

# Further Pure Mathematics 1

## Complex Numbers

### Section 1: Introduction to complex numbers

#### Study Plan

##### Background

You have already encountered several number systems in your study of mathematics. Starting with learning to count with the natural numbers, you have progressed through fractions and decimals, negative numbers, and real numbers. Each extension to the number system allows us to solve more problems. For example, the equation

$$x + 4 = 0$$

has no solution in the natural numbers, but it does in the integers.

The equation

$$x^2 - 2 = 0$$

has no solution in the rational numbers, but it does have two real solutions,

$$x = \sqrt{2} \text{ and } x = -\sqrt{2}.$$

However, within the real numbers there is no solution to an equation such as

$$z^2 + 4 = 0.$$

The complex numbers are an extension to the real numbers in which there is a solution to the equation above. It turns out that the complex numbers are the final extension we need for the number system, as all possible polynomial equations have solutions in the complex numbers.

In this section you will learn to manipulate complex numbers, and some of the basic terminology associated with complex numbers.

##### Detailed work plan



1. Read pages 46 – 49 carefully. You will find some help on some of the Activities in the **Notes and Examples**, as well as an example showing multiplication of complex numbers.



2. You can practice these techniques using the interactive questions **Addition and subtraction of complex numbers**, **Multiplying complex numbers** and **Complex conjugates**.



3. **Exercise 2A**  
Attempt questions 1, 2, 3, 4 and 5.  
In Question 2 you need only check the roots for the first one or two equations, as this is rather time consuming.



4. Read pages 50 – 53. This covers two important techniques: equating real and imaginary parts, and dividing complex numbers. There are two additional examples in the **Notes and Examples**, showing how these techniques can be used.

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5. You can practice division using the interactive questions [Dividing complex numbers](#). You can also test yourself on some of the techniques in this section using the Flash resource [Working with complex numbers](#).



6. **Exercise 2B**

Attempt at least half of the parts of questions 1 and 2, and also questions 3-9. If you have time try Questions 10 and 11 (you need to have covered the binomial expansion in C1 to do Question 11). You might also like to try the enrichment questions 12 and 13 – these are beyond the syllabus but you have all the tools you need to do them.