

# Write and Classify Polynomials in Standard Form

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# 9.2 Write and Classify Polynomials in Standard Form

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[Figure 1]

Erin's Math class was learning how to measure the **degree** of a **polynomial**. The first one she is supposed to classify is  $4x^3 + 3x + 9$ . Can you identify it by degree? Is it in **standard form**?

In this concept, you will learn to write and classify polynomials in standard form.

## Polynomials

A **polynomial** is an **algebraic expression** that shows the sum of monomials.

Here are some **polynomials**.

$$x^2 + 5 \quad 3x - 8 + 4x^5 \quad -7a^2 + 9b - 4b^3 + 6$$

An **expression** with a single **term** is a **monomial**, an expression with two **terms** is a **binomial**, and an expression with three terms is a **trinomial**. An expression with more than three terms is named simply by its number of terms.

First, let's think about how you can classify each polynomial. You classify them according to terms. Each term can be classified by its degree.

The **degree** of a term is determined by the **exponent** of the **variable** or the sum of the exponents of the variables in that term.

The expression  $x^2$  has an exponent of 2, so it is a term to the second degree.

The expression  $-2x^5$  has an exponent of 5, so it is a term to the fifth degree.

The expression  $x^2y$  has an exponent of 2 on the  $x$  and an unwritten exponent of 1 on the  $y$ , so this term is to the third degree ( $2 + 1$ ). Notice that you add the two degrees together because it has two variables.

The expression 8 is a monomial that is a **constant** with no variable, its degree is zero.

You can also work on the ways that you write polynomials. One way to write a polynomial is in **standard form**. In **order** to write any polynomial in standard form, **you** look at the degree of each term. You then write each term in order of degree, from highest to lowest, left to right.

Let's look at an example.

Write the expression  $3x - 8 + 4x^5$  in standard form.

First, look at the degrees for each term in the expression.

$3x$  has a degree of 1

8 has a degree of 0

$4x^5$  has a degree of 5

Next, write this trinomial in order by degree, highest to lowest

$$4x^5 + 3x - 8$$

The answer is  $4x^5 + 3x - 8$ .

The degree of a polynomial is the same as the degree of the highest term, so this expression is called a fifth degree trinomial.

## Examples

### Example 1

Earlier, you were given a problem about Erin and the polynomial.

Erin has to identify the degree of the polynomial  $4x^3 + 3x + 9$ .

First, look at the degrees for each term in the expression.

$4x^3$  has a degree of 3

$3x$  has a degree of 1

9 has a degree of 0

Next, the highest degree identifies the degree of the polynomial.

The term  $4x^3$  is the highest degree so the degree of the polynomial is 3.

The answer is that the polynomial is of the third degree.

### Example 2

Write the following polynomial in standard form.

$$4x^3 + 3x^5 + 9x^4 - 2xy + 11$$

First, look at the degrees for each term in the expression.

$4x^3$  has a degree of 3

$3x^5$  has a degree of 5

$9x^4$  has a degree of 4

$-2xy$  has a degree of 2

11 has a degree of 0

Next, write this polynomial in order by degree, highest to lowest

$$3x^5 + 9x^4 + 4x^3 - 2xy + 11$$

The answer is  $3x^5 + 9x^4 + 4x^3 - 2xy + 11$ .

### Example 3

Name the degree of the expression  $5x^4 + 3x^3 + 9x^2$ .

First, look at the degrees for each term in the expression.

$5x^4$  has a degree of 4

$3x^3$  has a degree of 3

$9x^2$  has a degree of 2

Next, the highest degree identifies the degree of the polynomial.

The term  $5x^4$  is the highest degree so the degree of the polynomial is 4.

The answer is that the polynomial is of the fourth degree.

#### Example 4

Name the degree of the expression  $6y^3 + 3xy + 9$ .

First, look at the degrees for each term in the expression.

$6y^3$  has a degree of 3

$3xy$  has a degree of 2

$9$  has a degree of 0

Next, the highest degree identifies the degree of the polynomial.

The term  $6y^3$  is the highest degree so the degree of the polynomial is 3.

The answer is that the polynomial is of the third degree.

#### Example 5

Write the following polynomial in standard form and identify the degree of the polynomial.

$$7x^2 + 3x - 2x^4 + 8x^6 - 7$$

First, look at the degrees for each term in the expression.

$7x^2$  has a degree of 2

$3x$  has a degree of 1

$-2x^4$  has a degree of 4

$8x^6$  has a degree of 6

$-7$  has a degree of 0

Next, write this polynomial in order by degree, highest to lowest

$$8x^6 - 2x^4 + 7x^2 + 3x - 7$$

Then, the highest degree identifies the degree of the polynomial.

The term  $8x^6$  is the highest degree so the degree of the polynomial is 6.

The answer is  $8x^6 - 2x^4 + 7x^2 + 3x - 7$  and the polynomial is of the sixth degree.

## Review

Write the following polynomials in standard form and then identify its degree:

1.  $4x^2 + 5x^3 + x - 1$

2.  $9 + 3y^2 - 2y$

3.  $8 + 3y^3 + 8y + 9y^2$

4.  $y + 6y^4 - 2y^3 + y^2$

5.  $-16y^6 - 18$

6.  $3x + 2x^2 + 9y + 8$

7.  $8y^4 + y - 7y^3 - 3y^2$

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

9.  $9 - 3y^2 - 2y^3 + 2y$

10.  $14 + 6x^2 - 2x - 8y$

11.  $4x + 3x^2 - 5x^3 + 8x^4$

12.  $-8 + 3y^2 - 2y^3 + y$

13.  $9 + 8y^2 + 2y^3 - 8y$

14.  $m^4 - 12m^7 + 6m^5 - 6m - 8$

15.  $-x^3y^2 + 5x^3y + 8xy$

## Review (Answers)

To see the review answers, return to the [Table of Contents](#) and select 'Other Versions' or 'Resources'.

## Resources

**Examples: Intro to Polynomials**

A polynomial is an expression involving a sum of the product of constants and variables with non-negative integer exponents.

Given:  $9y + 7y^3 - 5 - 4y^2$   $-5y^0 = -5$

1 <sup>st</sup> Term:	$9y$	Degree:	1	Coefficient:	9
2 <sup>nd</sup> Term:	$7y^3$	Degree:	3	Coefficient:	7
3 <sup>rd</sup> Term:	$-5$	Degree:	0	Coefficient:	-5
4 <sup>th</sup> Term:	$-4y^2$	Degree:	2	Coefficient:	-4

Leading coefficient: \_\_\_\_\_

Degree of leading term: \_\_\_\_\_

Degree of polynomial: \_\_\_\_\_

Write the polynomial in descending order.


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