

## Topic 2.4: Complex Numbers and Operations

Essential Question:

*How can you represent and operate on numbers that are not on the real number line?*

### CONCEPT

Imaginary Number:  $i = \sqrt{-1}$ ,  $i^2 = -1$

Complex Number:  $a + bi$

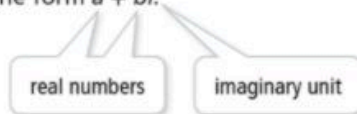
Complex Conjugate:  $(a + bi)(a - bi) = a^2 + b^2$

### CONCEPT Summary

#### Complex Numbers and Operations

The imaginary unit  $i$  is the number whose square is equal to  $-1$ :  $\sqrt{-1} = i$ , so  $i^2 = -1$ .

Complex numbers are written in the form  $a + bi$ .



The four basic operations can be applied to complex numbers, such as  $2 + 3i$  and  $5 - i$ .

#### ADDITION

Add as you would with binomials with like terms.

$$(2 + 3i) + (5 - i) = 7 + 2i$$

#### SUBTRACTION

Subtract as you would with binomials with like terms.

$$(2 + 3i) - (5 - i) = -3 + 4i$$

#### MULTIPLICATION

Distribute as you would with binomials.

$$(2 + 3i)(5 - i) = 10 - 2i + 15i - 3i^2 = 13 + 13i$$

#### DIVISION

Simplify so that the denominator is a real number. Multiply the numerator and denominator by the conjugate of the denominator.

$$\frac{2 + 3i}{5 - i} = \frac{(2 + 3i)(5 + i)}{(5 - i)(5 + i)} = \frac{7 + 17i}{26} = \frac{7}{26} + \frac{17}{26}i$$

Notes:

## Examples & Questions

### Examples 1

Q: How are the equations in Part A and Part B alike? How are they different?

Q: Why is the  $\sqrt{-9}$  not equation to -3?

### Examples 2

Q: In Part B, why is the difference written as an addition problem?

Q: How could the sum of two complex numbers be a real number?

### Examples 3

Q: How is the problem in Part B like multiplying binomials?

Q:

### Examples 4

Q: How does multiplying the denominator by its complex conjugate result in a real number?

### Examples 5

Q: How is factoring the sum of squares different than factoring the difference of squares?

Q: Why is the first step in factoring the expression in Part B to factor out a 3?

### Examples 6

Q: Graph  $y = x^2 + 4$ . How might the graph suggest that there are no real solutions to the equation?

Q: Does the Zero Product Property hold for imaginary numbers?

## Practice and Problem Solving

Complete MathXL for School: Enrichment (online)

Challenge: #12, 13, 46, 47, 50 – key will be posted in Power School Learning.

## Lesson Quiz 2.4