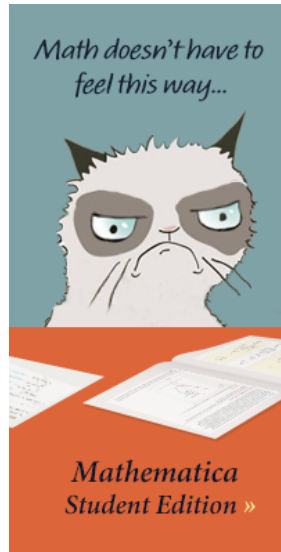


# Examples of Basic Operations in Mathematica



For each of the following inputs, try to guess how the output is produced :

$$\frac{1}{15} + \frac{7}{13}$$
$$\frac{118}{195}$$

$$\% + 1$$
$$\frac{313}{195}$$

`N[%]`  
`1.6051282051282052``

$$\frac{\frac{a}{b} + \frac{c}{d}}{\frac{e}{f} + \frac{g}{h}}$$

$$\frac{\frac{a}{b} + \frac{c}{d}}{\frac{e}{f} + \frac{g}{h}}$$

`Simplify[%]`

$$\frac{bcfh + adfh}{bdfg + bdeh}$$

Solve[a x + b == c x + d, x]

$$\left\{ \left\{ x \rightarrow \frac{-b+d}{a-c} \right\} \right\}$$

17 > 13

True

1/17 > 1/13

The symbol for the transcendental number  $e$  is chosen from the basic palette. It is not the same as the Roman letter  $e$ .

$e^\pi > \pi^e$

True

$$\text{Factor}\left[\frac{x^7 - y^7}{x - y}\right]$$

$$x^6 + x^5 y + x^4 y^2 + x^3 y^3 + x^2 y^4 + x y^5 + y^6$$

$$\text{Sin}\left[\frac{\pi}{12}\right]$$

$$\frac{-1 + \sqrt{3}}{2\sqrt{2}}$$

NSolve[x<sup>3</sup> + x + 1 == 0, x]

{x → -0.6823278038280194`}, {x → 0.34116390191400964` - 1.161541399997252` i},  
{x → 0.34116390191400964` + 1.161541399997252` i}

NSolve[x == 5 Log[x], x]

{x → 1.2958555090953687`}, {x → 12.713206788867632`}

Factor[x<sup>5</sup> - 3 x<sup>4</sup> + x<sup>2</sup> - 3 x]

$$(-3 + x) x (1 + x) (1 - x + x^2)$$

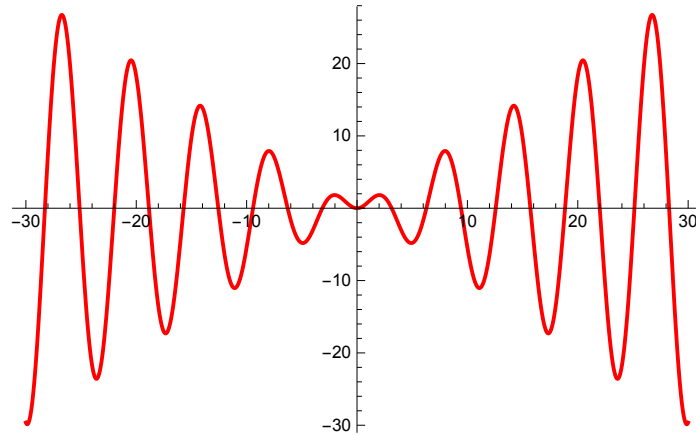
Factor[a<sup>5</sup> - b<sup>5</sup>]

$$(a - b) (a^4 + a^3 b + a^2 b^2 + a b^3 + b^4)$$

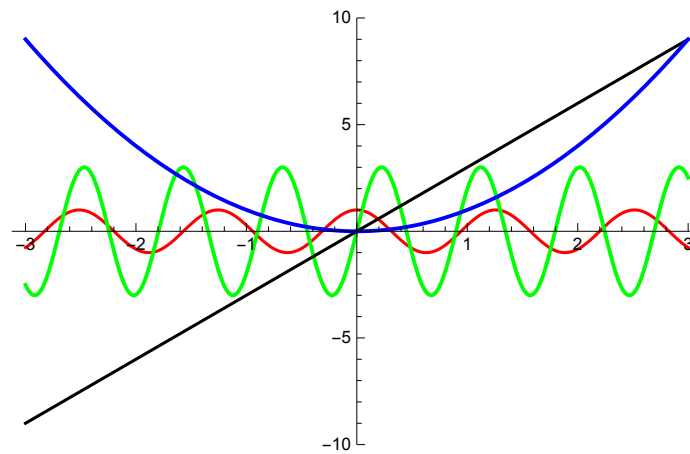
```
Expand[(1 + x + x^3)^5]
```

$$1 + 5x + 10x^2 + 15x^3 + 25x^4 + 31x^5 + 30x^6 + 35x^7 + 30x^8 + 20x^9 + 20x^{10} + 10x^{11} + 5x^{12} + 5x^{13} + x^{15}$$

```
Plot[x Sin[x], {x, -30, 30}, PlotStyle -> {Red, Thick}]
```



```
Plot[{Cos[5 x], 3 Sin[7 x], 3 x, x^2}, {x, -3, 3},
PlotStyle -> {Red, {Green, Thick}, Black, {Blue, Thick}}]
```



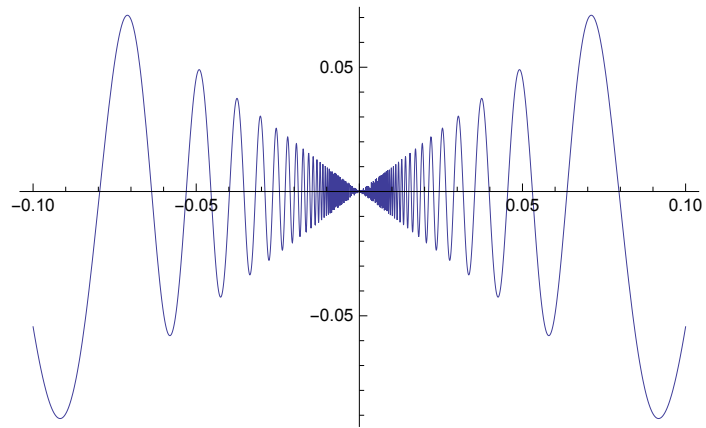
```
Expand[(a - b)^7]
```

$$a^7 - 7a^6b + 21a^5b^2 - 35a^4b^3 + 35a^3b^4 - 21a^2b^5 + 7ab^6 - b^7$$

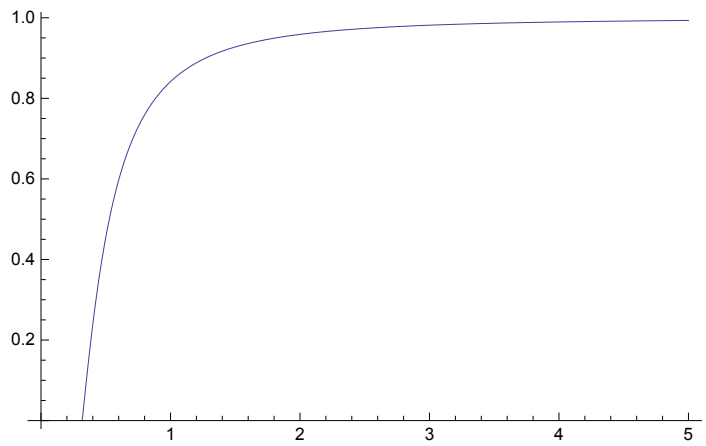
```
Expand[(1 + sqrt(7))^7 - (1 - sqrt(7))^7]
```

$$3248\sqrt{7}$$

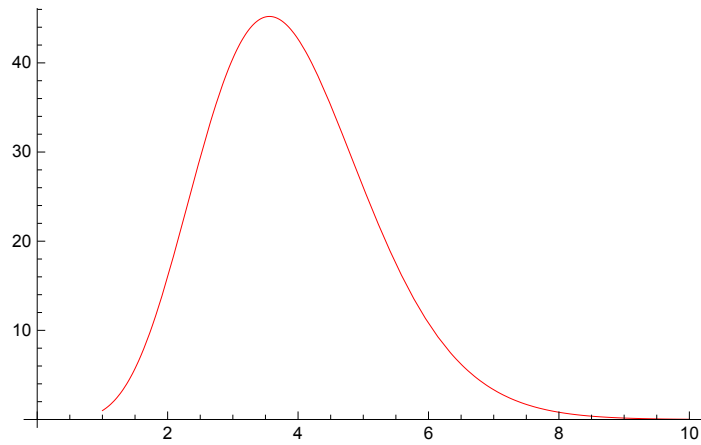
```
Plot[x Sin[ $\frac{1}{x}$ ], {x, -0.1, 0.1}]
```



```
Plot[x Sin[ $\frac{1}{x}$ ], {x, 0.3, 5}, AxesOrigin -> {0, 0}]
```

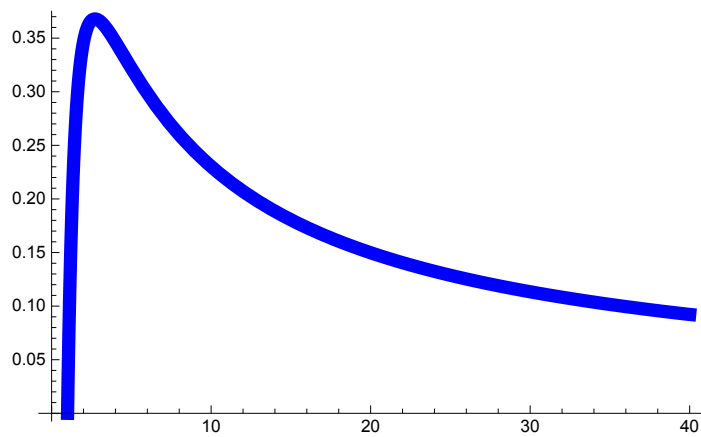


```
Plot[ $\frac{x^5}{x!}$ , {x, 1, 10}, AxesOrigin -> {0, 0}, PlotStyle -> {Red}]
```

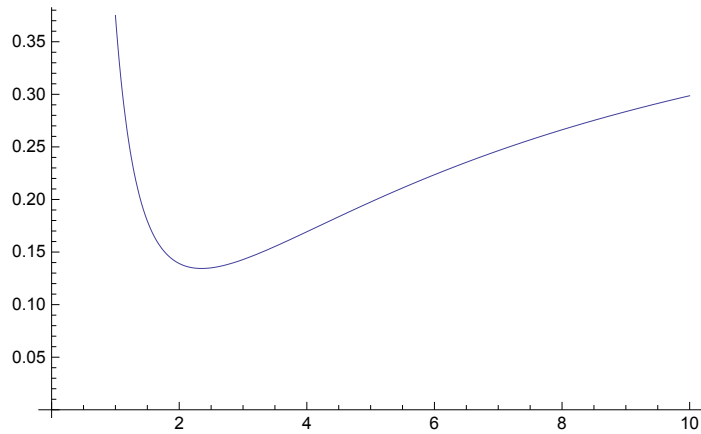


**Remark:** In Mathematica,  $\ln x$  is represented by `Log[x]`.

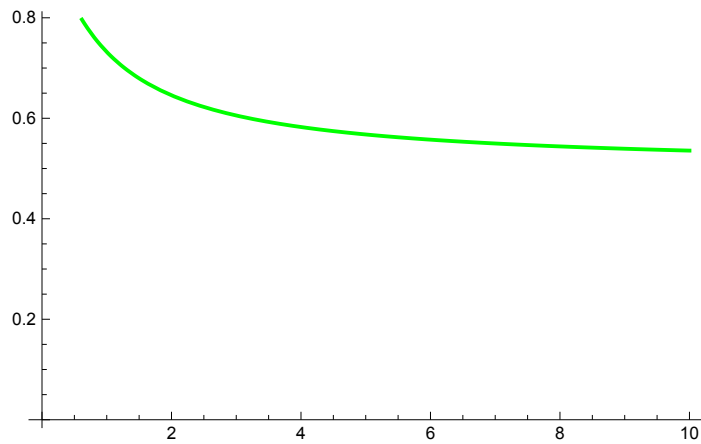
```
Plot[ $\frac{\text{Log}[x]}{x}$ , {x, 1, 40}, AxesOrigin -> {0, 0}, PlotStyle -> {Blue, Thickness[0.02]}]
```



```
Plot[ $\frac{(x^3 + 5)^2}{(2x + 1)(x + 1)^5}$ , {x, 1, 10}, AxesOrigin -> {0, 0}]
```



```
Plot[ $\sqrt{x^2 + x + 1} - x$ , {x, 0, 10}, AxesOrigin -> {0, 0}, PlotStyle -> {Green, Thick}]
```



## Functions

Defining a function is straightforward in Mathematica. For example :

```
g[x_] :=  $\frac{x}{x^2 + 4}$ 
```

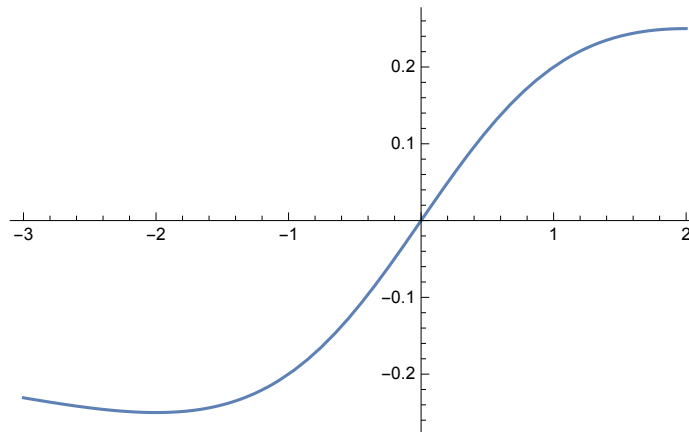
```
g[11]
```

```
 $\frac{11}{125}$ 
```

```
N[g[13]]
```

```
0.07514450867052024`
```

```
Plot[g[t], {t, -3, 2}]
```



## Limits

$$\text{Limit}\left[\frac{x^5 + 2017}{(2x + 2017)^5}, x \rightarrow \infty\right]$$

$$\frac{1}{32}$$

$$\text{Limit}\left[\frac{\text{Sin}[3x]}{x}, x \rightarrow 0\right]$$

$$3$$

$$\text{Limit}\left[\frac{\text{Log}[x^{2013}]}{\text{Log}[x^3]}, x \rightarrow \infty\right]$$

$$671$$

## Derivatives

Derivatives

$$D[\text{Sin}[17x] + (1 + x^5)^{17}, x]$$

$$85x^4(1 + x^5)^{16} + 17\text{Cos}[17x]$$

```
D[c x Log[x], x]  
c + c Log[x]
```

```
D[ArcTan[5 t], t]  

$$\frac{5}{1 + 25 t^2}$$

```

```
Clear[f, g]  
f[x_] := Log[1 + Sin[x]]  
D[f[x], x]  

$$\frac{\text{Cos}[x]}{1 + \text{Sin}[x]}$$
  
g[x_] := (Sec[x])31  
Sec[x]31  
D[g[x], x]  
31 Sec[x]31 Tan[x]
```