

Lesson 25: Complex Numbers Part 2 (5.10)

By the end of the lesson, we will be able to:

- ~ Find conjugates of complex numbers
- ~ Simplify fractions by using complex conjugates.

Review: Simplify each expression:

$$\begin{aligned} \text{a) } & (2 + 3i)(4 - 5i) \\ & = 8 - 10i + 12i - 15i^2 \\ & \qquad \qquad \qquad -15(-1) \\ & = 8 + 2i + 15 \\ & = \boxed{23 + 2i} \end{aligned}$$

$$\begin{aligned} \text{b) } & (\sqrt{5} + 2i)^2 \\ & = (\sqrt{5} + 2i)(\sqrt{5} + 2i) \\ & = 5 + 2i\sqrt{5} + 2i\sqrt{5} + 4i^2 \\ & = 5 + 4i\sqrt{5} - 4 \\ & = \boxed{1 + 4i\sqrt{5}} \end{aligned}$$

What is the ^{mult} product of a Complex number and its conjugate?

$$\begin{aligned} & (2 + 3i)(2 - 3i) \\ &= 4 - 6i + 6i - 3i^2 \\ &= 4 \qquad \qquad \qquad + 3 \\ &= \boxed{7} \end{aligned}$$

What is the conjugate?

a.) $(-3 + 8i)$

$(-3 - 8i)$

b.) $(5 - i)$

$(5 + i)$

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Examples: What is the conjugate?

a.) $10i = 0 + 10i$

$-10i$

b.) $7 - 8i$

$7 + 8i$

c.) $3 - i\sqrt{2}$

$3 + i\sqrt{2}$

d.) $-15i$

$15i$

multiply

Examples: Find the product of each complex number and its conjugate.

$$\text{a.) } (9 + 2i)(9 - 2i)$$

$$= 81 - 18i + 18i - 4i^2$$

-4(-1)

$$= 81 + 4$$

$$= \boxed{85}$$

$$\text{b.) } (5 - 7i)(5 + 7i)$$

$$= 25 + 35i - 35i - 49i^2$$

$$= 25 + 49$$

$$= \boxed{74}$$

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Examples: Find the product of each complex number and its conjugate.

$$\text{a.) } (1 + 2i)(1 - 2i)$$
$$\vdots$$

$$\text{b.) } (7 - 3i)(7 + 3i)$$
$$\vdots$$

Complex Conjugates

Just like with radicals, we do not like complex numbers in the denominator of a fraction. because $i = \sqrt{-1}$ so we have a $\sqrt{\quad}$ in the denominator.

★ We get rid of complex expressions by multiplying (both top & bottom) by its conjugate.

★ We get rid of monomials with i 's by multiplying (top & bottom) by an i .

$$i^2 = -1$$

Examples: Simplify each expression.

$$\begin{aligned}
 \text{a.) } & \frac{(2+7i)}{-5i} \cdot \frac{i}{i} \\
 & = \frac{2i+7i^2}{-5i^2} \\
 & = \frac{2i+7(-1)}{-5(-1)} \\
 & = \boxed{\frac{2i-7}{5}}
 \end{aligned}$$

$$\begin{aligned}
 \text{b.) } & \frac{(2-4i)(1-3i)}{(1+3i)(1-3i)} = \\
 & = \frac{2-6i-4i+12i^2}{1-\cancel{3i}+\cancel{3i}-9i^2} \\
 & = \frac{2-10i-12}{1+9} = \frac{-10-10i}{10} \\
 & = \frac{\cancel{10}(-1-i)}{\cancel{10}} = \boxed{-1-i}
 \end{aligned}$$

Examples: Simplify each expression.

$$\begin{aligned} \text{c.) } & \frac{3}{(6+4i)} \cdot \frac{(6-4i)}{(6-4i)} \\ & = \frac{18-12i}{36-16i^2} \\ & = \frac{18-12i}{36+16} = \frac{18-12i}{52} \\ & = \boxed{\frac{9-6i}{26}} \end{aligned}$$

$$\text{d.) } \frac{3}{\sqrt{5}+2i} \cdot \frac{(\sqrt{5}-2i)}{(\sqrt{5}-2i)} \dots$$

Examples: Simplify each expression.

$$\begin{aligned} \text{e.) } & \frac{(3 - 6i)}{-4i} \cdot \frac{i}{i} \\ & = \frac{3i - 6i^2}{-4i^2} \\ & = \boxed{\frac{3i + 6}{4}} \end{aligned}$$

$$\begin{aligned} \text{f.) } & \frac{3}{(\sqrt{2} - 5i)} \cdot \frac{(\sqrt{2} + 5i)}{(\sqrt{2} + 5i)} \\ & = \frac{3\sqrt{2} + 15i}{2 + \cancel{5i\sqrt{2}} - \cancel{5i\sqrt{2}} - 25i^2} \\ & = \frac{3\sqrt{2} + 15i}{2 + 25} = \frac{3\sqrt{2} + 15i}{27} \\ & = \boxed{\frac{\sqrt{2} + 5i}{9}} \end{aligned}$$

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Can you?

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Homework:

Assignment #25

Due the day **AFTER** the test.

Review for Test 6

Test **NEXT** time!