Name__________________

Logarithm Application Worksheet

1) Healing of Wounds 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 after n days, then the formula
$A = A_0e^{-0.35n}$
describes the area of a wound on the nth day following an injury when no infection is present to retard the healing. Suppose a wound initially had an area of 100 square centimeters.

(a) If healing is taking place, how large should the area of the wound be after 3 days?
(b) How large should it be after 10 days?
(c) How many days will it take before the wound is 11 square centimeters?

2) Response to TV Advertising The percent of ***R*** viewers who respond to a television commercial for a new product after ***t*** days is found by using the formula

$$R = 70 - 100e^{-0.2t}$$

(a) What percent is expected to respond after 10 days?

(b) How many days until 40% of the viewers have responded?

3) **Optics**: If a single pane of glass obliterates 10% of the light though it. If ***P*** is the percent of light that passes though and ***n*** is the number of successive panes of panes. Find the number of panes of glass needed to successfully block 50% of the light given the equation below.

$$P = 100e^{-.1n}$$

b) What percent of the light is blocked by 4 panes of glass?

4) If Tanisha has $100 to invest at 8% per annum compounded monthly, how long will it be before she has $150 if the money is compounded continuously?

b) What rate would Tanisha need to invest her money in order to make $200 in 7 years and her money is compounded continuously?

9) A) **Radioactive Decay** The half-life of radium is 1690 years. If 10 grams are present now, how much will be present in 50 years?

n = number of half-lives *t* = number of years

$$y = A\left(\frac{1}{2}\right)^{\frac{1}{n}(t)}$$

B) How many years until 2 grams are left?

11) Population of an Endangered Species Often environmentalists will capture an endangered species and transport the species to a controlled environment where the species can produce offspring and regenerate its population. Suppose 6 American Bald Eagles are captured and transported to Montana and set free. Based on experience, the environmentalists model

$$P(t) = \frac{500}{1 + 83.33e^{-0.162t}}$$

(a) What is the predicted population of the American Bald Eagle in 20 years?

(b) When will the population be 300?

10) Radioactivity from Chernobyl After the release of radioactive material into the atmosphere from a nuclear power plant at Chernobyl (Ukraine) in 1986, the hay in Austria was contaminated by iodine-131 (half-life 8 years.) If it is all right to feed the hay to cows when 10% of the iodine-131 remains, how long do the farmers need to wait to use this hay?

$$\% = \left(\frac{1}{2}\right)^{\left(\frac{1}{n}\right)t}$$

<u>Extra credit: Cooling Time of a Pizza</u>

A pizza baked at 450ºF is removed from the oven at 5 pm into a room that is a constant 70ºF. After 5 min the pizza is 300ºF.

a) Find k first.

b) Then at what time can you eat the pizza it you want the pizza to be 135ºF?

$$U(t) = T + (u_0 - T)e^{kt}$$

T=room temp

U_0= intitial temp pizza

t = time ; k = cooling constant

Solutions Manual: Use to check answers, not to copy solutions

1) a) $34.9938\ cm^2$

b) $3.01924\ cm^2$

c) $\frac{11}{100} = \frac{100e^{-.35n}}{100}$

$.11 = e^{-.35n}$

$\ln .11 = \ln e^{-.35n}$

$\frac{\ln .11}{-.35} = \frac{-.35n(\ln e)}{-.35}$

6.31 days $= n$

9) A) $y = A\left(\frac{1}{2}\right)^{\frac{1}{n}t}$

$y = 10\left(\frac{1}{2}\right)^{\frac{1}{1690}(50)}$

$= 10\left(\frac{1}{2}\right)^{\frac{5}{169}}$

$= 9.797$ grams

B) $\frac{2}{10} = \frac{10\left(\frac{1}{2}\right)^{\frac{1}{1690}t}}{10}$

$.2 = \left(\frac{1}{2}\right)^{\frac{1}{1690}t}$

$\frac{\log .2}{\log \frac{1}{2}} = \frac{\frac{1}{1690}t\left(\log \frac{1}{2}\right)}{\log \frac{1}{2}}$

$2.321 = \frac{1}{1690}t$

3924 yrs $= t$

2) A) $R = 70 - 100e^{-.2(10)}$

$= 70 - 100e^{-2}$

$= 70 - \frac{100}{e^2}$

$= 70 - 13.5335$

$= 56.4645\%$

B) $40 = 70 - 100e^{-.2t}$

$\frac{-30}{-100} = \frac{-100e^{-.2t}}{-100}$

$.3 = e^{-.2t}$

$\ln .3 = \ln e^{-.2t}$

$-1.2039 = -.2t$

$6.0199 = t$ days

11) c) $P(t) = \frac{500}{1 + 83.33e^{-.162(20)}}$

$= \frac{500}{4.2635}$

$= 117.2739$ eagles

d) $\frac{300}{1} = \frac{500}{1 + 83.33e^{-.162t}}$

$\frac{300(1 + 83.33e^{-.162t})}{300} = \frac{500}{300}$

$1 + 83.33e^{-.162t} = 1.6$

$\frac{83.33e^{-.162t}}{83.33} = \frac{.6}{83.33}$

$\ln e^{-.162t} = \ln .008$

$\frac{-.162t}{-.162} = \frac{-4.828}{-.162}$

29.8 yrs $= t$

3) a) $\frac{50}{100} = \frac{100e^{-.1n}}{100}$

$.5 = e^{-.1n}$

$\ln(.5) = \ln e^{-.1n}$

$-.6934 = -.1n$

6.9314 panes

3b) 67.0320%

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

$150 = 100\left(1 + \frac{.08}{12}\right)^{12t}$

$\frac{150}{100} = \frac{100(1.00\overline{6})^{12t}}{100}$

$1.5 = 1.00\overline{6}^{12t}$

$\frac{\log 1.5}{\log 1.006} = \frac{12t \log 1.006}{\log 1.006}$

$\frac{61.02}{12} = \frac{12t}{12}$

5.085 yrs $= t$

$A = Pe^{rt}$

$\frac{150}{100} = \frac{100e^{.08t}}{100}$

$1.5 = e^{.08t}$

$\ln 1.5 = \ln e^{.08t}$

$\frac{\ln 1.5}{.08} = \frac{.08t}{.08}$

$5.068 = t$ yrs

$A = Pe^{rt}$

$\frac{200}{100} = \frac{100e^{r(7)}}{100}$

$2 = e^{7r}$

$\ln 2 = 7r(\ln e)$

$\frac{\ln 2}{7} = \frac{7r}{7}$

$.0990 = r$

9.90%

10) $\% = \left(\frac{1}{2}\right)^{\frac{1}{n}(t)}$

$.10 = \frac{1}{2}^{\frac{1}{8}t}$

$\log .10 = \log .5^{\frac{1}{8}t}$

$\frac{\log .10}{\log .5} = \frac{\frac{1}{8}t(\log .5)}{\log .5}$

$3.321 = \frac{1}{8}t$

26.575 yrs $= t$

Extra Credit: (must have work to get credit)
17.58 min or 5:18pm