Pre-Calc 2.4a Complex Numbers

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

The imaginary unit "i"

Definition of a Complex Number

If a and b are real numbers, then the number **a + bi** is a complex number, and it is said to be written in standard form.

a - real part

b - imaginary part

If b = 0, then the # a + bi = a is a real #.

If b ≠ 0, then the # a + bi is called an imaginary #.

A number of form "bi" - pure imaginary number.

Equality of Complex Numbers

Two complex numbers a + bi and c + di, written in standard form, are equal to each other if and only if a = c and b = d.

Operations with Complex Numbers

Two complex numbers a + bi and c + di, written in standard form:

Sum: $(a + bi) + (c + di) = (a + c) + (b + d)i$

Difference: $(a + bi) - (c + di) = (a - c) + (b - d)i$

*Properties that apply to complex numbers:

Associative Properties of Addition and Multiplication

Commutative Properties of Addition and Multiplication

Distributive Property of Multiplication over Addition

Complex Conjugates
a + bi and a - bi

Notice: $(a+bi)(a-bi) = a^2 - abi + abi - b^2i^2$
$= a^2 - b^2(-1)$
$= a^2 + b^2$

Examples:

1) Find the real numbers a and b such that equation is true.

$a + bi = 12 + 5i$

2) Write the complex number in standard form.

$2i^2 - 6i$

3) Perform the operation and write result in standard form.

(a) $\left(\frac{3}{4}+\frac{7}{5}i\right)-\left(\frac{5}{6}-\frac{1}{6}i\right)$

(b) $-6(5-3i)$

(c) $(6-2i)(2-3i)$

(d) $(5-4i)^2$

4) Write the complex conjugate -

then multiply the numbers.

$-4-\sqrt{3}i$

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Examples:

1) Find the real numbers a and b such that equation is true.

a + bi = 12 + 5i

$a = 12$ $b = 5$

2) Write the complex number in standard form.

$2i^2 - 6i$

$i^2 = -1$

$2(-1) - 6i$

$-2 - 6i$

3) Perform the operation and write result in standard form.

(a) $\left(\frac{3}{4}+\frac{7}{5}i\right)-\left(\frac{5}{6}-\frac{1}{6}i\right) = -\frac{1}{12} + \frac{47}{30}i$

$= \frac{3}{4} - \frac{5}{6} + \frac{7}{5}i + \frac{1}{6}i$

$= \frac{9}{12} - \frac{10}{12} + \frac{42}{30}i + \frac{5}{30}i$

(b) $-6(5-3i) = -30 + 18i$

(c) $(6-2i)(2-3i)$ FOIL

$12 - 18i - 4i + 6i^2$

$12 - 22i + 6(-1)$

$6 - 22i$

(d) $(5-4i)^2 = (a-b)^2 = a^2 - 2ab + b^2$

$= 5^2 - 2(5)(4i) + 16i^2$

$= 25 - 16 - 40i = 9 - 40i$

4) Write the complex conjugate - then multiply the numbers.

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

$(-4-\sqrt{3}i)(-4+\sqrt{3}i) = a^2 + b^2$

$(-4)^2 + (-\sqrt{3}i)^2 = 16 + 3 = 19$

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