Exponential – Logarithmic Part 1 $\log_b(b)^{your \cdot name}$ = Key

Honors Algebra 2 **Date:** ________ **Period:** ________

Convert the logarithmic equation to exponential form. Rewrite the exponential equation in logarithmic form.

1.) $\log x = y$

$10^y = x$

2.) $m^k = n$

$\log_m(n) = k$

Expand the logarithm.

3.) $\ln \frac{5\sqrt{w}}{8x^y}$

$(\ln 5 \cdot \sqrt{w}) - (\ln 8 \cdot x^y)$

$\ln 5 + \frac{1}{2}\ln w - \ln 8 - y \cdot \ln x$

Condense the logarithm.

4.) $5\log_3 t - \log_3 n + 2\log_3 8$

$\log_3 t^5 - \log_3 n + \log_3 8^2$

$\log_3\left(\frac{64t^5}{n}\right)$ OR $\log_3\left(\frac{8^2 t^5}{n}\right)$

Solve each equation. Find exact answers, and then approximate to 4 decimal places if necessary.

5.) $49^{2x^2-2x} = \left(\frac{1}{7}\right)^{x^2+1}$

$(7^2)^{2x^2-2x} = (7^{-1})^{x^2+1}$

$2(2x^2-2x) = -1(x^2+1)$

$4x^2 - 4x = -x^2 - 1$

$+x^2 \quad +1 \quad +x^2 \quad +1$

$5x^2 - 4x + 1 = 0$

*Quadratic Formula

$a=5,\ b=-4,\ c=1$

$x = \frac{4 \pm \sqrt{(-4)^2 - 4(5)(1)}}{2(5)} = \frac{4 \pm \sqrt{-4}}{10}$

No solution

6.) $2\log_3 x - \log_3(x-2) = 2$

$\log_3 x^2 - \log_3(x-2) = 2$

$\log_3 \frac{x^2}{(x-2)} = 2$

$\frac{3^2}{1} = \frac{x^2}{(x-2)}$

$9(x-2) = x^2$

$9x - 18 = x^2$

$x^2 - 9x + 18 = 0$

$(x-6)(x-3) = 0$

$x = 6$ $x = 3$

*Neither is extraneous

7.) $\frac{2e^{4x-3}}{2} = \frac{8}{2}$

$e^{4x-3} = 4$

$\ln 4 = 4x - 3$

$1.39 = 4x - 3$

$+3 \quad +3$

$\frac{4.39}{4} = \frac{4x}{4}$

$x = 1.097$

8.) $\log_5(x-4) + \log_5(x+4) = \log_5(2x-1)$

$\log_5((x-4)(x+4)) = \log_5(2x-1)$

$(x-4)(x+4) = 2x-1$

$x^2 - 16 = 2x - 1$

$-2x \quad +1 \quad -2x \quad +1$

$x^2 - 2x - 15 = 0$

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

$x = 5$ ~~$x = -3$~~ extraneous

Continuous Population/Radioactive growth/decay:

$$N = N_o e^{kt}$$

N = Final number/amount

N_o = Initial number/amount

k = growth/decay constant

t = time

Continuously compounded interest:

$$A = Pe^{rt}$$

A = Final amount

P = Principle (initial) amount

r = interest rate

t = time

9.) A sample of your favorite element, Falinskium, decays from an initial mass of 500 grams to a mass of 320 grams in 50 days.

a) Find the value of the decay constant, k.

$\frac{320}{500} = \frac{500 \cdot e^{50 \cdot k}}{500}$

$.64 = e^{50k}$

$\ln(.64) = 50 \cdot k$

$\frac{-.446}{50} = \frac{50k}{50}$

$k = -.00893$

b) Calculate the half-life (time for half of a sample to decay) of Falinskium.

*start with any number for the initial & A is ½ of that value

$\frac{1}{2} = \frac{2 \cdot e^{-.00893t}}{2}$

$0.5 = e^{-.00893t}$

$\ln(0.5) = -.00893t$

$\frac{-.6931}{-.00893} = \frac{-.00893t}{-.00893}$

$t = 77.62$ years

10.) If you start a biology experiment with 50,000 cells and the decay rate of the cells dying every minute is -0.597837. The decay of the cells can be modeled by the equation: $A = 50,000e^{-0.597837t}$. How long will it take to have 1,000 cells remaining?

$\frac{1000}{50000} = \frac{50,000 \cdot e^{-0.597837t}}{50,000}$

$.02 = e^{-0.597837t}$

$\ln(.02) = -0.597837t$

$\frac{-3.912}{-0.597837} = \frac{-0.597837t}{-0.597837}$

$t = 6.54$ minutes

11.) Casper created a chart that shows that the population of killer bees will increase to 96,627 (A) bees from a current population of 11,211 (P) bees. The rate of increase is an annual increase of 4.18% (r). However, Casper forgot to include the number of years this increase will take; can you help him find out how many years this increase took? $A = P(1+r)^t$

$\frac{96,627}{11,211} = \frac{11,211(1+.0418)^t}{11,211}$

$8.619 = (1.0418)^t$

$\log_{1.0418}(8.619) = t$

$\frac{\log(8.619)}{\log(1.0418)} = t$

$t = 52.60$ years

Part 2

Expand each logarithm.

1) $\log_9 (uv^4)^3$

$3[\log_9(u \cdot v^4)]$

$3[\log_9 u + \log_9 v^4]$

$3[\log_9 u + 4 \cdot \log_9 v]$

2) $\log_2 \frac{x^6}{y^6}$ → $\log_2 x^6 - \log_2 y^6$

$6 \cdot \log_2 x - 6 \cdot \log_2 y$

3) $\log_9 \left(\frac{u}{v^6}\right)^3$

$3[\log_9 u - \log_9 v^6]$

$3 \cdot [\log_9 u - 6 \cdot \log_9 v]$

4) $\log_2 \left(\frac{u}{v^4}\right)^6$ $6[\log_2 v - \log_2 v^4]$

$6[\log_2 v - 4 \cdot \log_2 v]$

5) $\log (u^2 \cdot v)^2$

$2 \cdot [\log u^2 + \log v]$

$2[2 \cdot \log u + \log v]$

6) $\log_8 \frac{11^3}{10^3}$

$\log_8 11^3 - \log_8 10^3$

$3 \cdot \log_8 11 - 3 \cdot \log_8 10$

Condense each expression to a single logarithm.

7) $2\log_5 x + 2\log_5 y$

$\log_5 x^2 + \log_5 y^2$

$\log_5(x^2 y^2)$

8) $6\log_3 a - 2\log_3 b$

$\log_3 a^6 - \log_3 b^2$

$\log_3(a^6 b^2)$

9) $4\log_3 x - 16\log_3 y$

$\log_3 x^4 - \log_3 y^{16}$

$\log_3\left(\frac{x^4}{y^{16}}\right)$

10) $2\log u + 2\log v$

$\log u^2 + \log v^2$

$\log(u^2 v^2)$

11) $\ln x + \ln y + 4\ln z$

$\ln x + \ln y + \ln z^4$

$\ln(xyz^4)$

12) $\log_5 x + \log_5 y + 2\log_5 z$

$\log_5 x + \log_5 y + \log_5 z^2$

$\log_5(xyz^2)$