Complex numbers are used especially in the field of electronics. Where circuit components may have both capacitance *C* and an inductance *L* that describes its tendency to resist change in both voltage and current respectively, these ideas are best described using complex numbers.

The objectives for this section include:

- Simplifying radicals having negative values under the radical sign
- Evaluate powers of *j*

First let's review simplifying radicals:

1. $\sqrt{50}$

2. $\sqrt{200}$

3. $\sqrt{80}$

4. $\sqrt{25x^2}$

5. $\sqrt[3]{8}$

6. $\sqrt[3]{54x^3}$

Let's develop the imaginary unit below:

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Express each number in terms of *j*. Remember $j=\sqrt{-1}$ and $j^2=-1$

1. $\sqrt{-25}$

2. $-\sqrt{-49}$

3. $-\sqrt{-0.36}$

4. $\sqrt{-63}$

Rectangular Form of a complex number is →

Real part

Imaginary part

Express each number in rectangular form.

1. $-7+\sqrt{-1}$

2. $17-\sqrt{-64}$

3. $-3+\sqrt{-72}$

4. $2-\sqrt{-28}$

5. $\sqrt{-18}$

When working with square roots of negative numbers, you must express the imaginary part in terms of *j* first before proceeding.

Example: $\left(\sqrt{-4}\right)^2=\left(\sqrt{4j^2}\right)^2=(2j)^2=4j^2=-4$

If you had thought:

$$\left(\sqrt{-4}\right)^2=\sqrt{-4}\sqrt{-4}=\sqrt{16}=4$$

You would have been wrong! The first method gives the correct answer of -4 versus the incorrect answer of 4 in the second method.

The principle of radicals that says: $\sqrt{ab}=\sqrt{a}\cdot\sqrt{b}$ is only good when a and b are positive

Simplify each expression. Be sure to introduce *j* immediately before proceeding:

1. $\left(\sqrt{-9}\right)^2$

2. $\left(\sqrt{-81}\right)^2$

3. $\left(\sqrt{-0.6}\right)^2$

4. $\sqrt{-2} \cdot \sqrt{-8}$

5. $\sqrt{-3} \cdot \sqrt{-7}$

The powers of j are repetitive with the first four powers repeating themselves. Let's examine the pattern below:

Any expression involving j to a power can be simplified. Simplify each expression:

1. $j^8$

2. $j^{24}$

3. $j^{104}$

4. $j^{105}$

5. $j^{35}$

6. $j^{34}$

7. $(-j)^{26}$

8. $(-j)^{23}$

9. $-j^{83}$

The conjugate of a complex number is going to be used in the next section. The conjugate of $a+bj$ is the complex number $a-bj$. You will just change the sign of the imaginary part of any complex number in order to find its conjugate.

Find the conjugate of each complex number.

1. $-3+4j$

2. $-3-4j$

3. $2-6j$

4. $-7j$

5. 3

Finally, are *8j* and *-8j* solutions to the equation $x^2+64=0$