Lesson 5.4: Logarithm Properties

Log Properties

1) $\log_b xy = \log_b x + \log_b y$

2) $\log_b \frac{x}{y} = \log_b x - \log_b y$

3) $\log_b x^n = n log_b x$

Expand

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

$$\log_4 x - \log_4 16$$

$$\boxed{\log_4(x) - 2}$$

$$\log_7 x^5 y^2$$

$$\log_7 x^5 + \log_7 y^2$$

$$\boxed{5\log_7 x + 2\log_7 y}$$

$$\frac{\ln 3}{2}$$

$$\frac{\ln \frac{1}{3}}{-2}$$

$$\frac{\ln 1 - \ln 3}{-2}$$

$$\frac{-\ln 3}{-2}$$

Expand

$$\log_3 \frac{6x^2y}{w^3z^4}$$

$$\log_3 6 + \log_3 x^2 + \log_3 y - \log_3 w^3 - \log_3 z^4$$

$$\boxed{\log_3 6 + 2\log_3 x + \log_3 y - 3\log_3 w - 4\log_3 z}$$

$$\ln(ex^2)$$

$$\ln e + \ln x^2$$

$$\boxed{1 + 2\ln x}$$

Condense

$$5\log_3 x + 2\log_3 y$$

$$\log_3 x^5 + \log_3 y^2$$

$$\boxed{\log_3 (x^5 y^2)}$$

$$5\log_2 x - 3\log_2 x$$

$$\log_2 x^5 - \log_2 x^3$$

$$\log_2 \left(\frac{x^5}{x^3}\right)$$

$$\boxed{\log_2 (x^2)}$$

Condense

$$2\log_7 x - \log_7 y - 4\log_7 z$$

$$\log_7 x^2 - \log_7 y - \log_7 z^4$$

$$\boxed{\log_7 \frac{x^2}{y z^4}}$$

Condense

$$\log_5(x^2-9) - 5\log_5(x-3) + \log_5 x$$

$$\log_5(x^2-9) - \log_5(x-3)^5 + \log_5 x$$

$$\log_5 \frac{x(x+3)(x-3)}{(x-3)^5} = \boxed{\log_5 \frac{x(x+3)}{(x-3)^4}}$$

Solving

1) Condense
2) Eliminate
3) Solve
4) Check

$$\frac{2\log_4 x}{2} = \frac{6\log_4 2}{2}$$

$$\log_4 x = 3\log_4 2$$

$$4^{\log_4 x} = 4^{\log_4 2^3}$$

$$\boxed{x = 8}$$

$$3\log_2(x-1) + \log_2(4) = 5$$

$$3\log_2(x-1) + 2 = 5$$

$$-2 \qquad -2$$

$$\frac{3\log_2(x-1)}{3} = \frac{3}{3}$$

$$2^{\log_2(x-1)} = 2^1$$

$$x-1 = 2$$

$$\boxed{x = 3} \checkmark$$

$$\underbrace{\log x + \log(x+3)}_{\downarrow} = 1$$

$$\log[x(x+3)] = 1$$

$$\log(x^2+3x) = 1$$

$$10 \qquad\qquad 10$$

$$x^2+3x = 10$$

$$x^2+3x-10 = 0$$

$$(x+5)(x-2) = 0$$

$$x = -5 \qquad \boxed{x = 2}$$

ext.

$$\ln(x+1) - \ln x = 3$$

$$e^{\ln\left(\frac{x+1}{x}\right)} = e^3$$

$$\frac{x+1}{x} = e^3$$

$$x+1 = xe^3$$

$$-x \qquad -x$$

$$1 = xe^3 - x$$

$$\frac{1}{e^3-1} = \frac{x(e^3-1)}{e^3-1}$$

$$\boxed{x = \frac{1}{e^3-1}}$$