

Name:  
Instructor:

## 7.7 Complex Numbers

### Objectives

- 1 Recognize a complex number.
- 2 Add and subtract complex numbers.
- 3 Multiply complex numbers.
- 4 Divide complex numbers.
- 5 Find powers of  $i$ .

### Key Vocabulary

imaginary numbers, imaginary unit, complex numbers, pure imaginary number, conjugate of a complex number, powers of  $i$

#### 1 Recognize a complex number.

Example 1 Write each complex number in the form  $a + bi$ .

- a)  $5 + \sqrt{-49}$       b)  $3 - \sqrt{-18}$       c)  $-13$       d)  $\sqrt{-75}$

#### 2 Add and subtract complex numbers.

Example 2 Add or subtract.

- a)  $(7 + 5i) + (-6 - 3i)$       b)  $(5 - \sqrt{-72}) - (-6 + \sqrt{-98})$

#### 3 Multiply complex numbers.

Example 3 Multiply.

- a)  $3i(7 - 4i)$       b)  $\sqrt{-16}(\sqrt{-3} + 5)$       c)  $(3 - \sqrt{-32})(\sqrt{-2} + 4)$

#### 4 Divide complex numbers.

Example 4 Divide.

- a)  $\frac{5+i}{i}$       b)  $\frac{3+4i}{3-i}$

#### 5 Find powers of $i$ .

Example 5 Evaluate.

- a)  $i^5$       b)  $i^{12}$       c)  $i^{23}$       d)  $i^{98}$

Answers: 1a)  $5 + 7i$  b)  $3 - 3i\sqrt{2}$  c)  $-13 + 0i$  d)  $0 + 5i\sqrt{3}$  2a)  $1 + 2i$  b)  $11 - 13i\sqrt{2}$  3a)  $12 + 21i$  b)  $-4\sqrt{3} + 20i$  c)  $20 - 13i\sqrt{2}$   
4a)  $1 - 5i$  b)  $\frac{1+3i}{2}$  5a)  $i$  b)  $1$  c)  $-i$  d)  $-1$

1. Find  $x$  and  $y$ :  $6x - 3yi = 36 + 27i$

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For #2-3, solve the equations, finding all real and imaginary solutions.

2.  $3x^2 + 4 = -5x$

3.  $x^4 - x^2 - 6 = 0$

4.  $2x^4 - 54x = 0$

For #5-6, find a polynomial with real coefficients that satisfy the given conditions. Leave your answer in factored form without any imaginary numbers.

5. degree 5: zeros include  $-2$  (multiplicity 3) and  $4i$

6. degree 2: zeros include  $1 - 2i$ ;  $f(2) = 4$

7. Find **all** the zeros of the polynomial  
 $g(x) = x^4 - 5x^3 + 10x^2 - 20x + 24$ ,  
given that  $2i$  is a zero.

8. Find **all** the zeros of the polynomial  
 $g(x) = x^4 - 4x^3 + 6x^2 - 4x + 5$ ,  
given that  $2 - i$  is a zero.