Class 11 Maths Chapter 4: Complex Numbers and Quadratic Equations - Notes, Important Questions and MCQs (2026-27)

Free PDF notes from Nextoper.in | Session 2026-27 | Read online:
https://nextoper.in/class-11-maths-chapter-4-pdf-notes/

Class 11 Maths Chapter 4, Complex Numbers and Quadratic Equations, extends the number system so that equations like $x^2 + 1 = 0$ have solutions.

These notes cover the imaginary unit i, complex numbers and their algebra, powers of i, modulus and conjugate, the Argand plane, and solving quadratic equations with negative discriminant.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Powers of i
- Important Definitions and Terms
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

Want notes for every chapter? Explore the full Class 11 Maths notes on Nextoper, arranged book-wise and chapter-wise.

Chapter Overview

Real numbers cannot solve $x^2 + 1 = 0$, since the square of a real number is never negative. Mathematicians introduced the symbol i (iota) with $i^2 = -1$.

A complex number has the form $z = a + ib$, where a and b are real; a is the real part Re(z) and b the imaginary part Im(z).

Important Topics and Concepts

Complex Numbers

- $z = a + ib$, $a, b \in R$; $Re(z) = a$ and $Im(z) = b$.
- If $b = 0$, z is purely real; if $a = 0$ (and $b \neq 0$), z is purely imaginary.
- Two complex numbers are equal if their real parts and imaginary parts are equal.

- Every real number is a complex number with zero imaginary part.

Algebra of Complex Numbers

- Addition: $(a + ib) + (c + id) = (a + c) + i(b + d)$ – closure, commutative, associative; additive identity 0; additive inverse $-z$.
- Subtraction: $z_1 - z_2 = z_1 + (-z_2)$.
- Multiplication: $(a + ib)(c + id) = (ac - bd) + i(ad + bc)$ – closure, commutative, associative, distributive; identity 1.
- Multiplicative inverse of $z = a + ib$ $(z \neq 0)$: $1/z = (a - ib)/(a^2 + b^2)$.
- Division: $z_1/z_2 = z_1 \times (1/z_2)$.

Powers of i

- $i^1 = i$, $i^2 = -1$, $i^3 = -i$, $i^4 = 1$.
- In general $i^{(4k)} = 1$, $i^{(4k+1)} = i$, $i^{(4k+2)} = -1$, $i^{(4k+3)} = -i$.
- $\sqrt{(-a)} = i\sqrt{a}$ for $a > 0$; note $\sqrt{a} \times \sqrt{b} = \sqrt{(ab)}$ is not valid when both a and b are negative.

Identities

- $(z_1 + z_2)^2 = z_1^2 + 2z_1z_2 + z_2^2$; $(z_1 - z_2)^2 = z_1^2 - 2z_1z_2 + z_2^2$.
- $(z_1 + z_2)^3$ and $(z_1 - z_2)^3$ expand as for real numbers.
- $z_1^2 - z_2^2 = (z_1 + z_2)(z_1 - z_2)$.

Modulus and Conjugate

- Modulus $|z| = \sqrt{(a^2 + b^2)}$; conjugate $\bar{z} = a - ib$.
- $z\,\bar{z} = |z|^2$; $1/z = \bar{z}/|z|^2$.
- $|z_1z_2| = |z_1||z_2|$; $|z_1/z_2| = |z_1|/|z_2|$ $(z_2 \neq 0)$.
- Conjugate of a sum, difference, product or quotient equals the sum, difference, product or quotient of conjugates.

Argand Plane

- A complex number $a + ib$ is represented by the point (a, b) in the plane; the x-axis is the real axis and the y-axis the imaginary axis.
- $|z|$ is the distance of the point from the origin.
- The conjugate $a - ib$ is the mirror image of $a + ib$ in the real axis.

Quadratic Equations

- For $ax^2 + bx + c = 0$ with real coefficients and discriminant $D = b^2 - 4ac < 0$, the roots are $x = (-b \pm i\sqrt{(4ac - b^2)})/(2a)$.
- Such roots occur in conjugate pairs.
- Fundamental theorem of algebra: a polynomial equation of degree n has n roots (real or complex).
- Example: $x^2 + x + 1 = 0$ has $D = -3$, so $x = (-1 \pm i\sqrt{3})/2$.

Powers of i

n mod 4	0	1	2	3
i^n	1	i	-1	$-i$
Example	$i^8 = 1$	$i^9 = i$	$i^{10} = -1$	$i^{11} = -i$

Important Definitions and Terms

Term	Meaning
Iota (i)	Imaginary unit with $i^2 = -1$.
Complex number	Number of the form $a + ib$ with a, b real.
Real part	a in $a + ib$.
Imaginary part	b in $a + ib$.
Purely imaginary	Complex number with zero real part.
Modulus	$\|z\| = \sqrt{(a^2 + b^2)}$.
Conjugate	$\bar{z} = a - ib$.
Argand plane	Plane representing complex numbers as points.
Discriminant	$D = b^2 - 4ac$ of a quadratic equation.
Multiplicative inverse	$1/z = \bar{z}/\|z\|^2$.

Short Answer Questions

Q1. Evaluate i^{-39}.

$i^{-39} = 1/i^{39} = 1/i^3 = 1/(-i) = i$.

Q2. Express $(5 - 3i)^3$ in $a + ib$ form.

$(5 - 3i)^3 = 125 - 225i + 135i^2 - 27i^3 = 125 - 225i - 135 + 27i = -10 - 198i$.

Q3. Find the multiplicative inverse of $4 - 3i$.

$(4 + 3i)/(16 + 9) = 4/25 + 3i/25$.

Q4. Find the modulus of $1 + i$.

$\sqrt{(1 + 1)} = \sqrt{2}$.

Q5. Find the conjugate of $(3 - 2i)(2 + 3i)$.

Product $= 6 + 9i - 4i - 6i^2 = 12 + 5i$; conjugate $= 12 - 5i$.

Q6. Solve $x^2 + 3 = 0$.

$x^2 = -3$, so $x = \pm i\sqrt{3}$.

Q7. Solve $x^2 + x + 1 = 0$.

$D = 1 - 4 = -3$; $x = (-1 \pm i\sqrt{3})/2$.

Q8. If $(a + ib)(1 + i) = 2 + 2i$, find a and b.

$a + ib = (2 + 2i)/(1 + i) = 2$, so $a = 2, b = 0$.

Long Answer Questions

Q1. Express $(3 + i\sqrt{5})(3 - i\sqrt{5})/((\sqrt{3} + \sqrt{2}\, i) - (\sqrt{3} - i\sqrt{2}))$ in $a + ib$ form.

Numerator $= 9 - 5i^2 = 9 + 5 = 14$.

Denominator $= \sqrt{3} + \sqrt{2}\, i - \sqrt{3} + \sqrt{2}\, i = 2\sqrt{2}\, i$.

Q2. If $x + iy = (a + ib)/(a - ib)$, prove that $x^2 + y^2 = 1$.

Taking modulus, $|x + iy| = |a + ib|/|a - ib|$.

$|a + ib| = |a - ib| = \sqrt{(a^2 + b^2)}$, so $|x + iy| = 1$.

Hence $\sqrt{(x^2 + y^2)} = 1$, giving $x^2 + y^2 = 1$.

Q3. Solve $2x^2 + x + 1 = 0$.

Here $a = 2$, $b = 1$, $c = 1$; $D = 1 - 8 = -7$.

$x = (-1 \pm i\sqrt{7})/4$.

The roots are complex conjugates $(-1 + i\sqrt{7})/4$ and $(-1 - i\sqrt{7})/4$.

MCQs with Answers

1. i^2 =(a) 1 (b) −1 (c) i (d) −iAnswer: (b) −1

2. i^{4n+3} =(a) 1 (b) i (c) −1 (d) −iAnswer: (d) −i

3. Re(3 − 4i) =(a) 3 (b) −4 (c) 4 (d) −3Answer: (a) 3

4. |3 + 4i| =(a) 5 (b) 7 (c) 25 (d) 1Answer: (a) 5

5. Conjugate of 2 + 5i:(a) 2 − 5i (b) −2 + 5i (c) 5 + 2i (d) −2 − 5iAnswer: (a) 2 − 5i

6. $z\bar{z}$ =(a) |z| (b) $|z|^2$ (c) 2z (d) 0Answer: (b) $|z|^2$

7. Roots of $x^2 + 4 = 0$:(a) ±2 (b) ±2i (c) ±4i (d) ±iAnswer: (b) ±2i

8. 1/i =(a) i (b) −i (c) 1 (d) −1Answer: (b) −i

9. A purely imaginary number has:(a) b = 0 (b) a = 0 (c) a = b (d) a = −bAnswer: (b) a = 0

10. Complex roots of real quadratics occur in:(a) Equal pairs (b) Conjugate pairs (c) Triples (d) Real pairsAnswer: (b) Conjugate pairs

Quick Revision Points

- $i^2 = -1$; $z = a + ib$.
- Equality: real and imaginary parts equal.
- Addition, multiplication rules; additive and multiplicative identities.
- $1/z = \bar{z}/|z|^2$.
- Powers of i cycle every 4.
- $\sqrt{a}\sqrt{b} \neq \sqrt{(ab)}$ if both negative.
- $|z| = \sqrt{(a^2 + b^2)}$; $\bar{z} = a - ib$.
- $|z_1z_2| = |z_1||z_2|$.
- Argand plane – real and imaginary axes.
- $D < 0$: $x = (-b \pm i\sqrt{(4ac - b^2)})/2a$.

Chapter Summary

Complex numbers a + ib extend real numbers so that every quadratic equation has a solution. They can be added, subtracted, multiplied and divided, with $i^2 = -1$ and powers of i repeating every four steps.

Exam Tips and PYQ Pattern

- Reduce powers of i using the remainder on division by 4.
- To divide, multiply numerator and denominator by the conjugate of the denominator.
- Do not apply $\sqrt{a}\sqrt{b} = \sqrt{(ab)}$ to two negative numbers.
- Write final answers in a + ib form.
- Polar form is outside the rationalised 2026-27 syllabus.
- Check roots by substituting back into the equation.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 11 Mathematics textbook, prescribed in the CBSE 2026-27 syllabus.

Can I download these notes as a PDF?

Yes. Use the free PDF link at the top of this page – no signup needed.

What is iota?

The imaginary unit i, defined by $i^2 = -1$.

How do you find the multiplicative inverse of a complex number?

For $z = a + ib$, $1/z = (a - ib)/(a^2 + b^2)$.

Is polar form of complex numbers in the 2026-27 syllabus?

No. The rationalised syllabus covers algebra of complex numbers, modulus, conjugate, Argand plane and quadratic equations.

Conclusion

Complex Numbers and Quadratic Equations completes the number system. Practise powers of i, division and quadratic roots, revise the tables and download the free PDF.

More Notes: Class 11 Maths Chapter 3: Trigonometric Functions notes | Class 11 Maths Chapter 5: Linear Inequalities notes | All Class 11 Maths notes

Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE maths educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 11 Maths textbook, Mathematics (Class XI) (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 28 November 2026.