

EXPONENTS AND LOGARITHMS

For $a > 0$, $b > 0$, u , v , and $n \in \mathfrak{R}$; let $M = a^u$ and $N = a^v$
 then $u = \log_a M$ and $v = \log_a N$

1. $a^u > 0$, $a^v > 0$ and $a \neq 1$ $M > 0$ and $N > 0$
2. $a^u = a^v \Leftrightarrow u = v$ $\log_a M = \log_a N \Leftrightarrow M = N$
3. $a^u a^v = a^{u+v}$ $\log_a M N = \log_a M + \log_a N$
4. $\frac{a^u}{a^v} = a^{u-v}$ $\log_a \frac{M}{N} = \log_a M - \log_a N$
5. $a^{-u} = \frac{1}{a^u}$ $\log_a \frac{1}{M} = -\log_a M$
6. $a^{\log_a n} = n$
 $n > 0$ $\log_a a^n = n$
7. $(a^u)^n = a^{un}$ $\log_a (M^n) = n \log_a M$
8. $a^0 = 1$ $\log_a 1 = 0$
9. $a^1 = a$ $\log_a a = 1$
10. $1^u = 1$
11. $a^u b^u = (ab)^u$
12. $a^{u/v} = \sqrt[v]{a^u} = (\sqrt[v]{a})^u$
 $v \neq 0$
13. $\log_a M = \frac{\log_b M}{\log_b a} = \frac{\ln M}{\ln a} = \log_a e \ln M$
14. $\log_a b = \frac{1}{\log_b a}$
15. $a^u = b^{u \log_b a}$

$\log_e 10 = \ln 10 \doteq \log_{2.718281828459045235} 10 \doteq 2.3025850929405684 \dots$