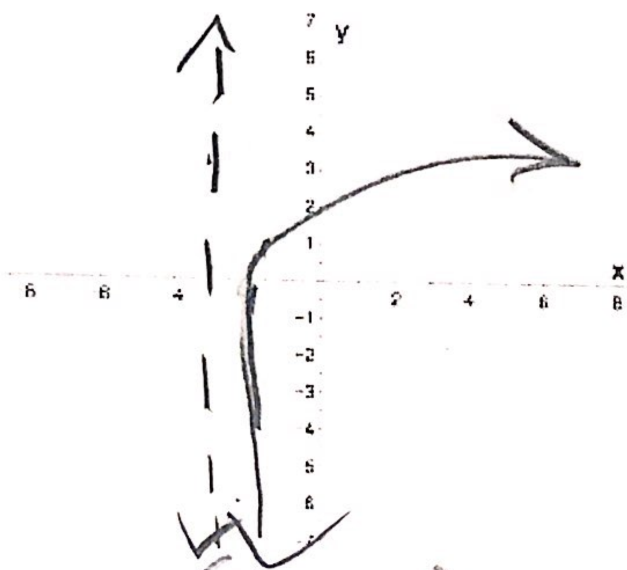
Domain: $(-\infty, \infty)$
Range: $(1, \infty)$
Asymptote: $y = 1$

3. $g(x) = \ln(x - 2)$



Domain: $(2, \infty)$
Range: $(-\infty, \infty)$
Asymptote: $x = 2$

4. $g(x) = \ln(x + 3) - 1$



Domain: $(-3, \infty)$
Range: $(-\infty, \infty)$
Asymptote: $x = -3$

Exponential Growth and Decay

1. The formula $A = 12.5e^{0.0201t}$ models the population of a US state, A, in millions, t years after 2000.

a) What was the population of the state in 2000? 12.5

b) When will the population of the state reach 20.2? 24 years $\boxed{2024}$

2. A computer valued at $6500 depreciates at the rate of 14.3% per year.

a) Write a function that models the value of the computer. $y = 6500(1-0.143)^x$

b) Find the value of the computer after three years.

$y = 6500(1-0.143)^3$

$\boxed{\$4091.25}$

3. Ryan gets 3 cattle for Christmas. In 4 years he has 20 cattle.

a) What is the rate of growth for his cattle?

$y = a(1+r)^t$

$20 = 3(1+r)^4$

$20/3 = (1+r)^4$

$\sqrt[4]{20/3} = 1+r$

$1.607 = 1+r$

$.607 = r$ $\boxed{60.7\%}$

b) If he let his cattle continue to grow at this rate when will he have 200 cattle?

$200 = 3(1+.607)^x$

$\frac{200}{3} = 1.607^x$

$\log(200/3) = x \log 1.607$

$\frac{\log(200/3)}{\log 1.607} = x$

$\boxed{9 \text{ years}}$

4. The number of mosquitoes at the beach has tripled every year since 1999. In 1999, there were 2,500 mosquitoes. Write a model for this situation. How many mosquitoes would you predict were at the beach in 2005?

$y = 2500(3)^x$

$y = 2500(3)^6$

$\boxed{y = 1822500 \text{ mosquitoes}}$

Compound and Continuously Compounded Interest

1. Jake invests $3500 at a rate of 7% compounded continuously. When will he double his investment?

$A = 3500e^{.07t}$

$7000 = 3500e^{.07t}$

$2 = e^{0.07t}$

$\ln 2 = 0.07t$

$\frac{\ln 2}{0.07} = t$

$9.9 = t$

$\boxed{10 \text{ yrs}}$

2. Trent invests $1500 in a company. In 6 years he has $4500. What was the rate of return if the investment was compounded quarterly?

$y = 4500 = 1500\left(1+\frac{r}{4}\right)^{4\cdot 6}$

$3 = \left(1+\frac{r}{4}\right)^{24}$

$1.047 = 1+\frac{r}{4}$

$.047 = \frac{r}{4}$

$.188 = r$

$\boxed{18.8\%}$

3. Sabrina invests $16,000 for 3 years at an interest rate of 5%. Will she have more money if she picks an account that compounds continuously or monthly? How much more will Sabrina make?

a) Continuous Amount: $A = 16{,}000e^{0.05(3)}$ $\boxed{A = \$18{,}589.35}$

b) Monthly amount: $A = 16{,}000\left(1+\frac{0.05}{12}\right)^{12(3)}$ $\boxed{A = \$18{,}583.56}$

c) What is the better option? Continuous

d) By how much? $\boxed{\$5.79}$

4. Keri invests $6,139 in a retirement account with a fixed annual interest rate compounded continuously. After 17 years, the balance reaches $8,624.97. What is the interest rate of the account?

$A = Pe^{rt}$

$8{,}624.97 = 6139e^{r(17)}$

$1.405 = e^{17r}$

$\ln(1.405) = 17r$

$.02 = r$

$\boxed{2\%}$

5. Averi invests $8,589 in a retirement account with a fixed annual interest rate of 7% compounded continuously. How long will it take for the account balance to reach $21,337.85?

$21{,}337.85 = 8589e^{0.07t}$

$2.484 = e^{0.07t}$

$\ln 2.484 = 0.07t$

$13 = t$

$\boxed{13 \text{ years}}$

Name: ______________________ Date: ______________

EXPONENTIAL AND LOGARITHMIC REGRESSION
ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK

APPLICATIONS

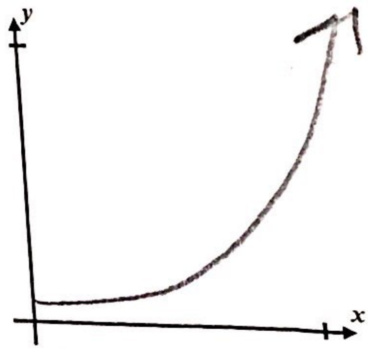
1. Rabbits were accidently introduced to an island where their population is growing rapidly. Biologists studying the rabbits have periodically recorded their population since they were introduced to the island. The data they took is shown below.

Years Since Introduction, x	2	5	7	11	15
Population of Rabbits, y	75	100	112	205	290

(a) Determine an exponential regression equation, in the form $y = a \cdot b^x$, that models this data. Round a to the *tenth* and b to the *hundredth*.

$y = 58.2\,(1.11)^x$

(b) Sketch a graph of the rabbit population below on the axes provided for $0 \le x \le 20$. Label your graphing window and your y-intercept.



(c) Based on your model in part (a), by what percent is the rabbit population growing each year?

11%

(d) Graphically determine, to the nearest *tenth* of a year, when the rabbit population will reach 350.

17.2

2. The infiltration rate of a soil is the number of inches or water per hour it can absorb. Hydrologists studied one particular soil and found its infiltration rate decreases exponentially as a rainfall continues.

Time, t (hours)	0	1.5	3.0	4.5	6.0
Infiltration Rate, I (inches per hour)	5.3	3.1	2.4	1.6	0.7

Create an exponential model that best fits this data set. Round coefficients to the nearest *hundredth*. Use your model to algebraically determine the time until the rate reaches 0.25 inches per hour. Round your answer to the nearest *tenth* of an hour.

$y = 5.47(.73)^x$

$.25 = 5.47(.73)^x$

$0.046 = .73^x$

$\log(.046) = \log(.73)^x$

$x = \dfrac{\log .046}{\log .73}$

$x = 9.8\text{hr}$

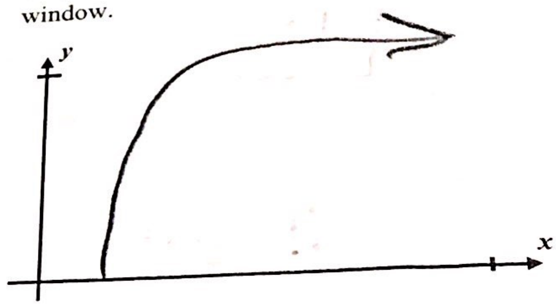
3. During prolonged cold in northern latitudes, thick ice will grow on lakes. A particular lake in Ladysmith, Wisconsin, has its ice thickness measured every day after the temperature fell below zero. The data is shown in the table below.

Days Below Freezing, x	6	9	14	20	27	32	55
Ice Thickness, y (inches)	0.8	1.7	3.5	4.0	5.2	5.5	7.2

(a) Find a logarithmic equation, of the form $y=a+b\ln x$, that best fits this data set. Round both coefficients to the nearest *tenth*.

$y=-4.5+2.9\ln x$

(b) Create a sketch of this function over the interval for the first hundred days the temperature is below freezing. Label your window.



(c) Use a table on your calculator to determine, to the nearest day, the number of days below freezing necessary for the ice to reach a thickness of one foot. Provide numerical evidence to the nearest *tenth* of a day.

12 in

$12=-4.5+2.9\ln x$

295.8

4. In the table below, the year, y, in which a certain population, x, was reached by Charleston, Illinois is given

Population, x	5,000	6,000	7,000	8,000	9,000
Year, y	1972	1980	1984	1987	1989

Find a logarithmic model, of the form $y=a+b\ln x$, that best fits this data. Round your coefficients to nearest integer. Using your model, algebraically determine the population, to the nearest whole number Charleston in the year 2010.

$y=1764+25\ln x$

$2010=1764+25\ln x$

$\boxed{18769.7}$