3.4 Log Application Problems
Pre-Calc

Name: ______________________________

1. A population of polar bears in Canada can be modeled by the following equation: $y = 8000(.7)^x$ where y is the number of bears and x is the number of years that have elapsed. If the current equation remains consistent how long would it take for this population to become extinct?

$1 = 8000(.7)^x$

$\frac{1}{8000} = .7^x$

$\log \frac{1}{8000} = \log .7^x$

$\log \frac{1}{8000} = x \log .7$

$x = \frac{\log \frac{1}{8000}}{\log .7}$

$x \approx 25.2$ yr.

2. If zombies are attacking (!!) and the zombie population can be represented by the equation: $y = 2^x$ where y is the number of zombies and x is the number of days that have elapsed. How many days will it take for 1 million people to become zombies?

$1{,}000{,}000 = 2^x$

$\log 1{,}000{,}000 = x \log 2$

$x = \frac{\log 1{,}000{,}000}{\log 2}$

$x \approx 19.93$ yr.

3. Kristi is deciding between several bank accounts. Each has a different interest rate and also calculates the interest accumulation in a different manner. She is going to deposit 300 dollars and the formulas for each bank are as follows: (Assume that she does not add or withdraw any funds and time is measured in years.)

Bank A uses the formula $A = 300\left(1 + \frac{.08}{2}\right)^{2t}$

Bank B uses the formula $A = 300\left(1 + \frac{.075}{12}\right)^{12t}$

Bank C uses the formula $A = 300\left(1 + \frac{.074}{365}\right)^{365t}$

Bank D uses the formula $A = 300e^{.07t}$

I. How much money would each account have after 5 years?

A $A = 300\left(1 + \frac{.08}{2}\right)^{2(5)}$

$A = 300\left(1 + \frac{.08}{2}\right)^{10}$

$A = \$444.07$

D $A = 300e^{.07(5)}$

$A = \$425.72$

II. When she will have 600 dollars in each account?

A $600 = 300\left(1 + \frac{.08}{2}\right)^{2t}$

$2 = \left(1 + \frac{.08}{2}\right)^{2t}$

$\log 2 = \log\left(1 + \frac{.08}{2}\right)^{2t}$

$\frac{\log 2}{2\log\left(1 + \frac{.08}{2}\right)} = \frac{2t \cdot \log\left(1 + \frac{.08}{2}\right)}{2\log\left(1 + \frac{.08}{2}\right)}$

$t \approx 8.84$ yr.

D $600 = 300e^{.07t}$

$2 = e^{.07t}$

$\ln 2 = \ln e^{.07t}$

$\frac{\ln 2}{.07} = \frac{.07t \ln e}{.07}$ $\ln e = 1$

9.9 yr. $\approx t$

III. Which account would you recommend to Kristi? Why?

NAME ______________________ DATE ____________ PERIOD ____________

3-4 Word Problem Practice

Exponential and Logarithmic Equations

1. RADIOACTIVE DECAY The amount of radium A present in a sample after t years can be modeled by $A = A_0e^{-0.00043t}$, where A_0 is the initial amount. How long will it take 50 grams to decay to 10 grams?

$10 = 50e^{-0.00043t}$

3743 yr.

2. BIOLOGY Suppose a certain type of bacteria reproduces according to the model $P(t) = 100e^{0.271t}$, where t is time in hours and $P(t)$ is the number of bacteria.

a. Determine the growth rate.

27.1%

b. What was the initial number of bacteria?

100

c. Find the number of bacteria in 5, 10, 24, and 72 hours. Round to the nearest whole number.

3. RADIOACTIVITY The amount of radioactivity in a sample is given by the equation $\ln(N) - \ln(N_0) = -kt$, where N is the current level, N_0 is the original level, k is the decay rate, and t is the time elapsed in hours. If the decay rate is 0.070, how many grams would be left after 24 hours if the original amount was 1000 grams?

$\ln N - \ln 1000 = -.070(24)$

$\ln \frac{n}{1000} = -1.68$

$e^{-1.68} = \frac{n}{1000}$

$1000e^{-1.68} = n$

186.4 grams

4. INTEREST RATE The effective annual yield E for an account that is compounded n times per year at r percent is given by the formula $E = \left[1 + \frac{r}{n}\right]^n - 1$. Suppose an account pays 5%. Use a calculator to find how many compounding periods it would take for the effective yield to be 5.1%.

17,288,942 kw hr.

5. If your precalculus teacher offers to give you 1 second of homework for the first week of school and double the amount of homework each week until the end of the school year (i.e. 2 seconds the second week), should you say yes? Explain.