Complex Numbers

The imaginary unit: i

Pure imaginary numbers:

Square roots of negative numbers:

$\sqrt{-27}$ $\sqrt{-18}$ $\sqrt{-125}$

Powers of *I*

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

$i^2 = -1$

Look for the pattern **that is formed when *i* is raised to the powers 1, 2, 3, 4, and so on.**

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

Now simplify:

1. i^{17}	**2.** i^{22}	**3.** i^{38}
4. i^{40}	**5.** i^{67}	**6.** i^{90}
7. i^{152}	**8.** $3i \bullet 6i^3$	**9.** $2i \bullet \left(4i^3\right)^2$

For any positive real number b,

$$\sqrt{-(b^2)} = \sqrt{b^2} \bullet \sqrt{-1} = bi$$

Example:

$$\sqrt{-24} = \sqrt{24} \bullet \sqrt{-1}$$
$$= \sqrt{4 \bullet 6} \bullet i$$
$$= 2i\sqrt{6}$$

Practice
Simplify

10. $\sqrt{-256}$	**11.** $\sqrt{-80}$	**12.** $\sqrt{-4}\bullet\sqrt{-9}$
13. $\sqrt{-\frac{25}{121}}$	**14.** $\sqrt{-6}\bullet\sqrt{-12}$	**15.** $(7-3i)(8+4i)$
16. $\left(-3\sqrt{-5}\right)^2$	**17.** $\left(2\sqrt{-8}\right)\left(3\sqrt{-2}\right)$	**18.** $\left(2i\bullet 3i^2\right)^2$
19. $(3i)^3\bullet(2i)^2$	**20.** $-\sqrt{15}\bullet\sqrt{-15}$	**21.** $\left(\sqrt{-13}\right)^2$

Equate complex numbers
set real parts equal to each other
and
set imaginary parts equal to each other

Find the value of x and y that make the equation true: $2x + yi = 14 - 3i$

Square Root Property

Solve: $x^2 + 36 = 0$

Solve 5y2 + 20 = 0

Complex Number $a + bi$,

where a and b are real numbers,

i is the imaginary unit,

a is called the real part, and

bi is called the imaginary part

Add and Subtract Complex Numbers

$(3 + 5i) + (2 - 4i)$

Multiply Complex Numbers

In an AC circuit, the voltage E, current I and impedance Z are related by the formula $E = I(Z)$

Find the voltage in a circuit with current $1 + 4j$ amps and impedance $3-6j$ ohms.

Divide Complex Numbers