

# Natural Logarithms

①  $e^{\ln(x)} = x$        $e = 2.7182818 \dots$

$$e^t = \lim_{n \rightarrow \infty} \left(1 + \frac{t}{n}\right)^n$$

②  $\ln(a \cdot b) = \ln(a) + \ln(b)$

③  $\ln\left(\frac{a}{b}\right) = \ln(a) - \ln(b)$

④  $\ln(a+b) = ?$        $\ln(a-b) = ?$       No formula for these - find sum (difference) take ln!

⑤  $a^b = e^{b \ln(a)}$

⑥  $b \ln(a) = \ln(a^b)$

⑦  $g(t) = e^{f(t)}$  then  $g'(t) = f'(t) e^{f(t)}$

⑧  $\frac{d}{dt} \ln(f(t)) = \frac{f'(t)}{f(t)}$

⑨  $\frac{d}{dt} a^t = \ln(a) a^t$