Key

Logarithmic Functions – Properties HW

Use the Laws of Logarithms to rewrite the expression in a form with no logarithm of a product, quotient, or power.

1. $\log_2(8x)^{\frac{1}{3}}$

$\log_2 8^{1/3} + \log_2 x^{1/3}$

$\frac{1}{3}\log_2(8) + \frac{1}{3}\log_2(x)$

$1 + \frac{1}{3}\log_2(x)$

2. $\log_2 \frac{8x^3}{2y}$

$= \log_2 8 + 3\log_2(x) - \log_2(2) - \log_2(y)$

$= 3 + 3\log_2(x) - 1 - \log_2 y$

$= 2 + 3\log_2(x) - \log_2 y$

3. $\log_b \frac{xy}{z}$

$\log_b(x) + \log_b(y) - \log_b(z)$

4. $\log_5 5^p = p$

Use properties of logarithms to simplify the expression.

5. (a) $\log x^2 - \log xy + 4\log y$

$\log\left(\frac{x^2}{xy}\right) + \log y^4 = \log\left(\frac{x}{y}\right) + \log y^4$

$= \log\left(\frac{xy^4}{y}\right) = \log(xy^3)$

6. $\log_3 5 + \log_3 2$

$\log_3(10)$

7. Use the logarithm laws to simplify the following:

(a) $\log_2 xy - \log_2 x^2$

$\log_2\left(\frac{xy}{x^2}\right) = \log_2\left(\frac{y}{x}\right)$

(b) $\log_2 \frac{8x^2}{y} + \log_2 2xy = \log_2\left(\frac{8x^2 \cdot 2xy}{y}\right) = \log_2(16x^3)$

$= 4 + \log_2(x^3)$

(c) $\log_3 9xy^2 - \log_3 27xy$

$\log_3\left(\frac{9xy^2}{27xy}\right) = \log_3\left(\frac{y}{3}\right)$

(d) $\log_4(xy)^3 - \log_4 xy = \log_4\left(\frac{x^3y^3}{xy}\right) = \log_4(x^2y^2)$

(e) $\log_3 9x^4 - \log_3(3x)^2$

$\log_3\left(\frac{9x^4}{9x^2}\right) = \log_3(x^2)$

Evaluate the following using the laws of logarithms

8. $\log_2 12 - \log_2 3$

$\log_2\left(\frac{12}{3}\right) = \log_2(4) = 2$

9. $\log_6 9 + \log_6 8 - \log_6 2$

$\log_6\left(\frac{9 \cdot 8}{2}\right) = 2$

10. $\log_2 2 + \log_2 3 - \log_2 6 - \log_2 8$

$\log_2\left(\frac{2 \cdot 3}{6 \cdot 8}\right) = \log_2\left(\frac{1}{8}\right) = -3$

11. $\log_8 16 + \log_8 4$

$\log_8(64) = 2$

12. $\log_2 24 - \log_2 3$

$\log_2(8) = 3$

13. $\log_3 45 - \log_3 5 + \log_3 \sqrt[4]{3}$

$\log_3\left(\frac{45}{5} \cdot \sqrt[4]{3}\right) = \log_3(9 \cdot 3^{1/4})$

$= \log_3(3^2 \cdot 3^{1/4}) = \frac{9}{4}$

14. $\log_2 y + \log_2 2x - \log_2 x^2 - \log_2 y$

$\log_2\left(\frac{2xy}{x^2y}\right) = \log_2\left(\frac{2}{x}\right)$

15. $\frac{1}{2}\log_2 16 - \frac{1}{3}\log_2 8$

$\log_2(4) - \log_2(2)$

$\log_2\left(\frac{4}{2}\right) = 1$

16. $\log_2 8^{25} + \log_2 16^5$

$\log_2(8^{25} \cdot 16^5)$

$\log_2((2^3)^{25} \cdot (2^4)^5)$

$\log_2(2^{75} \cdot 2^{20}) = \log_2(2^{95}) = 95$

17. $2\log_b 4 - 3\log_b 2 + \log_b 2 \overset{\text{minus}}{=} \log_b x$

$\log_b 16 - \log_b 8 + \log_b 2 = \log_b(x)$

$\log_b(2) + \log_b(2) - \log_b(x)$

$\log_b\left(\frac{4}{x}\right)$