

Steps to Factor a Polynomial

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|------|---------------------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prep | Arrange in descending order of powers and combine like terms. | ex) | $10x - 3x^2 + 5x = -3x^2 + 15x$ |
| I | Factor Out the Greatest Common Factor (GCF) , Get a positive leading coefficient. | ex) | $-3x^2 + 15x = -3x(x - 5)$ |
| II | If the Polynomial has 4 terms or more, Factor by Grouping | ex) | $\begin{aligned} & x^3 + x^2 \quad \quad + 2x + 2 \\ & = x^2(x + 1) \quad \quad + 2(x + 1) \\ & = (x + 1)(x^2 + 2) \end{aligned}$ |
| III | Factoring Trinomials (3 terms) | | |
| | A. Trial and Error | ex) | $\begin{array}{r} x^2 - x - 12 \\ (\quad) (\quad) \\ (+) (-) \\ (x +) (x -) \\ (x + 3) (x - 4) \end{array} \quad \begin{array}{r} 12 \\ 1 \cdot 12 \\ 2 \cdot 6 \\ \boxed{3 \cdot 4} \end{array}$ |
| | 1) Write down 2 pairs of parentheses | | |
| | 2) Determine your signs: ++, -- or +- ** See Below ** | | |
| | 3) Factor the front term | | |
| | 4) Try different factors of the last term until the binomials FOIL to the trinomial. | | |
| | B. Perfect Square Trinomial | ex) | $\begin{aligned} & x^2 + 6x + 9 \\ & = (x + 3)(x + 3) = (x + 3)^2 \end{aligned}$ |
| IV | Factoring Binomials (2 terms) | | |
| | A. Difference of Two Squares | ex) | $x^2 - 9 = (x + 3)(x - 3)$ |
| | B. Sum of Two Squares - Does Not Factor | ex) | $x^2 + 25$ Does Not Factor |
| | C. Difference of Two Cubes | ex) | $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$ |
| | D. Sum of Two Cubes | ex) | $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$ |
| V | Check for Complete Factorization: | ex) | $\begin{aligned} x^4 - 16 &= (x^2 + 4)(x^2 - 4) \\ &= (x^2 + 4)(x + 2)(x - 2) \end{aligned}$ |
| VI | The Polynomial Does Not Factor | ex) | $x^2 + 5x + 1$ Does Not Factor |

Determine the signs of the factors: ++, -- or +-

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|---------------------------------|-------------------------------------------------|
| $x^2 + 6x + 5 = (x + 1)(x + 5)$ | SIGNS ARE THE SAME , SIGNS BOTH + |
| $x^2 - 6x + 5 = (x - 1)(x - 5)$ | ↑↓ |
| $x^2 + 2x - 3 = (x + 3)(x - 1)$ | → |
| $x^2 - 2x - 3 = (x + 1)(x - 3)$ | → SIGNS ARE OPPOSITES : + - |