4-1 HW Answer Key

1. $\sqrt{-1}$
2. -1
3. $i\sqrt{r}$
4. 7i
5. -9i
6. $2i\sqrt{6}$
7. $6i\sqrt{5}$
8. -12
9. $2i\sqrt{15}$
10. $-3i\sqrt{5}$
11. -11
12. 50i
13. 2i
14. $-4i\sqrt{2}$
15. 12i
16. $x = \pm i\sqrt{5}$
17. $x = \pm 6i$
18. There is no real number that you can multiply by itself and get a negative number. For example, 2 • 2 = 4; -2 • -2 = 4.

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Name Key

Alg 2 Homework 4-1

1. $i = \sqrt{-1}$
2. $i^2 = -1$
3. $\sqrt{-r} = i\sqrt{r}$

Simplify:

4. $\sqrt{-49} = 7i$
5. $-\sqrt{-81} = -9i$
6. $\sqrt{-24} = i\sqrt{4}\sqrt{6} = 2i\sqrt{6}$
7. $2\sqrt{-45} = 2i\sqrt{9}\sqrt{5} = 6i\sqrt{5}$
8. $\sqrt{-4} \bullet \sqrt{-36} = 2i(6i) = 12i^2 = 12(-1) = -12$
9. $\sqrt{6} \bullet \sqrt{-10} = \sqrt{6} \cdot i\sqrt{10} = i\sqrt{60} = i\sqrt{4}\sqrt{15} = 2i\sqrt{15}$
10. $-\sqrt{-3} \bullet \sqrt{15} = -i\sqrt{3}\sqrt{15} = -i\sqrt{45} = -i\sqrt{9}\sqrt{5} = -3i\sqrt{5}$
11. $(\sqrt{-11})^2 = -11$
12. $5\sqrt{-100} = 5i\sqrt{100} = 5i(10) = 50i$
13. $\frac{1}{2}\sqrt{-16} = \frac{1}{2}i\sqrt{16} = \frac{1}{2}(4)i = 2i$
14. $-\sqrt{-32} = -i\sqrt{16}\sqrt{2} = -4i\sqrt{2}$
15. $\sqrt{-144} = 12i$

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Solve for x and put answer in i form.

16. $x^2 + 5 = 0$

$x^2 = -5$

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

$\sqrt{x^2} = \sqrt{-5}$

$x = \{\pm i\sqrt{5}\} = \cancel{\pm i\sqrt{4}}$

17. $x^2 + 36 = 0$

$x^2 = -36$

$x = \{\pm 6i\}$

18. Explain why there is no real number that is the square root of a negative number. For example, think about the $\sqrt{-4}$.

There's no real # that you can multiply by itself and get a negative #.

Ex. $2(2) = 4$

$-2(-2) = 4$

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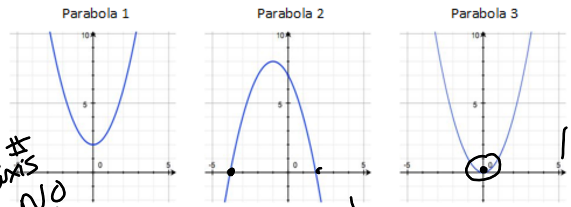
Complex numbers Algebra 2 Unit 4 Day 2

Yesterday we learned about a new number i. Today we are going to take it a step further and learn about complex numbers.

Which of these three parabolas are represented by a quadratic equation $y = ax^2+bx+c$ that has no real solution to $ax^2 + bx + c = 0$? Explain.



(x) real # axis

No real roots

2 real roots

1 real root

$i = \sqrt{-1}$

Using the quadratic formula, $x = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$, try solving $x^2 + 2x + 5 = 0$.

$ax^2+bx+c=0$

$x = \dfrac{-2 \pm \sqrt{4-4(1)(5)}}{2(1)} = \dfrac{-2 \pm \sqrt{4-20}}{2} = \dfrac{-2 \pm \sqrt{-16}}{2} = \dfrac{-2 \pm 4i}{2}$

$x = \dfrac{-1 \pm 2i}{1} = \{-1 \pm 2i\}$

or

$\{-1 + 2i, -1 - 2i\}$

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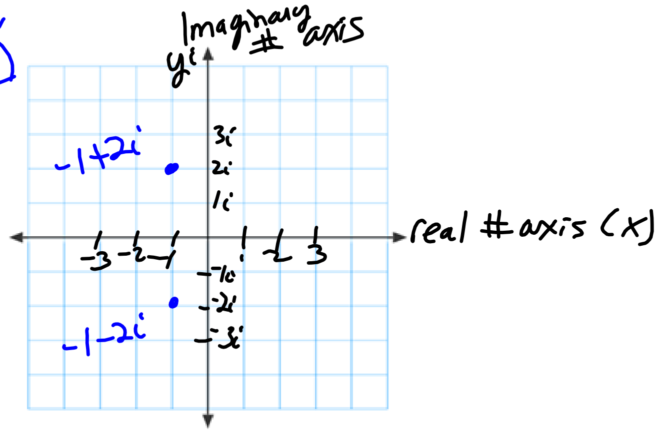
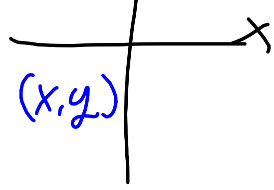
$-1+2i$, $-1-2i$

These numbers are called Complex #s, which we can locate in the complex plane.



Cartesian coordinate plane



In fact, all complex numbers can be written in the form a + bi ($x+yi$), where a and b are real numbers. Just as we can represent real numbers on the number line, we can represent complex numbers in the complex plane. Each complex number a+bi can be located in the complex plane in the same way we locate the point (a, b) (x,y) in the Cartesian plane. From the origin, translate a units horizontally along the real axis and b units vertically along the imaginary axis.

Complex #s ⟷

Real #s — Imag #s

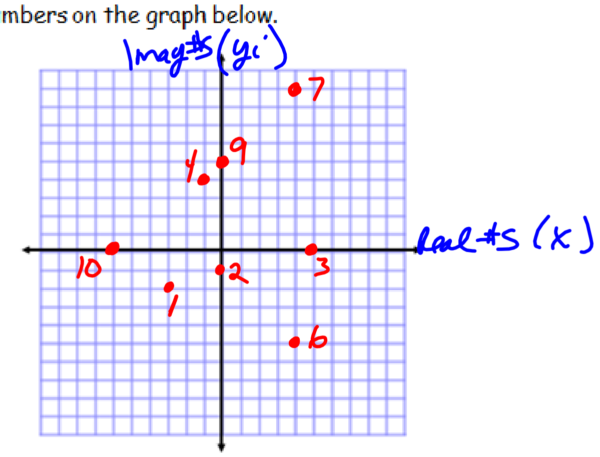
rational — irrational

Are real numbers also complex numbers? Explain.

yes $1 = 1 + 0i$

Plot and label the following complex numbers on the graph below.

1. $-3 - 2i$
2. $-i$ $= 0 + -i$
3. $5 + 0i$
4. $-1 + 4i$
5. ~~5.~~ $2 + (9/2)i$
6. $4 - 5i$
7. $9i + 4$ $= 4 + 9i$
8. ~~8.~~ $-5i - 6$
9. $5i$ $= 0 + 5i$
10. -6 $= -6 + 0i$



Since complex numbers are built from real numbers, we should be able to add, subtract, multiply and divide them. **Note: We are not going to look at division.**

Addition with Complex Numbers

Example 1: $(3 + 4i) + (7 - 20i)$

$= 10 - 16i$

You try: $(6 - i) + (3 - 2i)$

$= 9 - 3i$

Subtraction with Complex Numbers

Example 2: $(3 + 4i) - (7 - 20i)$

$= 3 + 4i - 7 + 20i$

$= -4 + 24i$

You try: $(6 - i) - (3 - 2i)$

$= 6 - i - 3 + 2i$

$= 3 + i$

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Multiplication with Complex Numbers (Note: rewrite i^2 as -1)

$i = \sqrt{-1}$

$i^2 = -1$

Example 3: $(1 + 3i)(4 - 2i)$

$= 4 - 2i + 12i - 6i^2$

$= 4 + 10i - 6(-1)$

$= 4 + 10i + 6$

$= 10 + 10i$

You try: $(6 - i)(3 - 2i)$

$= 18 - 12i - 3i + 2i^2$

$= 18 - 15i + \cancel{2(-1)} - 2$

$= 16 - 15i$

$\cancel{-15i + 16}$

Multiply the following complex numbers with its conjugate:

1. $(x + i)(x - i) = x^2 - ix + ix - i^2 = x^2 - i^2 = x^2 - (-1) = x^2 + 1$

2. $(x + 5i)(x - 5i) = x^2 - 5xi + 5xi - 25\overset{(-1)}{i^2} = x^2 + 25$

3. $(5 + 4i)(5 - 4i) = 25 - 16i^2 = 25 + 16 = 41$

What patterns do you notice?

Middle terms add to zero. Last term i^2 = -1.

Result has no i and is a real#.

Show that for any real numbers a and b, (a + bi)(a - bi) is a real number.

$(a + bi)(a - bi) = a^2 - abi + abi - b^2 i^2 (-1)$

$= a^2 + b^2$

Conjugates

The product of a Complex # and its Conjugate is a polynomial with real coefficients.

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You do:

Express the quantities below in a + bi form, then graph and label the corresponding points on the complex plane.

1. $(1 + i) - (1 - i) = 1 + i - 1 + i$

$= 2i$

$0 + 2i$

2. $(1 + i)(1 - i) = 1 - \cancel{i^2}^{(-1)} = 1 + 1 = 2$

$2 + 0i$

3. $i(2 - i)(1 + 2i)$

i^3

$= i(2 + 4i - i - 2i^2)$

$= i(2 + 3i + 2)$

$= i(4 + 3i)$

$= 4i + 3\cancel{i^2}^{(-1)} = 4i - 3 = -3 + 4i$

Q II