The background features six light purple circles arranged in two rows of three. The top row has one hollow circle on the left and two solid circles on the right. The bottom row has two solid circles on the left and one hollow circle on the right. The text is centered over these circles.

# Adding And Subtracting Complex Numbers

Adding and Subtracting  
(add or subtract the real parts, then add or subtract the  
imaginary parts)

**Ex:**  $(-1 + 2i) + (3 + 3i)$

**Ex:**  $(2 - 3i) - (3 - 7i)$

**Ex:**  $2i - (3 + i) + (2 - 3i)$

Adding and Subtracting  
(add or subtract the real parts, then add or subtract the imaginary parts)

Ex:  $(-1 + 2i) + (3 + 3i)$

$$\triangle -1 + \square 2i + \triangle 3 + \square 3i$$

**2 + 5i**

Ex:  $(2 - 3i) + (3 + 7i)$

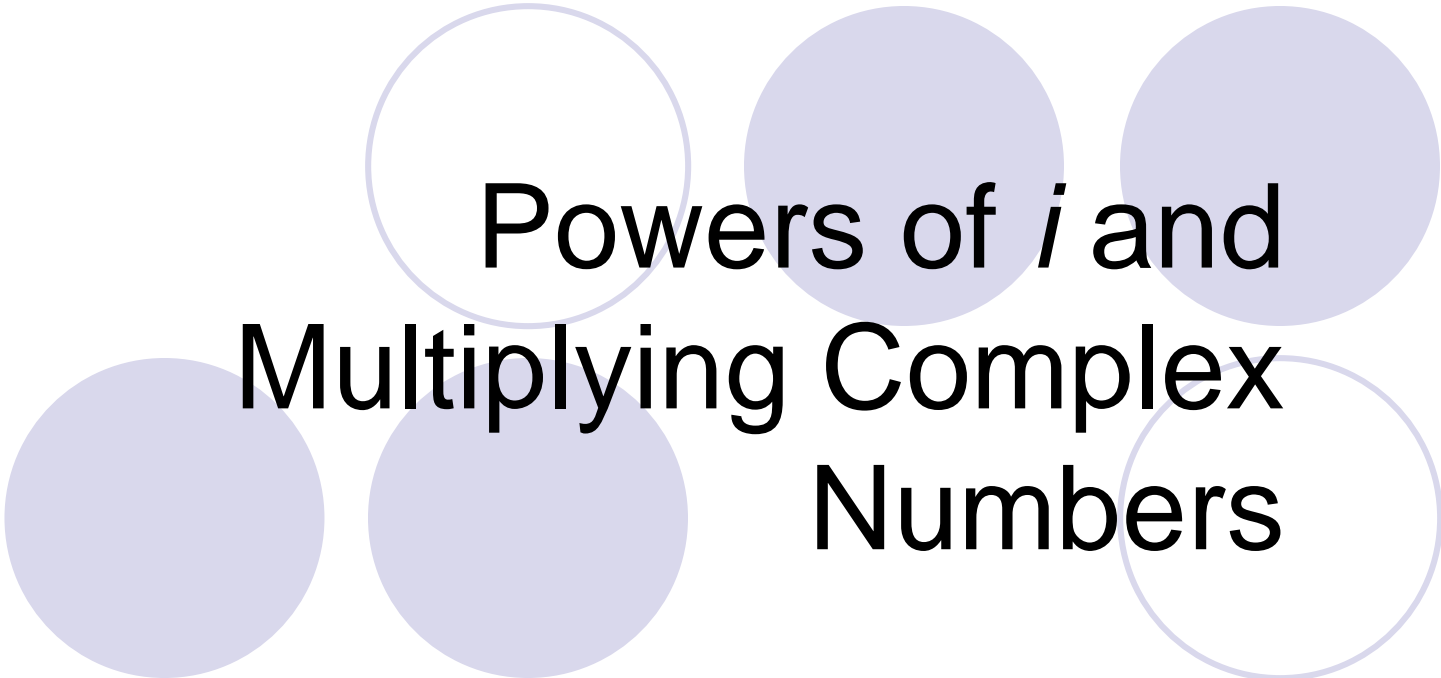
$$\triangle 2 - \square 3i + \triangle 3 + \square 7i$$

**-1 + 4i**

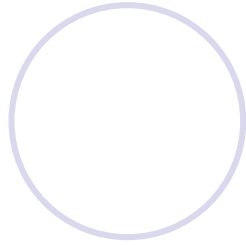
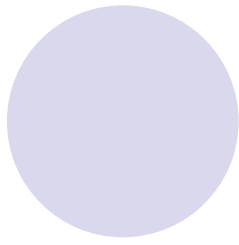
Ex:  $2i + (3 + i) + (2 - 3i)$

$$2i - 3 - i + 2 - 3i$$

**-1 - 2i**



Powers of  $i$  and  
Multiplying Complex  
Numbers



$$i^2 = -1$$

$$i^3 = -i$$

$$i^4 = 1$$

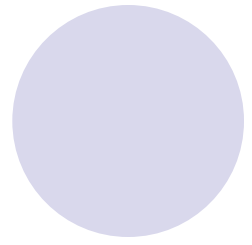
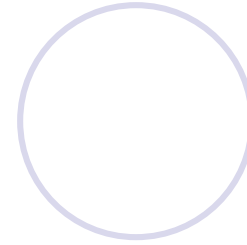
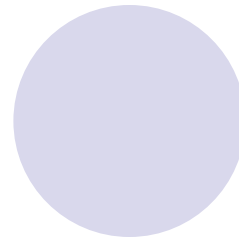
$$i^5 = i$$

$$i^6 = -1$$

$$i^7 = -i$$

$$i^8 = 1$$

*etc.*



\*For larger exponents, divide the exponent by 4, then use the remainder as your exponent instead.

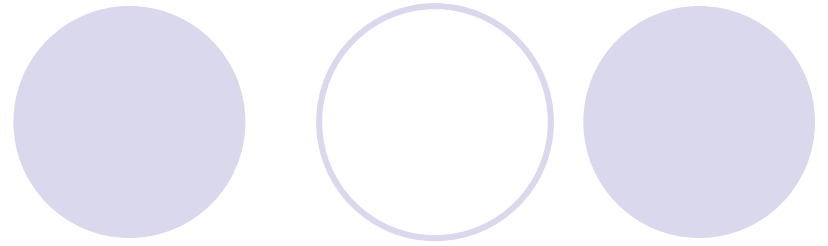
Example:  $i^{23} = ?$

$$\frac{23}{4} = 5 \text{ with a remainder of } 3$$

So, use  $i^3$  which =  $-i$

$$i^{23} = -i$$

*Try These!*



1.  $i^{13} = i$

2.  $i^{27} = -i$

3.  $i^{54} = -1$

4.  $i^{72} = 1$

# Multiplying Complex Numbers

1. Use FOIL, Box Method, or Distributive Property to multiply the Complex Numbers.

-Treat the  $i$ 's like variables

2. Change any  $i^2$ s to  $-1$

$$\begin{aligned}\text{Ex: } & -i(3+i) \\ & = -3i - i^2 \\ & = -3i - (-1) \\ & = 1 - 3i\end{aligned}$$

$$\begin{aligned}\text{Ex: } & (2+3i)(-6-2i) \\ & = -12 - 4i - 18i - 6i^2 \\ & = -12 - 22i - 6(-1) \\ & = -12 - 22i + 6 \\ & = -6 - 22i\end{aligned}$$

## Conjugates:

Two complex numbers of the form  $a + bi$  and  $a - bi$  are complex conjugates. The product is always a real number

$$\begin{aligned}\text{Ex: } & (2 + 4i)(2 - 4i) \\ & = 4 - 8i + 8i - 16i^2 \\ & = 4 - 16(-1)\end{aligned}$$





# Dividing Complex Numbers

## Writing in Standard Form

$$\text{Ex: } \frac{5-2i}{3+8i} * \frac{3-8i}{3-8i}$$

$$= \frac{(5-2i)(3-8i)}{(3+8i)(3-8i)}$$

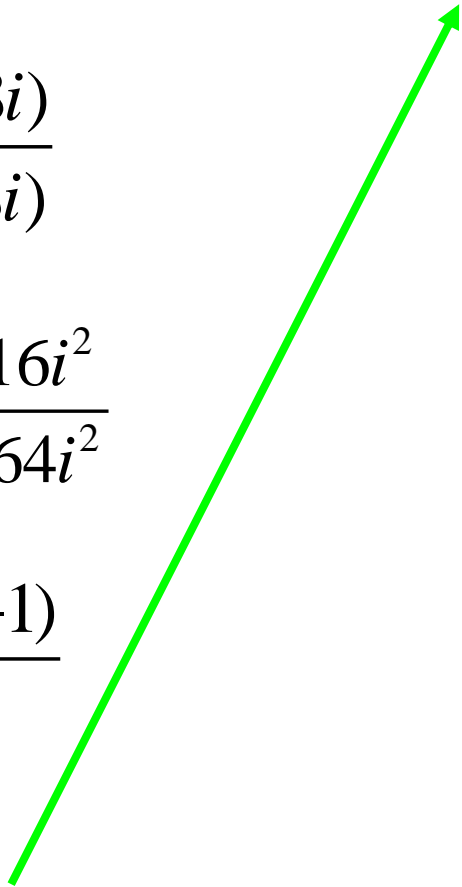
$$= \frac{15-40i-6i+16i^2}{9-24i+24i-64i^2}$$

$$= \frac{15-46i+16(-1)}{9-64(-1)}$$

$$= \frac{15-46i-16}{9+64}$$

$$= \frac{-1-46i}{73}$$

$$= \frac{-1}{73} - \frac{46}{73}i$$



## Writing in Standard Form

$$\text{Ex: } \frac{3+11i}{-1-2i} * \frac{-1+2i}{-1+2i}$$

$$= \frac{(3+11i)(-1+2i)}{(-1-2i)(-1+2i)}$$

$$= \frac{-3+6i-11i+22i^2}{1-2i+2i-4i^2}$$

$$= \frac{-3-5i+22(-1)}{1-4(-1)}$$

$$= \frac{-3-5i-22}{1+4}$$

$$= \frac{-25-5i}{5}$$

$$= \frac{-25}{5} - \frac{5i}{5}$$

$$= -5 - i$$

