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Math 48B, Lesson 17: Exponential and Logarithmic Equations

In Math 48B Lessons 14, 15, 16, 17, and 18, we study logarithmic functions:

Logarithmic Form	Exponential Form
$y = \log_b(x)$	$x = b^y$

To begin our exploration, let's recall the rules of powers/exponents.

1. WHAT ARE RULES OF POWERS/EXPONENTS?

Exponent Notation: $N = b^n$

Product Rule: $b^n \cdot b^m$

Quotient Rule: $\frac{b^n}{b^m}$

Power to a Power: $(b^n)^p$

Zero Power: $1 = \frac{b}{b} = \frac{b^1}{b^1}$

Negative Powers: $\frac{1}{b^n}$

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2. WHAT ARE RULES OF LOGARITHMS?

Logarithmic Notation: $n = \log_b(N)$ and $m = \log_b(M)$

Product Rule: $\log_b(M \cdot N)$

Quotient Rule: $\log_b\left(\frac{M}{N}\right)$

Power to a Power: $\log_b(N^p)$

Inverse Exponential: $\log_b(b^n)$

Inverse Log: $b^{\log_b(N)}$

Change of Base: $\log_b(N)$

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3. HOW TO USE LOG RULES?

Use the properties of logs we explored in problem 2 above to evaluate the logarithm in each problem:

3A. $\log_8 32 + \log_8 2$

3B. $\log_{81}(\sqrt[7]{3})$

3C. $\log_a(a^9)$

3D. $(5)^{\log_5(125)}$

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4. HOW TO SOLVE EXPONENTIAL EQUATIONS?

Solve the algebraic exponential equation: $4^{3x} = 16$

4A. Use the inverse operation known as "equating exponent" to solve algebraically
4B. Use the inverse operation known as logarithms to solve algebraically
4C. Use a graphical technique to solve this algebraic equation

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5. HOW TO SOLVE EXPONENTIAL EQUATIONS?

Solve each of the algebraic equations below.

5A. $8^{x+3} = 64$

5B. $2^{x-4} = \sqrt[3]{2}$

5C. $\log_2(8 - 6x) = 5$

5D $\log(x) + \log(x - 3) = 1$

5E. $2^{x+3} = 3^x$

5F. $4\ln(2x) = 8$

5F. $\ln(x^2) = \ln(3x + 4)$