


Lesson 39

Introduction to Logarithms

NAME:

 Start by navigating to the Online Lesson for instructions.

Objectives

- ✓ Write an exponential expression or equation in logarithmic form.
- ✓ Write a logarithmic expression or equation in exponential form.
- ✓ Evaluate a logarithmic expression.

Why?

Logarithms and exponents are inverses of one another. Knowing how to write expressions in either form allows you to solve more complex problems in Algebra 2.

Warm Up

Simplify. Do not use a calculator.


1) $81^{\frac{3}{4}}$

2) $32^{-\frac{2}{5}}$

 To continue, return to the Online Lesson.

Explore

Convert between Exponential and Logarithmic Equations

 Fill in the notes as you watch the video in the Online Lesson.

- Exponential equations and logarithmic equations are _____ of one another.
- To define exponential and logarithmic equations: $\log_b y = x$ $b^x = y$
 - b is called the _____ and $b > 0, b \neq 1$.
 - x is called the _____ or exponent.
 - y is called the _____ or the answer and $y > 0$.

- _____ an exponential equation to a logarithmic equation, and vice versa, allows you to work with both exponential and logarithmic equations.
- When working with logs, think: _____ multiplied by itself _____ times results in _____ .
- In words, “base b raised to the x power _____ y ” and “log base b of y _____ x ”

Convert equation from exponential to logarithmic	Convert equation from logarithmic to exponential
$b^x = y$ $\log_b y = x$	$\log_b y = x$ $b^x = y$

Example 1

▶ Complete the example as you watch the video in the Online Lesson.

Convert each equation to the equivalent logarithmic form.

A) $64^{\frac{1}{3}} = 4$

B) $2^5 = 32$

Example 2

▶ Complete the example as you watch the video in the Online Lesson.

Convert each equation to the equivalent exponential form.

A) $\log_8 32 = \frac{5}{3}$

B) $\log_3 81 = 4$

Checkpoint: Convert between Exponential and Logarithmic Equations

Convert the equation to its inverse (exponential to logarithmic or logarithmic to exponential).

A) $4^3 = 64$

B) $\log_{64} 32 = \frac{5}{6}$



To continue, return to the Online Lesson.

📺 Evaluating Logarithmic Expressions

▶ Fill in the notes as you watch the video in the Online Lesson.

- Foundational properties of logs when _____:
 - If $a^0 = 1$, then $\log_a 1 = 0$
 - If $a^n = a^n$, then $\log_a (a^n) = n$
- Foundational log properties and _____ rules are used to evaluate logs without using technology.
- A common _____ must exist to find the value of the variable.

To evaluate logarithms (by hand):

- 1) Set the expression equal to a _____. (In this lesson, use x .)
- 2) _____ the logarithmic equation to an exponential equation.
- 3) Write both sides of the equation with the _____.
- 4) _____.

Note: When no base is given, the base, b , is 10.

Example 3

▶ Complete the example as you watch the video in the Online Lesson.

Evaluate.

A) $\log_{16} 2$

B) $\log_2\left(\frac{1}{16}\right)$

Example 4

▶ Complete the example as you watch the video in the Online Lesson.

Evaluate.

A) $\log_{0.25} 64$

B) $\log_3(\sqrt[5]{3})$

Most logs are irrational numbers, and therefore, technology is used to estimate the value of a logarithm.

As with evaluating logarithms by hand, when no base is given, the base, b , is 10, which is the default base for calculators.

Example 5

 Complete the example as you watch the video in the Online Lesson.

Evaluate with a calculator to the ten thousandths (four decimal places).

A) $\log 8$

B) $\log 225$

Checkpoint: Evaluating Logarithmic Expressions

Evaluate.

$$\log_8 \frac{1}{2}$$

The More to Explore for this lesson provides helpful tips and guidance in using technology for these types of problems.

You may benefit from completing the More to Explore before continuing.



To continue, return to the Online Lesson.

 **Practice 1**

Complete problems on a separate sheet of paper.

Convert each equation to the equivalent logarithmic form.

1) $27^{\frac{2}{3}} = 9$

2) $49^{-\frac{1}{2}} = \frac{1}{7}$

3) $15^2 = 225$

4) $9^0 = 1$

Convert each equation to the equivalent exponential form.

5) $\log_{16} 2 = \frac{1}{4}$

6) $\log_3 3 = 1$

7) $\log_5 \sqrt[3]{5} = \frac{1}{3}$

8) $\log_4 64 = 3$

Evaluate.

9) $\log_4 8$

10) $\log_{27} 81$

11) $\log_5 625$

12) $\log_{\frac{1}{5}} 25$

13) $\log_{49} \frac{1}{343}$

14) $\log_4 \frac{1}{32}$

15) $\log_9 27$

16) $\log_2 64$

Evaluate with a calculator to the ten thousandths (four decimal places).

17) $\log 100$

18) $\log 295$

19) $\log 16$

20) $\log 84$



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 **Mastery Check** **Show What You Know**

A) Evaluate the logarithmic expressions.

$$\log_{125} 5$$

$$\log_{125} \frac{1}{5}$$

$$\log_5 125$$

$$\log_5 \frac{1}{125}$$

B) Draw a line matching the exponential expression to its correct logarithmic expression.

$$5^3$$

$$\log_{125} 5$$

$$5^{-3}$$

$$\log_{125} \frac{1}{5}$$

$$125^{-\frac{1}{3}}$$

$$\log_5 125$$

$$125^{\frac{1}{3}}$$

$$\log_5 \frac{1}{125}$$

 **Say What You Know**

In your own words, talk about what you have learned using the objectives for this lesson and your work on this page.



To continue, return to the Online Lesson.

 **Practice 2**

Complete problems on a separate sheet of paper.

Convert the equation to its inverse (exponential to logarithmic or logarithmic to exponential).

1) $5^{-2} = \frac{1}{25}$

2) $64^{\frac{2}{3}} = 16$

3) $49^{-\frac{3}{2}} = \frac{1}{343}$

4) $6^{-2} = \frac{1}{36}$

5) $\log_{23} 1 = 0$

6) $\log_{17} \sqrt{17} = \frac{1}{2}$

7) $\log_{196} 14 = \frac{1}{2}$

8) $\log_{20} \frac{1}{400} = -2$

Evaluate.

9) $\log_{11} \sqrt[4]{11}$

10) $\log_6 216$

11) $\log_{225} 15$

12) $\log_{12} \frac{1}{144}$

13) $\log_{25} 125$

14) $\log_{32} 64$

15) $\log_{81} 243$

16) $\log_{0.25} 4$

Evaluate with a calculator to the ten thousandths (four decimal places).

17) $\log 7$

18) $\log 1$

19) $\log (0.001)$

20) $\log 1225$



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Targeted Review*Complete items on a separate sheet of paper.***Simplify.**

1) $\sqrt{-12} + \sqrt{-75}$

2) $\sqrt{40} - \frac{2}{5\sqrt{6}}$

Rewrite the expression so all terms are in the numerator. Assume all bases are positive.

3) $\frac{x^5y^4z^{-9}}{x^{-6}y^{13}z^{-2}}$

4) $\left(\frac{3x^3y}{x^2y^5}\right)^{-2}$

5) Describe the transformation from $f(x)$ to $g(x)$.

$$f(x) = (3)^x, g(x) = -5(3)^{x+8} - 2$$

6) Sketch the graph using technology: $g(x) = \frac{1}{2}(4)^{x+1} - 3$ **Solve.**

7) $36\left(\frac{1}{2}\right)^x = 216(2^{x+5})$

8) $\left(\frac{1}{4}\right)^x < \left(\frac{1}{8}\right)^{x-2}$

Multiple Choice____ 9) Name the value of b , and if it represents growth or decay for the exponential equation:
 $y = 6(3)^{-x}$

A) 6, growth

B) 3, growth

C) $\frac{1}{3}$, decayD) $\frac{1}{6}$, decay

Multiple Choice

_____ 10) Find $[g \circ f](x)$ when $f(x) = 3x^2 - 2$ and $g(x) = -x + 6$.

A) $-3x^2 + 8$

B) $3x^2 - x + 4$

C) $3x^2 - 36x + 106$

D) $-3x^2 + 4$

_____ 11) Name the domain and range for the inverse of the function: $g(x) = \frac{3}{x} + 2$

A) domain: $\{x | x \in \mathbb{R}\}$

B) domain: $\{x | x \in \mathbb{R}, x \neq 0\}$

range: $\{y | y \in \mathbb{R}\}$

range: $\{y | y \in \mathbb{R}, y \neq 2\}$

C) domain: $\{x | x \in \mathbb{R}, x \neq 2\}$

D) domain: $\{x | x \in \mathbb{R}, x \neq 2\}$

range: $\{y | y \in \mathbb{R}, y \neq 0\}$

range: $\{y | y \in \mathbb{R}\}$

_____ 12) Write an exponential equation that passes through the points $(3, 128)$ and $(-1, \frac{1}{32})$.

A) $y = 2^x$

B) $y = \frac{1}{2^{11}}(64)^x$

C) $y = 8\left(\frac{1}{4}\right)^x$

D) $y = \frac{1}{4}(8)^x$

Problem	1	2	3	4	5	6	7	8	9	10	11	12
Origin	11	12	–	–	37	37	38	38	37	32	19	38

L = Lesson in this level, A1 = Algebra 1: Principles of Secondary Mathematics, FD = Foundational Knowledge



To continue, return to the Online Lesson.