7.6 Real Zeros

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How do I use the rational zeros theorem to find all real zeros of a polynomial?

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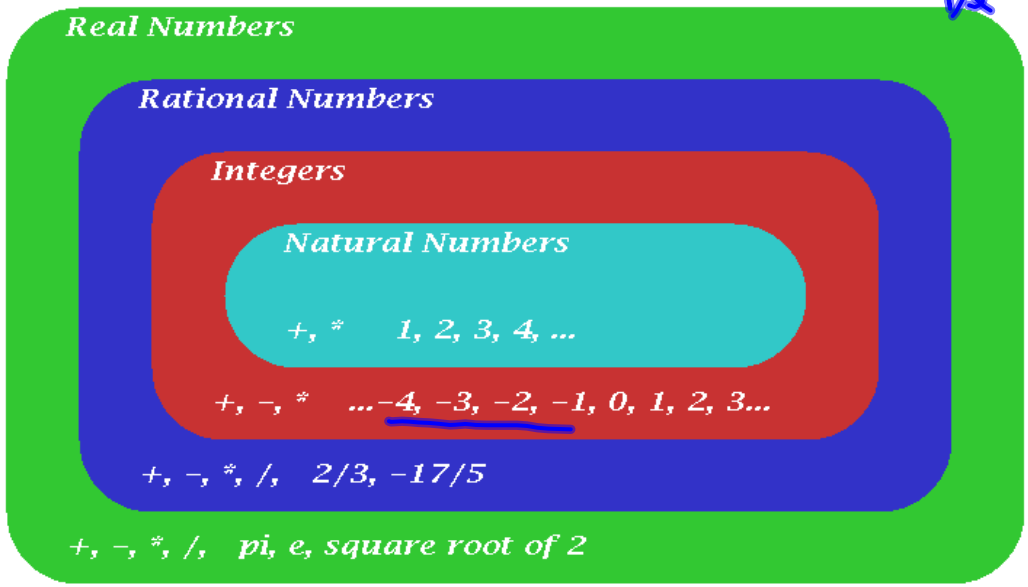
$\mathbb{N}$ natural numbers
counting

$\mathbb{Z}$ integers
neg, 0

$\mathbb{Q}$ rational numbers
fractions .75

$\mathbb{R}$ real numbers



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Rational Zero Theorem

finds POSSIBLE rational zeros of a polynomial

$\frac{P}{Q}$

- P: factors of the constant term
- Q: factors of the leading coefficient

ex. Find possible rational zeros

$4x^3 + 2x^2 - 8$

P: $\pm 1, \pm 2, \pm 4, \pm 8$

Q: $\cancel{\pm 1}, \cancel{\pm 2}, \pm 4$

$\frac{P}{Q} \pm \{1, 2, 4, 8, \frac{1}{2}, \frac{1}{4}\}$

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ex. Factor $2x^3 + x^2 - 13x + 6$

P: $\pm 1, \pm 2, \pm 3, \pm 6$

Q: $\pm 1, \pm 2$

Possible zeros: $\pm 1, \pm 2, \pm 3, \pm 6, \pm \frac{1}{2}, \pm \frac{3}{2}$

$\frac{P}{Q}$

$$\cancel{\begin{array}{r|rrrr} 3 & 2 & 1 & -13 & 6 \\ & \downarrow & 6 & 21 & 24 \\ \hline & 2 & 7 & 8 & \boxed{30} \end{array}}$$

$$\begin{array}{r|rrrr} 2 & 2 & 1 & -13 & 6 \\ & \downarrow & 4 & 10 & -6 \\ \hline & 2 & 5 & -3 & \boxed{0} \end{array}$$

:)

$$\begin{array}{c} -6 \\ 6 \quad -1 \\ 5 \end{array}$$

$(x-2)(2x^2+5x-3)$

$(x-2)(2x^2+6x-1x-3)$

$(x-2)(2x(x+3)-1(x+3))$

$\boxed{(x-2)(x+3)(2x-1)}$

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ex. Find the real zeros $x^3 - 5x^2 + 2x + 12$

p: $\pm1, \pm2, \pm3, \pm4, \pm6, \pm12$

Q: ±1

$$\begin{array}{r|rrrr} 3 & 1 & -5 & 2 & 12 \\ & \downarrow & 3 & -6 & -12 \\ \hline & 1 & -2 & -4 & \boxed{0} \end{array}$$

$(x-3)(x^2-2x-4)$

Quad Form

a: 1 b = -2 c = -4

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2(1)}$$

$$x = \frac{2 \pm \sqrt{20}}{2} = \frac{\cancel{2} \pm \cancel{2}\sqrt{5}}{\cancel{2}}$$

$$= 1 \pm \sqrt{5}$$

$$\boxed{\text{Real zeros: } \{3, 1+\sqrt{5}, 1-\sqrt{5}\}}$$