



Learning Targets – 7.5 Exponential and Logarithmic Equations

- a.) I can solve exponential equations (common and uncommon bases).
- b.) I can solve logarithmic equations using exponent and logarithmic properties.

Scenario 3: Using Logarithmic Properties to Solve Logarithmic Equations

PROPERTIES OF LOGARITHMS		
Property	Definition	Example
Product	$\log_b mn = \log_b m + \log_b n$	$\log_3 9x = \log_3 9 + \log_3 x$
Quotient	$\log_b \frac{m}{n} = \log_b m - \log_b n$	$\log_{\frac{1}{4}} \frac{4}{5} = \log_{\frac{1}{4}} 4 - \log_{\frac{1}{4}} 5$
Power	$\log_b m^p = p \cdot \log_b m$	$\log_2 8^x = x \cdot \log_2 8$

Solve each equation. If necessary, round to 4 decimal places.

1.) $\log_4 x + \log_4 2 = 3$

$$\begin{aligned} \log_4 2x &= 3 \\ 4^3 &= 2x \\ 64 &= 2x \\ x &= 32 \end{aligned}$$

2.) $\log_2(x-3) - \log_2(2x-3) = \log_2 \frac{2}{x}$

$$\begin{aligned} \log_2 \frac{x-3}{2x-3} &= \log_2 \frac{2}{x} \\ \frac{x-3}{2x-3} &= \frac{2}{x} \\ x(x-3) &= 2(2x-3) \\ x^2 - 3x &= 4x - 6 \\ x^2 - 7x + 6 &= 0 \\ (x-6)(x-1) &= 0 \\ x=6 \quad x=1 & \\ \text{EXTRANEAL} & \end{aligned}$$

3.) $2 \log_3 x = 4$

$$\begin{aligned} \log_3 x^2 &= 4 \\ 3^4 &= x^2 \\ 81 &= x^2 \\ x &= \pm 9 \\ x &= 9 \end{aligned}$$

4.) $\log(x+5) + \log(x-4) = 1$

$$\begin{aligned} \log(x+5)(x-4) &= 1 \\ 10^1 &= (x+5)(x-4) \\ 10 &= x^2 + 9x - 20 \\ 0 &= x^2 + 9x - 30 \\ 0 &= (x+6)(x-5) \\ x &= -6 \quad x=5 \\ \text{EXTRANEAL} & \end{aligned}$$

$$5.) \log_2 4x + \log_2 2x = 5$$

$$\log_2 4x \cdot 2x = 5$$

$$2^5 = 8x^2$$

$$32 = 8x^2$$

$$4 = x^2$$

$$x = \pm 2$$

$$x = 2$$

$$6.) \log_4(2x+4) - \log_4(x-1) = \log_4(x)$$

$$\log_4 \frac{2x+4}{x-1} = \log_4 x$$

$$\frac{2x+4}{x-1} = \frac{x}{1}$$

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

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

$$x^2 - 3x - 4 = 0$$

$$(x-4)(x+1) = 0$$

$$x = 4 \quad x = -1$$

EXTRANEALOUS

$$8.) \ln 2 + \ln(x+3) = 4$$

$$\ln 2(x+3) = 4$$

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

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

$$x = \frac{e^4 - 6}{2}$$

$$7.) 2 \log_5(x-10) = 2$$

$$\log_5 (x-10)^2 = 2$$

$$5^2 = (x-10)^2$$

$$25 = x^2 - 20x + 100$$

$$0 = x^2 - 20x + 75$$

$$0 = (x-15)(x-5)$$

$$x = 15 \quad x = 5$$

EXTRANEALOUS

$$9.) \log_2(3x+4) - \log_2 3 = 5$$

$$\log_2 \frac{3x+4}{3} = 5$$

$$2^5 = \frac{3x+4}{3}$$

$$32 = \frac{3x+4}{3}$$

$$96 = 3x+4$$

$$92 = 3x$$

$$x = \frac{92}{3}$$

$$10.) \log(5x-15) + \log(x-2) = 2$$

$$\log(5x-15)(x-2) = 2$$

$$10^2 = (5x-15)(x-2)$$

$$100 = 5x^2 - 10x - 15x + 30$$

$$0 = 5x^2 - 25x - 70$$

$$0 = 5(x^2 - 5x - 14)$$

$$0 = 5(x-7)(x+2)$$

$$x = 7 \quad x = -2$$

EXTRANEALOUS