THE DEFINITION OF LOG AND USING CHANGE OF BASE

3/17/21
Notes

Ch.6

Objective

TSWBAT: use the definitionof log to solve for variables, use change of base formula to rewrite, simplify, or solve log or exponential expressions and equations

Life Lesson/Math Skills

This is one tool to solve equations involving logs and exponents. Archiologists and Investers use exponential functions and to solve for the exponent we need logs.

Inverses

$x + 2 = y$
$-2 \quad -2$
$x = y - 2$

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

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

$x^2 = y$

$x = \sqrt{y}$

$2^x = y$

$\log_2 y = x$

$2^x = 5$

$\log_2 5 = x$

The Definition of Log The conversion to exponential form.

The log function solves for the exponent

$\log_m x = y$ is the same as $m^y = x$

base, exponent, exponent, base

Helpful things to remember:

- the base is always the base
- Logs produce Exponents
- move counter clockwise, starting with the base
- if m or x are negative, then check for extraneous solutions

The Definition of Log EXAMPLES

solve for the variable

$\log_2 8 = y$

$2^y = 8$

$2^y = 2^3$

$y = 3$

$\log_3 9 = y$

$3^y = 9$

$3^y = 3^2$

$y = 2$

$\log_3 x = 4$

$3^4 = x$

$3 \cdot 3 \cdot 3 \cdot 3 = x$

$9 \cdot 9$

$81 = x$

$\log_7 w = 9$

$7^9 = w$

40 353,607 $= w$

$\log_x 64 = 6$

$x^6 = 64$

$x = \pm \sqrt[6]{64}$

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$x = \pm 2$

{ Wrong

$\log_{3x} 144 = 2$

$(3x)^2 = 144$

$3x = \pm \sqrt{144}$

$x = \pm \frac{12}{3}$

$x = \pm 4$

Properties of Logarithms

Base B Rule: $\log_b b = 1$

$\log_3 3 = x$

$3^x = 3^1$

$x = 1$

$\log_2 2 = 1$

Log of 1 Rule: $\log_b 1 = 0$

$\log_3 1 = x$

$3^x = 1$

$x = 0$

$\log_2 1 = 0$

$2^0 = 1$

Log Bases

When you see a log with no base indicated, you assume base 10.

$\log 6 = \log_{10} 6$ (base 10 allows you to use the log function on your calculator)

When you see a ln x

This is called the natural log of x

$\ln x = \log_e x$ (use ln button, base e allows you to get to the exponent if e is the base)

Changing Bases

To graph, you will need to change bases

$$\log_m x = \frac{\log x}{\log m}$$

Helpful things to remember:

we want to use base 10,

so it is just log of what you want, divided by log of the base you need

Changing Bases EXAMPLES

$\log_7(105)$

$$\frac{\log(105)}{\log(7)}$$

$\log_7(x+5)$

$$\frac{\log(x+5)}{\log(7)}$$

$\log_4(2x-3)$

$$\frac{\log(2x-3)}{\log(4)}$$

$\log_{5x}(2x^2+7)$

$$\frac{\log(2x^2+7)}{\log(5x)}$$

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Name_____

The Meaning Of Logarithms

Date_____ Period____

Rewrite each equation in exponential form.

1) $\log_6 36 = 2$

$6^2 = 36$

2) $\log_{289} 17 = \frac{1}{2}$

$289^{\frac{1}{2}} = 17$

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

$14^{-2} = \frac{1}{196}$

4) $\log_3 81 = 4$

$3^4 = 81$

Rewrite each equation in logarithmic form.

5) $64^{\frac{1}{2}} = 8$

$\log_{64} 8 = \frac{1}{2}$

6) $12^2 = 144$

$\log_{12} 144 = 2$

7) $9^{-2} = \frac{1}{81}$

$\log_9 \frac{1}{81} = -2$

8) $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$

$\log_{\frac{1}{12}} \frac{1}{144} = 2$

Rewrite each equation in exponential form.

9) $\log_u \frac{15}{16} = v$

$u^v = \frac{15}{16}$

10) $\log_v u = 4$

$v^4 = u$

11) $\log_{\frac{7}{4}} x = y$

$\left(\frac{7}{4}\right)^y = x$

12) $\log_2 v = u$

$2^u = v$

13) $\log_u v = -16$

$u^{-16} = v$

14) $\log_y x = -8$

$y^{-8} = x$

Rewrite each equation in logarithmic form.

15) $u^{-14} = v$

$\log_u v = -14$

16) $8^b = a$

$\log_8 a = b$

17) $\left(\frac{1}{5}\right)^x = y$

$\log_{\frac{1}{5}} y = x$

18) $6^y = x$

$\log_6 x = y$

19) $9^y = x$

$\log_9 x = y$

20) $b^a = 123$

$\log_b 123 = a$

Evaluate each expression.

21) $\log_4 64$

3

22) $\log_6 216$

3

23) $\log_4 16$

2

24) $\log_3 \frac{1}{243}$

−5

25) $\log_5 125$

3

26) $\log_2 4$

2

27) $\log_{343} 7$

$\frac{1}{3}$

28) $\log_2 16$

4

29) $\log_{64} 4$

$\frac{1}{3}$

30) $\log_6 \frac{1}{216}$

−3

Simplify each expression.

31) $12^{\log_{12} 144}$

144

32) $5^{\log_5 17}$

17

33) $x^{\log_x 72}$

72

34) $9^{\log_3 20}$

400