Lesson 3.03 Solving Exponential Equations Using Logarithms

Students will be able to:

- Content Objective: Solve exponential equations using logarithms.
- Language Objective: Explain how converting from exponential to logarithmic form allows us to solve exponential equations.

Warm Up

Evaluate $\log_2 -32$, what do you notice? Why can't you take the logarithm of a negative number?

Vocabulary Review

Exponential Form:	Logarithmic Form:
$y = 5^x$	_____ Switch x & y to get the inverse of $y = 5^x$: _____

Graphic Organizer

Rules of Logarithms		
Rule 1:	**Product Rule**	$\log_b(MN) = \log_b M + \log_b N$
Rule 2:	**Quotient Rule**	$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$
Rule 3:	**Power Rule**	$\log_b(M)^N = N \cdot \log_b M$

You will use these three laws of logarithms throughout your study of mathematics however, in this course, we will focus on how we can use the third logarithm rule to solve exponential equations.

Skill 1: Solving Exponential Equations Using Logarithmic Form

Solve the exponential equation below for the given variable by converting exponential form to logarithmic form. Round to the nearest hundredth.

a. $4^x = 100$

b. $6^{x+3} = 50$

Exercise 1: Solving Exponential Equations Using Logarithmic Form

Solve the exponential equation below for the given variable by converting exponential form to logarithmic form. Round to the nearest hundredth.

a. $7^x = 4{,}500$

b. $4^{x+2} = 625$

Skill 2: Solving Exponential Equations Using Method of Common Bases

Solving exponential equations using method of common bases only works when you can write two exponential expressions using the same base. Let's see how we can use this method on the examples below to solve for x.

a. $64^{3x} = 16$

b. $36^{x-3} = 216$

Exercise 2: Solving Exponential Equations Using Method of Common Bases

Solve the exponential equations below using the method of common base.

a. $32^{2x} = 16^{x-1}$

b. $125^{2x-4} = 25$

When solving an exponential equation using logarithms:

- Isolate the base.
- Take the log of both sides by applying the third log law.
- Solve for the variable.

Skill 3: Solving Exponential Equations Using 3rd Log Rule

Solve the equations below for x. Round your answer to the *nearest hundredth*.

a. $(1.45)^{\frac{x}{2}} = 18$

b. $3^{5x} + 2 = 817$

Exercise 3: Solving Exponential Equations Using 3rd Log Rule

Solve the equations below for x. Round your answer to the *nearest hundredth*.

a. $4^{x+2} = 625$

b. $17^{x-10} + 10 = 36$

Check Point

Solve each of the exponential equations below. Round your answers to the nearest hundredth.

3 Ways to Solve Exponential Equations		
Converting to Logarithmic Form	**Method of Common Bases**	**3rd Log Rule**
$5^x = 18$	$(36)^{x-12} = 216$	$10^{5x} = 5900$

3.03- Problem Set

Name: _____

Part I- Solve the following exponential equations for the value of x. Round to the *nearest hundredth*.

1. $2^x = 1560$

2. $6^x = 99$

3. $4^{x+8} - 4 = 20$

4. $-3(6)^{8x} = -67$

5. $-10(2)^{x+2} = -86$

6. $4(16)^{9x-5} + 10 = 26$

7. The population of bunnies in a field is first recorded at 600 and is growing at a rate of 4% per year.
   a. Write an equation for the number of bunnies, $B(t)$, as a function of the number of years, t, since they were first recorded.

   b. Using your equation, *algebraically* determine the number of years it will take for the population of bunnies to reach about 1,039. Round to the nearest year.