Day 04 Properties of Logarithms

PRODUCT PROPERTY	QUOTIENT PROPERTY	POWER PROPERTY
Introduction: $\log_3(9\bullet27) = \log_3(3^2\bullet3^3) =$ $\log_3 3^{2+3} = 2 + 3 = 5$ When you multiply monomials with like bases, you **ADD** the exponents!!	**Introduction:** $\log_3\left(\frac{81}{27}\right) = \log_3\left(\frac{3^4}{3^3}\right) =$ $\log_3 3^{4-3} = 4 - 3 = 1$ When you divide monomials with like bases, you **SUBTRACT** the exponents!	**Introduction:** $\log_3 9^4 = \log_3(3^2)^4 =$ $\log_3 3^{2\bullet4} = 2 \bullet 4 = 8$ When you raise a monomial to a power, you **MULTIPLY** the exponents!
Conclusion: Since a logarithm is an exponent, then you "expand" and add the logs.	**Conclusion:** Since a logarithm is an exponent, then you "expand" and subtract the logs.	**Conclusion:** Since a logarithm is an exponent, then you multiply the power times the log.
PRODUCT Property $\log_b mn = \log_b m + \log_b n$ $m > 0, n > 0, \& b \neq 1$	**QUOTIENT Property** $\log_b \frac{m}{n} = \log_b m - \log_b n$ $m > 0, n > 0, \& b \neq 1$	**POWER Property** $\log_b m^p = p \log_b m$ p must be real, $m > 0, b > 0$ and $b \neq 1$
Example: $\log 5 + \log 3 = \log x$ $\log(5\bullet3) = \log x$ $\log 15 = \log x$ $15 = x \rightarrow \boxed{x = 15}$	**Example:** $\log_5 8 - \log_5 2 = \log_5 2x$ $\log_5\left(\frac{8}{2}\right) = \log_5 2x$ $\frac{8}{2} = 2x \rightarrow 4 = 2x \rightarrow \boxed{x = 2}$	**Example:** Evaluate $\log_3 9^4$ $\log_3 9^4 = 4\log_3 9$, since $\log_3 9 = 2$ (because $3^2 = 9$) $\log_3 9^4 = 4 \bullet 2 = \boxed{8}$
1-9: Expand each expression.		
1. $\log_6 3x$	**2.** $\log_2 \frac{x}{5}$	**3.** $\log xy^2$
4. $\log_4 \frac{xy}{3}$	**5.** $\log_3 \sqrt{x}yz$	**6.** $\log_5 2\sqrt{x}$
7. $\log \frac{x^2}{4}$	**8.** $\log \frac{10}{\sqrt{x}}$	**9.** $\log_2 \frac{x^2y}{z}$

10-15: Condense each expression.

10. $\log_3 7 - \log_3 x$

11. $2\log_5 x + \log_5 3$

12. $\log_4 5 + \log_4 x + \log_4 y$

13. $\frac{1}{2}\log x - \log 4$

14. $\frac{2}{3}\log_2 x - 3\log_2 y$

15. $\log_3 4 + 2\log_3 x - \log_3 5$

The pH of a patient's blood can be calculated using the Henderson-Hasselbach Formula, pH = 6.1 + log $\frac{B}{C}$, where B is the concentration of bicarbonate and C is the concentration of carbonic acid. The normal pH blood is approximately 7.4.

16. Expand the right side of the formula.

17. A patient has a bicarbonate concentration of 24 and a carbonic acid concentration of 1.9. Find the pH of the patient's blood.

18. Is the patient's pH above or below normal?

19-24: Solve each equation. Round to three decimal places when necessary.

19. $\log_2 x + \log_2(x + 1) = 1$

20. $\log(x + 1) - 3 = \log x$

21. $\log(x + 2) + \log(x - 3) = \log(x + 29)$

22. $\log_8(t + 10) - \log_8(t - 1) = \log_8 12$

23. $3\log_5(x^2 + 9) - 6 = 0$

24. $\log_2 x = 5\log_2 2 - \log_2 8$