

# ComplexInfinity

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## Notations

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### Traditional name

The complex quantity with infinite magnitude but indeterminate phase

### Traditional notation

$\infty$

### Mathematica StandardForm notation

ComplexInfinity

## Primary definition

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$\infty$  represents an infinite numerical quantity whose direction in the complex plane is unknown (undetermined).

## General characteristics

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$\infty$  is a special symbol. On the Riemann sphere it is the north pole. In the projective complex plane it is the line at infinity.

## Limit representations

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$$\infty = \lim_{z \rightarrow 0} \frac{1}{z}$$

02.12.09.0001.01

## Transformations

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### Products, sums, and powers of the direct function

#### Products involving the direct function

$$0 \infty = \iota$$

02.12.16.0001.01

$$a \infty = \infty ; a \neq 0$$

02.12.16.0002.01

02.12.16.0003.01

$$\frac{\tilde{\infty}}{\tilde{\infty}} = i$$

### Sums of the direct function

02.12.16.0004.01

$$\tilde{\infty} + \tilde{\infty} = i$$

02.12.16.0005.01

$$\tilde{\infty} - \tilde{\infty} = i$$

### Related transformations

02.12.16.0006.01

$$\tilde{\infty}^0 = i$$

02.12.16.0007.01

$$1^{\tilde{\infty}} = i$$

02.12.16.0008.01

$$(\tilde{\infty})^{\infty} = \tilde{\infty}$$

## Identities

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### Functional identities

02.12.17.0001.01

$$\tilde{\infty} = \tilde{\infty} \infty$$

## Complex characteristics

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### Real part

02.12.19.0001.01

$$\operatorname{Re}(\tilde{\infty}) = i$$

### Imaginary part

02.12.19.0002.01

$$\operatorname{Im}(\tilde{\infty}) = i$$

### Absolute value

02.12.19.0003.01

$$|\tilde{\infty}| = \infty$$

### Argument

02.12.19.0004.01

$$\arg(\tilde{\infty}) \in (-\pi, \pi]$$

### Conjugate value

02.12.19.0005.01

$$\overline{\tilde{\omega}} = \tilde{\omega}$$

## Differentiation

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### Low-order differentiation

02.12.20.0001.01

$$\frac{\partial \tilde{\omega}}{\partial z} = 0$$

## Integration

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### Indefinite integration

02.12.21.0001.01

$$\int \tilde{\omega} dz = z \tilde{\omega}$$

## Summation

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### Finite summation

02.12.23.0001.01

$$\sum_{k=0}^m \tilde{\omega} = \tilde{\omega}$$

02.12.23.0002.01

$$\tilde{\omega} - \tilde{\omega} = \iota$$

## Integral transforms

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### Fourier exp transforms

02.12.22.0001.01

$$\mathcal{F}_t[\tilde{\omega}](z) = \tilde{\omega}$$

### Inverse Fourier exp transforms

02.12.22.0002.01

$$\mathcal{F}_t^{-1}[\tilde{\omega}](z) = \tilde{\omega}$$

### Fourier cos transforms

02.12.22.0003.01

$$\mathcal{F}_{C_t}[\tilde{\omega}](z) = \tilde{\omega}$$

### Fourier sin transforms

02.12.22.0004.01

$$\mathcal{F}_S[\tilde{\infty}](z) = \tilde{\infty}$$

## Laplace transforms

02.12.22.0005.01

$$\mathcal{L}_i[\tilde{\infty}](z) = \tilde{\infty}$$

## Inverse Laplace transforms

02.12.22.0006.01

$$\mathcal{L}_i^{-1}[\tilde{\infty}](z) = \tilde{\infty}$$

## Representations through more general functions

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### Through other functions

02.12.26.0001.01

$$\tilde{\infty} = \zeta \infty$$

02.12.26.0002.01

$$\tilde{\infty} = (0 \infty)$$

## Representations through equivalent functions

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02.12.27.0001.01

$$\tilde{\infty} = \frac{1}{0}$$

## History

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- John Wallis (1655) introduced the sign  $\infty$  to signify infinite number
- K. Weierstrass (1876) used symbol  $\infty$  to represent an actual infinity, which is prototype of symbol ComplexInfinity  $\tilde{\infty}$  in Mathematica

The symbol  $\infty$  is encountered often in mathematics and the natural sciences.

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