The Imaginary Number

$$\sqrt{-49} = \sqrt{49} \cdot \sqrt{-1} = \sqrt{49}\, i$$
$$= 7i$$

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

Powers of i:

R1 $i^1 = i$

R2 $i^2 = -1$

R3 $i^3 = -i$

R0 $i^4 = 1$

$i^5 = i$

$i^6 = -1$

$i^7 = -i$

$i^8 = 1$

$\vdots$

To Simplify powers of i:

- 4 steps in the pattern
- Divide the exponent by 4 and look at the <u>remainder</u>

$i^{27} = -i$

$$4\overline{)27} \quad 6\ (R3)$$

-24

3

$i^{36} = 1$

$$\begin{array}{r} 9 \text{ R } 0 \\ 4\overline{)36} \\ \underline{-36} \\ 0 \end{array}$$

Remember $i^2 = -1$

Complex Numbers

- two parts
  - real number
  - imaginary number

$$a + bi$$

a: real number

bi: imaginary number

(any)

$\pi + \frac{2}{3}i$, $0 + 6i$, $12 + 0i$, $-5 - \sqrt{7}\,i$

Simplifying Roots into Imaginary Numbers

$$\sqrt{-72} = \sqrt{72}\, i$$

① factor the negative and it becomes i

$$72 = (2\cdot 2)\cdot 2\cdot (3\cdot 3)$$

$$2\ 36 \quad 2\ 18 \quad 2\ 9 \quad 3\ 3$$

② Simplify the radical.

$$= 6\sqrt{2}\, i$$

$$= 6i\sqrt{2}$$

$$\sqrt{-98m^{10}n^6} = \sqrt{98m^{10}n^6}\ i$$

i

$98 = 2(7\cdot 7)$

$2\ 49$

$7\cdot 7$

$$= 7m^5n^3i\sqrt{2}$$

$$\sqrt{-121x^8y^{16}} = \sqrt{121x^8y^{16}}\ i$$

$$11x^4y^8i$$

*Always change roots to imaginary numbers before doing the problem!

Add / Subtract Complex Numbers:

- Combine Like Terms
  (real w/ real & imaginary w/ imaginary)

$$(3+2i)+(4-6i)$$

$$7-4i$$

$$(2+7i)-(12+6i)$$

$$-10+i$$

Multiplication:

- Distribute
- $i^2 = -1$

$$(3+4i)(7-2i)$$

$$21 - 6i + 28i - 8i^2$$

$$+8$$

$$29 + 22i$$

$(6+5i)(3+7i)$

$18+42i+15i+35i^2$

-35

$-17+57i$

Divide

- multiply the top & bottom by the conjugate of the denominator.

conjugate = $3-2i$

$$\frac{6}{3+2i}\cdot\frac{(3-2i)}{(3-2i)} = \frac{18-12i}{9-6i+6i-4i^2}$$

$-(-1)$

$+4$

$$= \frac{18-12i}{13}$$

$$\frac{18}{13} - \frac{12}{13}i$$

$$\frac{4-i}{5+2i}\cdot\frac{(5-2i)}{(5-2i)} = \frac{20-8i-5i+\cancel{2i^2}^{-2}}{25-\cancel{10i}+\cancel{10i}-\cancel{4i^2}^{+4}}$$

$$\frac{18-13i}{29}$$

$$\frac{18}{29}-\frac{13}{29}i$$

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

Change to i first

$$\sqrt{5}\,i \cdot \sqrt{10}\,i$$

$$\sqrt{50}\,i^2$$

$$\sqrt{50}(-1)$$

$$-\sqrt{50} = -5\sqrt{2}$$

$2i\,(3i)^2$

$(3i)(3i) = 9i^2$

$3^2 i^2 = 9i^2$

$2i \cdot 9i^2 = 18i^3$

$(-i)$

$= -18i$

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SHOW WORK