Solve the following for the unknown variable.

1.) $(1/9)^x = \sqrt{3}$

2.) $2^a = \sqrt{32}$

3.) $b^{(-1/2)} = 4$

4.) $n^{-2} = 9$

Vocabulary

Logarithm - in the function $x = b^y$, y is called the logarithm, base b of x. This is usually written as $y = \log_b x$.

Common Logarithm - a logarithm whose base is 10, written as log x. ($\log x = \log_{10} x$)

Natural Logarithm - logarithm whose base is e, $y = e^x$ and is written as ln x. $(\ln x = \log_e x)$

Logarithmic Functions

EQ: What are logarithms? How are they used?

Standards:

MCC9-12.F.BF.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents

MCC9-12.A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. *(Limit to exponential and logarithmic functions.)*

MCC9-12.A.SSE.3c Use the properties of exponents to transform expressions for exponential functions.

MCC9-12.F.IF8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. *(Limit to exponential and logarithmic functions.)*

MCC9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. *(Limit to exponential and logarithmic functions.)*

What am I learning today?

How to manipulate and evaluate logarithms

How will I show that I learned it?

Simplify, evaluate, and rewrite exponential and logarithmic expressions

What is the difference between simplify and evaluate?

Simplify: make it "*pretty* "

ex. $\sqrt{24} = 2\sqrt{6}$

Evaluate: number answer

ex. $\sqrt{24} = 4.898979486... \approx 4.90$

When simplifying "e" exponents, use the same rules as other bases!

Examples

1) $e^3 \cdot e^7$
e^{10}

2) $e^{-2x} \cdot e^5$
e^{-2x+5}

3) $6e^{5x} \cdot 4e^{3x}$
$24e^{8x}$

4) $(7e^3)^2$
$49e^6$

5) $\frac{5e^2}{20e^5} = \frac{1}{4e^3}$

$\frac{1}{4}e^{-3}$

6) $\frac{e^{4x}}{e^x} = e^{3x}$

7) $\sqrt{121e^6}$

$11e^3$

8) $\sqrt[3]{343e^{24x}}$

$(7^3e^{24x})^{1/3}$

$7e^{8x}$

Evaluate

1) $e^2 \approx 7.39$

2) $e^{-3/4} \approx 0.47$

3) $e^{4.3} = 73.70$

4) $e^{-0.12} \approx 0.89$

Logarithmic Functions

Logarithm of y with base b

$$\log_b y = x \quad \text{iff} \quad b^x = y$$

$b \Rightarrow$ base

$y \Rightarrow$ answer

$x \Rightarrow$ exponent

Logs are defined for positive answers only! ($y > 0$)

Logs have only positive bases also. ($b > 0$)

Exponents (x) can be ANYTHING!!!

Natural logs are logs in base e and abbreviated Ln

ln is the same as $\log_e$

...in other words $\ln x = \log_e x$

Common logs are logs in base 10 and abbreviated log or $\log_{10}$

Rewriting Logs and Exponential Equations

** To work with certain log functions and exponent function we need to be able the convert from one form from the next.

"ROLL LIKE A LOG!"

Rewrite from Log notation to Exponential notation

1. $\log_3 243 = 5$

$243 = 3^5$

2. $\log_8 2 = \frac{1}{3}$

$2 = 8^{1/3}$

3. $\log_4 4 = 1$

$4 = 4^1$

4. $\ln_e 16 = 2.77$

$16 = e^{2.77}$

Rewrite from Exponential to Log notation

1. $4^3 = 64$

$3 = \log_4 64$

2. $5^0 = 1$

$0 = \log_5 1$

3. $(½)^{-1} = 2$

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

4. $e^3 = 20.09$

$3 = \ln(20.09)$

Evaluate WITH a calculator.

1. $\log 23 = 1.36$

   $10^{1.36} \approx 23$

2. $\ln 2 \quad 0.69$

   $e^{0.69} \approx 2$

3. $\log 1.25 = 0.10$

   $10^{0.1} \approx 1.25$

4. $\ln 100 = 4.61$

   $e^{4.61} \approx 100$

5. $\log(\sqrt{5}+2) = 0.63$

6. $5.6\ln\sqrt{431} = 16.99$

Properties

Goal is to get both sides of the equation to have the same base so that the exponents can be set equal to each other.

If $a^x = a^y$, then $x = y$

**from Coordinate Alg

$3^x = 3^2$

convert to a logarithm to see other rule: $a^x = a^y$

If $\log_a x = \log_a y$, then $x = y$

convert to an exponent to see other rule: $\log_a x = \log_a y$

Evaluate WITHOUT a calculator

STEPS...

1. Set the expression to "x" if not already done for you.
2. Rewrite log function as an exponential equation.
3. Rewrite so that both sides have a common (smallest) base.
4. Solve for x.

Evaluate WITHOUT a calculator.

1. $\log_3 81 = 4$

$$\log_3 81 = x$$
$$81 = 3^x$$
$$3^4 = 3^x$$
$$4 = x$$

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

$$\log_9 3 = x$$
$$3 = 9^x$$
$$3^1 = 3^{2x}$$
$$1 = 2x$$
$$x = \frac{1}{2}$$

3. $\log_{16} 2 = \frac{1}{4}$

$$\log_{16} 2 = x$$
$$2 = 16^x$$
$$2^1 = 2^{4x}$$
$$1 = 4x$$
$$x = \frac{1}{4}$$

4. $\log_5 \sqrt{5} = \frac{1}{2}$

$$\log_5 \sqrt{5} = x$$
$$\sqrt{5} = 5^x$$
$$5^{1/2} = 5^x$$
$$\frac{1}{2} = x$$

5. $\log_{\sqrt{3}} 27 = 6$

$\log_{\sqrt{3}} 27 = x$

$27 = \sqrt{3}^{x}$

$3^3 = 3^{\frac{1}{2}x}$

$3 = \frac{1}{2}x$

$6 = x$

6. $\log_8 4 = \frac{2}{3}$

$\log_8 4 = x$

$4 = 8^x$

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

$2 = 3x$

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

7. $\log_{16} \frac{1}{4} = -\frac{1}{2}$

$\log_{16} \frac{1}{4} = x$

$\frac{1}{4} = 16^x$

$4^{-1} = 4^{2x}$

$-1 = 2x$

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

8. $\log 0.001 = -3$

$\log_{10}\left(\frac{1}{1000}\right) = x$

$\frac{1}{1000} = 10^x$

$10^{-3} = 10^x$

$x = -3$

Attachments

Brody_Roll Like a Log.xspf

Brody_Roll Like a Log 2.xspf