If a polynomial doesn't have rational roots what kind of roots could it have?

- 1. Irrational Roots
- 2. Imaginary Roots

Where do irrational roots come from? Taking square roots.

This happens when.....

- 1. Using the Quadratic Formula
- 2. Finding zeros of factors such as $(x^2 7)$

What are irrational roots?

Roots that have square roots of non-perfect squares. Example:

$$x = \sqrt{3}$$

How many answers do you get when you take the square root of something?

Therefore, if you know there is one irrational root, for example,

if
$$\sqrt{3}$$
 is a root, what else is a root? $-\sqrt{3}$

If
$$11 - \sqrt{5}$$
 is a root, what else is a root?

$$11 + \sqrt{5}$$

Theorem

Irrational Root Theorem

Let a and b be rational numbers and let \sqrt{b} be an irrational number. If $a + \sqrt{b}$ is a root of a polynomial equation with rational coefficients, then the conjugate $a - \sqrt{b}$ also is a root.

Irrational roots always come in PAIRS.

Numbers of the form $11 - \sqrt{5}$ and $11 + \sqrt{5}$ are called CONJUGATES.

Use the given roots to find the remaining roots of this polynomial:

$$x^5 - 5x^4 - 2x^3 + 34x^2 - 35x + 7$$

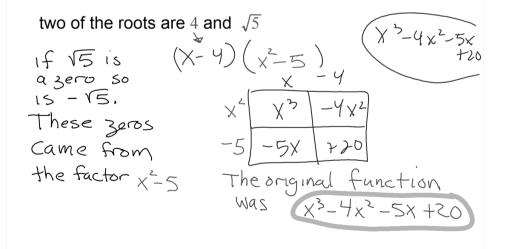
three roots are: 1, $\sqrt{7}$, 2 – $\sqrt{3}$

The other two roots are: $-\sqrt{2}$

Use the given root to find the remaining 3 roots of this polynomial: $v = x^4 + x^3 - 4x^2 - 2x + 4$

one root is $\sqrt{2} \rightarrow -\sqrt{2}$ must also be a zero. $\pm \sqrt{2}$ come $x^2 + 2$. $x^2 + 0x - 2$ $x^4 + x^3 - 4x^2 - 2x + 4$ From $x^2 - 2$. $x^4 + 0x - 2$ $x^4 + 0x^3 - 2x^2$ Do Division with $-x^4 + 0x^3 - 2x^2$ this factor. $-x^3 + 0x^2 - 2x$ this Quotient $-2x^2 + 0x + 4$ The remaining $-2x^2 + 0x + 4$ $-2x^2 + 0x + 4$ $-2x^2 + 0x + 4$ The remaining $-2x^2 + 0x + 4$

Find the equation of the cubic that has the given roots. Give your answer in Standard Form.



Use the given root to find the remaining 2 roots of this polynomial: $v = x^3 - x^2 - 11x + 3$

What is also true about Imaginary Roots?

They come in PAIRS called Complex Conjugates.

In other words, if 7 + 2i is a root, so is 7 - 2i.

Theorem

Imaginary Root Theorem

If the imaginary number a + bi is a root of a polynomial equation with real coefficients, then the conjugate a - bi also is a root.

Use the given root to find the remaining 3 roots of this polynomial:

one root is
$$4i \rightarrow -4i$$
 must also be

If $4i \stackrel{?}{\cdot} -4i$ are $3eros$
 $x^2 + 10 must$ be a factor. Use this factor to

 $x^2 + 0x + 16 \stackrel{?}{\cdot} \stackrel{?}{\cdot} + x - 2$
 $x^2 + x -$

Use the given roots to find the remaining roots of this polynomial:

$$x^5 - 8x^4 + 30x^3 - 92x^2 + 189x - 180$$

three of the roots are 4, 3i, and 2-i

The other two roots are: -3i, 2+i 3eros always come in