7.5 – Apply Properties of Logarithms

Properties of Logarithms

Product Property	$\log_b mn = \log_b m + \log_b n$
Quotient Property	$\log_b \frac{m}{n} = \log_b m - \log_b n$
Power Property	$\log_b m^n = n \log_b m$

Example 1 Use $\log_4 3 \approx 0.792$ and $\log_4 7 \approx 1.404$ to evaluate the logarithm

a. $\log_4 \frac{3}{7} = \log_4 3 - \log_4 7$

$= 0.792 - 1.404$

$= -0.612$

b. $\log_4 21$

$= \log_4 3 + \log_4 7$

$= .792 + 1.404$

$= 2.196$

c. $\log_4 49 = \log_4 7^2 = 2\log_4 7$

$= 2(1.404)$

$= 2.808$

Example 2 Expand a Logarithmic Expression

Expand. $\log_6 \frac{5x^3}{y} = \log_6 5 + 3\log_6 x - \log_6 y$

Example 3 Condensing a Logarithmic Expression

Which of the following is equivalent to log 9 + 3 log 2 – log 3?

Ⓐ log 8 Ⓑ log 14 Ⓒ log 18 Ⓓ log 24

$\log \frac{9(2^3)}{3} = \log \frac{9(8)}{3} = \log 3(8) = \log 24$

Change of Base Formula

$$\log_c a = \frac{\log a}{\log c} = \frac{\ln a}{\ln c}$$

Example 4

Use $\log_3 8$ using common and natural logarithms

$\log_3 8 = \frac{\log 8}{\log 3} \approx 1.893$

$\log_3 8 = \frac{\ln 8}{\ln 3} \approx 1.893$

HW: (3-59 odd)

EXAMPLE 1 on p. 507 for Exs. 3–14

MATCHING EXPRESSIONS **Match the expression with the logarithm that has the same value.**

3. $\ln 6 - \ln 2$
4. $2 \ln 6$
5. $6 \ln 2$
6. $\ln 6 + \ln 2$

A. $\ln 64$
B. $\ln 3$
C. $\ln 12$
D. $\ln 36$

APPROXIMATING EXPRESSIONS **Use $\log 4 \approx 0.602$ and $\log 12 \approx 1.079$ to evaluate the logarithm.**

7. $\log 3$
8. $\log 48$
9. $\log 16$
10. $\log 64$
11. $\log 144$
12. $\log \frac{1}{3}$
13. $\log \frac{1}{4}$
14. $\log \frac{1}{12}$

EXAMPLE 2 on p. 508 for Exs. 15–32

EXPANDING EXPRESSIONS **Expand the expression.**

15. $\log_3 4x$
16. $\ln 15x$
17. $\log 3x^4$
18. $\log_5 x^5$
19. $\log_2 \frac{2}{5}$
20. $\ln \frac{12}{5}$
21. $\log_4 \frac{x}{3y}$
22. $\ln 4x^2y$
23. $\log_7 5x^3yz^2$
24. $\log_6 36x^2$
25. $\ln x^2y^{1/3}$
26. $\log 10x^3$
27. $\log_2 \sqrt{x}$
28. $\ln \frac{6x^2}{y^4}$
29. $\ln \sqrt[4]{x^3}$
30. $\log_3 \sqrt{9x}$

ERROR ANALYSIS ***Describe*** **and correct the error in expanding the logarithmic expression.**

31. $\log_2 5x = (\log_2 5)(\log_2 x)$

32. $\ln 8x^3 = 3 \ln 8 + \ln x$

EXAMPLE 3 on p. 508 for Exs. 33–43

CONDENSING EXPRESSIONS **Condense the expression.**

33. $\log_4 7 - \log_4 10$
34. $\ln 12 - \ln 4$
35. $2 \log x + \log 11$
36. $6 \ln x + 4 \ln y$
37. $5 \log x - 4 \log y$
38. $5 \log_4 2 + 7 \log_4 x + 4 \log_4 y$
39. $\ln 40 + 2 \ln \frac{1}{2} + \ln x$
40. $\log_5 4 + \frac{1}{3} \log_5 x$
41. $6 \ln 2 - 4 \ln y$
42. $2(\log_3 20 - \log_3 4) + 0.5 \log_3 4$

EXAMPLE 4 on p. 509 for Exs. 45–61

CHANGE-OF-BASE FORMULA **Use the change-of-base formula to evaluate the logarithm.**

45. $\log_4 7$
46. $\log_5 13$
47. $\log_3 15$
48. $\log_8 22$
49. $\log_3 6$
50. $\log_5 14$
51. $\log_6 17$
52. $\log_2 28$
53. $\log_7 19$
54. $\log_4 48$
55. $\log_9 27$
56. $\log_8 32$
57. $\log_6 \frac{24}{5}$
58. $\log_2 \frac{15}{7}$
59. $\log_3 \frac{9}{40}$
60. $\log_7 \frac{3}{16}$