EXPONENTIALS AND LOGS

$y = e^x$

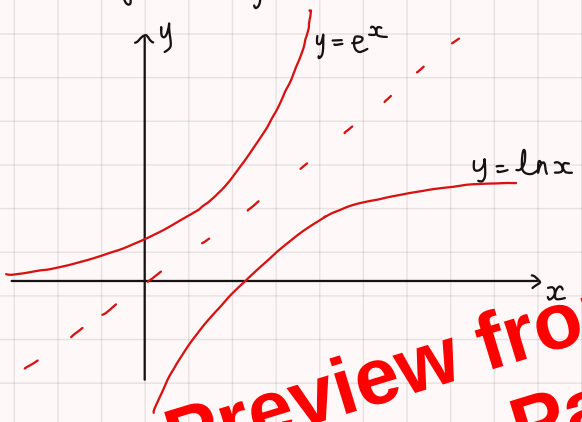
exponential functions of the form $f(x) = a^x$ have a special mathematical property. The graphs of their gradient functions are a similar shape to the graphs of the functions themselves.

if $y = e^x$ then $\frac{dy}{dx} = e^x$

if $y = e^{kx}$ then $\frac{dy}{dx} = ke^{kx}$

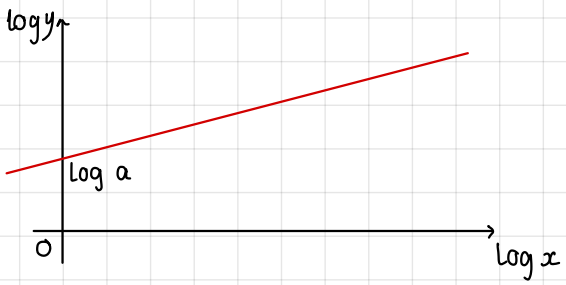
natural logarithms

the graph of $y = \ln x$ is a reflection of the graph $y = e^x$ in the line $y = x$



$e^{\ln x} = \ln(e^x) = x$

if $y = ax^n$ then the graph of $\log y$ against $\log x$ will be a straight with gradient n and vertical intercept $\log a$.



logarithms

the inverse of exponential functions are logarithms.

$$\log_a n = x \leftrightarrow a^x = n$$

laws of logs.

$\log_a x + \log_a y = \log_a xy$ (multi law)

$\log_a x - \log_a y = \log_a\left(\frac{x}{y}\right)$ (div law)

$\log_a(x^k) = k \log_a x$ (power law)

Special cases:

$\log\left(\frac{1}{x}\right) = \log_a(x^{-1}) = -\log_a x$

$\log_a a = 1$

$\log_a 1 = 0$

logarithms non-linear data

we can use logarithms to model a non-linear relationship as the equation of a straight line. This can be useful when plotting a graph to look at the link between two variables.

$Y = mx + c$

$\log y = n \log x + \log a$

variable	gradient	variable	constant