

1. Complete the table by evaluating the logarithm without using a calculator. NO DECIMAL ANSWERS.

$\log_4 256$ 4	$\log_2 \frac{1}{16}$ -4	$\log_{49} 7$ $\frac{1}{2}$
$\log_9 9$ 1	$\log_3 81$ 4	$\log_5 \frac{125}{8}$ -3
$\log_6 1$ 0	$\log_4 64$ 3	$\log_{\frac{1}{2}} 32$ -5
$\log_6 216$ 3	$\log_7 2401$ 4	$\log_{64} 4$ $\frac{1}{3}$
$\ln e^3$ 3	$\log_{14} 14$ 1	$\log_9 0$ UNDEFINED
$\log_2 1$ 0	$\log_{27} 3$ $\frac{1}{3}$	$\log_{25} (-4)$ UNDEFINED

2. Rewrite the equation in exponential form.

2. $\log_2 32 = 5$ $2^5 = 32$

4. $\log_{25} 16 = -4$ $.25^{-2} = 16$

6. $\log_6 36 = 2$ $6^2 = 36$

3. $\log 100 = 2$ $10^2 = 100$

5. $\log_{625} 5 = \frac{1}{4}$ $625^{\frac{1}{4}} = 5$

6. $\log_{49} 7 = \frac{1}{2}$ $49^{\frac{1}{2}} = 7$

Rewrite the equation in logarithmic form.

7. $5^3 = 125$ $\log_5 125 = 3$

8. $10^{-2} = 0.01$ $\log .01 = -2$

9. $64^{\frac{1}{3}} = 4$ $\log_{64} 4 = \frac{1}{3}$

10. $81^{\frac{1}{4}} = 3$ $\log_{81} 3 = \frac{1}{4}$

11. $(\frac{25}{49})^{\frac{1}{2}} = \frac{7}{5}$ $\log_{\frac{25}{49}} \frac{7}{5} = -\frac{1}{2}$

12. $36^{-\frac{3}{2}} = \frac{1}{216}$ $\log_{36} \frac{1}{216} = -\frac{3}{2}$

Rewrite the equation in exponential form. Then solve.

13. $\log_{343} x = \frac{1}{3}$
 $343^{\frac{1}{3}} = x$

$x = 7$

14. $\log_x 8 = \frac{1}{2}$
 $x^{\frac{1}{2}} = 8$

$x = 64$

15. $\log_2 128 = x$
 $2^x = 128$

$x = 7$

16. $\log_4(2x+6) = 3$
 $4^3 = 2x+6$
 $64 = 2x+6$

$x = 29$
 $58 = 2x$
 $x = 29$

17. $\log_7(x-1) = 5$
 $7^5 = x-1$
 $16,807 = x-1$

$x = 16,808$

18. $\log_{\frac{1}{3}}(2x) = -4$
 $(\frac{1}{3})^{-4} = 2x$
 $81 = 2x$

$x = 40.5$

19. $\log_2(x-3) = 6$
 $2^6 = x-3$
 $64 = x-3$
 $x = 67$

$x = 67$

20. $\log(2x+4) = 2$
 $10^2 = 2x+4$
 $100 = 2x+4$
 $96 = 2x$

$x = 48$

21. $\log_8(7-3x) = 3$
 $8^3 = 7-3x$
 $512 = 7-3x$
 $505 = -3x$

$x = -\frac{505}{3}$

22. $\ln(x-6) = -2$
 $e^{-2} = x-6$
 $.135 \dots = x-6$

$x \approx 6.135$

23. $\log_4(6x-13) = 5$
 $4^5 = 6x-13$
 $1024 = 6x-13$

$x = \frac{1037}{6}$

24. $9 = \log_{32}(3x+7)$
 $.32^9 = 3x+7$
 $.000 \dots = 3x+7$
 $-6.99 \dots = 3x$

$x = -2.33$

25. $\log_{\frac{1}{4}}(2x) = -4$
 $(\frac{1}{4})^{-4} = 2x$
 $256 = 2x$
 $x = 128$

$x = 128$

26. $\log(x^2-5) = 2$
 $10^2 = x^2-5$
 $100 = x^2-5$
 $105 = x^2$
 $x = \pm\sqrt{105}$

27. $7 = \ln(1-3x)$
 $e^7 = 1-3x$

$x \approx -365.21$
 $1096.63 \dots = 1-3x$
 $1095.63 \dots = -3x$
 $x \approx -365.21$

28. $\log_2(x^2+4x) = 5$
 $2^5 = x^2+4x$
 $0 = x^2+4x-32$
 $0 = (x+8)(x-4)$
 $x = -8, x = 4$

$x = -8, x = 4$

29. $\log_{\frac{1}{3}} x = -4$
 $(\frac{1}{3})^{-4} = x$
 $x = 81$

$x = 81$

30. $\log x^{\frac{3}{2}} = 3$
 $10^3 = x^{\frac{3}{2}}$
 $1000 = x^{\frac{3}{2}}$
 $1000^{\frac{2}{3}} = x$
 $x = 100$

$x = 100$

31. $\ln(4-x) = 5$
 $e^5 = 4-x$
 $148.41 \dots = 4-x$
 $144.4 \dots = 4-x$
 $140.4 \dots = -x$

$x \approx -140.43$

32. $6 = \log_3(3x+1)$
 $3^6 = 3x+1$
 $729 = 3x+1$
 $728 = 3x$

$x = 728$
 3

Use the given values and the properties of logarithms in order to estimate the value of each log expression. SHOW ALL STEPS!

1. Given $\log_5 8 \approx 1.292$, $\log_5 4 \approx 0.861$, and $\log_5 3 \approx 0.683$, estimate

a. $\log_5 64$

$$\begin{aligned} \log_5 8^2 \\ 2 \log_5 8 \\ 2(1.292) \\ \approx 2.584 \end{aligned}$$

b. $\log_5 32$

$$\begin{aligned} \log_5 (8 \cdot 4) \\ \log_5 8 + \log_5 4 \\ 1.292 + 0.861 \\ \approx 2.153 \end{aligned}$$

c. $\log_5 81$

$$\begin{aligned} \log_5 3^4 \\ 4 \log_5 3 \\ 4(.683) \\ \approx 2.732 \end{aligned}$$

d. $\log_5 \frac{16}{3}$

$$\begin{aligned} \log_5 \frac{4^2}{3} \\ 2 \log_5 4 - \log_5 3 \\ 2(.861) - .683 \\ 1.722 - .683 \\ \approx 1.039 \end{aligned}$$

e. $\log_5 \frac{4}{9}$

$$\begin{aligned} \log_5 \frac{4}{3^2} \\ \log_5 4 - 2 \log_5 3 \\ .861 - 2(.683) \\ .861 - 1.366 \\ \approx -.505 \end{aligned}$$

f. $\log_5 144$

$$\begin{aligned} \log_5 (4 \cdot 3)^2 \\ 2[(\log_5 (4 \cdot 3))] \\ 2[\log_5 4 + \log_5 3] \\ 2[.861 + .683] \\ 2(1.544) \\ \approx 3.088 \end{aligned}$$

2. Given $\log_7 18 \approx 1.485$,

$\log_7 5 \approx 0.827$, and $\log_7 \frac{1}{2} \approx -0.356$, estimate

a. $\log_7 .25$

b. $\log_7 10$

c. $\log_7 9$

d. $\log_7 8$

e. $\log_7 90$

f. $\log_7 \frac{18}{25}$

you try!

Name:

Date:

Period:

Practice Worksheet: Expanding & Condensing Logs

Use Properties of Logs to expand the expression fully. Simplify completely and show all work.

1] $\log(xy^3)$

$$\log x + 3\log y$$

2] $\log\left(\frac{xy}{10}\right)$

$$\log x + \log y - \log 10$$

$$\log x + \log y - 1$$

3] $\log_2\left(\frac{4}{3x^2}\right)$

$$\log_2 4 - \log_2 3 - 2\log_2 x$$

$$2 - \log_2 3 - 2\log_2 x$$

4] $\ln(x \cdot \sqrt[3]{e})$

$$\ln x + \frac{1}{3} \ln e$$

$e \rightarrow$ look

$$\ln x + \frac{1}{3} \textcircled{1}$$

$$\ln x + \frac{1}{3}$$

5] $\ln\sqrt{x^4 y}$

$$\frac{1}{2} \ln x^4 + \frac{1}{2} \ln y$$

$$4\left(\frac{1}{2}\right) \ln x + \frac{1}{2} \ln y$$

$$2 \ln x + \frac{1}{2} \ln y$$

6] $\log_4\left(\frac{(2x)^4}{y}\right)$

$$\log_4 \frac{16x^4}{y}$$

$$\log_4 16 + \log_4 x^4 - \log_4 y^4$$

$$2 + 4\log_4 x - 4\log_4 y$$

7] $\log\frac{100}{\sqrt{x} \cdot y^4}$

$$\log 100 - \frac{1}{2} \log x - 4 \log y$$

$$2 - \frac{1}{2} \log x - 4 \log y$$

8] $\log\left(\frac{x-1}{x+1}\right)^2$

$$2 \log(x-1) - 2 \log(x+1)$$

If there is a coefficient, move into exponent position

Use Properties of Logs to condense the expression fully. Simplify completely and show all work.

9] $\log 4 + 3 \log x + \log y$

$$\log 4 + \log x^3 + \log y$$

$$\log 4x^3y$$

↑ one log only

10] $3 \log x + \log 2 - \log y - \log 4$

$$\log \frac{x^3 \cdot 2}{y \cdot 4}$$

$$\log \frac{x^3}{2y}$$

11] $\log_2 9 - \log_2 y + \frac{1}{2} \log_2 x - \log_2 3$

$$\log_2 \frac{9\sqrt{x}}{y \cdot 3}$$

$$\log_2 \frac{3\sqrt{x}}{y}$$

12] $2(\ln x + \ln 3) - 3 \ln y$

$$\ln x^2 + \ln 3^2 - 3 \ln y$$

$$\ln \frac{9x^2}{y^3}$$

13] $\frac{1}{2}(\ln 8x^2 - \ln 4 - 3 \ln x - \ln y)$

$$\ln \sqrt{\frac{8x^2}{4 \cdot x^3 \cdot y}}$$

$$\ln \sqrt{\frac{2}{xy}}$$

14] $2 \ln(x+3) + \ln(x-3) - \ln(x^2-9)$

$$\ln (x+3)^2 \cdot (x-3)$$

$$\frac{\quad}{(x^2-9) \leftarrow \text{D.O.T.S}}$$

$$\frac{\ln (x+3)(x+3) \cdot (x-3)}{(x+3)(x-3)}$$

$$\ln (x+3)$$

ODDS only

Logarithms: Expand, Condense, Properties, Equations

Expand each logarithm.

1) $\ln(x^6 y^3)$ $6 \ln x + 3 \ln y$

2) $\log_8(x \cdot y \cdot z^3)$
 $\log_8 x + \log_8 y + 3 \log_8 z$

3) $\log_9\left(\frac{3^3}{7}\right)^4$ $\rightarrow \frac{3^{12}}{7^4}$

4) $\log_7\left(\frac{x^3}{y}\right)^3$ $\log_7 \frac{x^9}{y^3}$
 $9 \log_7 x - 3 \log_7 y$

5) $\log_8(a^6 b^5)$ $6 + 4 \log_8 7$
 $6 \log_8 a + 5 \log_8 b$

6) $\log_4(6^3 \cdot 11^3)$
 $3 \log_4 6 + 3 \log_4 11$

7) $\log_3\left(\frac{u^3}{v}\right)^2$ $\log_3 \frac{u^6}{v^2}$
 $6 \log_3 u - 3 \log_3 v$

8) $\ln \sqrt[3]{x \cdot y \cdot w}$
 $\frac{1}{3} \ln x + \frac{1}{3} \ln y + \frac{1}{3} \ln w$

9) $\log_6(3 \cdot 2 \cdot 5^6)$
 $\log_6 3 + \log_6 2 + 6 \log_6 5$

10) $\log_4(2 \cdot 11 \cdot 7^4)$
 $\log_4 2 + \log_4 11 + 4 \log_4 7$
 $\frac{1}{2} + \log_4 11 + 4 \log_4 7$

11) $\log_6(c^5 \sqrt[3]{a})$
 $5 \log_6 c + \frac{1}{3} \log_6 a$

12) $\ln\left(\frac{5^2}{2}\right)^5$ $\ln \frac{5^{10}}{2^5}$
 $10 \ln 5 - 5 \ln 2$

13) $\log_5\left(\frac{x^3}{y}\right)^6$ $\log_5 \frac{x^{18}}{y^6}$
 $18 \log_5 x - 6 \log_5 y$

14) $\log_4(7^3 \sqrt[3]{2})$
 $3 \log_4 7 + \frac{1}{3} \log_4 2$
 $3 \log_4 7 + \frac{1}{3} \left(\frac{1}{2}\right)$

15) $\log_2(u \cdot v \cdot w^2)$
 $\log_2 u + \log_2 v + 2 \log_2 w$

16) $\log_9(12^3 \cdot 7^6)$
 $3 \log_9 12 + 6 \log_9 7$

17) $\log_9(c^5 \sqrt[3]{a})$
 $5 \log_9 c + \frac{1}{3} \log_9 a$

ODDS

18) $\log_7 (x^5 \cdot y)^4$

$\log_7 (x^{20} \cdot y^4)$
 $20 \log_7 x + 4 \log_7 y$

19) $\log_7 (z^2 \sqrt{x})$

$2 \log_7 z + \frac{1}{2} \log_7 x$

20) $\log_8 (u \cdot v \cdot w^5)$

$\log_8 u + \log_8 v + 5 \log_8 w$

Condense each expression to a single logarithm.

21) $2 \log_6 u - 8 \log_6 v$

$\log_6 \frac{u^2}{v^8}$

22) $8 \log_5 a + 2 \log_5 b$

$\log_5 a^8 + \log_5 b^2$
 $\log_5 a^8 b^2$

23) $8 \log_3 12 + 2 \log_3 5$

$\log_3 12^8 \cdot 5^2$

24) $3 \log_4 u - 18 \log_4 v$

$\log_4 \frac{u^3}{v^{18}}$

25) $2 \log_5 z + \frac{\log_5 x}{2}$

$\log_5 z^2 + \frac{1}{2} \log_5 x$
 $\log_5 z^2 x^{\frac{1}{2}}$

26) $6 \log_2 u - 24 \log_2 v$

$\log_2 \frac{u^6}{v^{24}}$

27) $6 \log 8 - 30 \log 11$

$\log \frac{8^6}{11^{30}}$

28) $4 \log_9 11 - 4 \log_9 7$

$\log_9 \frac{11^4}{7^4}$

29) $3 \log x - 5 \log y$

$\log \frac{x^3}{y^5}$

30) $6 \log_6 10 - 24 \log_6 3$

$\log_6 \frac{10^6}{3^{24}}$

31) $\ln z + \frac{\ln x}{3} + \frac{\ln y}{3}$

$\ln z + \frac{1}{3} \ln x + \frac{1}{3} \ln y$
 $\ln z \sqrt[3]{xy}$

32) $3 \log_4 x + 9 \log_4 y$

$\log_4 \frac{x^3}{y^4}$

33) $5 \log_4 a - 6 \log_4 b$

$\log_4 \frac{a^5}{b^6}$

34) $\log_9 z + \frac{\log_9 x}{2} + \frac{\log_9 y}{2}$

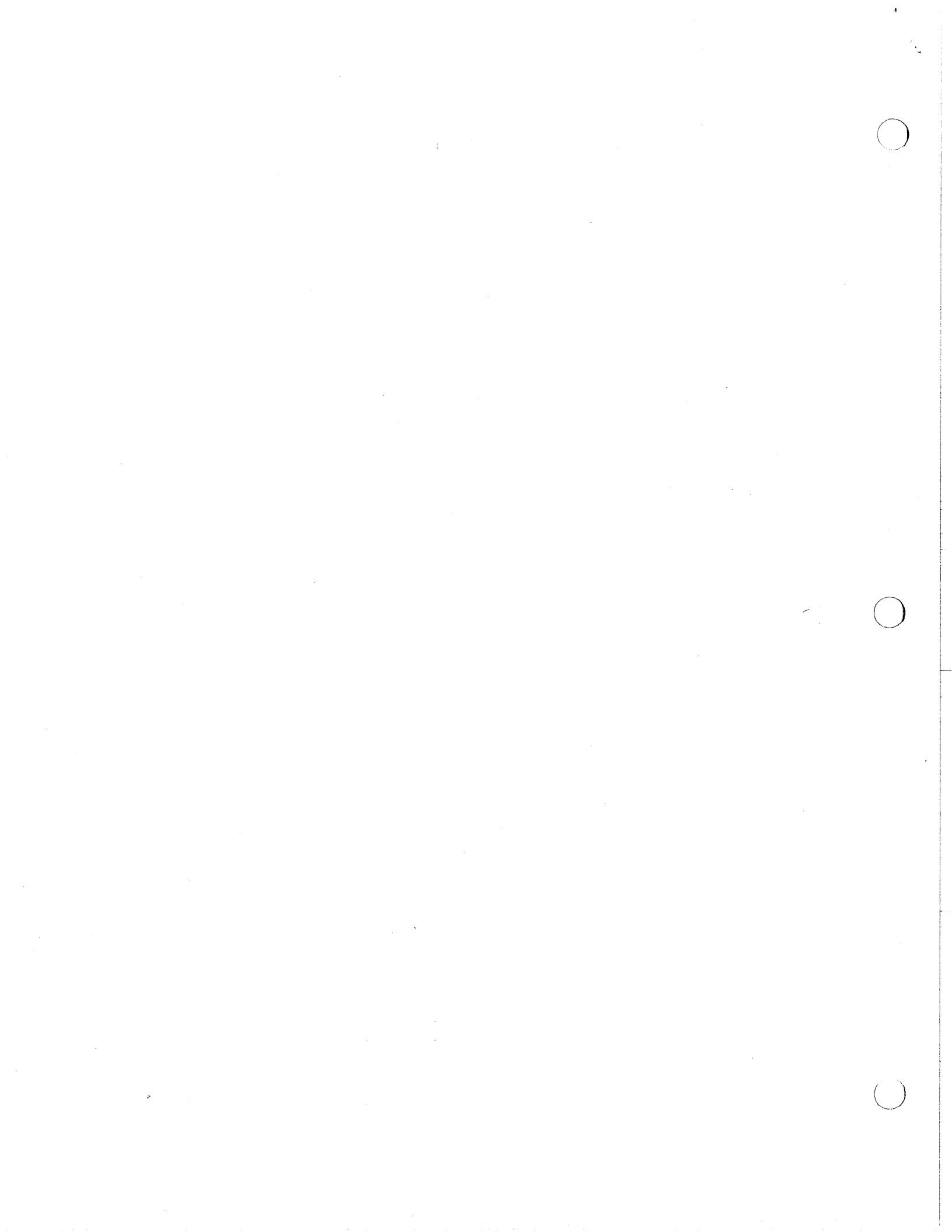
$\log_9 z + \frac{1}{2} \log_9 x + \frac{1}{2} \log_9 y$
 $\log_9 z \sqrt{xy}$

35) $4 \log_2 11 - 6 \log_2 6$

$\log_2 \frac{11^4}{6^6}$

36) $\log_7 z + \frac{\log_7 x}{3} + \frac{\log_7 y}{3}$

$\log_7 z + \frac{1}{3} \log_7 x + \frac{1}{3} \log_7 y$
 $\log_7 z \sqrt[3]{xy}$



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3] $\log_2\left(\frac{4}{3x^2}\right)$

4] $\ln(x \cdot \sqrt[3]{e})$

5] $\ln\sqrt{x^4y}$

6] $\log_4\left(\frac{(2x)^4}{y}\right)$

7] $\log\frac{100}{\sqrt{x} \cdot y^4}$

8] $\log\left(\frac{x-1}{x+1}\right)^2$

Use Properties of Logs to condense the expression fully. Simplify completely and show all work.

9] $\log 4 + 3 \log x + \log y$

10] $3 \log x + \log 2 - \log y - \log 4$

11] $\log_2 9 - \log_2 y + \frac{1}{2} \log_2 x - \log_2 3$

12] $2(\ln x + \ln 3) - 3 \ln y$

13] $\frac{1}{2}(\ln 8x^2 - \ln 4 - 3 \ln x - \ln y)$

14] $2 \ln(x + 3) + \ln(x - 3) - \ln(x^2 - 9)$

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3) $\log_9\left(\frac{3^3}{7}\right)^4$

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13) $\log_5\left(\frac{x^3}{y}\right)^6$

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15) $\log_2(u \cdot v \cdot w^2)$

16) $\log_9(12^3 \cdot 7)^6$

17) $\log_9(c^5 \sqrt[3]{a})$

18) $\log_7 (x^5 \cdot y)^4$

19) $\log_7 (z^2 \sqrt{x})$

20) $\log_8 (u \cdot v \cdot w^5)$

Condense each expression to a single logarithm.

21) $2 \log_6 u - 8 \log_6 v$

22) $8 \log_5 a + 2 \log_5 b$

23) $8 \log_3 12 + 2 \log_3 5$

24) $3 \log_4 u - 18 \log_4 v$

25) $2 \log_5 z + \frac{\log_5 x}{2}$

26) $6 \log_2 u - 24 \log_2 v$

27) $6 \log 8 - 30 \log 11$

28) $4 \log_9 11 - 4 \log_9 7$

29) $3 \log x - 5 \log y$

30) $6 \log_6 10 - 24 \log_6 3$

31) $\ln z + \frac{\ln x}{3} + \frac{\ln y}{3}$

32) $3 \log_4 x + 9 \log_4 y$

33) $5 \log_4 a - 6 \log_4 b$

34) $\log_9 z + \frac{\log_9 x}{2} + \frac{\log_9 y}{2}$

35) $4 \log_2 11 - 6 \log_2 6$

36) $\log_7 z + \frac{\log_7 x}{3} + \frac{\log_7 y}{3}$

