When using Real #'s
$(a + b)^2$ is ALWAYS a TRINOMIAL.

$(x+5)^2$ is never just 2 terms!!!!

$(x+5)^2 = x^2 + 10x + 25$

HOWEVER: When using Imagninary #'s
$(a + bi)^2$ is ALWAYS a BINOMIAL.

$$\begin{aligned}(1+5i)^2 &= 1^2 + 10i + 25i^2 \\ &= 1 + 10i + 25(-1) \\ &= 1 + 10\,i - 25 \\ &= -24 + 10i\end{aligned}$$

$(a + bi)^2$ is ALWAYS
another Complex Number.

When dealing with Real Numbers only:
$(x + 5)(3x + 2)$ is a Trinomial

When dealing with Complex Numbers:
$(5 + i)(2 + 3i)$ is a Binomial

it's another Complex #

Factors such as $(a + b)$ and $(a - b)$
are called CONJUGATES

Conjugate

The conjugate is where we **change the sign in the middle** of two terms like this:

$3x + 1$

Conjugate: $3x - 1$

When using REAL #'s:

$(a + b)(a - b) = a^2 - b^2$

When using COMPLEX #'s:

$$\begin{aligned}(a + bi)(a - bi) &= a^2 - (bi)^2 \\ &= a^2 - b^2i^2 \\ &= a^2 - b^2(-1) \\ &= a^2 + b^2\end{aligned}$$

It turns out to be a Constant!

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

$i^2 = -1$

$i^3 = -i$

Simplify each.

1. $(3i)(7i)(2i) =$

$\underbrace{(3i)(7i)}(2i)$

$21i^2$

$21(-1)$

$(-21)\cdot(2i)$

$-42i$

2. $(-2i)(10i)(i)(-5) =$

$\underbrace{(-2i)(10i)}\underbrace{(i)(-5)}$

$-20i^2$

$-20(-1)$

$(20)\cdot(-5i)$

$-100i$

3. $(2 - 5i)^3 = (2-5i)(2-5i)(2-5i)$

Multiply the first two factors then take that result and multiply by the third factor.

	2	$-5i$
2	4	$-10i$
$-5i$	$-10i$	$25i^2$

$25i^2 - 20i + 4$

(-1) $\quad -25$

$-21 - 20i \longrightarrow (-21-20i)(2-5i)$

	2	$-5i$
-21	-42	$105i$
$-20i$	$-40i$	$100i^2$

$100i^2 + 65i - 42$

(-1) $\quad -100$

$-142 + 65i$

Find ALL solutions using Square Roots:

$$(x + 1)^2 + 21 = 5$$

$-21 \quad -21$

$\sqrt{(x+1)^2} = \sqrt{-16}$

$x+1 = \pm 4i$

$-1 \quad -1$

$x = -1 \pm 4i$

Now, all quadratic equations have 2 solutions.

Some of these solutions may be imaginary.

Find all Complex Solutions (real and imaginary).

1. $3x^2 + 70 = 22$

$-70 \quad -70$

$\frac{3x^2}{3} = \frac{-48}{3}$

$\sqrt{x^2} = \sqrt{-16}$

$\boxed{x = \pm 4i}$

2. $6 - 2x^2 = 96$

$-6 \quad -6$

$\frac{-2x^2}{-2} = \frac{90}{-2}$

$\sqrt{x^2} = \sqrt{-45}$

$\sqrt{45} = \sqrt{9 \cdot 5}$

$\boxed{x = \pm 3i\sqrt{5}}$

3. $(x + 7)^2 - 38 = -13$

$+38 \quad +38$

$\sqrt{(x+7)^2} = \sqrt{25}$

$x+7 = \pm 5$

$x+7 = -5$

$-7 \quad -7$

$x = -12$

$x+7 = 5$

$-7 \quad -7$

$x = -2$

$\boxed{x = -12, -2}$

4. $(x - 2)^2 + 71 = 7$

$-71 \quad -71$

$\sqrt{(x-2)^2} = \sqrt{-64}$

$x - 2 = \pm 8i$

$+2 \quad\quad +2$

$\boxed{x = 2 \pm 8i}$

5. $2(x + 1)^2 + 119 = 15$

$-119 \quad -119$

$\frac{2(x+1)^2}{2} = \frac{-104}{2}$

$\sqrt{(x+1)^2} = \sqrt{-52}$ 4·13

$x + 1 = \pm 2i\sqrt{13}$

$-1 \quad -1$

$x = -1 \pm 2i\sqrt{13}$

Now you can finish Hwk #17

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Problems 41-45, 50-52, 56

simplify imaginary solutions

$i = \sqrt{-1} = i$	$i^5 = i$	$i^9 = i$
$i^2 = -1$	$i^6 = -1$	$i^{10} = -1$
$i^3 = -i$	$i^7 = -i$	$i^{11} = -i$
$i^4 = 1$	$i^8 = 1$	$i^{12} = 1$

Powers of i have a repeating pattern.
It repeats in groups of four.

Simplify each Power of i

$i^{18} = -i$

$i^{27} = -i$

Simplify each power of i

1. $i^{37} = i$

$$\begin{array}{r} 9 \text{ R}=1 \\ 4\overline{)37} \\ -36 \\ \hline 1 \end{array}$$

the remainder represents how far into the next pattern you are. A remainder of 1 means you are 1 into the next pattern of 4 so it's same as i^1

2. $i^{172} = 1$

$$\begin{array}{r} 43 \\ 4\overline{)172} \\ -16 \\ \hline 12 \\ -12 \\ \hline 0 \end{array}$$

remainder of zero means you've just completed a pattern of 4 so it's the same as i^4

3. $i^{331} = -i$

$\frac{331}{4} = 82.75$

this decimal represents a remainder of 3 so it's the same as i^3

4. $i^{454} = -1$

$\frac{454}{4} = 113.5$

this decimal represents a remainder of 2 so it's the same as i^2