TOPIC: COMPLEX NUMBERS

Introduction to Complex Numbers

● **Recall:** We've learned *real & imaginary numbers* separately, but you'll see expressions with *both* types of numbers.

- We call these **complex numbers**, which have a **standard form** of:

$$a + b\boldsymbol{i}$$

$\boldsymbol{a}$ is the _________ part $\boldsymbol{b}$ is the _____________ part

EXAMPLE: Identify the real and imaginary parts of each complex number.

COMPLEX NUMBERS

$(\boldsymbol{A})$ $4 - 3i$

$a =$ _____ $b =$ _____

$(\boldsymbol{B})$ $0 + 7i$

$a =$ _____ $b =$ _____

$(\boldsymbol{C})$ $2 + 0i$

$a =$ _____ $b =$ _____

PRACTICE: Identify the real and imaginary parts of the complex number.

$-4 - 9i$

$a =$ _____ $b =$ _____

PRACTICE: Identify the real and imaginary parts of the complex number.

$3 + 2i\sqrt{3}$

$a =$ _____ $b =$ _____

PRACTICE: Write the complex number in standard form.

$\frac{9+\sqrt{-16}}{3}$

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Adding & Subtracting Complex Numbers

- Just like with algebraic expressions, when you add or subtract complex #s, simply **combine like terms.**
  - Always express your answer in ____________ form!

Adding/Subtracting Algebraic Expressions

$(4 + 8x) + (2 + 3x)$

$4 + 8x + 2 + 3x$

$6 \quad + \quad 11x$

EXAMPLE: Perform the given operation, expressing the result in standard form.

ADDING COMPLEX NUMBERS	SUBTRACTING COMPLEX NUMBERS
$(4 + 8i) + (2 + 3i)$	$(4 + 8i) - (2 + 3i)$

PRACTICE: Find the difference. Express your answer in standard form.

$$(2 + 8i) - (4 - i)$$

PRACTICE: Find the sum. Express your answer in standard form.

$$5(4 + 7i) + 6(3 - 2i)$$

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Multiplying Complex Numbers

- Complex numbers are multiplied just like algebraic expressions! We A) ____________ or B) ________
  - Multiplying will *ALWAYS* produce an i^2 term that will get simplified.

EXAMPLE: Find the product. Write answers in standard form.

(A) $3i(7-2i)$

(B) $(-6+2i)(3+4i)$

MULTIPLYING COMPLEX NUMBERS
1) Distribute or FOIL
2) Apply $i^2 = -1$
3) Combine like terms

PRACTICE: Perform the indicated operation. Express your answer in standard form.

$(3+8i)^2$

PRACTICE: Find the product. Express your answer in standard form.

$2i(9-4i)(6+5i)$

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Complex Conjugates

● Reverse the ______ of *only* the **imaginary** part of a complex number to get the **conjugate:** $a + bi \Leftrightarrow$

EXAMPLE: Find the conjugate of each complex number.

(A) $1 + 2i$ **(B)** $1 - 2i$ **(C)** $-1 + 2i$

● Multiplying **complex conjugates** (by FOIL) ***ALWAYS*** results in a ________ number

EXAMPLE: Find the product.

$$(2 + 3i)(2 - 3i)$$

$(a + bi)(a - bi) =$ ______________

PRACTICE: Find the product of the given complex number and its conjugate.

$$4 - 5i$$

PRACTICE: Find the product of the given complex number and its conjugate.

$$-7 - i$$

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Dividing Complex Numbers

- Dividing by a complex number results in a fraction with i in the bottom: this is **BAD**
  - Denominators should ***ALWAYS*** be real! To do this, multiply by its ___________

$$\frac{c}{a + bi}$$

DIVIDING COMPLEX NUMBERS
1) Multiply top AND bottom by complex conj. of bottom & simplify
2) Expand fraction into real & imaginary parts
3) Simplify fractions to lowest terms

EXAMPLE: Find the quotient. Write answer in standard form.

$$\frac{3}{1 + 2i}$$

PRACTICE: Find the quotient. Express your answer in standard form.

$$\frac{6 + i}{4 - 2i}$$

PRACTICE: Find the quotient. Express your answer in standard form.

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