

# Complex Numbers

$$a+bi \quad i = \sqrt{-1}$$

$a$  and  $b$  are real numbers,  $i$  is the imaginary unit

- Simplifying radical expressions
- Simplifying powers of  $i$
- Operations with complex numbers
- Graphing, distance, and absolute value

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Complex –  $\mathbb{C}$ , includes all real and imaginary numbers. Every number we have talked about is in the complex number set. Complex numbers are written in standard form as  $a + bi$ .

For each number below, state the value of  $a$  and  $b$  in the complex number  $a + bi$ .

Number	$a$	$b$
$-4 + 2i$	$-4$	$2$
$12$	$12$	$0$
$-7i$	$0$	$-7$
$5 + i$	$5$	$1$
$\frac{7}{2} - i$	$\frac{7}{2}$	$-1$

Aug 15-8:54 AM

## Simplify the expression

1.  $\sqrt{-64}$   
 $\sqrt{64} \cdot \sqrt{-1}$   
 $8i$

2.  $\sqrt{-28} = \sqrt{28} i$   
 $\sqrt{4} \cdot \sqrt{7} i$   
 $2\sqrt{7} i$  or  $2i\sqrt{7}$

3.  $\frac{1}{4} \sqrt{-108}$   
 $\frac{1}{4} \sqrt{108} i$   
 $\frac{1}{4} \cdot \frac{6\sqrt{3}}{1} i$   
 $\frac{3}{2} \sqrt{3} i$

$\sqrt{108} = \sqrt{36} \cdot \sqrt{3}$   
 $= \sqrt{9} \cdot \sqrt{12}$   
 $\sqrt{9} \cdot \sqrt{4} \cdot \sqrt{3}$   
 $3 \cdot 2 \sqrt{3}$   
 $6\sqrt{3}$

4.  $3\sqrt{-700}$   
 $3\sqrt{700} i$   
 $3 \cdot 10\sqrt{7} i$   
 $30\sqrt{7} i$

$\sqrt{700} = \sqrt{100} \cdot \sqrt{7} = 10\sqrt{7}$

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## Simplify the expression.

$i^1 = i$        $i^5 = i^4 \cdot i^1 = i$        $i = \sqrt{-1}$   
 $i^2 = -1$        $i^6 = i^2 = -1$        $i^2 = (\sqrt{-1})^2$   
 $i^3 = i^2 \cdot i^1 = -1 \cdot i = -i$        $i^7 = i^3 = -i$   
 $i^4 = i^2 \cdot i^2 = -1 \cdot -1 = 1$        $i^8 = 1$

Divide exponent by 4  
 remainder  $(\sqrt{3})^2$

$i^{18} = -1$        $i^{24} = 1$        $i^{31} = -i$        $i^{49} = i$   
 $i^2$        $i^0$        $i^3$        $i^1$

$i^9 = i$        $i^{14} = -1$        $i^{28} = 1$        $i^{39} = -i$   
 $i^1$        $i^2$        $i^0$        $i^3$

$i^{6313} = i^{13} = i^1 = i$

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## Adding and Subtracting Complex Numbers

- $(-3 + 7i) + (15 + 12i) = 12 + 19i$
- $(24 - 46i) + (-12 - 14i) = 12 - 60i$
- $(-2 - 2i) - (3 + 8i) = -5 - 10i$   
 $-2 - 2i - 3 - 8i$
- $(5 + 9i) - (-6 - 4i) = 11 + 13i$

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## Multiplying Complex Numbers

Use distributive property or FOIL.

Simplify whenever possible.  $i^2 = -1$ Combine like terms and write in standard form:  $a + bi$ 

} Read directions!

1.  $-i(3 + i) = -3i - i^2 = -3i - (-1) = \boxed{1 - 3i}$
2.  $(2 + 3i)(-6 - 2i) = -12 - 4i - 18i - 6i^2 = -12 - 22i + 6 = \boxed{-6 - 22i}$   
 $-6(-1) = 6$
3.  $(4 - 6i)^2 = (4 - 6i)(4 - 6i) = 16 - 24i - 24i + 36i^2 = 16 - 48i - 36 = \boxed{-20 - 48i}$
4.  $(7 - 3i)(7 + 3i) = 49 + 21i - 21i - 9i^2 = 49 + 9 = \boxed{58}$

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