10.2 Logarithm Basics

Warm-Up Tuesday

1. For all real numbers x and y, which of the following is always true?

A. $(2x)^3 = 6x^3$ $2^3 = 8$

B. $(x^2y^3)^6 = x^8y^9$ $(x^2)^6 (y^3)^6$

C. $(5x^2)(y^2) = (5xy)^2$ $25x^2y^2$

D. $(x^2y^4)^0 = 1$ ✓

2. Simplify the expression $(25a^{-4}b^{16})^{1/2}$

$\sqrt{25a^{-4}b^{16}}$

$25^{1/2} (a^{-4})^{1/2} (b^{16})^{1/2}$

$\sqrt[2]{25^1}$

$5\boxed{a^{-2}}b^8 = \boxed{\frac{5b^8}{a^2}}$

About Me

1. What's your biggest regret?
2. What's the most difficult thing you've ever done?

10.2 Logarithm Basics

Essential Question: How do I convert an exponential equation to log form?

$$\log_b a = x \Leftrightarrow b^x = a$$

"log base b of a"

$\log_b a = x$

$\log_2 8 =$ 3 because $2^? = 8$

$\log_5 \frac{1}{25} =$ -2 because $5^? = \frac{1}{25}$

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a) When there is no base: base 10 $\log 10 \Rightarrow \log_{10} 10$

Ex. $\log_{10} 100 =$ 2, because $10^? = 100$

b) "$\ln x$" natural log

$\log_e x = \ln x$

$e \approx 2.7\ldots$

Ex. $\ln e^5 =$ $1^5 = 1$, because $\log_e e = 1$

$e^? = e$

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Essential Question: How do I convert an exponential equation to log form?

Example 1 – Express in exponential form.

a) $\log_3 81 = 4$

$\boxed{3^4 = 81}$

b) $\ln 5 = x$

$\log_e 5 = x$

$\boxed{e^x = 5}$

c) $\log_2 \frac{1}{8} = -3$

$\boxed{2^{-3} = \frac{1}{8}}$

Example 2 – Express in logarithmic form.

a) $2^5 = 32$

$\log_2 32 = 5$

b) $\frac{1}{9} = 3^{-2}$ $\Rightarrow 3^{-2} = \frac{1}{9}$

$\log_3 \frac{1}{9} = -2$

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

$\log_{81} 3 = \frac{1}{4}$

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Essential Question: How do I convert an exponential equation to log form?

Example 3 – Evaluate using logarithms.

a) $\log \frac{1}{100} = x$

$\log_{10} \frac{1}{100} = x$

$10^x = \frac{1}{100}$

$10^x = 10^{-2}$

$\boxed{x = -2}$

b) $\log_4 64 = x$

$4^x = 64$

$4^x = 4^3$

$\boxed{x = 3}$

c) $\log_4 \sqrt[3]{4} = x$

$4^x = \sqrt[3]{4^1}$

$4^x = 4^{\frac{1}{3}}$

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

d) $\log_{16} \frac{1}{32}$

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Essential Question: How do I convert an exponential equation to log form?

Using the Calculator...

- Change of Base Formula

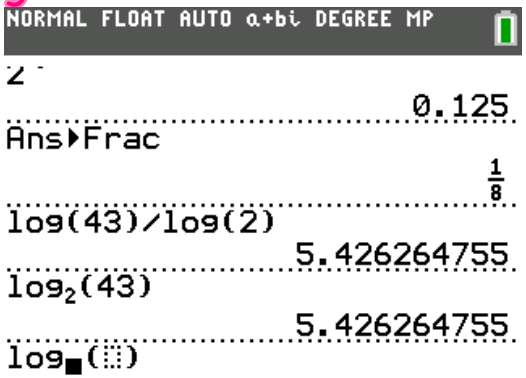
$$\log_b a = \frac{\log a}{\log b}$$ ← base in bottom

> ex. Find $\log_2 43$ $= \frac{\log 43}{\log 2} \approx 5.426$

- Math > A: logBASE
- Alpha WINDOW 5

CAUTION

NO VARIABLES



10.2 – Logarithms Name _____

Express in exponential form.

1. $\log_2 16 = 4$
2. $\ln 1 = 0$
3. $\log_{\frac{1}{3}} 27 = -3$
4. $\log_{\frac{1}{2}} \frac{1}{4} = 2$
5. $\log \frac{1}{10} = -1$
6. $\log 1000 = 3$
7. $\log_2 \frac{1}{8} = -3$
8. $\log_8 64 = 2$

Express in logarithmic form.

9. $2^3 = 8$
10. $10^{-2} = \frac{1}{100}$
11. $e^0 = 1$
12. $2^{10} = 1024$
13. $4^{\frac{1}{2}} = 2$
14. $27^{\frac{1}{3}} = 3$
15. $625^{\frac{3}{4}} = 125$
16. $4^{-\frac{3}{2}} = \frac{1}{8}$

Evaluate without a calculator.

17. $\log 10{,}000$
18. $\log_2 32$
19. $\log_3 27$
20. $\log 10$
21. $\log \frac{1}{100{,}000}$
22. $\log_2 \frac{1}{4}$
23. $\log_3 1$
24. $\log_3 \frac{1}{9}$

Evaluate without a calculator.

25. $\log_{\frac{1}{3}} 27$

26. $\log_{\frac{1}{2}} 8$

27. $\log_{27} 81$

28. $\log_{8} 32$

29. $\log_{\sqrt{2}} 16$

30. $\log \sqrt{10}$

31. $\log_{\frac{1}{3}} 81$

32. $\log_{\frac{1}{2}} \frac{1}{16}$

Use your calculator and one of the change of base formulas to estimate. Round to 3 places.

33. $\log_{2} 10$

34. $\log_{2} \frac{1}{22}$

35. $\log_{7} 5$

36. $\log_{5} 7$

37. $\log_{500} 1000$

38. $\log_{500} 250$

39. $\log_{12} \frac{7}{56}$