**MHF 4U**

**LAWS OF LOGARITHMS**

| RECALL **Laws of Exponents**: | ***LAWS OF LOGARITHMS***: |
|---|---|
| $\boldsymbol{a^m \times a^n = a^{m+n}}$ | $\boldsymbol{log_a m + log_a n = log_a(mn)}$ |
| $\boldsymbol{a^m \div a^n = a^{m-n}}$ | $\boldsymbol{log_a m - log_a n = log_a\left(\frac{m}{n}\right)}$ |
| $\boldsymbol{(a^m)^n = a^{m\times n}}$ | $\boldsymbol{n log_a m = log_a m^n}$ |
| $\boldsymbol{a^0 = 1}$ | $\boldsymbol{log_a 1 = 0}$ |

**EXERCISE:** Use the laws of logarithms for each of the following questions.

1. Express as a single logarithm.

A) $2loga + 4logb$

B) $2log_3 k - \frac{1}{2}log_3 w - 3log_3 t$

C) $3ln2 - 2lnh + \frac{1}{3}lnk$

D) $-2log_2 p - \frac{3}{2}log_2 d$

2. Expand each logarithm.

A) $log_2(a^2bc^3)$

B) $log_5\left(\frac{3a}{5bc^2}\right)$

C) $ln\left(\frac{6e^2}{\sqrt{h}}\right)$

D) $ln\left(\frac{1}{4\sqrt[3]{e}}\right)$

3. Simplify each of the following. Then evaluate.

A) $log_3\left(\frac{1}{81}\right)$

B) $log_6\sqrt[3]{\frac{1}{36}}$

C) $ln\left(\frac{1}{\sqrt[5]{e^2}}\right)$

D) $log_2 25.6 + log_2 5$

4. Given $log_a 3 = k$ and $log_a 5 = d$, use the laws of logarithms to rewrite each expression:

A) $log_a 15$ B) $log_a 0.6$

C) $log_a 9$ D) $log_a 0.2$

E) $log_a 3a$ F) $log_a (25a^3)$

G) $log_a 0.04a$ H) $log_a 5.4a^2$

5. Rewrite each logarithmic function using the laws of logarithms.

A) $f(x) = log\ (1000x)$ B) $y = log_2 64x^2$

C) $g(x) = log_4 \frac{1}{64\sqrt{x}}$ D) $P(t) = ln\left(\frac{1}{e^2 t^3}\right)$

E) $H(t) = ln\left(\sqrt{et^3}\right)$ F) $a(n) = log_2\left(\frac{1}{32n}\right)$

***Answers:***

1. a) $\log[a^2b^4]$; b) $\log[k^2/(w^{1/2}t^3)]$; c) $\ln[8k^{1/3}/h^2]$;
2. a) 2loga+logb+3logc; b) log3+loga-log5-logb-2logc; c) ln6+2-½lnh;
3. a) -4; b) -2/3; c) -2/5; d) 7;
4. a) kd; b) k/d; c) 2k; d) –d; e) d+1; f) 2d+3; g) -2d+1; h) 3k-d+2;
5. a) logx + 3; b) 2logx+6; c) -1/2logx-3; d) -3lnt-2; e) 3/2lnt+1/2; f) –logn-5