9.5 Practice – Properties of Logarithms

Name: Solutions

Expand each logarithm.

1. $\log_2 11^5$

$5\log_2 11$

2. $\log_9(xy)$

$\log_9 x + \log_9 y$

3. $\log_2 \sqrt[3]{u}$

$\log_2 u^{\frac{1}{3}}$

$\frac{1}{3}\log_2 u$

4. $\log_8 \frac{u}{v}$

$\log_8 u - \log_8 v$

5. $\log_6 \sqrt{xyz}$

$\log_6 (xyz)^{\frac{1}{2}}$

$\frac{1}{2}\log_6 x + \frac{1}{2}\log_6 y + \frac{1}{2}\log_6 z$

6. $\log_7(x^6y^4)$

$\log_7 x^6 + \log_7 y^4$

$6\log_7 x + 4\log_7 y$

7. $\log_7 \left(\frac{6^2}{5}\right)^3 = \log_7 \frac{6^6}{5^3}$

$6\log_7 6 - 3\log_7 5$

8. $\log_8 \left(\frac{(wu)^4}{v}\right)^2$

$\log_8 \left(\frac{w^8 u^8}{v^2}\right)$

$8\log_8 w + 8\log_8 u - 2\log_8 v$

9. $\log_6 \left(\frac{x}{y^5 z}\right)^6$

$\log_6 \left(\frac{x^6}{y^{30} z^6}\right)$

$6\log_6 x - 30\log_6 y - 6\log_6 z$

10. $\log_5(x^4y^2)$

$4\log_5 x + 2\log_5 y$

11. $\log_2(vwx\sqrt{u})$

$\log_2 v + \log_2 w + \log_2 x + \frac{1}{2}\log_2 u$

12. $\frac{\log_3(xy)}{2}$

$\frac{1}{2}\log_3(xy)$

$\frac{1}{2}\log_3 x + \frac{1}{2}\log_3 y$

13. $\log_6(ab^2c)^{10}$

$\log_6(a^{10}b^{20}c^{10})$

$10\log_6 a + 20\log_6 b + 10\log_6 c$

14. $\ln(w^3\sqrt{xyz})$

$\ln(w^3 x^{\frac{1}{2}} y^{\frac{1}{2}} z^{\frac{1}{2}})$

$3\ln w + \frac{1}{2}\ln x + \frac{1}{2}\ln y + \frac{1}{2}\ln z$

15. $\ln \frac{wu^6}{v^4}$

$\ln w + 6\ln u - 4\ln v$

Condense each expression to a single logarithm.

16. $4 \ln 11$

$\ln 11^4$

17. $5 \log_4 12$

$\log_4 12^5$

18. $\log_3 a + \log_3 b$

$\log_3(ab)$

19. $\frac{\log_5 7}{3}$

$\frac{1}{3}\log_5 7$

$\log_5 7^{\frac{1}{3}}$

$\log_5 \sqrt[3]{7}$

20. $\log_2 x - \log_2 y + 3\log_2 z$

$\log_2 \left(\frac{x}{y}\right) + \log_2 z^3$

$\log_2 \left(\frac{xz^3}{y}\right)$

21. $\frac{\ln x}{2} - 2\ln y$

$\frac{1}{2}\ln x - 2\ln y$

$\ln x^{\frac{1}{2}} - \ln y^2$

$\ln\left(\frac{\sqrt{x}}{y^2}\right)$

22. $\log_8 x + \log_8 y - 5\log_8 z$

$\log_8(xy) - \log_8 z^5$

$\log_8 \left(\frac{xy}{z^5}\right)$

23. $15\log_9 a - 5\log_9 b$

$\log_9 a^{15} - \log_9 b^5$

$\log_9 \left(\frac{a^{15}}{b^5}\right)$

24. $6\log_9 12 + \frac{1}{2}\log_9 11$

$\log_9 12^6 + \log_9 11^{\frac{1}{2}}$

$\log_9 \left(12^6 \sqrt{11}\right)$

25. $3\ln a - \frac{\ln b}{3} - 3\ln c$

$\ln a^3 - \ln b^{1/3} - \ln c^3$

$\ln\left(\frac{a^3}{\sqrt[3]{b}\,c^3}\right)$

26. $5\log_7 w - 5\log_7 u - 15\log_7 v$

$\log_7 w^5 - \log_7 u^5 - \log_7 v^{15}$

$\log_7\left(\frac{w^5}{u^5 v^{15}}\right)$

27. $\log_5 p + 2\log_5 q + \frac{1}{3}\log_5 r$

$\log_5 p + \log_5 q^2 + \log_5 \sqrt[3]{r}$

$\log_5\left(p q^2 \sqrt[3]{r}\right)$

28. $\ln s + \ln u + 2\ln l + \ln y$

$\ln(sul^2y)$

29. $\log_5 x + \frac{\log_5 y + \log_5 z}{2}$

$\log_5 x + \frac{1}{2}\log_5 y + \frac{1}{2}\log_5 z$

$\log_5(x\sqrt{yz})$

30. $\log_6 a + \log_6 b + \frac{\log_6 c}{3} + \frac{\log_6 d}{3}$

$\log_6(ab) + \frac{1}{3}\log_6 c + \frac{1}{3}\log_6 d$

$\log_6(ab\sqrt[3]{cd})$

Use a calculator to approximate to the nearest thousandth. Use the change-of-base formula to show work.

31. $\log_3 42$

$\frac{\log 42}{\log 3}$ or $\frac{\ln 42}{\ln 3}$

≈ 3.402

32. $\log_5 3.3$

$\frac{\log 3.3}{\log 5}$ or $\frac{\ln 3.3}{\ln 5}$

≈ 0.742

33. $\log_5 1$

$\frac{\log 1}{\log 5}$ or $\frac{\ln 1}{\ln 5}$

$= 0$

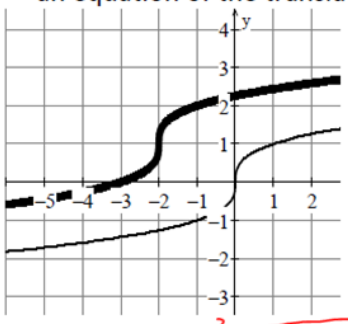
34. $\log_7 5.6$

$\frac{\log 5.6}{\log 7}$ or $\frac{\ln 5.6}{\ln 7}$

≈ 0.885

Algebra Skills:

1. Below are graphs of $f(x) = \sqrt[3]{x}$ (thin line) and its translation (bold line). Write an equation of the translation.



$f(x) = \sqrt[3]{x+2} + 1$

Simplify the fraction by rationalizing the denominator.

2. $\frac{4}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{4\sqrt{6}}{6} = \frac{2\sqrt{6}}{3}$

3. $\frac{5}{2\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{5\sqrt{5}}{2 \cdot 5}$

$\frac{\sqrt{5}}{2}$

Solve by factoring.

4. $3x^3 + 27x^2 - 66x = 0$

$3x(x^2 + 9x - 22) = 0$

$3x(x+11)(x-2) = 0$

$x = 0,\ x = -11,\ x = 2$

5. $25x^2 + 45x - 10 = 0$

$5(5x^2 + 9x - 2) = 0$

$5(5x-1)(x+2) = 0$

$x = \frac{1}{5}$ or $x = -2$

SAT Prep:

1. Simplify: $(2^{5-x})^{3x}$

(A) $(2)^{5-2x}$

(B) $(2)^{8x-3x^2}$

(C) $(2)^{5-3x^2}$

(D) $(2)^{15x-3x^2}$

$(5-x)(3x)$

$15x - 3x^2$

2. If $f(x) = 4(8)^{5-x}$, find $f(7)$.

$f(7) = 4(8)^{5-7}$

$f(7) = 4(8)^{-2}$

$= 4\left(\frac{1}{64}\right)$

$= \frac{4}{64} = \frac{1}{16}$