Honors Precalculus Applications of Logarithms & Exponential Functions Name_____

YES Calculator is permitted. Show your work and box your answers when appropriate. ROUNDING RULES: Round money to the nearest penny. Round Bacteria to nearest whole. Round any rate to the at least three decimal places. Do not round in the middle of a problem, only at the end of the problem. Provide exact values when requested.

1. Find the amount that results when $1500 is invested at 8% compounded monthly after a period of 14 years.	2. Find the amount that results when $375 is invested at 4% compounded continuously after a period of 3 years.
3. Find the principal needed now (present value) to get $13,000 after 5 years at 9% compounded quarterly.	4. Find the effective interest rate of interest for 8.5% compounded continuously.
5. How long does it take for an investment to double in value if it is invested at 3% compounded monthly?	6. How many years will it take for an initial investment of $25,000 to grow to $80,000? Assume a rate of 7% interest compounded continuously.
7. A skillet is removed from an oven whose temperature is $450°$ and placed in a room whose temperature is $70°$. After 5 minutes, the temperature of the skillet is $400°$. a. Write a formula to model the temperature of the skillet after t seconds. Use an exact value for k. b. How long will it be until the skillet is $150°$?	8. A culture of bacteria obeys the laws of uninhibited growth. a. Write a formula if 600 bacteria are present initially, and there are 790 after 1 hour. b. How many bacteria will be present after 12 hours?

9. A colony of bacteria grows according to the law of uninhibited growth where $N(t)=100e^{0.054t}$ Where N is measured in grams and t is measured in days.
   a. Determine the initial amount of bacteria

   b. What is the growth rate of the bacteria?

   c. What is the population after 5 days?

   d. How long will it take for the population to reach 140 grams?

10. A piece of charcoal is found to contain 25% of the carbon 14 that it originally had. When did the tree from which the charcoal came from die? Remember the half-life of Carbon 14 is about 5600 years. (Do not round any value until the end!)

11. The normal healing of wounds can be modeled by an exponential function. If A_0 represents the original area of the wound and if A equals the area of the wound, then the function $A(n)=A_0e^{-0.35n}$ describes the area of a wound after n days following an injury when no infection is present to slow healing. Suppose a wound is initially 80 square millimeters.
   a. After how many days will the wound be half its original size?

   b. How long before the wound is 10% of its original size.

12. Solve. You do not have to show work if calculator is your method.
$\log_2 x+\log_4 x=\log_3(2-x)$

13. Solve. Round answer to three decimal places
$e^x-\ln 5=2-x^2$

14. State the domain $y=\log_5(x^2-2x-15)$

15. $f(x)=\log_7(7-x)$
   a. Solve $f(x)=0$

   b. Evaluate $f(0)$

11/26/2018

Honors Precalculus Applications of Logarithms & Exponential Functions Name KEY 2018

YES Calculator is permitted. Show your work and box your answers when appropriate. ROUNDING RULES: Round money to the nearest penny. Round Bacteria to nearest whole. Round any rate to the at least three decimal places. Do not round in the middle of a problem, only at the end of the problem. Provide exact values when requested.

1. Find the amount that results when $1500 is invested at 8% compounded monthly after a period of 14 years.

$1500\left(1+\frac{.08}{12}\right)^{168}$

$4580.23

2. Find the amount that results when $375 is invested at 4% compounded continuously after a period of 3 years.

$375e^{(.04*3)}$

$422.81

3. Find the principal needed now (present value) to get $13,000 after 5 years at 9% compounded quarterly.

$13{,}000 = P\left(1+\frac{.09}{4}\right)^{20}$

$8330.61

4. Find the effective interest rate of interest for 8.5% compounded continuously.

$r = 1-e^{r}$

$= 1-e^{.085}$

$.085717067$

8.871%.

5. How long does it take for an investment to double in value if it is invested at 3% compounded monthly?

$2 = \left(1+\frac{.03}{12}\right)^{12t}$

$\ln 2 = 12t\ln\left(1+\frac{.03}{12}\right)$

$t \approx 23.133775$

About 23.134 years

6. How many years will it take for an initial investment of $25,000 to grow to $80,000? Assume a rate of 7% interest compounded continuously.

$80{,}000 = 25000e^{.07t}$

About 16.616 years

7. A skillet is removed from an oven whose temperature is 450° and placed in a room whose temperature is 70°. After 5 minutes, the temperature of the skillet is 400°.

$T(t) = T_s + (T_0 - T_s)e^{-kt}$

a. Write a formula to model the temperature of the skillet after t seconds. Use an exact value for k.

$T(t) = 70 + (450-70)e^{-kt}$

$T(t) = 70 + 380e^{-kt}$ use (5, 400)

$400 = 70 + 380e^{-5k}$

$\frac{\ln\left(\frac{33}{38}\right)}{-5} = k$

$T(t) = 70 + 380e^{+0.2\ln\left(\frac{33}{38}\right)t}$

b. How long will it be until the skillet is 150°?

$150 = 70 + 380e^{+.2\ln\left(\frac{33}{38}\right)t}$

$\ln\left(\frac{4}{19}\right) = +.2\ln\left(\frac{33}{38}\right)t$

55.22257

About 55.223 minutes

8. A culture of bacteria obeys the laws of uninhibited growth.

a. Write a formula if 600 bacteria are present initially, and there are 790 after 1 hour.

$A = A_0e^{rt}$

$790 = 600e^{r}$ $\quad \frac{790}{600} = e^{r}$

$r = \ln\left(\frac{79}{60}\right)$

$A = 600e^{\ln\left(\frac{79}{60}\right)t}$

b. How many bacteria will be present after 12 hours?

16287.75925

About 16288 bacteria

9. A colony of bacteria grows according to the law of uninhibited growth where $N(t) = 100e^{0.054t}$ Where N is measured in grams and t is measured in days.

a. Determine the initial amount of bacteria

100 Bacteria

b. What is the growth rate of the bacteria?

5.4%

c. What is the population after 5 days?

130.9964 About 131 Bacteria

d. How long will it take for the population to reach 140 grams?

$\frac{140}{100} = e^{0.054t}$ $t \approx 6.230967$

About 6 to 7 days. 6.231 days.

10. A piece of charcoal is found to contain 25% of the carbon 14 that it originally had. When did the tree from which the charcoal came from die? Remember the half-life of Carbon 14 is about 5600 years. (Do not round any value until the end!)

use.

$.25 = e^{\frac{\ln(1/2)}{5600}}$

$\ln(.25) = \frac{\ln(1/2)}{5600}$

About 11,200 years

$\frac{1}{2} = e^{K5600}$

$\ln(\frac{1}{2}) = 5600K$

$K = \frac{\ln(1/2)}{5600}$

$K \approx -0.000123776\ldots$

11. The normal healing of wounds can be modeled by an exponential function. If A_0 represents the original area of the wound and if A equals the area of the wound, then the function $A(n) = A_0 e^{-0.35n}$ describes the area of a wound after n days following an injury when no infection is present to slow healing. Suppose a wound is initially 80 square millimeters.

a. After how many days will the wound be half its original size?

$0.5 = e^{-0.35n}$

$n \approx 1.98042$

About 1.980 or 2 days

b. How long before the wound is 10% of its original size.

$0.10 = e^{-0.35n}$

$\ln(.1) = -0.35n$

$n \approx 6.5788$

About 6.579 days or 7 days

12. Solve. You do not have to show work if calculator is your method.

$\log_2 x + \log_4 x = \log_3(2-x)$

In calculator

$Y_1 = \frac{\ln x}{\ln 2} + \frac{\ln x}{\ln 4}$

$Y_2 = \frac{\ln(2-x)}{\ln 3}$

$X = 1$

13. Solve. Round answer to three decimal places

$e^x - \ln 5 = 2 - x^2$ use calculator

$Y_1 = e^x - \ln 5$

$Y_2 = 2 - x^2$

$x \approx -1.858$ or $x \approx 0.977$

14. State the domain $y = \log_5(x^2 - 2x - 15)$

$x^2 - 2x - 15 > 0$

$(x-5)(x+3) > 0$

-3 5

+ | - | +

$(-\infty, -3) \cup (5, \infty)$

15. $f(x) = \log_7(7-x)$

a. Solve $f(x) = 0$

$0 = \log_7(7-x)$

$7^0 = 7-x$

$1 = 7-x$

$x = 6$

b. Evaluate $f(0)$

$\log_7(7-0)$

$\log_7 7 = 1$