

# SECTION 10-3



## Properties of Logarithms

*product property:*  
For all positive numbers  $m, n$ ,  
and  $b$  ( $b \neq 1$ );  
 $\log_b mn = \log_b m + \log_b n$

*quotient property:*  
For all positive numbers  
 $m, n$ , and  $b$  ( $b \neq 1$ );  
 $\log_b \frac{m}{n} = \log_b m - \log_b n$

Examples:

1) Use  $\log_2 3 \approx 1.5850$  to approximate the value of  $\log_2 48$ .

$$\begin{aligned} \log_2 48 &= \log_2 (2^4 \cdot 3) \\ &= \log_2 2^4 + \log_2 3 \\ &= 4 + \log_2 3 \approx 4 + 1.5850 \approx 5.5850 \end{aligned}$$

2) If  $\log_3 5 \approx 1.4650$  and  $\log_3 20 \approx 2.7268$ , find the approximate value of  $\log_3 4$ .

$$\begin{aligned} \log_3 4 &= \log_3 \frac{20}{5} \\ &= \log_3 20 - \log_3 5 \\ &\approx 2.7268 - 1.4650 \approx 1.2618 \end{aligned}$$

Examples:

3) Given  $\log_4 6 \approx 1.2925$ , find  $\log_4 36$ .

$$\begin{aligned} \log_4 36 &= \log_4 6^2 \\ &= 2 \log_4 6 \\ &\approx 2(1.2925) \approx 2.585 \end{aligned}$$

4) Given  $\log_3 7 \approx 1.7712$ , find  $\log_3 \frac{1}{49}$ .

$$\begin{aligned} \log_3 1/49 &= \log_3 1/7^2 \\ &= \log_3 7^{-2} \\ &= -2 \log_3 7 \approx -2(1.7712) \approx -3.5424 \end{aligned}$$

Solve the equations using the logarithm properties.

5)  $3\log_5 x - \log_5 4 = \log_5 16$

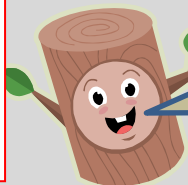
$$\begin{aligned} \log_5 x^3 - \log_5 4 &= \log_5 16 & \frac{x^3}{4} &= 16 \\ \log_5 \frac{x^3}{4} &= \log_5 16 & x^3 &= 64 \\ \frac{x^3}{4} &= 16 & x &= 4 \end{aligned}$$

6)  $\log_4 x + \log_4 (x - 6) = 2$

$$\begin{aligned} \log_4 x(x - 6) &= 2 & 0 &= x^2 - 6x - 16 \\ 4^2 &= x(x - 6) & 0 &= (x - 8)(x + 2) \\ 16 &= x^2 - 6x & x &= 8 \quad \text{and} \quad x = -2 \\ 0 &= x^2 - 6x - 16 & \text{If you check } x = -2, \log_4 (-2) & \text{is} \\ & & \text{undefined, thus } x & \neq -2 \end{aligned}$$

7)  $2\log_7 x = \log_7 27 + \log_7 3$

$$\begin{aligned} \log_7 x^2 &= \log_7 (27 \cdot 3) & \text{Again, checking } x = -9, \\ \log_7 x^2 &= \log_7 81 & 2\log_7 (-9) \text{ is undefined} \\ x^2 &= 81 & \text{so } x = 9 \text{ is the only} \\ x &= \pm 9 & \text{solution} \end{aligned}$$



Homework:  
Edmodo HW9 Sect.3