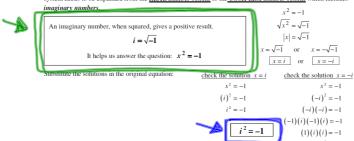**Section 5.2G**

1) What does $\sqrt{9}$ *mean*? Write a complete sentence.

2) Solve using the square root property: $x^2 - 36 = 0$

3) Solve using the square root property: $x^2 + 1 = 0$

In order to solve some of the equations you will come upon throughout the rest of your math career, the number system needs to be expanded from the **REAL number system** to the **COMPLEX number system** which includes **imaginary numbers**.

An imaginary number, when squared, gives a positive result.

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

It helps us answer the question: $x^2 = -1$

$$x^2 = -1$$
$$\sqrt{x^2} = \sqrt{-1}$$
$$|x| = \sqrt{-1}$$
$$x = \sqrt{-1} \quad \text{or} \quad x = -\sqrt{-1}$$
$$\boxed{x = i} \quad \text{or} \quad \boxed{x = -i}$$

Substitute the solutions in the original equation:

check the solution $x = i$
$$x^2 = -1$$
$$(i)^2 = -1$$
$$i^2 = -1$$
$$\boxed{i^2 = -1}$$

check the solution $x = -i$
$$x^2 = -1$$
$$(-i)^2 = -1$$
$$(-i)(-i) = -1$$
$$(-1)(i)(-1)(i) = -1$$
$$(1)(i)(i) = -1$$
$$i^2 = -1$$

4) Simplify the following:

a) i

b) i^2

c) $i^3 = i \cdot i \cdot i$
$= i^2 \cdot i$
$= \underline{\quad} \cdot i$
$= \underline{\quad}$

d) $i^4 = i \cdot i \cdot i \cdot i$
$= i^2 \cdot i^2$
$= \underline{\quad} \cdot \underline{\quad}$
$= \underline{\quad}$

e) i^5

f) i^6

5) How can you find the value of i^n ?

6) Simplify the following:

a) i^7

b) i^{22}

c) i^{56}

d) i^{79}

7) Joe and Sophie were given the following problem: Simplify $-\sqrt{9}$ and $\sqrt{-9}$. Joe says that both answers are -3. Sophie thinks Joe is wrong.

Who is correct? Explain your thinking.

real -3 *imaginary* $3i$

8) Complete the statement: $i^2 = \underline{\quad}$

a) Complete the simplification process:

$i^2 = (\sqrt{-1})^2 = (\sqrt{-1})(\sqrt{-1}) = \sqrt{\underline{\quad} \cdot \underline{\quad}} = \sqrt{\underline{\quad}} = \underline{\quad}$

b) What do you notice?

c) Important point to remember: _____

Remember that $\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$. We can use this property with i to simplify square roots of negative numbers.

9) Simplify $\sqrt{-49}$? $= \sqrt{-1 \cdot 49} = \sqrt{-1} \cdot \sqrt{49} = \boxed{7i}$

imaginary i 7 $4 \cdot 20$ / $8 \cdot 10$ / $16 \cdot 5$

10) Simplify the following:

a) $\sqrt{-4} = \sqrt{-1 \cdot 4} = \sqrt{-1} \cdot \sqrt{4} = \boxed{2i}$

b) $\sqrt{-90} = \sqrt{-1 \cdot 9 \cdot 10} = \sqrt{-1}\sqrt{9}\sqrt{10} = \boxed{3i\sqrt{10}}$

$\sqrt{-80} = 5\sqrt{-1}\sqrt{16 \cdot 5} = 5\sqrt{-1}\sqrt{16}\sqrt{5} = 5i \cdot 4\sqrt{5} = \boxed{20i\sqrt{5}}$

$-3\sqrt{-225} = -3\sqrt{-1}\sqrt{9}\sqrt{25} = -3i \cdot 3 \cdot 5 = \boxed{-45i}$

e) $\sqrt{-4} \cdot \sqrt{-9}$

f) $\sqrt{-2} \cdot \sqrt{-6}$

g) $\sqrt{-3} \cdot \sqrt{-8}$ $\sqrt{225} = -3 \cdot 15i = -45i$

h) $\sqrt{-10} \cdot \sqrt{-5}$

A **complex number** is any number that can be written in the standard form **a** + **b**i, where **a** and **b** are real numbers and i is the imaginary unit.

We can perform *operations* with complex numbers.

11) Simplify the following:

a) $(7 - 3i) + (-9 + 12i)$

b) $(6 + i) - (5 - 8i)$

c) $(3 + \sqrt{-1}) - (2 - \sqrt{-81})$

d) $(11 + \sqrt{-12}) + (2 - \sqrt{-27})$

12) Explain how to add or subtract complex numbers in your own words.

Round Table

1.   2.   3.   4.

HOMEWORK:

Blue Worksheet