

Introduction to Logarithms

Exponential variables:

$$3^x = 27 \quad 3^x = 81$$
$$x = 3 \quad x = 4$$

But how could you solve this?

$$3^x = 35$$

Use logarithms to solve for x!

A logarithm is the inverse of an exponent.
(Like divide is the inverse of multiply)

Exponential

To

Logarithmic

$$\text{base}^{\text{exp}} = \#$$

$$\log_{\text{base}} \# = \text{exp}$$

$$3^4 = 81 \quad \log_3 81 = 4$$
$$5^{-2} = \frac{1}{25} \quad \log_5 \frac{1}{25} = -2$$
$$16^2 = 64$$

$$\log_{\frac{1}{5}} 5 = -5$$
$$\log_5 64 = \frac{3}{2}$$

$$a^b = c$$

$$\log_a c = b$$

Rewrite as an exponential equation

$$\log_5 25 = 2$$

$$5^2 = 25$$

$$\log_{11} 1 = 0$$

$$11^0 = 1$$

$$\log_{81} 27 = \frac{3}{4}$$

$$81^{\frac{3}{4}} = 27$$

$$5^2 = 25$$

$$11^0 = 1$$

$$81^{\frac{3}{4}} = 27$$

Exponents can be...

- Whole numbers: x^2 x^5 x^9

- Fractions: $x^{\frac{1}{2}}$ $x^{\frac{3}{5}}$

- Zero: x^0 0^0 1^0

To Evaluate log equations

- 1) Set expression equal to x .
- 2) Rewrite it into Exponential form. ($base^{exp} = \#$)
- 3) Solve without a calculator.

Examples

1) $\log_2 32 = x$
 $2^x = 32$ $x = 5$

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

3) $\log_5 125 = x$
 $5^x = 125$ $x = 3$

4) $\log_{25} 5 = x$
 $25^x = 5$ $x = \frac{1}{2}$

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

6) $\log_3 \frac{1}{9} = x$
 $3^x = \frac{1}{9}$ $x = -2$

7) $\log_{\frac{1}{2}} 8 = x$
 $\left(\frac{1}{2}\right)^x = 8$ $x = -3$

8) $\log_{65} 1 = x$
 $65^x = 1$ $x = 0$

9) $\log 100 = x$
 $10^x = 100$ $x = 2$

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Date _____ Period _____

Rewrite each equation in exponential form.

1) $\log_{16} 256 = 2$

$$16^2 = 256$$

3) $\log_7 49 = 2$

$$7^2 = 49$$

5) $\log_5 125 = 3$

$$5^3 = 125$$

7) $\log_{256} 16 = \frac{1}{2}$

$$256^{\frac{1}{2}} = 16$$

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

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

Rewrite each equation in logarithmic form.

11) $169^{\frac{1}{2}} = 13$

$$\log_{169} 13 = \frac{1}{2}$$

13) $8^1 = 8$

$$\log_8 8 = 1$$

15) $2^4 = 16$

$$\log_2 16 = 4$$

17) $11^2 = 121$

$$\log_{11} 121 = 2$$

Remember:

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

$$25^x = 5$$

$$\sqrt{25} = 5$$

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

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

4) $\log_{15} 1 = 0$

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

8) $\log_8 64 = 2$

10) $\log_{11} 121 = 2$

12) $6^2 = 36$

14) $2^2 = 4$

16) $361^{\frac{1}{2}} = 19$

18) $8^{-2} = \frac{1}{64}$

19) $14^1 = 14$

$$\log_{14} 14 = 1$$

Evaluate each expression.

21) $\log_3 81$

$$x = 4$$

23) $\log_3 9$

$$x = 2$$

25) $\log_2 16$

$$x = 4$$

27) $\log_4 16$

$$x = 2$$

29) $\log_4 1$

$$x = 0$$

31) $\log_{49} 7$

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

33) $\log_3 \frac{1}{9}$

$$x = -2$$

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

$$x = -5$$

37) $\log_6 \frac{1}{36}$

$$x = -2$$

39) $\log_{49} 343 = x$

$$49^x = 343$$

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

20) $13^2 = 169$

22) $\log_4 \frac{1}{64}$

24) $\log_2 4$

26) $\log_3 3$

28) $\log_4 \frac{1}{16}$

30) $\log_3 243$

32) $\log_{81} 3$

34) $\log_4 \frac{1}{64}$

36) $\log_4 16$

38) $\log_{36} 216$

40) $\log_8 16$