Name:	Date:	Period:

4.3 Imaginary Numbers Notes

Warm up

Multiply without a calculator!!!!!!!

$(\sqrt{3})^2$ ← $\sqrt{3}\cdot\sqrt{3}$ → $\sqrt{9}$

$(\sqrt{3})^2 \rightarrow 3$, $\sqrt{9} \rightarrow 3$, $3 = 3$

Imaginary Numbers

Ex: Solve $x^2 + 1 = 0$

$x^2 = -1$

$x = \pm\sqrt{-1}$

This is not a real number solution. mathematicians defined imaginary numbers to represent solution

- i ($i = \sqrt{-1}$) is the **imaginary unit**.
- An **imaginary number** is written in the form bi, where b is a real number and i is the imaginary unit..

example $4i$, $-2i$, i

Directions: Solve each equation. $i = \sqrt{-1}$

Ex1: $2x^2 + 9 = 1$

$-9 \quad -9$

$2x^2 = -8$

$x^2 = -4$

$x = \pm\sqrt{-4}$

$= \pm\sqrt{-1}\sqrt{4}$

$= \pm 2i$

Ex2: $4x^2 + 15 = -9$

$-15 \quad -15$

$4x^2 = -24$

$x^2 = -6$

$x = \pm\sqrt{-6}$

$= \pm i\sqrt{6}$

If a $\sqrt{\ }$ is in solution, i usually is placed in front.

Ex3: $x^2 + 13 = 1$

$x^2 = -12$

$x = \pm\sqrt{-12}$

$= \pm i\sqrt{4}\sqrt{3}$

$= \pm 2i\sqrt{3}$

Powers of *i*

$i = \underline{\quad i \quad} = \underline{\quad i \quad}$

$i^2 = \underline{i \cdot i = \sqrt{-1} \cdot \sqrt{-1}} = \underline{\quad -1 \quad}$

$i^3 = \underline{i^2 \cdot i = -1 \cdot i} = \underline{\quad -i \quad}$

$i^4 = \underline{i^2 \cdot i^2 = (-1)(-1)} = \underline{\quad 1 \quad}$

$i^5 = \underline{i^2 \cdot i^2 \cdot i} = \underline{\quad i \quad}$
$(-1)(-1)\,i$

$i^6 = \underline{i^2 \cdot i^2 \cdot i^2} = \underline{\quad -1 \quad}$
$(-1)(-1)(-1)$

$i^7 = \underline{i^2 \cdot i^2 \cdot i^2 \cdot i} = \underline{\quad -i \quad}$
$(-1)(-1)(-1)\,i$

$i^8 = \underline{i^2 \cdot i^2 \cdot i^2 \cdot i^2} = \underline{\quad 1 \quad}$
$(-1)(-1)(-1)(-1)$

Every group of 4 factors of i, (i^4), equals 1

Ex4: i^{15}

$i^4\, i^4\, i^4\, i^3 = (i^4)^3\, i^3$
$(1)\, i^3$
$-i$

$4\overline{)15}$ R 3
12
3

$i^3 = -i$

Remainder

Ex5: i^{62}

$4\overline{)62}$ R 2
4
22
20
2

$i^2 = -1$

Quick exponent review

$x^2 \cdot x^6$

x^{2+6}

x^8

$(2x)^2x^5$

$2^2x^2x^5$

$4x^7$

Products of Imaginary Numbers

exponent properties of i are the same as exponent props of variables.

Ex6: $(2i)^3(5i)$

$2^3i^3 \cdot 5 \cdot i$

$8 \cdot 5 \cdot i^4$

$40(1)$

40

Ex7: $(i\sqrt{3})^2(-8i)^2$

$i^2(\sqrt{3})^2(-8)^2i^2$

$i^2 \cdot 3 \cdot 64 \cdot i^2$

$192i^4$

$192(1)$

192

EX 8 $\sqrt{-18} \cdot \sqrt{-10}$

$\sqrt{-1}\sqrt{9}\sqrt{2} \cdot \sqrt{-1} \cdot \sqrt{10}$

$i \cdot 3 \cdot \sqrt{2} \cdot i \cdot \sqrt{10}$

$3i^2\sqrt{20}$

$3 \cdot (-1) \cdot \sqrt{4}\sqrt{5}$

$3 \cdot 2 \cdot (-1)\sqrt{5}$

$-6\sqrt{5}$

EX 9 $\sqrt{-24} \cdot \sqrt{-3} \cdot \sqrt{-2}$

$i\sqrt{24} \cdot i\sqrt{3} \cdot i\sqrt{2}$

$i^3\sqrt{4} \cdot \sqrt{6}\sqrt{3}\sqrt{2}$

$i^3 \cdot 2 \cdot \sqrt{36}$

$(-i)2 \cdot 6$

$-12i$