

## Secondary Math 3H Expanding/Condensing Logarithmic Equations and Calculating Logarithms Notes

Objectives:

1. Use logarithmic rules to expand expressions
2. Use logarithmic rules to condense expressions
3. Use a calculator to evaluate logarithms

For each of the following rules,  $b \neq 1$ ,  $x$ ,  $y$ , and  $c$  are real numbers.

### **Product Rule**

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

$$\ln(xy) = \ln x + \ln y$$

### **Quotient Rule**

$$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$$

$$\ln\left(\frac{x}{y}\right) = \ln x - \ln y$$

### **Power Rule**

$$\log_b(x)^c = c \log_b x$$

$$\ln(x)^c = c \ln x$$

### Objective 1 Examples: Use the logarithmic rules to expand the expressions

a.  $\log \frac{a^4 b}{c^5}$

b.  $\ln \sqrt{m^3 n}$

c.  $\log \frac{2w^4 h^3}{a^2 b^5}$

### Objective 2 Examples: Use the logarithmic rules to condense the expressions

a.  $\ln(x+1) - 3\ln(x-2)$     b.  $\log 3 + 4\log a - \frac{2}{3}\log b$     c.  $4\ln a - 3\ln b + 7\ln c - 5\ln(d+1)$

### Change of Base Formula for Logarithms

Most calculators only have  $\log x$  and  $\ln x$ . In order to evaluate logarithms with a different base, you will need the change of base formula.

$$\log_b x = \frac{\log x}{\log b}, b \neq 1$$

or

$$\log_b x = \frac{\ln x}{\ln b}, b \neq 1$$

**Objective 3 Examples: Use the change of base formula to calculate the following expressions**

a.  $\ln 7$

b.  $\log 0.15$

c.  $\log_4 17$

d.  $\log_{52} 26$