

## 7-4

## Practice

Form G

## Properties of Logarithms

Write each expression as a single logarithm.

1.  $\log_5 4 + \log_5 3$   
 $\log_5 12$

2.  $\log_6 25 - \log_6 5$   
 $\log_6 5$

3.  $\log_2 4 + \log_2 2 - \log_2 8$   
 $\log_2 1$

4.  $5 \log_7 x - 2 \log_7 x$   
 $\log_7 x^3$

5.  $\log_4 60 - \log_4 4 + \log_4 x$   
 $\log_4 15x$

6.  $\log 7 - \log 3 + \log 6$   
 $\log 14$

7.  $2 \log x - 3 \log y$   
 $\log \frac{x^2}{y^3}$

8.  $\frac{1}{2} \log r + \frac{1}{3} \log s - \frac{1}{4} \log t$   
 $\log \frac{r^{\frac{1}{2}} s^{\frac{1}{3}}}{t^{\frac{1}{4}}}$

9.  $\log_3 4x + 2 \log_3 5y$   
 $\log_3 100xy^2$

10.  $5 \log 2 - 2 \log 2$   
 $\log 8$

11.  $\frac{1}{3} \log 3x + \frac{2}{3} \log 3x$   
 $\log 3x$

12.  $2 \log 4 + \log 2 + \log 2$   
 $\log 64$

13.  $(\log 3 - \log 4) - \log 2$   
 $\log \frac{3}{8}$

14.  $5 \log x + 3 \log x^2$   
 $\log x^{11}$

15.  $\log_6 3 - \log_6 6$   
 $\log_6 \frac{1}{2}$

16.  $\log 2 + \log 4 - \log 7$   
 $\log \frac{8}{7}$

17.  $\log_3 2x - 5 \log_3 y$   
 $\log_3 \frac{2x}{y^5}$

18.  $\frac{1}{3}(\log_2 x - \log_2 y)$   
 $\log_2 \frac{x^{\frac{1}{3}}}{y^{\frac{1}{3}}}$

19.  $\frac{1}{2} \log x + \frac{1}{3} \log y - 2 \log z$   
 $\log \frac{x^{\frac{1}{2}} y^{\frac{1}{3}}}{z^2}$

20.  $3(4 \log t^2)$   
 $\log t^{24}$

21.  $\log_5 y - 4(\log_5 r + 2 \log_5 t)$   
 $\log_5 \frac{y}{r^4 t^8}$

Expand each logarithm. Simplify if possible.

22.  $\log xyz$   
 $\log x + \log y + \log z$

23.  $\log_2 \frac{x}{yz}$   
 $\log_2 x - \log_2 y - \log_2 z$

24.  $\log 6x^3y$   
 $\log 6 + 3 \log x + \log y$

25.  $\log 7(3x - 2)^2$   
 $\log 7 + 2 \log (3x - 2)$

26.  $\log \sqrt{\frac{2rst}{5w}}$   
 $\frac{1}{2} \log s + \frac{1}{2} \log t - \frac{1}{2} \log 5 - \frac{1}{2} \log w$

27.  $\log \frac{5x}{4y}$   
 $\log 5 + \log x - \log 4 - \log y$

28.  $\log_5 5x^{-5}$   
 $\log_5 5 - 5 \log_5 x$   
or  $1 - 5 \log_5 x$

29.  $\log \frac{2x^2y}{3k^3}$   
 $\log 2 + 2 \log x + \log y - \log 3 - 3 \log k$

30.  $\log_4 (3xyz)^2$   
 $2 \log_4 3 + 2 \log_4 x + 2 \log_4 y + 2 \log_4 z$

Use the Change of Base Formula to evaluate each expression. Round your answer to the nearest thousandth.

31.  $\log_4 32$  2.5

32.  $\log_3 5$  1.465

33.  $\log_2 15$  3.907

34.  $\log_6 17$  1.581

35.  $\log_6 10$  1.285

36.  $\log_5 6$  1.113

37.  $\log_8 1$  0

38.  $\log_9 11$  1.091

39. The concentration of hydrogen ions in a batch of homemade ketchup is  $10^{-4}$ . What is the pH level of the ketchup? 4

# 7-4 Practice (continued)

## Properties of Logarithms

Form G

Determine if each statement is *true* or *false*. Justify your answer.

40.  $\log 12 = \log 4 + \log 3$

true;  $\log 12 = \log (3 \cdot 4) = \log 4 + \log 3$ 

41.  $\log \frac{3}{5} = \frac{\log 3}{\log 5}$

false;  $\log \frac{3}{5} = \log 3 - \log 5 \neq \frac{\log 3}{\log 5}$ 

42.  $\log_6 12 + \log_6 3 = 2$

true;  $\log_6 12 + \log_6 3 = \log_6 36 = 2$ 

43.  $\frac{1}{2} \log_4 4x = \log_4 2x$

false;  $\frac{1}{2} \log_4 4x = \log_4 (4x)^{\frac{1}{2}} = \log_4 2x^{\frac{1}{2}} \neq \log_4 2x$ 

Use the properties of logarithms to evaluate each expression.

44.  $\log_2 8 - \log_2 4$  1

45.  $\log_2 160 - \log_2 5$  5

46.  $\log_6 27 + \log_6 8$  3

47.  $\log_7 14 - \log_7 2$  1

48.  $\log_4 64 + 2 \log_4 2$  4

49.  $\frac{1}{4} \log_3 162 - \log_3 \sqrt[4]{2}$  1

State the property or properties used to rewrite each expression.

50.  $\log 6 - \log 3 = \log 2$

Quotient Prop.

51.  $6 \log 2 = \log 64$

Power Prop.

52.  $\log 3x = \log 3 + \log x$

Product Prop.

53.  $\frac{1}{3} \log_2 x = \log_2 \sqrt[3]{x}$

Power Prop.

54.  $\frac{2}{3} \log 7 = \log \sqrt[3]{49}$

Power Prop.

55.  $\log_4 20 - 3 \log_4 x = \log_4 \frac{20}{x^3}$

Power and Quotient Prop.

The formula for loudness in decibels (dB) is  $L = 10 \log \frac{I}{I_0}$ , where  $I$  is the intensity of a sound in watts per square meter ( $\text{W}/\text{m}^2$ ) and  $I_0$  is  $10^{-12} \text{W}/\text{m}^2$ , the intensity of a barely audible sound.

56. A sound has an intensity of  $5.92 \times 10^{25} \text{W}/\text{m}^2$ . What is the loudness of the sound in decibels? Use  $I_0 = 10^{-12} \text{W}/\text{m}^2$ . **about 377.7 decibels**

57. Suppose you decrease the intensity of a sound by 45%. By how many decibels would the loudness be decreased? **about 2.6 decibels**

58. **Writing** Explain why  $\log \left(\frac{9}{4}\right) \neq \frac{\log 9}{\log 4}$ .  **$\log \left(\frac{9}{4}\right) = \log 9 - \log 4 \neq \frac{\log 9}{\log 4}$**