

# Unit 4 - Polynomials

What is a Polynomial?

Extrema

Synthetic Division

Increasing / Decreasing

Positive / Negative

Zeros

Polynomial Vocabulary

Multiplicity

End Behavior

$$-(4x + 8)$$

Long Division

Polynomial: An expression in the form

$$a_n x^n + a_{n-1} x^{n-1} + \dots + a_2 x^2 + a_1 x + a_0$$

where  $n$  is a positive integer.

Examples

①  $\frac{1}{2}x^2$

②  $-4x^3 + 7x - 1$

③  $6$

Non-Examples

①  $x^{-1}$

②  $5x^{1/3} - 8$

③  $11^x$

What is a Polynomial?

# Polynomial

Terms: Numbers and/or variables separated by a + or - sign

<u>monomial</u> 1 term	<u>Binomial</u> 2 terms	<u>Trinomial</u> 3 terms	<u>Polynomial</u> 4+ terms (any expression)
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Degree: The highest exponent of the variable in the polynomial

<u>Constant</u> degree is 0 * No variable *	<u>Linear</u> degree is 1	<u>Quadratic</u> degree is 2	<u>Cubic</u> degree is 3	<u>Quartic</u> degree is 4
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## Examples

Polynomial	# of terms	Classification by terms	Degree	classification by degree
$f(x) = x^4 - 2x + 1$	3	trinomial	4	quartic
$f(x) = 7x^3 + 5x^2 - x - 2$	4	polynomial	3	cubic
$y = 8$	1	monomial	0	constant

## Polynomial Long Division

Before you begin, make sure your polynomial is in standard form. Make sure that missing terms are written with coefficient of 0.

### Steps

- 1) Divide
- 2) multiply
- 3) Subtract
- 4) Bring Down next term
- 5) Repeat

Example 1  $(3x^2 - 7x + 2) \div (3x - 1)$

$$\begin{array}{r} \phantom{3x-1} \overline{3x^2 - 7x + 2} \\ \phantom{3x-1} \underline{3x^2 - x} \phantom{+ 2} \\ \phantom{3x-1} -6x + 2 \end{array}$$

$$\phantom{3x-1} \phantom{3x^2 - 7x + 2}$$

$$\phantom{3x-1} \phantom{3x^2 - 7x + 2} \phantom{+ 2}$$

$$\phantom{3x-1} \phantom{3x^2 - 7x + 2} \phantom{+ 2} \phantom{+ 2}$$

$$\phantom{3x-1} \phantom{3x^2 - 7x + 2} \phantom{+ 2} \phantom{+ 2} \phantom{+ 2}$$

$$\phantom{3x-1} \phantom{3x^2 - 7x + 2} \phantom{+ 2} \phantom{+ 2} \phantom{+ 2} \leftarrow \text{Remainder}$$

Answer:  $\boxed{x - 2}$

Example 2       $\frac{x^2 - 3x + 1}{x - 4}$

$$\begin{array}{r}
 x+1 \\
 x-4 \overline{) x^2 - 3x + 1} \\
 \underline{-(x^2 - 4x)} \downarrow \\
 x+1 \\
 \underline{-(x-4)} \\
 \hline
 \end{array}$$

5 ← Remainder

Answer:  $x+1 + \frac{5}{x-4}$

Example 3       $(x^4 - 6x^2 - 27) \div (x+2)$

$$\begin{array}{r}
 x^3 - 2x^2 - 2x + 4 \\
 x+2 \overline{) x^4 + 0x^3 - 6x^2 + 0x - 27} \\
 \underline{-(x^4 + 2x^3)} \downarrow \\
 -2x^3 - 6x^2 \\
 \underline{-(-2x^3 - 4x^2)} \downarrow \\
 -2x^2 + 0x \\
 \underline{-(-2x^2 - 4x)} \downarrow \\
 4x - 27 \\
 \underline{-(4x + 8)} \\
 -35
 \end{array}$$

Answer:  $x^3 - 2x^2 - 2x + 4 + \frac{-35}{x+2}$

Remainder: -35

Long Division