KEY

Name:	Date:
Topic: Day 37: Laws of Logarithms	Class:

Main Ideas/Questions	Notes/Examples
What is a **LOGARITHM?**	**A logarithm (log) is another way of writing exponents.** **Logarithmic Form** $\log_b a = x$ ↔ **Exponential Form** $b^x = a$ ↑ Read as "**log base b of a equals x.**"
Converting **LOG ➲ EXP**	**Directions:** Write each equation in **exponential form.**

1. $\log_3 9 = 2$ $3^2 = 9$	**2.** $\log_6 216 = 3$ $6^3 = 216$
3. $\log_7 1 = 0$ $7^0 = 1$	**4.** $\log_2 16 = 4$ $2^4 = 16$
5. $\log_4 \frac{1}{16} = -2$ $4^{-2} = \frac{1}{16}$	**6.** $\log_9 27 = \frac{3}{2}$ $9^{\frac{3}{2}} = 27$

Converting **EXP ➲ LOG**	**Directions:** Write each equation in **logarithmic form.**

7. $14^2 = 196$ $\log_{14} 196 = 2$	**8.** $3^4 = 81$ $\log_3 81 = 4$
9. $12^1 = 12$ $\log_{12} 12 = 1$	**10.** $36^{\frac{1}{2}} = 6$ $\log_{36} 6 = \frac{1}{2}$
11. $2^{-3} = \frac{1}{8}$ $\log_2 \frac{1}{8} = -3$	**12.** $8^{\frac{4}{3}} = 16$ $\log_8 16 = \frac{4}{3}$

COMMON LOGARITHM

A logarithm with base 10 is called a **common logarithm** and can be written without the base.

$\log_{10} x \longrightarrow \log x$

EVALUATING LOGARITHMS

Directions: Use your knowledge of exponents to evaluate the following logarithms.

13. $\log_7 49 = 2$

because $7^2 = 49$

14. $\log_3 27 = 3$

because $3^3 = 27$

15. $\log 100 = 2$

because $10^2 = 100$

16. $\log_{12} 1 = 0$

$12^0 = 1$

17. $\log_2 64 = 6$

18. $\log_3 243 = 5$

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

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

20. $\log_{64} 4 = \frac{1}{3}$

$64^{?} = 4$ $\quad \sqrt[3]{64} = 4$ $\quad 64^{\frac{1}{3}} = 4$

CHANGE OF BASE FORMULA

Some logarithms are not as easy to evalute as those above, and will require the **change of base formula.**

$\log_b a = \frac{\log_c a}{\log_c b}$

Choose BASE 10 because there is a calculator button for it!

Calculator steps:

MATH

▲

▲

A: logBASE(

Directions: Evalute each log using the change of base formula.

21. $\log_{16} 64 = 1.5$

22. $\log_8 32 = \frac{5}{3}$

23. $\log_2 54 \approx 5.75$

24. $\log_{10} 294 \approx 2.47$

25. $\log_4 136 \approx 3.54$

26. $\log_6 \frac{1}{36} = -2$

Name:	Date:
Topic:	Class:

Main Ideas/Questions	Notes/Examples		
Product Property $\log_b(m \cdot n) =$ $\log_b m + \log_b n$	**Condense into a single logarithm. Simplify if possible.**		
	1. $\log_2 7 + \log_2 4$ $\log_2 28$	**2.** $\log 25 + \log 4$ $\log 100$ 2	**3.** $\log_4 2x + \log_4 4x^2$ $\log_4 8x^3$
	Expand using the product property.		
	4. $\log 6$ $\log(2 \cdot 3)$ $\log 2 + \log 3$	**5.** $\log_7 45$ $\log_7(5 \cdot 9)$ $\log_7 5 + \log_7 9$	**6.** $\log_2(5x)$ $\log_2 5 + \log_2 x$
Quotient Property $\log_b\left(\frac{m}{n}\right) =$ $\log_b m - \log_b n$	**Condense into a single logarithm. Simplify if possible.**		
	7. $\log_3 24 - \log_3 8$ $\log_3 \frac{24}{8}$ $= \log_3 3$ $= 1$	**8.** $\log_2 15 - \log_2 15$ $\log_2 \frac{15}{15}$ $= \log_2 1$ $= 0$	**9.** $\log_4 x^9 - \log_4 x^2$ $\log_4 \frac{x^9}{x^2}$ $\log_4 x^7$
	Expand using the quotient property.		
	10. $\log_8 4$ $\log_8\left(\frac{8}{2}\right)$ $\log_8 8 - \log_8 2$	**11.** $\log_5 \frac{1}{3}$ $\log_5 1 - \log_5 3$ $0 - \log_5 3$ $-\log_5 3$	**12.** $\log\left(\frac{m}{7}\right)$ $\log m - \log 7$
Power Property $\log_b m^n =$ $n \log_b m$	**Condense into a single logarithm. Simplify if possible.**		
	13. $5 \cdot \log_4 2$ $\log_4 2^5$ $\log_4 32$ $\frac{5}{2}$ $4^x = 32$ $2^{2x} = 2^5$	**14.** $7 \cdot \log_2 x$ $\log_2 x^7$	**15.** $\frac{1}{3} \cdot \log 8$ $\log 8^{1/3}$ $\log 2$
	Expand using the power property. Simplify if possible.		
	16. $\log_2 8^7$ $7 \log_2 8$ $7 \cdot 3$ 21	**17.** $3 \cdot \log 4^{x-1}$ $3(x-1)\log 4$	**18.** $\log_7 \sqrt{w}$ $\frac{1}{2}\log_7 w$ $\sqrt{w} = w^{\frac{1}{2}}$

PROPERTIES OF LOGARITHMS

GRAPHIC ORGANIZER

Name	Rule(s)	Example 1	Example 2
BASIC LOGARITHMS	$\log_b b =$ 1 ; $\log_b 1 =$ 0	**Simplify:** $\log_{14} 14 =$ 1	**Simplify:** $\log_3 1 =$ 0
PRODUCT RULE	$\log_b (m \cdot n) =$ $\log_b m + \log_b n$	**Condense:** $\log_5 6 + \log_5 7 =$ $\log_5 42$	**Expand:** $\log_2 63 =$ $\log_2 7 + \log_2 9$
QUOTIENT RULE	$\log_b \left(\frac{m}{n}\right) =$ $\log_b m - \log_b n$	**Condense:** $\log_4 84 - \log_4 12 =$ $\log_4 7$	**Expand:** $\log 9 =$ $\log 27 - \log 3$
POWER RULE	$\log_b m^n =$ $n \log_b m$	**Condense:** $2 \cdot \log_3 8 =$ $\log_3 64$	**Expand:** $\log_2 6^{x-1} =$ $(x-1)\log_2 6$ $x \log_2 6 - \log_2 6$
CHANGE OF BASE FORMULA	$\log_b a =$ $\frac{\log a}{\log b}$	**Using a common base, evaluate the expression below.** $\log_7 32 =$ $\frac{\log 32}{\log 7} \approx 1.78$	

REMEMBER: BASE 10 LOGS ARE COMMON LOGS AND WRITTEN WITHOUT A BASE! **(log x)**