

Warm Up

simplify

$$\sqrt{98x^5y^2} \quad \sqrt{49} \cdot \sqrt{2}$$

$$7x^2y \sqrt{2x}$$

$$\sqrt{-36} = 6i$$

$$\sqrt{4} \quad \sqrt{36}$$

$$\sqrt{-36}$$

$$-6 \cdot -6 = 36$$

- 4.
- 9.
- 16.
- 25.
- 36
- 49
- 64
- 81
- 100

What if the result of solving equation had the results

$$x^2 = -1$$

take the square root of both sides.

$$\sqrt{x^2} = \sqrt{-1} \quad x = \sqrt{-1}$$

What number multiplied by itself results in -1?

Complex Numbers

The Imaginary Unit

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

$$\sqrt{48} \\ \sqrt{16 \cdot 3}$$

This can be used to simplify radicals with negative radicands.

$$\sqrt{-144} = \sqrt{-1} \cdot \sqrt{144} \\ 12i$$

$$\sqrt{-50x^4} \quad \sqrt{-1} \cdot \sqrt{50} \sqrt{x^4} \\ i \cdot \sqrt{25 \cdot 2} \quad 2 \\ 5\sqrt{2} \quad x \\ 5x^2 i \sqrt{2}$$

$$\begin{matrix} \leftarrow \sqrt{-90x^5} & \sqrt{9} \sqrt{10} \\ & 3 \sqrt{10} \\ 3x^2 i & \sqrt{10x} \\ & 3x^2 i \sqrt{10x} \end{matrix}$$

$$\begin{matrix} \sqrt{-124y^9} & \sqrt{4} \sqrt{31} \\ & 2 \sqrt{31} \\ 2y^4 i \sqrt{31y} & \end{matrix}$$

Complex Numbers

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

If $i = \sqrt{-1}$ then $i^2 = \sqrt{-1}^2$ or, $i^2 = -1$
 $i \cdot i = \sqrt{-1} \cdot \sqrt{-1}$
 $i = \sqrt{-1}$

This is useful for simplifying the product of two complex numbers.

$$\begin{aligned} &(\sqrt{-13})(\sqrt{-26}) \\ &(i\sqrt{13})(i\sqrt{26}) \\ &i^2 \sqrt{338} \\ &-1 \sqrt{169} \sqrt{2} \\ &-13\sqrt{2} \end{aligned}$$

$$\begin{aligned} &(-2i)(7i) \\ &-14i^2 \\ &-14(-1) = 14 \end{aligned}$$

$$\begin{aligned} &(12i)(-15i) \\ &-180i^2 \\ &180 \end{aligned}$$

$$\begin{aligned} &(\sqrt{-15})(\sqrt{-48}) \\ &(i\sqrt{15})(i\sqrt{48}) \\ &i\sqrt{16}\sqrt{3} \\ &(i\sqrt{15})(4i\sqrt{3}) \\ &4i^2 \sqrt{45} \\ &\sqrt{9}\sqrt{5} \\ &3\sqrt{5} \\ &-12\sqrt{5} \end{aligned}$$

$$\begin{aligned} &(5i)(4i)(3i) \\ &60i^3 \\ &60i^2 \cdot i \\ &-60i \end{aligned}$$

Simplify

$$-1^2 \quad -1 \cdot -1 = 1$$

$$-1^3 \quad -1 \cdot -1 \cdot -1 = -1$$

$$-1^4 \quad \underbrace{-1 \cdot -1}_{=1} \cdot \underbrace{-1 \cdot -1}_{=1} = 1$$

$$-1^5 \quad \underbrace{-1 \cdot -1 \cdot -1 \cdot -1}_{=1} \cdot -1 = -1$$

$$-1^6 \quad = 1$$

- any neg # raised to an even power is POSITIVE

- any neg # raise to an odd power is NEGATIVE

Complex Numbers

$i^2 = -1$ can also help to simplify powers of i .

$$i^{24} (i^2)^{12}$$

$$-1^{12} = 1$$

$$i^{38} (i^2)^{19}$$

$$-1^{19} = -1$$

$$i^{63} i \cdot i$$

$$(i^2)^{31} \cdot i$$

$$-1^{31} \cdot i$$

$$-i$$

$$i^{64}$$

$$i^{25} i^{24} \cdot i$$

$$(i^2)^{12} \cdot i$$

$$-1^{12} \cdot i$$

$$+i$$

$$i^{90}$$

$$i^{55}$$

$$i^{16}$$