Name:___________________________

SM3 7.2 Log Evaluations & Properties

Exponential expressions are of the form a^x and have the value of multiplying $a \cdot a \cdot a \cdot a \cdot a \cdots a$ until a total of x copies of a have been multiplied together. If x is negative, we divide by x copies of a instead.

Example: Evaluate 2^4

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

16

Example: Evaluate 3^{-4}

$\frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3}$

$\frac{1}{81}$

Logarithmic expressions are of the form $\log_b a$ where b represents the logarithmic base and a represents the argument of the logarithm. The expression has a value that answers the question "how many bs need to be multiplied to produce a?"

Example: Evaluate $\log_3 81$

81 is a power of 3

Since$3 \cdot 3 \cdot 3 \cdot 3 = 81$, we need to multiply by 4 copies of 2 to get 81.

$\log_3 81 = 4$

Example: Evaluate $\log_2 \frac{1}{16}$

16 is a power of 2 but since it's in the bottom, we'll need negative power.

Since $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$, we need to divide by 4 copies of 2 to get $\frac{1}{16}$.

$\log_2 \frac{1}{16} = -4$

Logarithmic and exponential operations are inverses: they undo one another. If you have to evaluate a base raised to a like-based log, the two operations cancel. Likewise, when evaluating the log of an exponential that shares the same base, the two operations cancel.

Example: Evaluate $\log_3 3^7$

$\log_3 x$ and 3^x are inverse operations and eliminate one another.

$\log_3 3^7 = 7$

Example: Evaluate $6^{\log_6 11}$

6^x and $\log_6 x$ are inverse operations and eliminate one another.

$6^{\log_6 11} = 11$

Since logarithms and exponentials are related then we can switch between their forms. We know that $3^2 = 9$ and $\log_3 9 = 2$ (because 2 copies of 3's are needed to make 9), this leads us to see that we can switch between exponential form and logarithmic if needed.

Exponential Form		Logarithmic Form
$b^c = a$	$\leftrightarrow$	$\log_b a = c$

Evaluate the following expressions

1. 3^5	2. 4^{-2}	3. 10^3	4. -2^{-2}
5. $\log_3 27$	6. $\log_4 4$	7. $\log_8 1$	8. $\log_3 \frac{1}{81}$
9. $\log_5 125$	10. $\log_{12} 144$	11. $\log 1000$	12. $\log 0.001$
13. $2^{\log_2 12}$	14. $\log_{11} 11^{-3}$	15. $\log_4 16^x$	16. $\log_2 \frac{1}{32}$
17. $6^{\log_6(2x+1)}$	18. $\log_6 \frac{1}{216}$	19. $\log_8 8^7$	20. $\log_{16} 4$
21. e^0	22. $\ln 1$	23. $\mathrm{e}^{\ln x}$	24. $\ln(\mathrm{e})^2$

Rewrite each exponential in logarithmic form.

25. $81^{1/2} = 9$ 26. $19^2 = 361$ 27. $\frac{1}{32} = 2^{-5}$ 28. $r^8 = 117$

Rewrite each logarithm in exponential form.

29. $\log_{12} \frac{1}{144} = -2$ 30. $\log_{15} 225 = 2$ 31. $\log_{11} y = x$ 32. $\log_6 1 =$

Complete the tables of values of a function:

33) $f(x) = \log_3 x$	
x	$f(x)$
$\frac{1}{9}$	
$\frac{1}{3}$	
1	
3	
9	

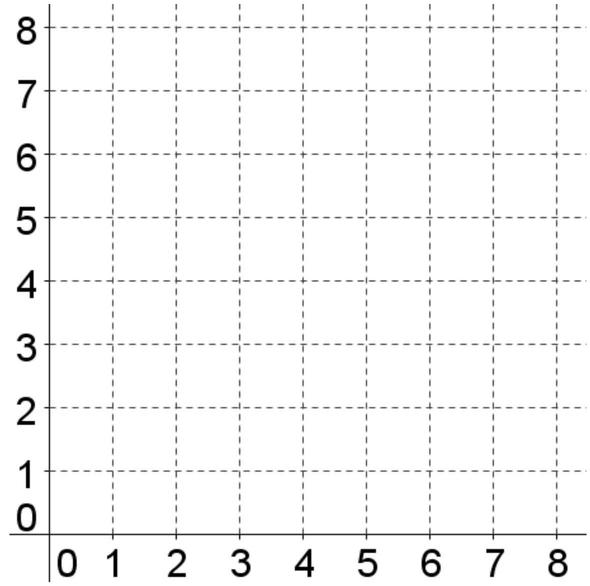
34) $g(x) = \log_2 x$	
x	$g(x)$
1	
16	
$\frac{1}{8}$	
1024	
$\frac{1}{32}$	

35) $p(x) = \log_5 x$	
x	$p(x)$
	2
	0
	-3
	4
	$\frac{1}{2}$

36) $q(x) = \log x$	
x	$q(x)$
	4
	-1
	0
	6
	-3

37) Complete the tables then graph both functions on the same coordinate axis by plotting points and connecting with a curve.

$v(x) = 2^x$		$w(x) = \log_2 x$	
x	$v(x)$	x	$w(x)$
1			1
2			2
3			3



$v(x) = e^x$		$w(x) = ln\, x$	
x	$v(x)$	x	$w(x)$
1			1
2			2
3			3