Name: _____ Date: _____

Learning Goal 8.1	Solving exponential and logarithmic equations with same base and with different bases, including base e.

Power Law	**Product Law**	**Quotient Law**	**Change of Base**
$\log_b x^n = n\log_b x$	$\log_b(xy)$ $= \log_b x + \log_b y$	$\log_b\left(\frac{x}{y}\right)$ $\log_b x - \log_b y$	$\log_b x = \frac{\log_a x}{\log_a b}$ $a \in \mathbb{N}$

Example Solve for x.

a. $2^x = 2^{x^2}$

$x = x^2$

$0 = x^2 - x$

$0 = x(x-1)$

$x = 0$ $\quad$ $x = 1$

Never divide by the variable!!

b. $64^{3x-1} = \left(\frac{1}{16}\right)^{2x+4}$

As powers of 2

$(2^6)^{3x-1} = (2^{-4})^{2x+4}$

$2^{18x-6} = 2^{-8x-16}$

$18x - 6 = -8x - 16$

$26x - 6 = -16$

$26x = -10$

$x = -\frac{10}{26} = -\frac{5}{13}$

As powers of 4

$(4^3)^{3x-1} = (4^{-2})^{2x+4}$

$4^{9x-3} = 4^{-4x-8}$

$9x - 3 = -4x - 8$

$13x - 3 = -8$

$13x = -5$

$x = -\frac{5}{13}$

Example Solve for x. Round your answers to the nearest hundredth.

a. $2^x = 5$

Power

$\log(2^x) = \log 5$

$\frac{x\log 2}{\log 2} = \frac{\log 5}{\log 2}$

$x = \frac{\log 5}{\log 2}$ CoB

$(= \log_2 5)$

b. $4^{2x-3} = 3^{x+2}$

$\log(4^{2x-3}) = \log(3^{x+2})$

$(2x-3)\log 4 = (x+2)\log 3$

$2x\log 4 - 3\log 4 = x\log 3 + 2\log 3$

$2x\log 4 - x\log 3 = 2\log 3 + 3\log 4$

$x(2\log 4 - \log 3) = 2\log 3 + 3\log 4$

$x(\log 4^2 - \log 3) = \log 3^2 + \log 4^3$

$x\left(\log\left(\frac{16}{3}\right)\right) = \log(3^2 \times 4^3)$

$\frac{\log(16/3)}{\log(16/3)}$ $\quad$ $\frac{\log(3^2\times 4^3)}{\log(16/3)}$

Full

$x = \frac{\log(3^2\times 4^3)}{\log(16/3)}$

Assignment p. 412 # 2, 7, 11, 13 – 17, 22, C3 Quiz Next Day!

credit $= \log_{\frac{16}{3}}(3^2 \times 4^3)$

Example Solve and check.

$3(2^{2x-1}) = 6^x$

$\log(3(2^{2x-1})) = \log(6^x)$

$\log 3 + \log 2^{2x-1} = \log(6^x)$

$\log 3 + (2x-1)\log 2 = x \log 6$

$\log 3 + 2x\log 2 - \log 2 = x\log 6$

$\log 3 - \log 2 = x\log 6 - 2x\log 2$

$\log 3 - \log 2 = x(\log 6 - 2\log 2)$

$\log\left(\frac{3}{2}\right) = x\left(\log\left(\frac{6}{4}\right)\right)$

$x = \frac{\log\left(\frac{3}{2}\right)}{\log\left(\frac{3}{2}\right)} = 1$

CHECK

$3(2^{2(1)-1}) = 6^1$

$3(2^{2-1}) = 6$

$3(2) = 6$

$6 = 6$

Example A car was purchased for \$15 000. The value of the car depreciates 15% of its previous value each year. To the nearest tenth of a year, how long will it take before it is worth only \$9 000?

$t_R = 1$ ⇒ t will be in years.

$A = A_0(r)^{t/t_R}$

$9000 = 15000(1-0.15)^t$ ~ 3.1 years.

$\frac{3}{5} = (0.85)^t$

$\log\left(\frac{3}{5}\right) = \log(0.85^t)$

$\log\left(\frac{3}{5}\right) = t\log(0.85)$

$t = \log\left(\frac{3}{5}\right) / \log(0.85) = 3.14$

Example A radioactive material has a half – life of 80 months. What percent of the sample is left after 48 months?

$r = \frac{1}{2}$ $t_R = 80$ t

$A = A_0(r)^{t/t_R}$

$\frac{A}{A_0} = \left(\frac{1}{2}\right)^{48/80}$

$\frac{A}{A_0} = 0.65975$

THE PERCENT REMAINING IS 66%