4.6 – Logarithmic and Exponential Equations

Name: _____ Date: _____ Per: _____

SWBAT: 1. Solve Logarithmic equations using properties of logs. 2. Solve exponential equations

Ex.1 – Solve $2\log_5 x = \log_5 9$

$\log_5 x^2 = \log_5 9$

$x^2 = 9$

$x = 3, -3$

Check

$2\log_5(3) = \log_5 9$

$\log_5 (3)^2 = \log_5 9$

$\log_5 9 = \log_5 9$ ✓

Ex.2 – Solve $\log_4(x+3) + \log_4(2-x) = 1$

$\log_4[(x+3)(2-x)] = 1$

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

$4 = -x^2 - x + 6$

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

$0 = -(x^2 + x - 2)$

$0 = -(x+2)(x-1)$

$x = -2$ or 1

Check

$\log_4(-2+3) + \log_4(2-(-2)) = 1$

$\log_4 1 + \log_4 4 = 1$

$0 + 1 = 1$ ✓

Check

$\log_4(1+3) + \log_4(2-1) = 1$

$\log_4 4 + \log_4 1 = 1$

$1 + 0 = 1$ ✓

Ex.3 – Solve $4^x - 2^x - 12 = 0$

$4^x = (2^2)^x = 2^{2x}$

rewrite

$(2^x)^2 - 2^x - 12 = 0$

$(2^x - 4)(2^x + 3) = 0$

$2^x = 4$ $\quad 2^x = -3$

$x = 2$ $\quad$ no solution

Check

$4^{(2)} - 2^{(2)} - 12 = 0$

$16 - 4 - 12 = 0$ ✓

Ex.4 : Solve $2^x = 5$

① Take ln of each side

$$\ln 2^x = \ln 5$$

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

$$x = \frac{\ln 5}{\ln 2} \rightarrow \text{exact solution}$$

$$x \approx 2.322 \rightarrow \text{approximate solution}$$

Ex.5 : Solve $8(3^x) = 5$

$$\frac{8 \cdot 3^x}{8} = \frac{5}{8}$$

$$3^x = \frac{5}{8}$$

$$\ln 3^x = \ln\left(\frac{5}{8}\right)$$

$$\frac{x \ln 3}{\ln 3} = \frac{\ln\left(\frac{5}{8}\right)}{\ln 3}$$

$$x = \frac{\ln\left(\frac{5}{8}\right)}{\ln 3} \rightarrow \text{exact sol.}$$

$$x \approx -0.428 \rightarrow \text{approximate sol.}$$

Ex.6 : Solve $5^{x-2} = 3^{3x+2}$

$$5^{x-2} = 3^{3x+2}$$

$$\ln 5^{x-2} = \ln 3^{3x+2}$$

$$(x-2)\ln 5 = (3x+2)\ln 3$$

$$x\ln 5 - 2\ln 5 = 3x \ln 3 + 2\ln 3$$

$$x\ln 5 - 3x \ln 3 = 2\ln 3 + 2\ln 5$$

$$\frac{x(\ln 5 - 3\ln 3)}{\ln 5 - 3\ln 3} = \frac{2(\ln 3 + \ln 5)}{\ln 5 - 3\ln 3}$$

$$x \approx -3.212$$

Ex.7 : Solve $x + e^x = 2$ using a graphing utility

① graph $y = x + e^x$ in y_1 AND $y = 2$ in y_2

② use the intersect function (2ND trace → intersect) AND write the x-coordinate of the intersection point → $x \approx 0.44$