

## 'Notes 5.1 Complex Numbers

Addition and Subtraction of Complex Numbers  
Multiplication and Division of Complex Numbers  
Powers of  $i$

### **Complex Number:**

A complex number has a real part and an imaginary part.

Standard Form is:

Examples:

### **Imaginary Unit $i$ :**

Express each in terms of  $i$  and simplify:

$$\sqrt{-3}$$

$$\sqrt{-36}$$

$$\sqrt{-20}$$

$$3 + \sqrt{-16}$$

In Exercises 1 to 10, write the complex number in standard form.

5.  $\sqrt{16} + \sqrt{-81}$

9.  $8 - \sqrt{-18}$

### **Sums and Differences of Complex Numbers:**

In Exercises 11 to 36, simplify and write the complex number in standard form.

13.  $(-2 - 4i) - (5 - 8i)$

11.  $(5 + 2i) + (5 - 8i)$

17.  $(-3 - 5i) - (7 - 5i)$

### **Multiply Complex Numbers:**

$$3i \cdot 4i$$

$$\sqrt{20} \cdot \sqrt{-12}$$

In Exercises 11 to 36, simplify and write the complex number in standard form.

29.  $(-3 - 4i)(2 + 7i)$

32.  $(3 + 7i)(3 - 7i)$

36.  $(5 - 3\sqrt{-48})(2 - 4\sqrt{-27})$

27.  $(4 + 2i)(3 - 4i)$

31.  $(4 - 5i)(4 + 5i)$

35.  $(3 + 2\sqrt{-18})(2 + 2\sqrt{-50})$

**Divide Complex Numbers:**

**In Exercises 37 to 54, write each expression as a complex number in standard form.**

38.  $\frac{-8}{2i}$

44.  $\frac{5i}{2-3i}$

45.  $\frac{5-i}{4+5i}$

**Powers of  $i$ :**

$i =$   $i^5 =$

$i^2 =$   $i^6 =$

$i^3 =$   $i^7 =$

$i^4 =$   $i^8 =$

Write the power of  $i$  in simplest terms:

Steps:

- 
- 
- 
- 

Remember,  $i = \sqrt{-1}$ ,  $i^2 = -1$ ,  $i^3 = -i$ ,  $i^4 = 1$

What is  $i^0 =$

In Exercises 55 to 62, evaluate the power of  $i$ .

56.  $i^{66}$

58.  $-i^{51}$

60.  $\frac{i}{i^{83}}$

62.  $i^{-52}$

57.  $-i^{40}$

59.  $\frac{i}{i^{25}}$

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Addition and Subtraction of Complex Numbers  
Multiplication and Division of Complex Numbers  
Powers of  $i$

### Complex Number:

A complex number has a real part and an imaginary part.

Standard Form is:  $a+bi$

Examples:

$\downarrow$  real       $\downarrow$  imaginary       $3+2i, -3i, 4$

Imaginary Unit  $i$ :

$$i = \sqrt{-1}$$

Express each in terms of  $i$  and simplify:

$$\sqrt{-3} = i\sqrt{3}$$

$$\sqrt{-36} = 6i$$

$$\sqrt{-20} = i\sqrt{20} = 2i\sqrt{5}$$

$$3 + \sqrt{-16} = 3 + 4i$$

In Exercises 1 to 10, write the complex number in standard form.

5.  $\sqrt{16} + \sqrt{-81}$   
 $4 + 9i$

9.  $8 - \sqrt{-18}$   
 $8 - 3i\sqrt{2}$

### Sums and Differences of Complex Numbers:

In Exercises 11 to 36, simplify and write the complex number in standard form.

13.  $(-2 - 4i) - (5 - 8i) = (-7 + 4i)$

11.  $(5 + 2i) + (5 - 8i)$   
 $(10 - 6i)$

17.  $(-3 - 5i) - (7 - 5i)$   
 $-10$

### Multiply Complex Numbers:

$3i \cdot 4i$

$$12i^2 = 12(-1) = -12$$

$\sqrt{20} \cdot \sqrt{-12}$

$$2\sqrt{5} \cdot 2i\sqrt{3} = 4i\sqrt{15}$$

In Exercises 11 to 36, simplify and write the complex number in standard form.

29.  $(-3 - 4i)(2 + 7i)$

$$-6 - 21i - 8i - 28i^2 = \boxed{22 - 29i}$$

32.  $(3 + 7i)(3 - 7i) = (3)^2 - (7i)^2$

$$9 - 49i^2 = 58$$

36.  $(5 - 3\sqrt{-48})(2 - 4\sqrt{-27}) = (5 - 12i\sqrt{3})(2 - 12i\sqrt{3}) =$

$$10 - 60i\sqrt{3} - 24i\sqrt{3} + 144i^2(3) = \boxed{-422 - 84i\sqrt{3}}$$

27.  $(4 + 2i)(3 - 4i)$

$$12 - 16i + 6i - 8i^2 + 8$$

$$\boxed{20 - 10i}$$

31.  $(4 - 5i)(4 + 5i)$

$$(4)^2 - (5i)^2 = 16 - (-25) = \boxed{41}$$

