Block: _____

Name: _____ Date: _____

Class Examples: Properties of Logarithms **Honors PreCalculus**

Use the Properties of Logarithms to evaluate each expression.

1. $\log_4 192 - \log_4 3$

$\log_4 \frac{192}{3}$

$\log_4 64 = x$

$4^x = 64$

$\boxed{x = 3}$

2. $\log_3 \sqrt{27}$

$\log_3 27^{1/2}$

$\frac{1}{2}\log_3 27$

$3^x = 27$

$x = 3$

$\frac{1}{2}(3) = \boxed{3/2}$

3. $\log_2 6 - \log_2 15 + \log_2 20$

$\log_2 \frac{6 \cdot 20}{15}$

$\log_2 8 = x$

$2^x = 8$

$\boxed{x = 3}$

4. $\log \frac{1}{\sqrt{1000}}$

$\log 1000^{-1/2}$

$-1/2 \log 1000$

$10^x = 1000$

$x = 3$

$-1/2(3) = \boxed{-3/2}$

5. $\log_9 \frac{1}{3} + 3\log_9 3$

$\log_9 \frac{1}{3}(3^3)$

$\log_9 \frac{1}{3}(27)$

$\log_9 9 = x$

$9^x = 9$

$\boxed{x = 1}$

6. $\log_3 100 - \log_3 18 - \log_3 50$

$\log_3 \frac{100}{18 \cdot 50}$

$\log_3 \frac{1}{9} = x$

$3^x = \frac{1}{9}$

$\boxed{x = -2}$

Expand each logarithm.

7. $\log_2 (xy)^{10}$

$10 \log_2 x + 10 \log_2 y$

8. $\ln \sqrt[3]{3r^2 s}$

$\frac{1}{3}(\ln 3 + 2\ln r + \ln s)$

$\frac{1}{3}\ln 3 + \frac{2}{3}\ln r + \frac{1}{3}\ln s$

9. $\log_3 \frac{5x^3\sqrt{y}}{9z^4}$

$\log_3 5 + 3\log_3 x + \frac{1}{2}\log_3 y - \log_3 9 - 4\log_3 z$

$3^x = 9$

$x = 2$

$\log_3 5 + 3\log_3 x + \frac{1}{2}\log_3 y - 2 - 4\log_3 z$

10. $\log\left(\frac{a^2}{b^4\sqrt{c}}\right)$

$2\log a - 4\log b - \frac{1}{2}\log c$

11. $\ln\left(\frac{x^3\sqrt{x-1}}{3x+4}\right)$

$3\ln x + \frac{1}{2}\ln(x-1) - \ln(3x+4)$

12. $\log\left(\frac{10^x}{x(x^2+1)(x^4+2)}\right)$

$x \log 10 - \log x - \log(x^2+1) - \log(x^4+2)$

$10^x = 10$

$x = 1$

$x - \log x - \log(x^2+1) - \log(x^4+2)$

Condense: Write each logarithm as a single logarithm.

13. $2(\log_5 x + 2\log_5 y - 3\log_5 z)$

$2\log_5 x + 4\log_5 y - 6\log_5 z$

$\log_5 \frac{x^2 y^4}{z^6}$

14. $2\log a - 4\log b - \frac{1}{2}\log c$

$\log \frac{a^2}{b^4\sqrt{c}}$

15. $2[\ln x + \ln(x-2)] - \frac{1}{2}\ln(2x-3)$

$2\ln x + 2\ln(x-2) - \frac{1}{2}\ln(2x-3)$

$\ln \frac{x^2(x-2)^2}{\sqrt{2x-3}}$

16. $4\log x - \frac{1}{3}\log(x^2+1) + 2\log(x-1)$

$\log \frac{x^4(x-1)^2}{\sqrt[3]{x^2+1}}$

17. $4\log_2 x - \frac{1}{3}[\log_2(2x+1) + \log_2 x] + \frac{1}{2}\log_2(x+3)$

$4\log_2 x - \frac{1}{3}\log_2(2x+1) - \frac{1}{3}\log_2 x + \frac{1}{2}\log_2(x+3)$

$\log_2 \frac{x^4\sqrt{x+3}}{\sqrt[3]{x(2x+1)}}$

Write each in simplest form.

18. $21\log_3 \sqrt[3]{x} + \log_3(9x^2) - \log_3 9$

$\log_3 \frac{x^{21/3} \cdot 9x^2}{9} \rightarrow \log_3 x^7 \cdot x^2$

$\rightarrow \log_3 x^9$

$\rightarrow 9\log_3 x$

19. $\log(\sqrt{x} - \sqrt{x-1}) + \log(\sqrt{x} + \sqrt{x-1})$

$\log[(\sqrt{x} - \sqrt{x-1})(\sqrt{x} + \sqrt{x-1})]$

$\log[x - (x-1)]$

$\log 1$

0

20. $\log_5(x^2-1) - \log_5(x-1)$

$\log_5 \frac{x^2-1}{x-1}$

$\log_5 \frac{(x-1)(x+1)}{x-1}$

$\log_5(x+1)$

Partner Activity:

1. Without using a calculator, find the exact value of $\dfrac{\log_3 81 - \log_\pi 1}{\log_{2\sqrt{2}} 8 - \log 0.001}$

$4 - 0$

$2 - (-3)$

$= \boxed{\frac{4}{5}}$

$3^x = 81$ $\quad x = 4$

$\pi^x = 1$ $\quad x = 0$

$(2\sqrt{2})^x = 8$ $\quad x = 2$

$10^x = \frac{1}{1000}$ $\quad x = -3$

2. Without using a calculator, determine which is the greater number: $\log_4 60$ or $\log_3 40$

$4^x = 60$

$4^3 = 64$

close to 3

$3^x = 40$

$3^3 = 27$

$3^4 = 81$

larger