Learning Goal: I will be able to evaluate logarithms and simplify logarithmic expressions ar write a power with different bases.

Minds On: Changing bases to solve!

Action: Examples

Consolidation: page 466 Practice + Exit Card

Minds On

Evaluating Logarithms

We should realize by now that a logarithm is an *exponent* and that the logarithm is the answer to the question: ***To what power must the base be raised to produce a specific value?***

Evaluate simple logarithmic expressions using the relationship between powers and logarithms. One strategy is to replace the value with its equivalent power.

Value = Base $^{\text{Exponent}}$ Exponent = $\log_{\text{Base}}$ Value

Or by substitution,

Exponent = $\log_{\text{Base}}$ (Base $^{\text{Exponent}}$)

$y = a^x \longleftrightarrow x = \log_a y$

Minds On

Minds On:

1. Evaluate each logarithm.

a) $\log_2 4$ $= 2$

b) $\log_3 27 = 3$ $3^y = 27$ $3^y = 3^3$

c) $\log_2 32 = 5$ $2^y = 32$ $2^y = 2^5$

d) $\log_7 49 = 2$

e) $\log_5 (1/5) = -1$ $5^y = \frac{1}{5}$ $5^y = 5^{-1}$

f) $\log_6 1 = 0$ $6^y = 1$ $6^y = 6^0$

2. Write each logarithm in exponential form.

a) $\log_2 8 = 3$ $2^3 = 8$

b) $\log_6 36 = 2$ $6^2 = 36$

c) $\log_{16} 4 = ½$ $16^{\frac{1}{2}} = 4$ $\sqrt{16} = 4$

d) $\log_5 625 = 4$ $5^4 = 625$

e) $\log_3 3 = 1$ $3^1 = 3$

f) $\log_{10} 1 = 0$ $10^0 = 1$

Minds On

3. Write each exponential equation in logarithmic form.

a) $3^7 = 2187$ $\log_3 2187 = 7$

b) $6^6 = 46656$ $\log_6 46656 = 6$

c) $5^{-2} = 0.04$ $\log_5 0.04 = -2$

d) $7^3 = 343$ $\log_7 343 = 3$

e) $8^4 = 4096$ $\log_8 4096 = 4$

f) $16^{1.5} = 64$ $\log_{16} 64 = 1.5$

Action

Example 1: Use the definition of a logarithm to determine the value of each expression.

a) $\log_4 64 = y$

$4^y = 64$

$= 3$

b) $\log_3 \frac{1}{27} = y$

$3^y = \frac{1}{27}$

$= -3$

Because we have a fraction, we know it's a negative exponent.

3 to the what = 27? Make it negative

c) $\log_2(-4)$ impossible!

$2^y = -4$

To get a negative value using an exponent: start with negative number and apply odd exponent.

d) $\log_5 \sqrt[3]{25} = y$

$5^y = \sqrt[3]{25}$

$5^y = \sqrt[3]{5^2}$

$5^y = 5^{2/3}$

$= \frac{2}{3}$

Action

Example 1: Evaluate each of the following logarithms:

a) $\log_6 1 = y$

$6^y = 1$

$6^y = 6^0$

$= 0$

b) $\log_5 5^x = y$

$5^y = 5^x$

$y = x$

$= x$

c) $6^{\log_6 x} = y$

$\log_6 x = \log_6 y$

$x = y$

$= x$

$y = a^x$

$x = \log_a y$

Action

Example 3: Determine an approximate and an exact value of $\log_5 47$.

Solution A: Guess and check

$y = \log_5 47$

$5^y = 47$

$5^2 = 25$

$5^3 = 125$

$5^{2.5} = 55.9$

$5^{2.4} = 47.6$

$5^{2.3} = 40.5$

$5^{2.36} = 46.1$

$5^{2.39} = 46.9$

$5^{2.392} = 46.99$

= approximately 2.392

Solution B: Using techology

$y = \log_5 47$

$5^y = 47$

graph $y = 5^x$ and $y = 47$

Find where they meet.

Consolidation

Exit Questions

Evaluate:

a) $\log_2 64 = y$

$2^y = 64$

$2^y = 2^{6}$

$= 6$

Consolidation

Exit Questions

Evaluate:

b) $\log_{1/4} x = -2$

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

$\left(\frac{4}{1}\right)^{2} = x$

$16 = x$

Consolidation

Exit Questions

Evaluate:

c) $\log_2 32^{1/3} = y$

$2^y = 32^{\frac{1}{3}}$

$2^y = (2^5)^{\frac{1}{3}}$

$2^y = 2^{\frac{5}{3}}$

$y = \frac{5}{3}$

$= \frac{5}{3}$

Consolidation

Exit Questions

Evaluate:

d) $3^{\log_3 11} = y$

$\log_3 11 = \log_3 y$

$y = 11$

$= 11$

$y = a^x$

$x = \log_a y$

Consolidation

Practice

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1 - 3, 5, 6, 9 -11, 14