

## Math 150, Section 3.4

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## Purpose of this section

In this section we learn complex numbers and how to do algebra with them.

## Definition of a complex number

A **complex number** is an expression of the form  $a + bi$  where  $a$  and  $b$  are real numbers and  $i^2 = -1$ . The **real part** of this complex number is  $a$  and the **imaginary part** is  $b$ . Two complex numbers are **equal** if and only if their real parts are equal and their imaginary parts are equal.

## Algebra with complex numbers

- ▶ **Addition** To add the complex numbers  $a + bi$  and  $c + di$  we add the real parts and the imaginary parts:  
 $(a + bi) + (c + di) = (a + c) + i(b + d)$ .
- ▶ **Subtraction** To subtract the complex number  $c + di$  from  $a + bi$  we subtract the real parts and the imaginary parts:  
 $(a + bi) - (c + di) = (a - c) + i(b - d)$ .
- ▶ **Multiplication** To multiply the complex numbers  $a + bi$  and  $c + di$  expand them and then use  $i^2 = -1$ :  
 $(a + bi)(c + di) = (ac - bd) + (ad + bc)i$ .
- ▶ **Division** To divide the complex number  $a + bi$  with the complex number  $c + di$  we multiply and divide with  $c + di$ :

$$\frac{a + bi}{c + di} = \left( \frac{a + bi}{c + di} \right) \left( \frac{c - di}{c - di} \right) = \frac{(ac + bd) + (bc - ad)i}{c^2 + d^2}.$$

## Roots of quadratic equations

We know that the roots of the quadratic equation  $ax^2 + bx + c = 0$  are

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

If  $b^2 - 4ac < 0$  then the roots will be complex roots.

Try problems 4, 5, 8, 10, 14, 15, 24, 27, 32, 33, 38, 42, 57, 62.