HOMEWORK – Properties of Logarithms

Name: _____ Date: _____ Period: _____

Write the expression as a SINGLE logarithm. SIMPLIFY, if possible.

1. $\log_3 x + \log_3 4 - \log_3 2$	2. $\log_2\left(\frac{1}{x}\right) + \log_2\left(\frac{1}{x^2}\right)$
3. $7\log_3 x - 4\log_3 x$	4. $\frac{1}{2}\log 3c + \frac{1}{2}\log 4d - 2\log 5e$

EXPAND the logarithm completely. SIMPLIFY, if possible.

5. $\log(3 \cdot 2^3)$	6. $\log_5\left(\frac{2x}{5}\right)^4$
7. $\log_2 \sqrt{8a^7}$	8. $\log \frac{1}{mn}$

EVALUATE without a calculator.

9. $\log_3 3^5 + \log_5 125$	10. $\log_3 \frac{1}{9} - 2^{\log_2 3}$
11. $\log_2 6 \cdot \log_6 8$	12. $5^{\log_5 6 + \log_5 7}$

PRACTICE using the Properties of Logarithms

Write the expression as a SINGLE logarithm. SIMPLIFY, if possible.

1. $\log_2 14 - \log_2 7$

$= \log_2 \frac{14}{7}$

$= \log_2 2 = \boxed{1}$

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

$= \log_2 5x - \log_2 10$

$= \log_2 \frac{5x}{10} = \boxed{\log_2 \frac{x}{2} \text{ OR } \log_2 \frac{1}{2}x}$

3. $2\log 5 + \log 4$

$= \log 5^2 + \log 4$

$= \log 25 + \log 4$

$= \log 25(4) = \log 100$

$= \boxed{10}$

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

$= \log_7 \frac{\cancel{3x}}{\cancel{9x}} + \log_7 6y$

$= \log_7 \frac{1}{3}(6y) = \boxed{\log_7 2y}$

5. $5\log_2 x - 2\log_2 y$

$= \log_2 x^5 - \log_2 y^2$

$= \boxed{\log_2 \frac{x^5}{y^2}}$

6. $4\log_b x + \frac{1}{2}\log_b y - 3\log_b 2z$

$= \log_b x^4 + \log_b y^{1/2} - \log_b (2z)^3$

$= \log_b x^4\sqrt{y} - \log_b 8z^3$

$= \boxed{\log_b \frac{x^4\sqrt{y}}{8z^3}}$

EXPAND the logarithm completely. SIMPLIFY, if possible.

7. $\log_3 8x^2y$

$= \log_3 8 + \log_3 x^2 + \log_3 y$

$= \boxed{\log_3 8 + 2\log_3 x + \log_3 y}$

8. $\log\left(\frac{x}{9}\right)^5$

$= \log \frac{x^5}{9^5} = \log x^5 - \log 9^5$

$= \boxed{5\log x - 5\log 9}$

9. $\log_b \frac{b}{x}$

$= \log_b b - \log_b x$

$= \boxed{1 - \log_b x}$

10. $\log \frac{x^2y^3}{z^4}$

$= \log x^2 + \log y^3 - \log z^4$

$= \boxed{2\log x + 3\log y - 4\log z}$

11. $\log_4 4\sqrt{3x^3}$

$= \log_4 4 + \log(3x^3)^{1/2}$

$= \boxed{1 + \frac{1}{2}\log 3 + \frac{3}{2}\log x}$

12. $\log_2 \sqrt{\frac{m}{n^3}}$

$= \log_2 \frac{m^{1/2}}{(n^3)^{1/2}} = \log_2 \frac{m^{1/2}}{n^{3/2}}$

$= \boxed{\frac{1}{2}\log_2 m - \frac{3}{2}\log_2 n}$

EVALUATE without a calculator.

13. $\log 10^2$

$\boxed{2}$

14. $\log_9 9^{11} - \log_4 64$

$11 - 3 = \boxed{8}$

15. $6^{\log_6 3} - \log_5 \frac{1}{25}$

$= 3 - \log_5 5^{-2}$

$= 3 - (-2) = \boxed{5}$

16. $\log_3 8 \cdot \log_8 9$

$= \frac{\cancel{\log 8}}{\log 3}\left(\frac{\log 9}{\cancel{\log 8}}\right) = \frac{\log 9}{\log 3}$

$= \log_3 9 = \boxed{2}$

17. $\log_4 48 - \frac{1}{2}\log_4 9$

$= \log_4 48 - \log_4 9^{1/2}$ ← $\sqrt{9}$

$= \log_4 48 - \log_4 3$

$= \log_4 \frac{48}{3} = \log_4 16 = \boxed{2}$

18. $\frac{1}{2}\log_5 15 - \log_5 \sqrt{75}$

$= \log_5 \sqrt{15} - \log_5 \sqrt{75}$

$= \log_5 \frac{\sqrt{15}}{\sqrt{75}} = \log_5 \sqrt{\frac{1}{5}}$

$= \log_5 5^{-1/2} = \boxed{-\frac{1}{2}}$

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Write the expression as a SINGLE logarithm. SIMPLIFY, if possible.

1. $\log_3 x + \log_3 4 - \log_3 2$ $= \log_3 4x - \log_3 2$ $= \log_3 \frac{4x}{2}$ $= \log_3 2x$	2. $\log_2\left(\frac{1}{x}\right) + \log_2\left(\frac{1}{x^2}\right)$ $= \log_2\left(\frac{1}{x}\right)\left(\frac{1}{x^2}\right)$ $= \log_2 \frac{1}{x^3}$
3. $7\log_3 x - 4\log_3 x$ $= \log_3 x^7 - \log_3 x^4$ $= \log_3 \frac{x^7}{x^4}$ $= \log_3 x^3$	4. $\frac{1}{2}\log 3c + \frac{1}{2}\log 4d - 2\log 5e$ $= \log(3c)^{\frac{1}{2}} + \log(4d)^{\frac{1}{2}} - \log(5e)^2$ $= \log\sqrt{3c}\left(\sqrt{4d}\right) - \log 25e^2$ $= \log\frac{\sqrt{12cd}}{25e^2} = \log\frac{2\sqrt{3cd}}{25e^2}$

EXPAND the logarithm completely. SIMPLIFY, if possible.

5. $\log(3 \cdot 2^3)$ $= \log 3 + \log 2^3$ $= \log 3 + 3\log 2$	6. $\log_5\left(\frac{2x}{5}\right)^4$ $= \log_5 \frac{2^4x^4}{5^4}$ $= 4\log_5 2 + 4\log_5 x - 4\log_5 5$ $= 4\log_5 2 + 4\log_5 x - 4$ *OR* $= 4(\log_5 2 + \log_5 x - 1)$
7. $\log_2\sqrt{8a^7}$ $= \log_2 8^{\frac{1}{2}}a^{\frac{7}{2}}$ $= \frac{1}{2}\log_2 8 + \frac{7}{2}\log a$ $= \frac{1}{2}(3) + \frac{7}{2}\log a$ $= \frac{3}{2} + \frac{7}{2}\log a$	8. $\log\frac{1}{mn}$ $= \log 1 - (\log m + \log n)$ $= 0 - \log m - \log n$ $= -\log m - \log n$

EVALUATE without a calculator.

9. $\log_3 3^5 + \log_5 125$ $= 5 + 3$ $= 8$	10. $\log_3 \frac{1}{9} - 2^{\log_2 3}$ $= -2 - 3$ $= -5$
11. $\log_2 6 \cdot \log_6 8$ $= \frac{\log 6}{\log 2}\left(\frac{\log 8}{\log 6}\right)$ $= \frac{\log 8}{\log 2}$ $= \log_2 8$ $= 3$	12. $5^{\log_5 6 + \log_5 7}$ $= 5^{\log_5 42}$ $= 42$