

$$x^2 - 14x + 3 = 10$$

$$x^2 - 14x + (-7)^2 = 7 + 49$$

$$(x-7)^2 = 56$$

$$x-7 = \pm \sqrt{56}$$

$$x = 7 \pm \sqrt{56}$$

$$x^2 + x$$

$$x^2 + x + \left(\frac{1}{2}\right)^2 - \frac{1}{4}$$

$$\left(x + \frac{1}{2}\right)^2 - \frac{1}{4}$$

10.4 Complex Numbers

Note: We could have issues with quadratic equations

$$x^2 = -9$$

Oops!

Go back in your history —

First Grade

$$3 + 2 = 5$$

$$3 - 2 = 1$$

$$2 - 3 = -1$$

Fourth Grade

$$\frac{6}{2} = 3$$

$$\frac{2}{6} = \frac{2}{6}$$

9th

$$x^2 = 9$$

$$x = 3, -3$$

$$x^2 = -1$$

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

$$x^2 = 8$$

$$x = \sqrt{8}, -\sqrt{8}$$

Imaginary Numbers

Shorthand $i = \sqrt{-1}$

Complex Numbers : $a + bi$

a, b : real numbers

Imaginary number

Complex number

Ex:

$$x^2 = -9$$

$$x = 3i, -3i \\ \pm 3i$$

Ex:

$$x^2 + 2x = -8$$

$$x^2 + 2x + (1)^2 = -8 + 1$$

$$(x+1)^2 = -7$$

$$x+1 = \pm \sqrt{7}i$$

$$x = -1 \pm \sqrt{7}i$$

Adding and Subtracting Complex Numbers

$$\begin{aligned} \text{EX: } & (2 + 3x) + (4 - 7x) \\ & 6 - 4x \end{aligned}$$

$$\text{EX: } (2 + 3i) + (4 - 7i)$$

$$6 - 4i$$

$$\begin{aligned} & (2 + 3i) - (4 - 7i) \\ & \quad -2 + 10i \\ & \quad -4i - 6 \\ & \underbrace{2 + 3i} \quad \underbrace{-4 + 7i} \\ & \quad -2 + 10i \end{aligned}$$

Multiplying Complex Numbers

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EX: $(2 + 3x)(4 - 6x)$

~~$8 - 3x$~~

$8 - 18x^2$

$8 - 12x + 12x - 18x^2$

$(1 + 4x)(2 + 3x)$

$2 + 11x + 12x^2$

$$(1 + 4i)(2 + 3i)$$

$$2 + 3i + 8i + 12i^2$$

$$2 + 11i + 12(-1)$$

$$-10 + 11i$$

Quadratic Equations with Complex Roots

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