

Exponential Functions

Aim

To introduce the exponential function.

Learning Outcomes

At the end of this section you will:

- Understand what the exponential function is,
- Understand the properties of the exponential function,
- Know what the graph of the exponential function looks like.

The exponential number (e) can be defined as follows:

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

The exponential function (e^x) can therefore be defined as

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

In some books, the function e^x is written $\exp(x)$.

Properties of the Exponential Function

- $e^x > 0$ for every real number x
- $e^0 = 1$
- $e^1 = e$
- $e^{x+y} = e^x e^y$
- $e^{x-y} = \frac{e^x}{e^y}$
- $e^{-x} = \frac{1}{e^x}$
- $e^{cx} = (e^x)^c$
- $\lim_{x \rightarrow \infty} e^x = \infty$

- $\lim_{x \rightarrow -\infty} e^x = 0$
- $\ln e^x = x$
- $e^{\ln x} = x$, if $x > 0$

The Graph of the Exponential Function

The graph of the exponential function can be determined by taking x values in a desirable interval and finding the exponential of these values using your calculator. The limit properties listed on the previous page tell us the long term behaviour of the graph so these can be used as a check to ensure that our graph looks correct.

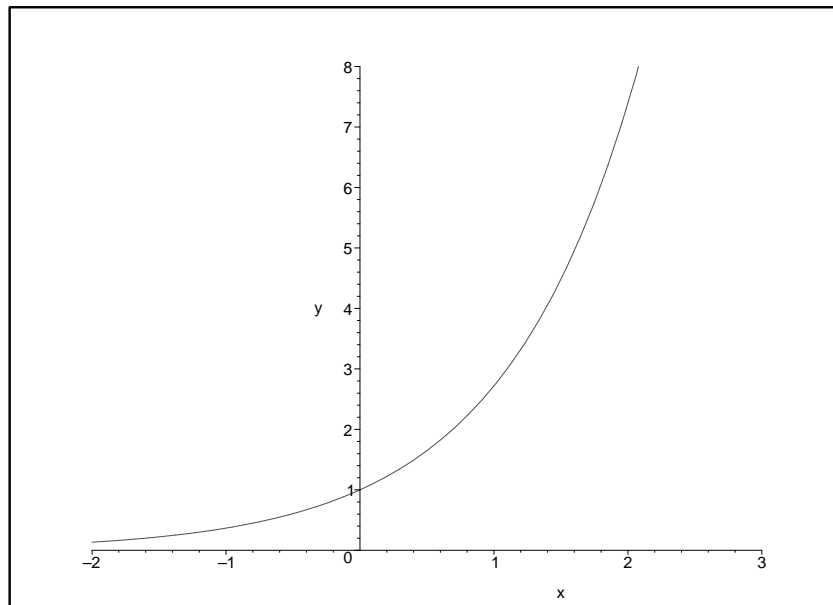


Figure 1: The graph of $y = e^x$

Related Reading

Booth, D.J. 1998. *Foundation Mathematics*. 3rd Edition. Pearson Education Limited.

Croft, A., R. Davison. 2003. *Foundation Mathematics*. 3rd Edition. Pearson Education Limited.