7.4 – Evaluate Logarithms

The definition of Logarithm with Base b

$\log_b y = x$ if and only if $b^x = y$

Example 1 Rewrite Logarithmic equations

a. $\log_2 8 = 3$

$2^3 = 8$

b. $\log_4 1 = 0$

$4^0 = 1$

c. $\log_{12} 12 = 1$ $12^1 = 12$

d. $\log_{1/4} 4 = -1$

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

Example 2 Evaluate Logarithms

a. $\log_4 64$

$4^x = 64$

so $\log_4 64 = 3$

b. $\log_5 0.2$

$5^x = 0.2$

$0.2 = \frac{2}{10} = \frac{1}{5} \Rightarrow \log_5 0.2 = -1$

c. $\log_{1/5} 125$ $\left(\frac{1}{5}\right)^x = 125$

$5^3 = 125 \Rightarrow \left(\frac{1}{5}\right)^{-3} = \frac{1}{5^{-3}}$ or 5^3

so $\log_{1/5} 125 = -3$

d. $\log_{36} 6$

$36^x = 6$

$\sqrt{36} = 6 \Rightarrow 36^{1/2} = 6$

so $\log_{36} 6 = \frac{1}{2}$

Common and Natural Logarithms

Common Logarithm

$\log_{10} x = \log x$

Natural Logarithm

$\log_e x = \ln x$

Example 3 Evaluate Common and Natural Logarithms

a. $\log 8 = .903$

b. $\ln 0.3 = -1.204$

Inverse Functions $\log_b b^x = x$ *and* $b^{\log_b x} = x$

Example 5 Use Inverse Properties

a. $10^{\log 4}$ $= 4$

b. $\log_5 25^x$

$= \log_5 (5^2)^x = \log_5 (5^{2x})$

$\log_5 5^{2x} = 2x$

HW: (3-35 odds)

EXAMPLE 1
p. 499
Exs. 3–7

EXPONENTIAL FORM **Rewrite the equation in exponential form.**

3. $\log_4 16 = 2$ 4. $\log_7 343 = 3$ 5. $\log_6 \frac{1}{36} = -2$ 6. $\log_{64} 1 = 0$

7. **ERROR ANALYSIS** *Describe* and correct the error in rewriting the equation $2^{-3} = \frac{1}{8}$ in logarithmic form.

$\log_2 -3 = \frac{1}{8}$ X

EXAMPLE 2
p. 500
Exs. 8–19

EVALUATING LOGARITHMS **Evaluate the logarithm without using a calculator.**

8. $\log_{15} 15$ 9. $\log_7 49$ 10. $\log_6 216$ 11. $\log_2 64$

12. $\log_9 1$ 13. $\log_{1/2} 8$ 14. $\log_3 \frac{1}{27}$ 15. $\log_{16} \frac{1}{4}$

16. $\log_{1/4} 16$ 17. $\log_8 512$ 18. $\log_5 625$ 19. $\log_{11} 121$

EXAMPLE 3
on p. 500
for Exs. 20–27

CALCULATING LOGARITHMS **Use a calculator to evaluate the logarithm.**

20. $\log 14$ 21. $\ln 6$ 22. $\ln 0.43$ 23. $\log 6.213$

24. $\log 27$ 25. $\ln 5.38$ 26. $\log 0.746$ 27. $\ln 110$

EXAMPLE 5
on p. 501
for Exs. 28–36

USING INVERSE PROPERTIES **Simplify the expression.**

28. $7^{\log_7 x}$ 29. $\log_5 5^x$ 30. $30^{\log_{30} 4}$ 31. $10^{\log 8}$

32. $\log_6 36^x$ 33. $\log_3 81^x$ 34. $\log_5 125^x$ 35. $\log_2 32^x$

36. ★ **MULTIPLE CHOICE** Which expression is equivalent to $\log 100^x$?

(A) x (B) $2x$ (C) $10x$ (D) $100x$