Name [redacted] Mr. Ward Date _____ Class _____

LESSON 7-5

Reteach

Exponential and Logarithmic Equations and Inequalities

An **exponential equation** contains an expression that has a variable as an exponent.

$5^x = 25$ is an exponential equation.

$x = 2$, since $5^{2} = 25$.

If $x = y$, then $\log x = \log y$ ($x > 0$ and $y > 0$).

Remember: You can take the logarithm of both sides of an exponential equation. Then use other properties of logarithms to solve.

Solve $6^{x+2} = 500$.

Step 1 Since the variable is in the exponent, take the log of both sides.

$6^{x+2} = 500$

$\log 6^{x+2} = \log 500$

Step 2 Use the Power Property of Logarithms: $\log a^p = p \log a$.

$\log 6^{x+2} = \log 500$

$(x + 2) \log 6 = \log 500$

"Bring down" the exponent to multiply.

Step 3 Isolate the variable. Divide both sides by log 6.

$(x + 2) \log 6 = \log 500$

$$x + 2 = \frac{\log 500}{\log 6}$$

Step 4 Solve for x. Subtract 2 from both sides.

$$x = \frac{\log 500}{\log 6} - 2$$

Step 5 Use a calculator to approximate x.

$x \approx 1.468$

Step 6 Use a calculator to check.

$6^{1.468+2} \approx 499.607$

Solve and check.

1. $4^{-x} = 32$

$\log 4^{-x} = \log 32$

$-x \log 4 = \log 32$

$-x = \frac{\log 32}{\log 4}$

$x = -2.5$

2. $3^{4x} = 90$

$\log 3^{4x} = \log 90$

$4x \log 3 = \log 90$

$4x = \frac{\log 90}{\log 3}$

$x = 1.02$

3. $5^{x-3} = 600$

$\log 5^{x-3} = \log 600$

$(x-3) \log 5 = \log 600$

$x - 3 = \frac{\log 600}{\log 5}$

$x = 6.97$

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Name Mr. Ward Date _____ Class _____

LESSON 7-5

Reteach

Exponential and Logarithmic Equations and Inequalities (continued)

A **logarithmic equation** contains a logarithmic expression that has a variable.

$\log_5 x = 2$ is a logarithmic equation.

$x = 25$, since $5^2 = 25$.

Combine and use properties of logarithms to solve logarithmic equations.

Solve: $\log 80x - \log 4 = 1$

Step 1 Use the Quotient Property of Logarithms.

$\log 80x - \log 4 = 1$

$\log \frac{80x}{4} = 1$

$\log x - \log y = \log \frac{x}{y}$

Step 2 Simplify.

$\log \frac{80x}{4} = 1$

$\log 20x = 1$

Step 3 Use the definition of the logarithm:
if $b^x = a$, then $\log_b a = x$.

$\log_{10} 20x = 1$

$10^1 = 20x$

Remember: Use 10 as the base when the base is not given.

Step 4 Solve for x. Divide both sides by 20.

$10 = 20x$

$\frac{1}{2} = x$

Solve and check.

4. $\log_3 x^4 = 8$

$4 \log_3 x = 8$

$\log_3 x = \frac{8}{4}$

$3^2 = x$

$x = 9$

5. $\log 4 + \log (x + 2) = 2$

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

$\log_{10} (4x + 8) = 2$

$4x + 8 = 10^2$

$4x + 8 = 100$

$x = 23$

6. $\log 75x - \log 3 = 1$

$\log \frac{75x}{3} = 1$

$\log_{10} 25x = 1$

$10^1 = 25x$

$x = 10/25$

$x = 2/5$

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Mr. Ward Answer Key

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2. $4^{2x} = 32^{1/2}$

$\log 4^{2x} = \log 32^{1/2}$

$\frac{2x \log 4}{\log 4} = \frac{\frac{1}{2} \log 32}{\log 4}$

$2x = \frac{1}{2}\left(\frac{\log 32}{\log 4}\right) \times 2$

$4x = \frac{\log 32}{\log 4}$

$4x \approx 2.5$

$x = 0.625$

3. $9^{x} = 3^{x-2}$

$\log 9^{x} = \log 3^{x-2}$

$x \frac{\log 9}{\log 3} = \frac{(x-2) \log 3}{\log 3}$

$x\left(\frac{\log 9}{\log 3}\right) = x - 2$

$x(2) = x - 2$

$2x = x - 2$

$-x \quad -x$

$x = -2$

4. $2^{x} = 4^{x+1}$

$\log 2^{x} = \log 4^{x+1}$

$x \frac{\log 2}{\log 4} = \frac{(x+1) \log 4}{\log 4}$

$x\left(\frac{\log 2}{\log 4}\right) = x + 1$

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

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

$-x \quad -x$

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

$x = -2$

5. $4^{x} = 10$

$\log 4^{x} = \log 10$

$x \frac{\log 4}{\log 4} = \frac{\log 10}{\log 4}$

$x = 1.66$

6. $\left(\frac{1}{4}\right)^{2x} = \left(\frac{1}{2}\right)^{x}$

$\log\left(\frac{1}{4}\right)^{2x} = \log\left(\frac{1}{2}\right)^{x}$

$2x \frac{\log\left(\frac{1}{4}\right)}{\log\left(\frac{1}{4}\right)} = x \frac{\log\left(\frac{1}{2}\right)}{\log\left(\frac{1}{4}\right)}$

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

$2x = \frac{1}{2}x$

Can only work if

$x = 0$

7. $2.4^{3x+1} = 9$

$\log 2.4^{3x+1} = \log 9$

$(3x+1) \frac{\log 2.4}{\log 2.4} = \frac{\log 9}{\log 2.4}$

$3x + 1 \approx 2.5098$

$3x = 1.5098$

$x = 0.503$

8. $P = 3400(1 + 0.03)^{t}$

- Make a table and start plugging in values for t.
- Keep trying numbers until you get a P value of 10,000+

Answer = 37 years

9. $\log_2(7x+1) = \log_2(2-x)$

$7x + 1 = 2 - x$

$+x \quad +x$

$8x + 1 = 2$

$8x = 1$

$x = 1/8$

10. $\log_6(2x+3) = 3$

$6^{3} = 2x + 3$

$216 = 2x + 3$

$213 = 2x$

$106.5 = x$

11. $\log 72 - \log\left(\frac{2x}{3}\right) = 0$

$+\log\left(\frac{2x}{3}\right) \quad +\log\left(\frac{2x}{3}\right)$

$\log 72 = \log \frac{2x}{3}$

$3 \times 72 = \left(\frac{2x}{3}\right) \times 3$

$216 = 2x$

$108 = x$

12. $\log_3 x^9 = 12$

$\frac{9 \log_3 x}{9} = \frac{12}{9}$

$\log_3 x = 4/3$

$3^{(4/3)} = x$

$4.33 \approx x$

13. $\log_7 (3-4x) = \log_7 \left(\frac{x}{3}\right)$

$\times 3 \quad (3-4x) = \left(\frac{x}{3}\right) \times 3$

$9 - 12x = x$

$\frac{9}{13} = \frac{13x}{13}$

$9/13 = x$

14. $\log 50 + \log\left(\frac{x}{2}\right) = 2$

Product Property

$\log\left(50 \cdot \frac{x}{2}\right) = 2$

$10^2 = \frac{50x}{2}$

$\times 2 \quad (100) = \left(\frac{50x}{2}\right) \times 2$

$200 = 50x$

$4 = x$

15. $\log x + \log(x+48) = 2$

Product Property

$\log x(x+48) = 2$

$10^2 = x(x+48)$

$100 = x^2 + 48x$

Quadratic so set = to 0

$0 = x^2 + 48x - 100$

$0 = (x+50)(x-2)$

$x + 50 = 0 \qquad x - 2 = 0$

$-50 \quad -50 \qquad +2 \quad +2$

$x = -50 \qquad x = 2$