Roots and Zeros

I can find all the solutions (real & compex) of a polynomial equation.

Zeros, Factors, Roots and intercepts

Let $P(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \ldots + a_1 x + a_0$ be a polynomial function. Then the following statements are <u>equivalent</u>.

- c is a zero of $P(x)$.
- c is a root or solution of $P(x)=0$.
- $x - c$ is a factor of $a_n x^n + \ldots + a_1 x + a_0$,
- If c is a real number, then $(c,0)$ is an x-intercept of the graph of $P(x)$

→ Given $P(x) = x^2 - 3x - 10$:

- 5 and -2 are **<u>zeros</u>** of $P(x)$
- 5 and -2 are **<u>roots</u>** or **<u>solutions</u>** of $P(x)$
- $x - 5$ and $x + 2$ are **<u>factors</u>** of $P(x)$
- $(5,0)$ and $(-2,0)$ are x-intercepts of the graph of $P(x)$
- $p(5)=0$ and $p(-2)=0$

Roots and Zeros

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Fundamental Theorem of Algebra

- Every polynomial equation with degree greater than 0 has at least one root in the set of complex numbers.

  → Every polynomial equation has a solution

Roots and Zeros

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Find all the zeros of each function given solution(s).
**State number and type of roots.**

from graph

1. $f(x) = x^3 + 7x^2 + 4x + 28$

**Use technology to find the first zero.

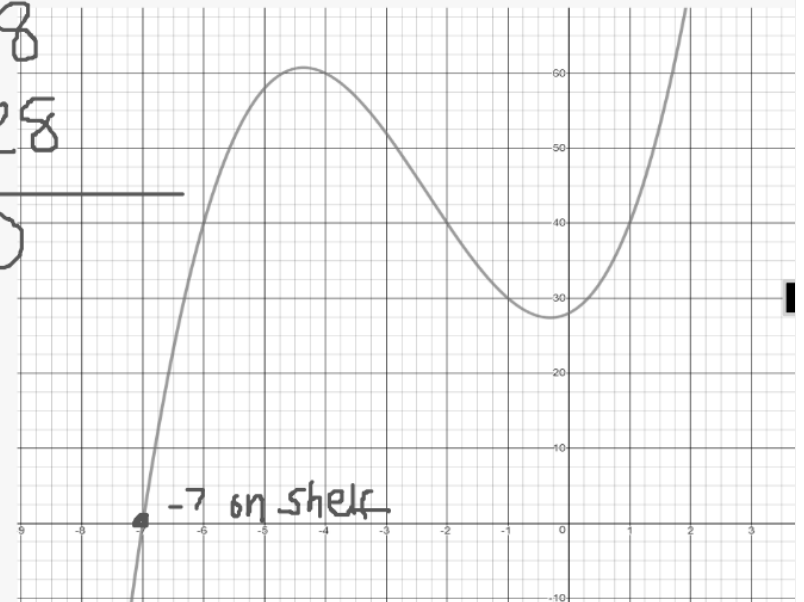$$-7 \begin{array}{|cccc} 1 & 7 & 4 & 28 \\ & -7 & 0 & -28 \\ \hline 1 & 0 & 4 & 0 \end{array}$$

$$x^2 + 4 = 0$$
$$x^2 = -4$$
$$x = \pm\sqrt{-4}$$
$$x = \pm 2i$$

$$\{-7, 2i, -2i\}$$

-7 on shelf

1 rational
2 imaginary

Find all the zeros of each function given solution(s). *State number and type of roots.*

$1, 10$
$2, 5$

$(x -)(x -)=0$

2. $f(x)= x^4 - 6x^3 +9x^2 +6x - 10$ given x=1, x=-1

$$\begin{array}{c|ccccc} 1| & 1 & -6 & 9 & 6 & -10 \\ & & 1 & -5 & 4 & 10 \\ \hline -1| & 1 & -5 & 4 & 10 & 0 \\ & & -1 & 6 & -10 & \\ \hline & 1 & -6 & 10 & 0 \end{array}$$

$x^2 - 6x + 10 = 0$

$x = \dfrac{6 \pm \sqrt{-4}}{2} \rightarrow \dfrac{6 \pm 2i}{2}$

$a=1 \quad b=-6 \quad c=10$

$b^2 - 4ac = 36 - 4(10)$
$36 - 40$
-4

$\{1, -1, 3+i, 3-i\}$

2 rational
2 complex

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Complete the 2 Your Turn Problems.

☆ <u>CHANGE YOUR TURN PROBLEM</u>

2. $f(x) = 5x^3 - 33x^2 + 16x + 12$ given $x = 6$