

### Product and Quotient Properties of Logarithms

For  $m > 0$ ,  $n > 0$ ,  $b > 0$ , and  $b \neq 1$ :

Product Property  $\log_b(mn) = \log_b m + \log_b n$

Quotient Property  $\log_b \frac{m}{n} = \log_b m - \log_b n$

**Complete #13-16 all and #18 – 36 even(14 problems)**

### Practice and Apply

Write each expression as a sum or difference of logarithms. Then simplify, if possible.

13.  $\log_8(5 \cdot 8)$

14.  $\log_2 8xy$

15.  $\log_3 \frac{x}{9}$

16.  $\log_4 \frac{x}{32}$

Use the values given below to approximate the value of each logarithmic expression in Exercises 17–28.

$\log_2 7 = 2.8074$	$\log_2 5 = 2.3219$	$\log_4 5 = 1.1610$
$\log_4 3 \approx 0.7925$	$\log_2 3 \approx 1.5850$	$\log_{10} 8.3 \approx 0.9191$

17.  $\log_4 15$

18.  $\log_2 35$

19.  $\log_2 28$

20.  $\log_4 12$

21.  $\log_4 60$

22.  $\log_2 105$

23.  $\log_{10} 830$

24.  $\log_{10} 0.0083$

25.  $\log_4 \frac{3}{5}$

26.  $\log_2 \frac{7}{10}$

27.  $\log_4 \frac{5}{4}$

28.  $\log_2 \frac{2}{7}$

Write each expression as a single logarithm. Then simplify, if possible.

29.  $\log_2 5 + \log_2 7$

30.  $\log_4 8 + \log_4 2$

31.  $\log_3 45 - \log_3 9$

32.  $\log_2 14 - \log_2 7$

33.  $\log_2 5 + \log_2 x - \log_2 10$

34.  $\log_3 x + \log_3 4 - \log_3 2$

35.  $\log_7 3x - \log_7 9x + \log_7 6y$

36.  $\log_5 6s - \log_5 s + \log_5 4t$