

# Algebra 2 - Complex Numbers: Adding, Subtracting and Multiplying - Answer Key

Common Core N-CN.A.1, N-CN.A.2 · [maths-pdf.fr/en/](https://maths-pdf.fr/en/)

Every worksheet problem on adding, subtracting and multiplying complex numbers is solved here, one step at a time. Compare your method as well as your final answer, because the steps show where a forgotten sign or a missed i-squared can go wrong. Final answers appear in bold so you can find them quickly when you only need a check.

**Algebra 2** · Common Core State Standards: **N-CN.A.1, N-CN.A.2**

## Exercise 1 - Square root of a negative

$$\sqrt{-49} = \sqrt{49} \cdot \sqrt{-1} = 7i.$$

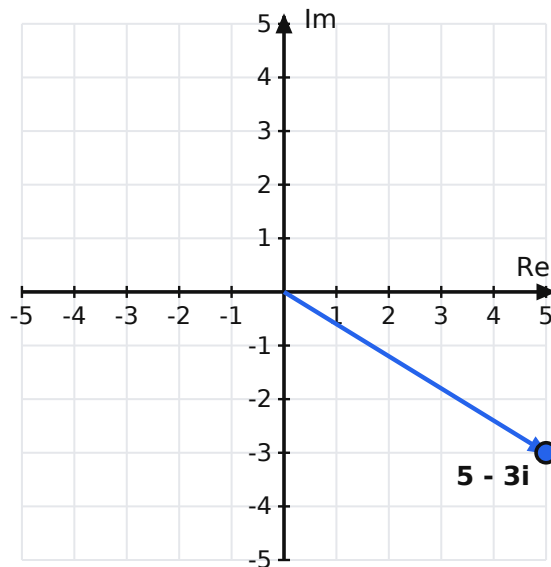
$$7i$$

## Exercise 2 - Radical with a factor

$$\sqrt{-18} = i\sqrt{18}. \text{ Since } 18 = 9 \cdot 2, \sqrt{18} = 3\sqrt{2}.$$

$$3i\sqrt{2}$$

## Exercise 3 - Real and imaginary parts



The point is 5 units right and 3 units down.

The number  $5-3i$  equals  $5+(-3)i$ . The real part is the number with no  $i$ , and the imaginary part is the coefficient of  $i$ .

**Real part 5, imaginary part  $-3$**

#### Exercise 4 - Power of $i$

Divide the exponent by 4:  $7 = 4 \cdot 1 + 3$ , so the remainder is 3.

$$i^7 = i^3 = -i.$$

$$-i$$

#### Exercise 5 - Large power of $i$

Divide:  $58 = 4 \cdot 14 + 2$ , so the remainder is 2.

$$i^{58} = i^2 = -1.$$

$$-1$$

#### Exercise 6 - Add complex numbers

Real parts:  $3+2=5$ . Imaginary parts:  $5-9=-4$ .

$$5-4i$$

### Exercise 7 - Subtract complex numbers

Distribute the minus sign:  $7-2i-4+6i$ .

Real parts:  $7-4=3$ . Imaginary parts:  $-2+6=4$ .

$$3+4i$$

### Exercise 8 - Multiply by i

Distribute:  $3i \cdot 2 - 3i \cdot 5i = 6i - 15i^2$ .

Replace  $i^2$  with  $-1$ :  $6i+15$ .

$$15+6i$$

### Exercise 9 - Multiply two binomials

|    | 4   | -1i         |
|----|-----|-------------|
| 2  | 8   | -2i         |
| 3i | 12i | $-3i^2 = 3$ |

Partial products 8, -2i, 12i, and  $-3i^2 = 3$ .

$8-2i+12i-3i^2$ . With  $i^2=-1$ ,  $-3i^2=3$ .

Real:  $8+3=11$ . Imaginary:  $-2+12=10$ .

$$11+10i$$

### Exercise 10 - Product with a conjugate pair

$25-10i+10i-4i^2=25-4(-1)=29$ .

The imaginary parts cancel, so the product is real.

$$29$$

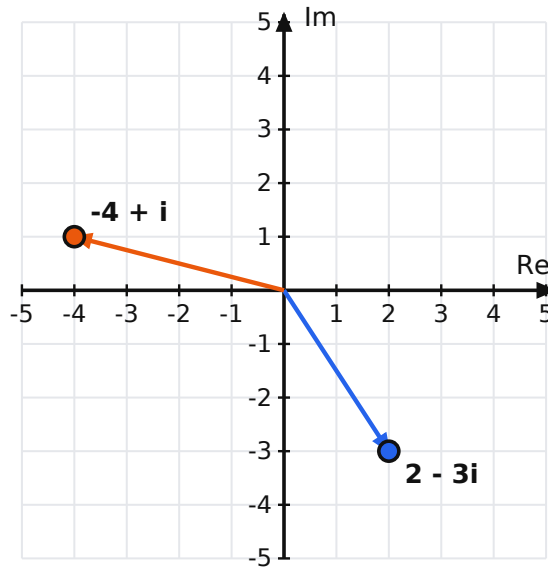
### Exercise 11 - Square a complex number

$$(3-4i)(3-4i)=9-12i-12i+16i^2.$$

$$16i^2=-16, \text{ so } 9-16-24i=-7-24i.$$

$$-7-24i$$

### Exercise 12 - Plot complex numbers

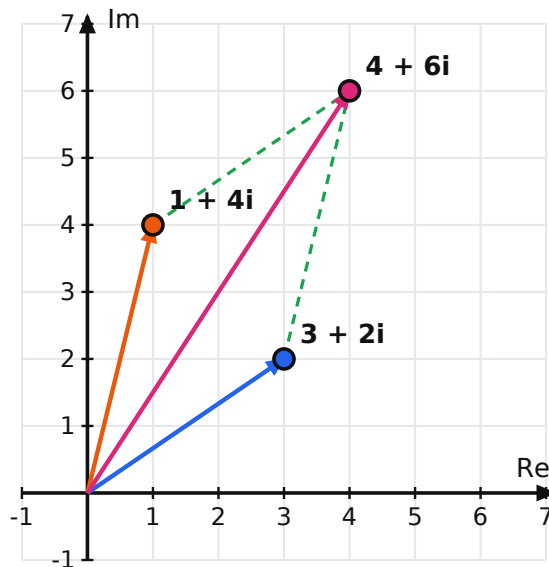


Points (2, -3) and (-4, 1).

Real part is the x-coordinate and imaginary part is the y-coordinate.

$2-3i$  is at (2,-3) and  $-4+i$  is at (-4,1)

### Exercise 13 - Add as vectors



The sum is the fourth corner of the parallelogram.

$$(3+1)+(2+4)i=4+6i.$$

$4+6i$ , at the point  $(4,6)$

### Exercise 14 - Solve with imaginary roots

Subtract 25:  $x^2 = -25$ .

Take square roots:  $x = \pm\sqrt{-25} = \pm 5i$ .

$x = 5i$  or  $x = -5i$

### Exercise 15 - Mixed powers

$$i^3 = -i, i^2 = -1, i^4 = 1.$$

$$2(-i) + 5(-1) - 1 = -2i - 5 - 1.$$

$$-6 - 2i$$

### Exercise 16 - Fourth power

$$(1+i)^2 = 1 + 2i + i^2 = 2i.$$

$$(2i)^2 = 4i^2 = -4.$$

### Exercise 17 - Series circuit

$$Z = (3+5) + (4-1)i.$$

$8+3i$  ohms

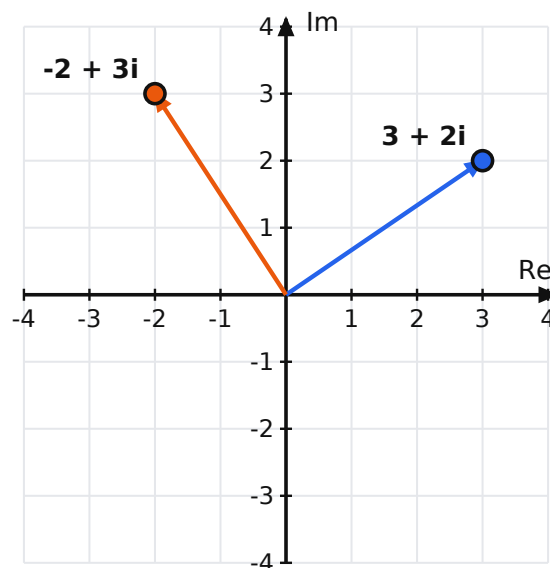
### Exercise 18 - Voltage from current

$$V = (2+i)(3+4i) = 6+8i+3i+4i^2.$$

$$4i^2 = -4, \text{ so } 6-4+11i.$$

$2+11i$  volts

### Exercise 19 - Rotation by $i$



Multiplying by  $i$  turns the point a quarter turn counterclockwise.

$$i(3+2i) = 3i+2i^2 = -2+3i.$$

The point  $(3,2)$  moves to  $(-2,3)$ : a 90 degree counterclockwise rotation about the origin, and the distance from the origin stays the same.

$-2+3i$ : **a quarter turn counterclockwise**

### Exercise 20 - Make a real product

$$(2+3i)(1+ki) = 2+2ki+3i+3ki^2 = (2-3k) + (2k+3)i.$$

The product is real when the imaginary part is 0:  $2k+3=0$ , so  $k = -\frac{3}{2}$ .

$$k = -\frac{3}{2}$$

### Exercise 21 - Find a square root

$$(a+bi)^2 = (a^2-b^2) + 2abi.$$

So  $a^2-b^2 = -5$  and  $2ab = 12$ , giving  $ab = 6$ .

Try  $a=2$ ,  $b=3$ :  $4-9 = -5$  and  $2 \cdot 2 \cdot 3 = 12$ . Both conditions hold.

$$a=2, b=3$$