Algebra 2 7.4

Solve logarithmic equations

Solve logarithmic inequalities

domain

x>0

extraneous (solution) DQ

argument

Richter Scale

$8^x = 128^3$

$(2^3)^x = (2^7)^3$

$\frac{3x}{3} = \frac{21}{3}$

$x = 7$

Charles Richter, c. 1970

$$M_{\mathrm{L}} = \log_{10} A - \log_{10} A_0(\delta) = \log_{10}[A/A_0(\delta)],$$

A, Ao, = distance from seismograph, etc.

must be +

Example 1 Solve a Logarithmic Equation

Solve $\log_{36} x = \frac{3}{2}$.

$36^{\frac{3}{2}} = x$

$216 = x$

arguments must be +

$18^{\frac{4}{7}} = 5.21$

(36)( )( )( )( )

Exponential form
domain x>0 Why???
always verify solutions

Solve each equation.

1A. $\log_9 x = \frac{3}{2}$

$9^{\frac{3}{2}} = x$

$27 = x$

1B. $\log_{16} x = \frac{5}{2}$

KeyConcept Property of Equality for Logarithmic Functions

Symbols	If b is a positive number other than 1, then $\log_b x = \log_b y$ if and only if $x = y$.
Example	If $\log_5 x = \log_5 8$, then $x = 8$. If $x = 8$, then $\log_5 x = \log_5 8$.

If bases are the same
and exponents (logs) are equal
then numbers (antilogs) are the same.

(*Remember: Log is code for exponent*)

Are bases equal?
Are the numbers equal?
Then the exponents are equal!

Standardized Test Example 2 Solve a Logarithmic Equation

Solve $\log_2 (x^2 - 4) = \log_2 3x$.

A -2 B -1 C 2 D 4

$x^2 - 4 = 3x$

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

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

$x - 4 = 0$, $+4 \; +4$, $x = 4$

$x + 1 = 0$, $-1 \; -1$, $x = -1$

Might be extraneous solutions: argument must be positive (Why?)

GuidedPractice

2. Solve $\log_3 (x^2 - 15) = \log_3 2x$.

F -3 **G** -1 **H** 5 **J** 15

$x^2 - 15 = 2x$

$x^2 - 2x - 15 = 0$

$(x - 5)(x + 3) = 0$

$x - 5 = 0$ $\quad x + 3 = 0$

$x = 5$ $\quad x = -3$

$b > 1$

Example 3 Solve a Logarithmic Inequality

Solve $\log_3 x \geq 4$.

$\log_3 x = 4$

$3^4 = x$

$81 = x$

$x > 3^4$

$x > 81$

My number...their number

~~X~~ Argument must be positive.

Is my number (x) bigger or smaller than 3^4?

How can I tell?

Is my number bigger or smaller than 4^3?

GuidedPractice

Solve each inequality.

3A. $\log_4 x \geq 3$

$4^3 = 64$

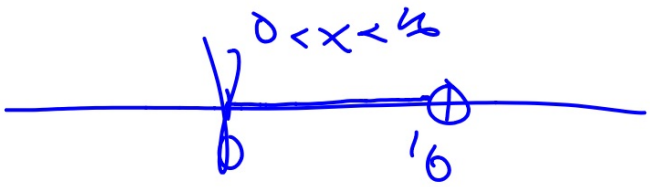
$x \geq 64$

3B. $\log_2 x < 4$

2^4

$x < 16$

Is my number bigger or smaller than 2^4?
Reminder: argument must be positive



Do they have the same base?

Example 4 Solve Inequalities with Logarithms on Each Side

Solve $\log_4 (x + 3) > \log_4 (2x + 1)$.

$2x+1>0$

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

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

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

$x+3 > 2x+1$

$-2x-3 \quad -2x-3$

$-x > -2$

$x < 2$

$x+3 > 0$

$-3 \quad -3$

$x > -3$

GuidedPractice

4. Solve $\log_5(2x + 1) \leq \log_5(x + 4)$. Check your solution.

$2x+1 \leq x+4$

$-x \quad -1 \qquad -x \quad -1$

$x \leq 3$

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

$2x+1 > 0$

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

$x+4 > 0$

$x > -4$

$-\frac{1}{2} < x \leq 3$