Complex Numbers

- Complex Numbers are based on a number whose square is -1.

- The **imaginary unit** *i*:

$$\boldsymbol{i = \sqrt{-1}}$$
$$\boldsymbol{i^2 = -1}$$

- Imaginary numbers and real numbers together make up the set of *complex numbers*.

- Complex numbers can be written in the form: $a + bi$
  - Where *a* and *b* are real numbers

- *In COMPLEX number plane,* to Graph (*a*, *b*) which represents $a + bi$:
  - Locate real part on horizontal axis and imaginary part on vertical axis.

- *Absolute value of a complex number*: Distance from the origin in the complex plane.

$$|a + bi| = \sqrt{a^2 + b^2}$$

- To *add* or *subtract* complex numbers, combine real parts together and combine imaginary parts together.

- *Multiply* complex numbers/binomials the same as you do real numbers.

- $a + bi$ and $a - bi$ are called *complex conjugates* of each other. Their product is a real number! We often multiply the numerator and denominator by the conjugate of the denominator to get rid of the radical (*i*) in the denominator.

Examples

- How do you write $\sqrt{-24}$ using the imaginary unit *i*?

- What are the graphs and absolute value of each complex number?
  - 1 - 3*i*

  - -4 + *i*

- What is each sum or difference?
  - $(2 + i) + (-3 + 3i)$

- $(5 + i) + (5 - i)$

- $(-6 - 2i) - (4 + 2i)$

- What is each product?
  - $-i(4 - 8i)$

  - $(5 - 7i)(-4 - 3i)$

- What is each quotient?
  - $\frac{7i}{8+i}$

  - $\frac{5+2i}{3-2i}$

- What are the solutions of $3x^2 + 12 = 0$?

- What are the solutions of $-x^2 + 4x - 5 = 0$?