

## 1.12 Complex numbers

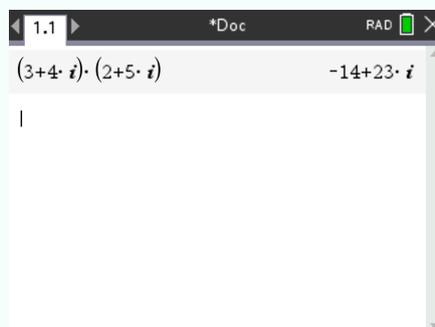
To write the imaginary unit  $i$ , press  and select  $i$ .

### 1.12.1 Operations on complex numbers

Consider the complex numbers  $3 + 4i$  and  $2 + 5i$ .

Suppose you want to add them. For this, just add them as you would add real numbers. The result should be  $5 + 9i$ .

Suppose you want to multiply them. For this, put each of them in brackets and multiply each bracket:

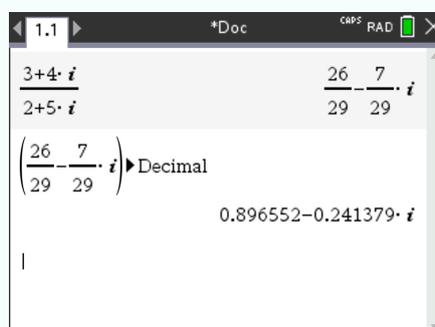


Calculator screen showing the multiplication of complex numbers:

$$(3+4 \cdot i) \cdot (2+5 \cdot i) = -14+23 \cdot i$$

Press . The result should be  $-14 + 23i$ .

Suppose you have to divide them. For this, press  and select  to display a fraction, and put the numbers in each part of the fraction:



Calculator screen showing the division of complex numbers:

$$\frac{3+4 \cdot i}{2+5 \cdot i} = \frac{26}{29} - \frac{7}{29} \cdot i$$

Decimal result:  $0.896552 - 0.241379 \cdot i$

Press . The result should be about  $0.897 - 0.241i$ , or  $\frac{26}{29} - \frac{7}{29}i$ . If you want to switch from fraction to decimal writing, press  and select Number > Convert to Decimal.

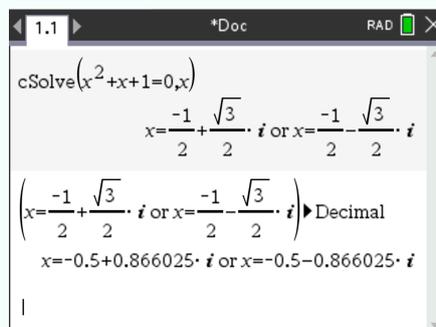
### 1.12.2 Solve polynomial equations (complex solutions)

Suppose you have to solve the equation  $x^2 + x + 1 = 0$ .



The right hand side must be 0

- ① Press , select Algebra > Complex > Solve. Then **csolve()** is displayed.
- ② Between the brackets, enter the equation and the variable of interest after a comma.
- ③ Press  and the solutions are displayed.



$$cSolve(x^2+x+1=0,x)$$

$$x = \frac{-1 + \sqrt{3}}{2} \cdot i \text{ or } x = \frac{-1 - \sqrt{3}}{2} \cdot i$$

$$\left( x = \frac{-1 + \sqrt{3}}{2} \cdot i \text{ or } x = \frac{-1 - \sqrt{3}}{2} \cdot i \right) \blacktriangleright \text{Decimal}$$

$$x = -0.5 + 0.866025 \cdot i \text{ or } x = -0.5 - 0.866025 \cdot i$$

The results should be  $x_1 = -\frac{1}{2} + \frac{\sqrt{3}}{2}i$  and  $x_2 = -\frac{1}{2} - \frac{\sqrt{3}}{2}i$ , or  $x_1 = -0.5 + 0.866i$  and  $x_2 = -0.5 - 0.866i$  (decimal form rounded).

To change from fraction to decimal, press  and select Number > Convert to Decimal.