

## 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.  $a^u = b^{u \log_b a}$

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