

Math Binder - AMC/AIME

Hansel Grimes

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1 Polynomials

1.1 Definition and Factorization

A polynomial is defined as $P(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0$ with names corresponding to their degree (constant, linear, quadratic, cubic, quartic).

The factored form is written as $P(x) = a(x - r)(x - p) \cdots (x - q)$. The simplest and most useful polynomial is the quadratic. It can be written as $ax^2 + bx + c$ and factored respectively. The formula to solve for x is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The most important formula for polynomials is the Vieta Formulas.

Formula 1 *Vieta Formulas include*

Sum of roots $(r_1 + r_2 + r_3 + \cdots + r_n)$: $-\frac{a_{n-1}}{a_n}$

Product of roots $(r_1 \cdot r_2 \cdot r_3 \cdots r_n)$: $(-1)^n \cdot \frac{a_0}{a_n}$

Pairwise sums of p ($p = 2$: $r_1 r_2 + r_1 r_3 + r_1 r_4 + \cdots + r_{n-1} r_n$): $(-1)^p \cdot \frac{a_{n-p}}{a_n}$

Theorem 1 *Fundamental theorem of algebra states that a single variable polynomial with degree n has exactly n complex roots.*