Class Notes

4.4 Complex Numbers

Algebra 2 - Davis

Name:

Date:

Vocabulary

imaginary unit

pure imaginary number

complex number

complex conjugate

SAT WARM-UP: A store charges $49 for a pair of pants. This price is 40% more than the amount it costs the store to buy the pants. After a sale, any employee is allowed to purchase any remaining pairs of pants at 30% off the store's cost. How much would it cost an employee to purchase the pants after the sale?

Separate what

1. The imaginary unit i i is defined to be $i^2 = -1$. So $i = \sqrt{-1}$

pure imaginary numbers are $2i$, $-6i$, $i\sqrt{3}$ (square roots of neg real #s)

IMPORTANT: $\sqrt{-b} = i\sqrt{b}$ Key Concept - pull -1 out

a. $\sqrt{-25}$ $\sqrt{25}\sqrt{-1}$ $5i$

b. $\sqrt{-28}$ $\sqrt{4}\sqrt{7}\sqrt{-1}$ $2i\sqrt{7}$

c. $\sqrt{-32}$ $\sqrt{16}\sqrt{2}\sqrt{-1}$ $4i\sqrt{2}$

d. $\sqrt{-125}$ $\sqrt{25}\sqrt{5}\sqrt{-1}$ $5i\sqrt{5}$

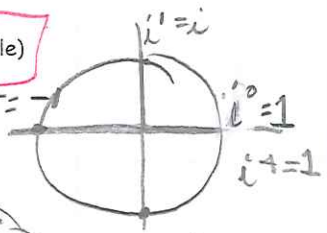
2. $i^1 = i$, $i^2 = -1$, $i^3 = -i$, $i^4 = 1$ (Show Circle)

messy

Divide by 4 Remainder

What is i^{31} ?

i^{28}, i^3 $-i$



3. Products of Pure Imaginary Numbers

a. $-3i \cdot 2i$ $-6(i^2)$ $-6(-1)$ 6

$-5i \cdot 3i$ -15 (-15)

b. $\sqrt{-12} \cdot \sqrt{-2}$ $\sqrt{24}$ $\sqrt{24}$ $4\sqrt{6}$

$2i\sqrt{3} \cdot i\sqrt{2}$ $-2\sqrt{6}$

4. Equations with Pure Imaginary Solutions

a. $x^2 + 64 = 0$ $x^2 = -64$ $x = \pm\sqrt{-64}$ $x = \pm 8i$

b. $5y^2 + 20 = 0$ $5(y^2+4) = 0$ $y^2 + 4 = 0$ $y = \pm\sqrt{-4}$ $\pm 2i$

5. Complex Numbers: $2+3i$ a real number and a pure imaginary number can't combine - just stay that way

a. Add/Subtract: add/subt real parts, and add/sub imaginary parts

i. $(3+5i)+(2-4i)$ $5+i$

ii. $(4-6i)-(3-7i)$ $-6i - -7i$ $1+i$ $1-3$

b. Equate: What make the equation true?

$2x+yi=-14-3i$

$2x+yi = 14$ $yi = -3i$

$x = 7$ $y = -3$

$5x+1+(3+2y)i = 2-2i$

$2x-2+(y-6)i$

$(3+2y)i = (y-6)i$ $3i+2yi = yi-6i$ $y = -9$

$5x+1 = 2x-2$ $3x = -3$ $x = -1$

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5c. Multiplying Complex numbers - USE FOIL

Electricity: In an AC circuit, the voltage E, current I, and impedance Z, are related by the formula $E = I \cdot Z$. Find the voltage in a circuit with current 1+4j amps and impedance 3-6j ohms.

$(1+4j)(3-6j)$

$3 + 6j - 24j^2$

$-24(-1)$

$3 + 6j + 24$

$27 + 6j$

6. Dividing Complex numbers, (simplifying) - use the COMPLEX CONJUGATE (imaginary number in denominator is not simplified!)

Conjugate of 3+4i is $3-4i$

a. *Simplify* $\frac{5i}{3+2i}$ $(3-2i)$ $(3-2i)$

$5i(3-2i)$

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

$15i - 10i^2$

$9 - 4i^2$

$\frac{15i + 10}{13}$

$\frac{10}{13} + \frac{5}{13}i$

b. *Simplify* $\frac{5+i}{2i}$ $(2i)$ $(2i)$

$\frac{10i + 2i^2}{-4}$

$\frac{10i - 2}{-4}$

$\frac{1}{2} - \frac{5}{2}i$

7. In Class Practice # 1-17

8. Honors Group Work

1. Jennifer and Jessica come up with different answers to the same problem. They had to multiply $(4 + i)(4 - i)$ and give their answer as a complex number. Jennifer claims that the answer is 15 and Jessica claims that the answer is 17. Who is correct? Explain.

2. Always, sometimes, never? Every complex number has both a real part and an imaginary part. Explain

3. Simplify $(1+2i)^3$

Practice at Home: 4.4 #18-58 Even (These are simple - just need practice)