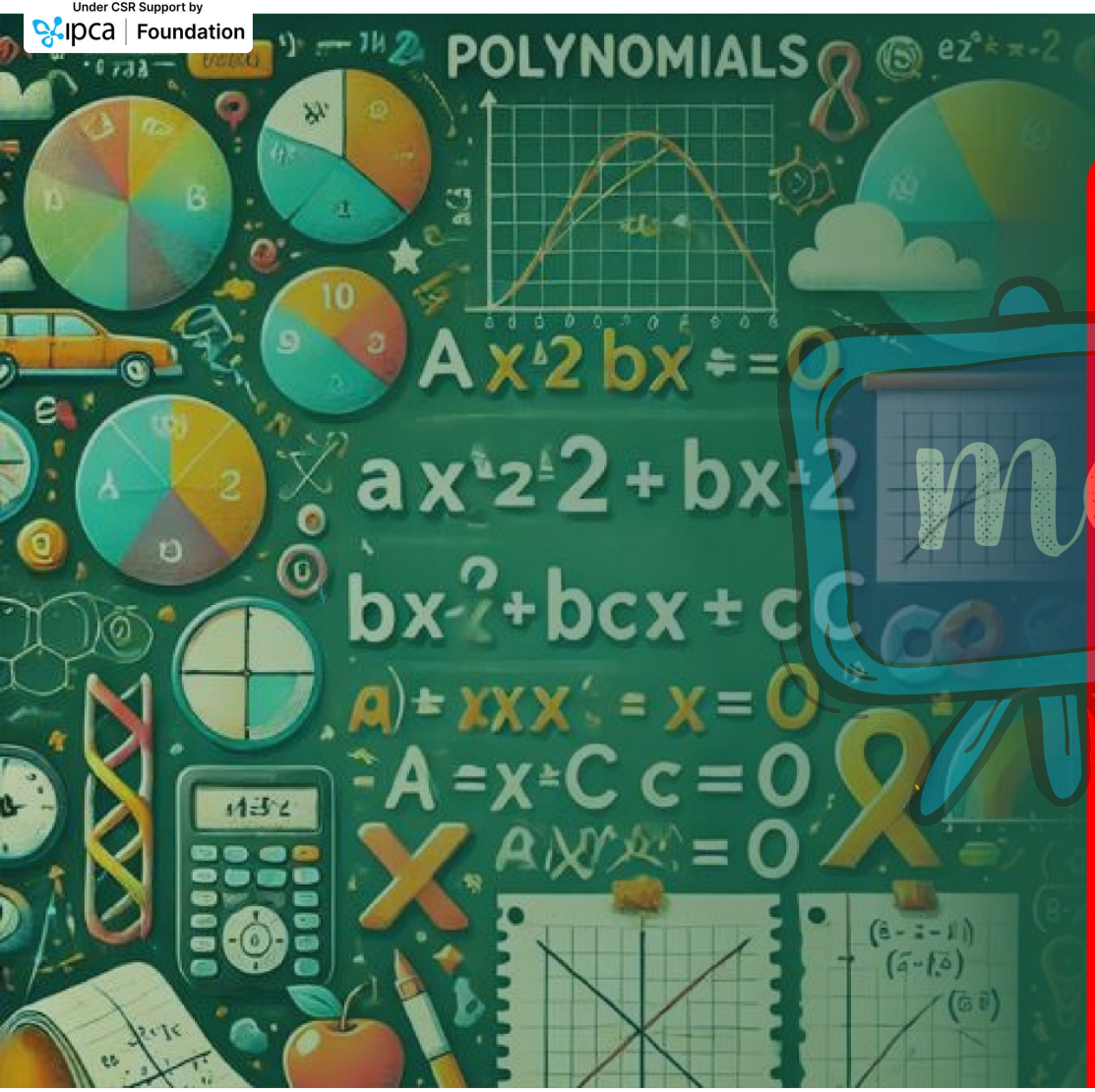
Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



CLASS – 9

MATHS

Chapter - 2

Polynomials

Part – 1

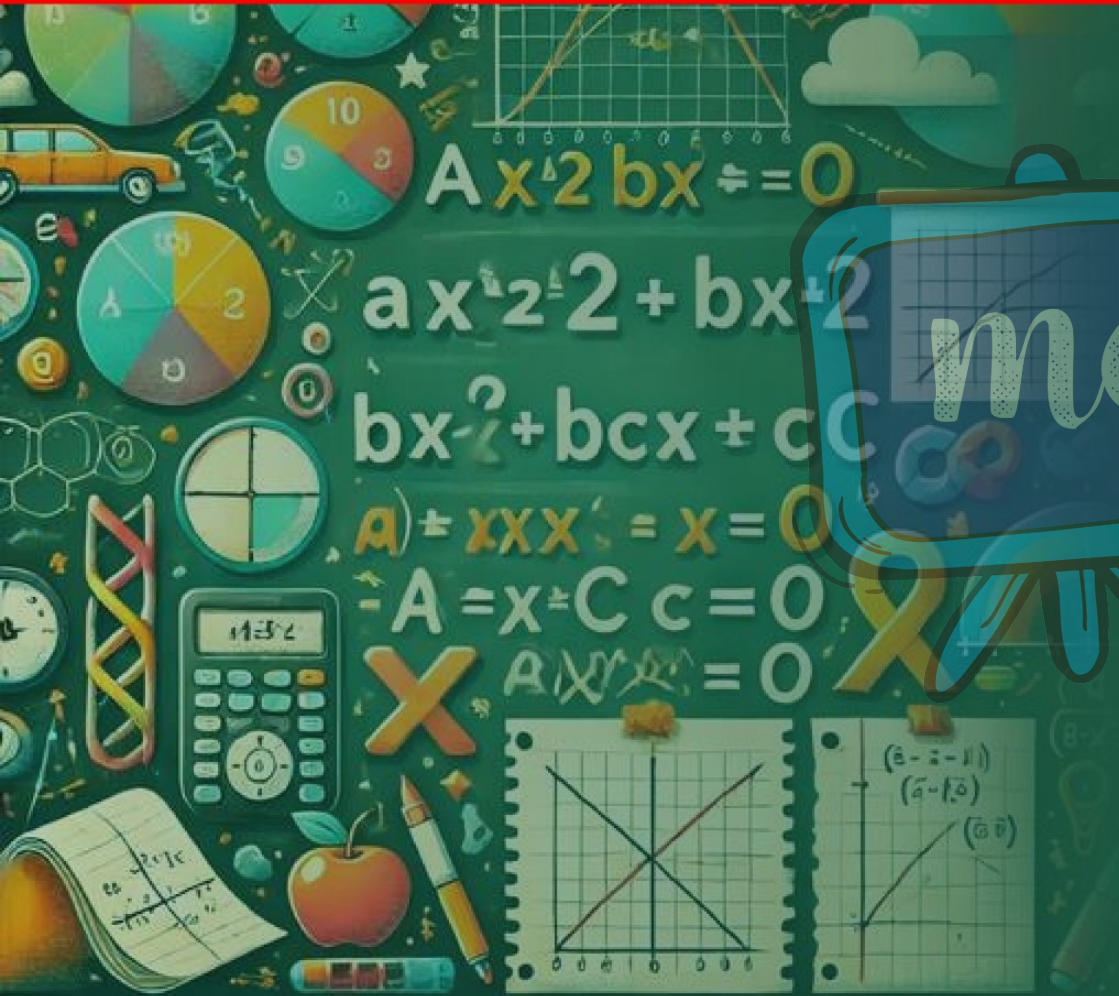
Introduction to Polynomials

Vikas Saini

Under CSR Support by ipca | Foundation

OVERVIEW

missiongyan LET'S LEARN TOGETHER

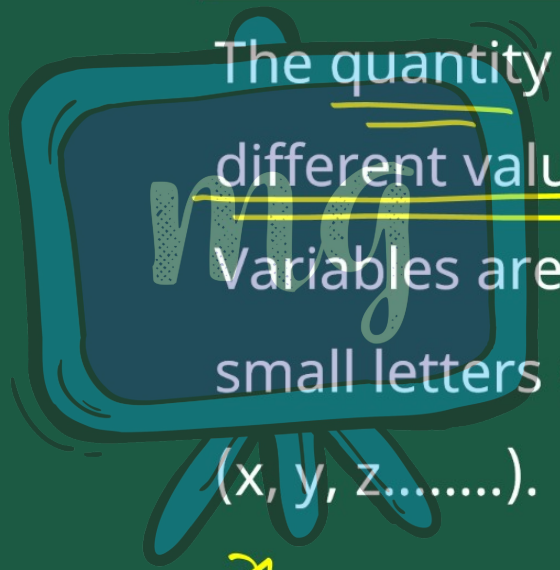


1. Introduction to Polynomials
2. Zeros of Polynomials
3. Factorisation of Polynomials
4. Algebraic Identities

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

VARIABLE

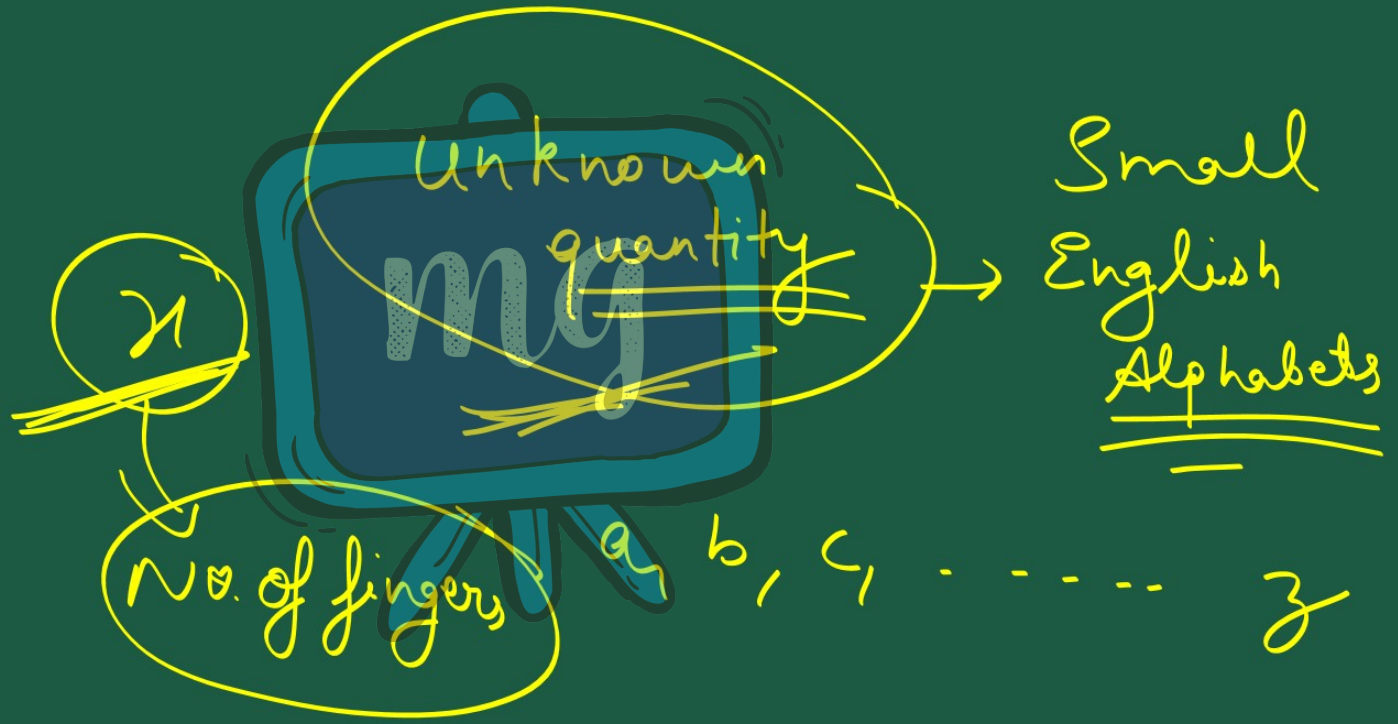


The quantity which can assume different values is called a variable. Variables are usually represented by small letters of the English alphabet (x, y, z.....).

x
y
z

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



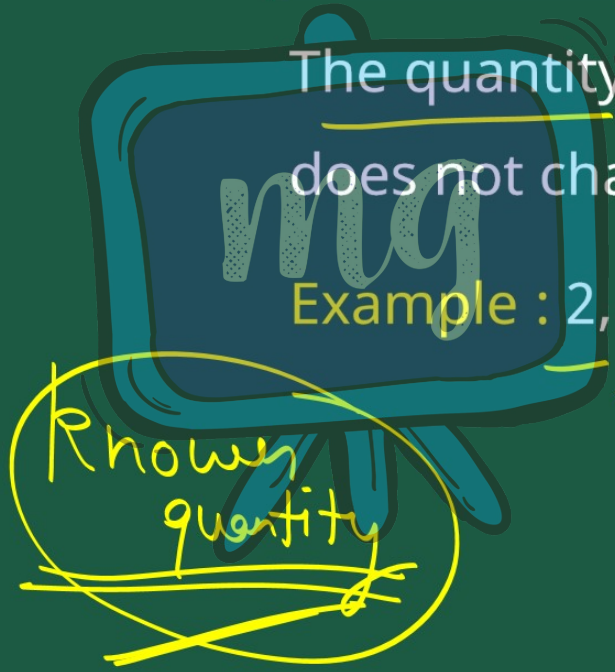
Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

CONSTANT

The quantity which is fixed i.e. which does not change is called constant.

Example : $2, \frac{1}{7}, 0, -3$

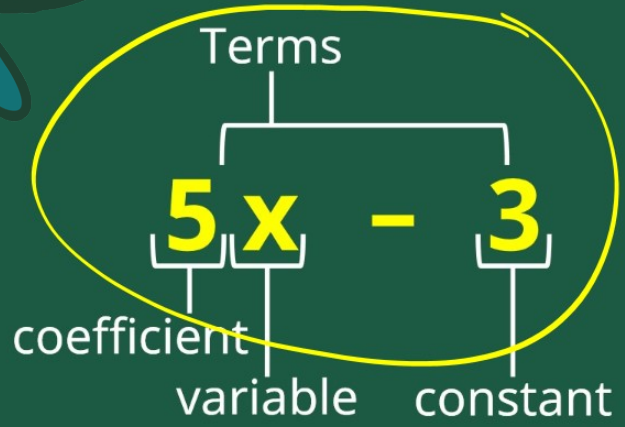


Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

ALGEBRAIC EXPRESSION

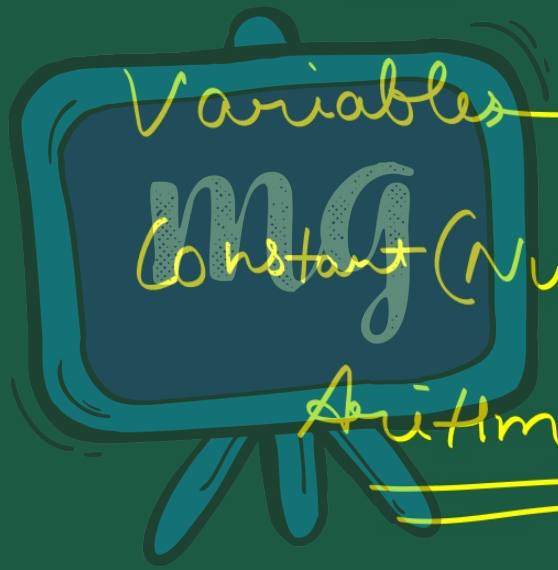
An algebraic expression is a group of variables, constants & mathematical operations that represent problems or situations in mathematical form.



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

$5x - 3$



Variables

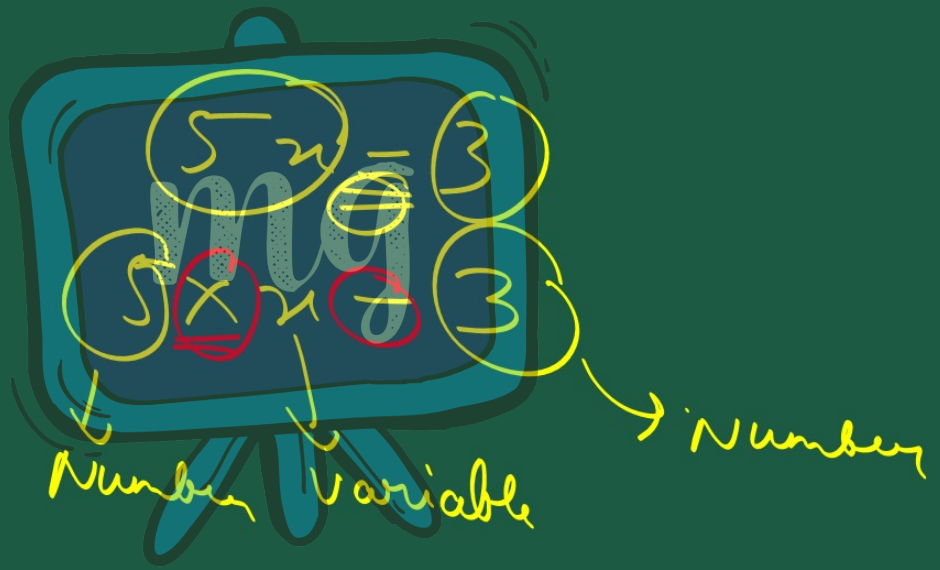
Constant (Numbers)

→ Relation

Arithmatic operation

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



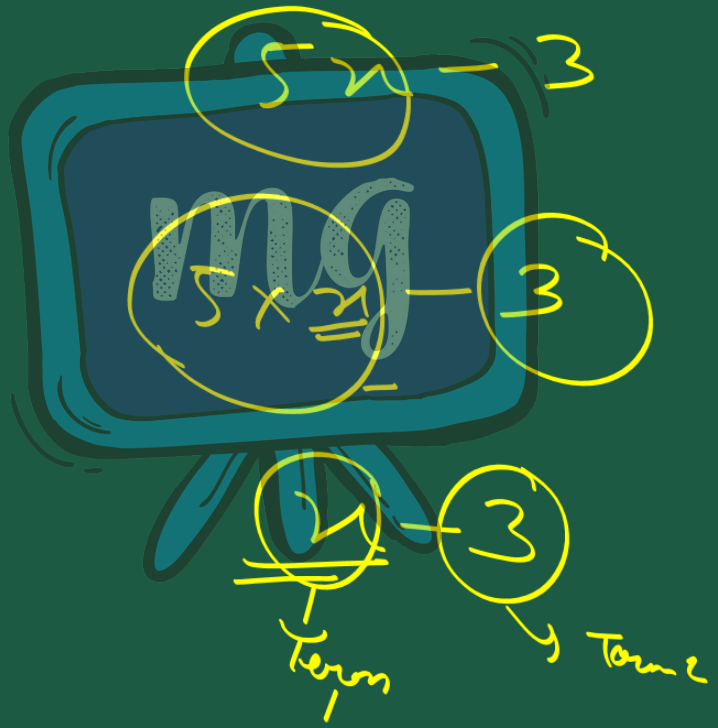
Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



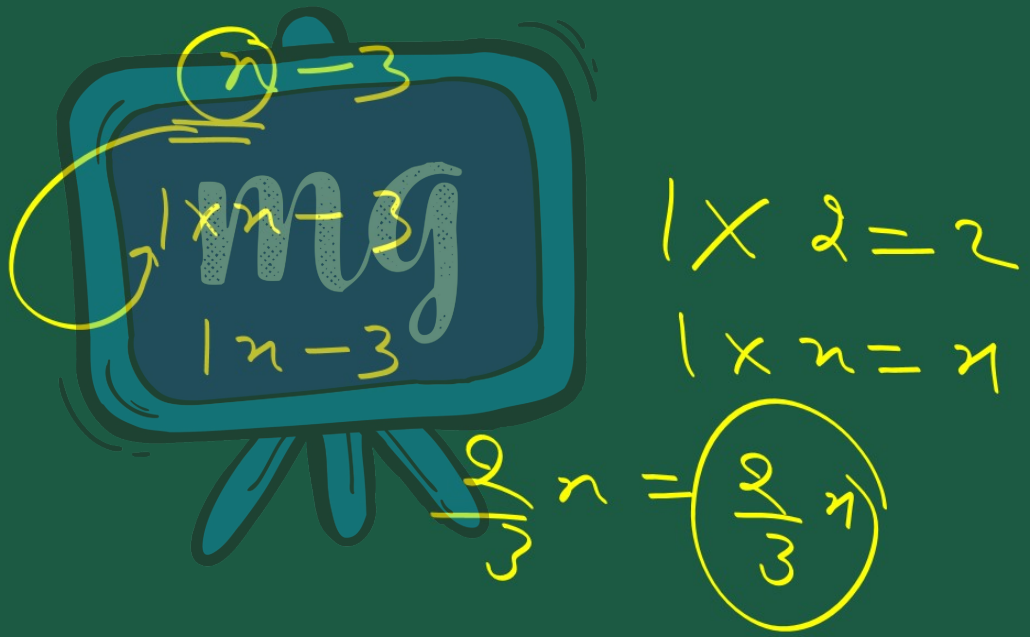
Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

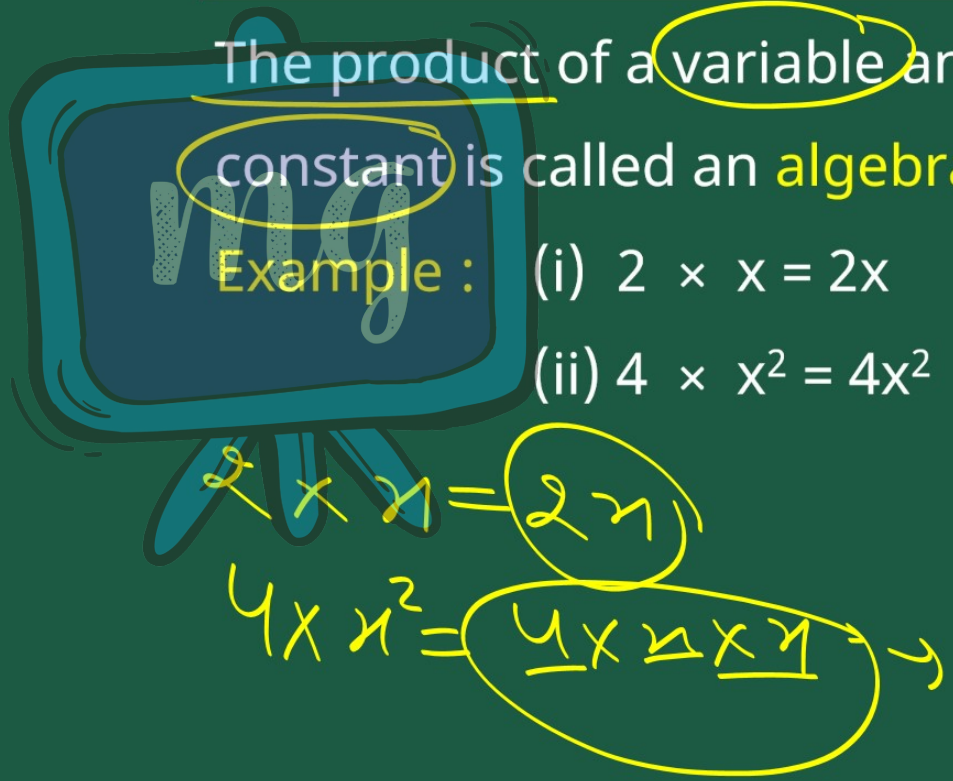
missiongyan LET'S LEARN TOGETHER

ALGEBRAIC TERMS

The product of a variable and a constant is called an algebraic term.

Example : (i) $2 \times x = 2x$

(ii) $4 \times x^2 = 4x^2$



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

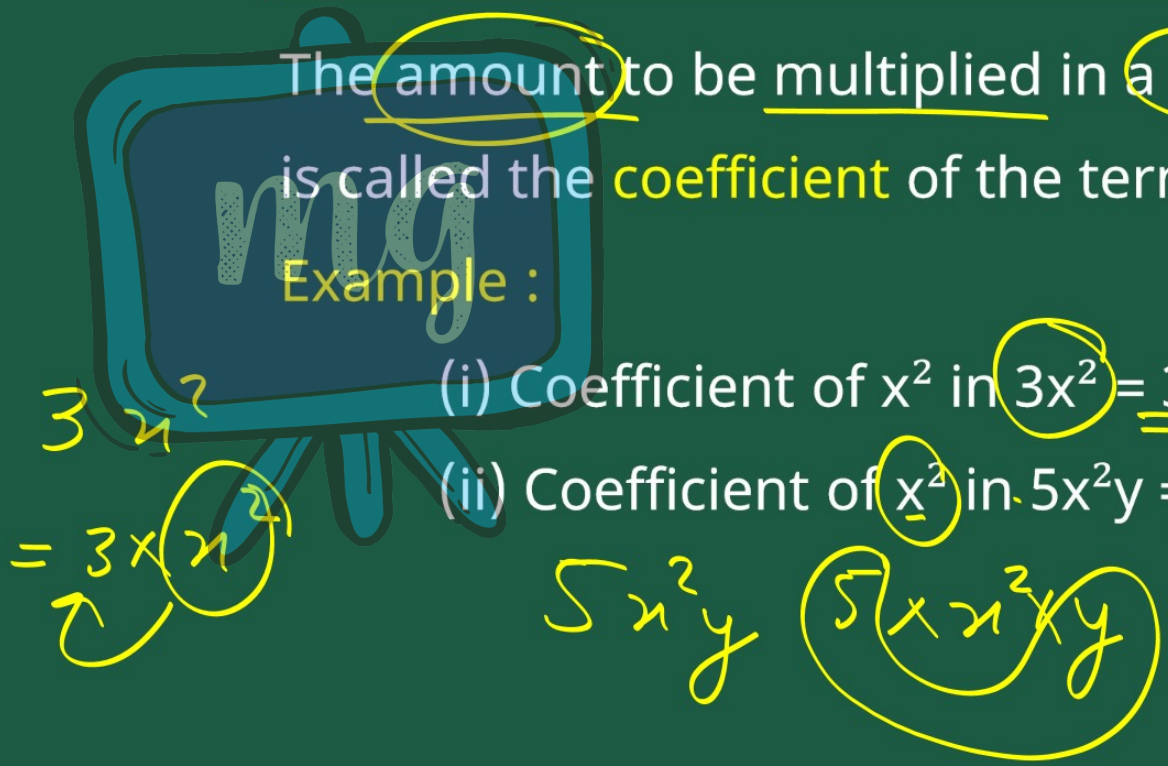
COEFFICIENT

The amount to be multiplied in a term is called the coefficient of the term.

Example :

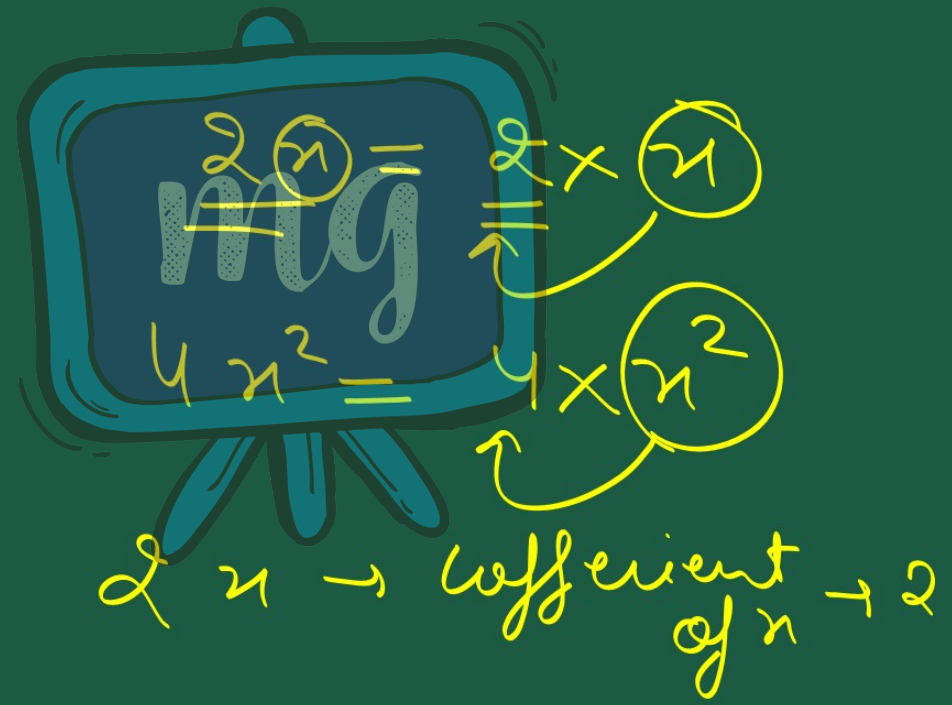
(i) Coefficient of x^2 in $3x^2$ = 3

(ii) Coefficient of x^2 in $5x^2y$ = 5y



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

$5x^2y = (5 \times x^2) \times y$



Coefficient of $y \rightarrow 5x^2$

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER

POLYNOMIAL

A polynomial is an algebraic expression that contains one or more algebraic terms. It consists of variables, constants, coefficients, exponents and operators. Where the degree of polynomial is a whole number.

Example :

1. $2x^2 + 4x + 1$
2. $y^2 + x$

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

Algebraic Expression

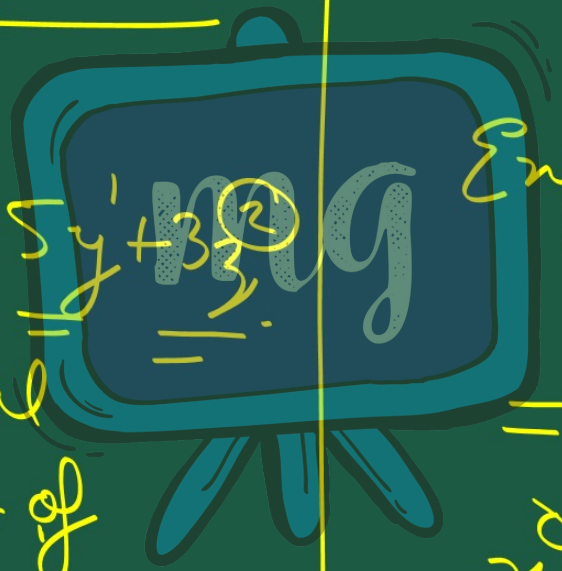
$x^{-2} + 5y^{1} + 3z^{2}$

Exponential value of variable → Real No.

Polynomial

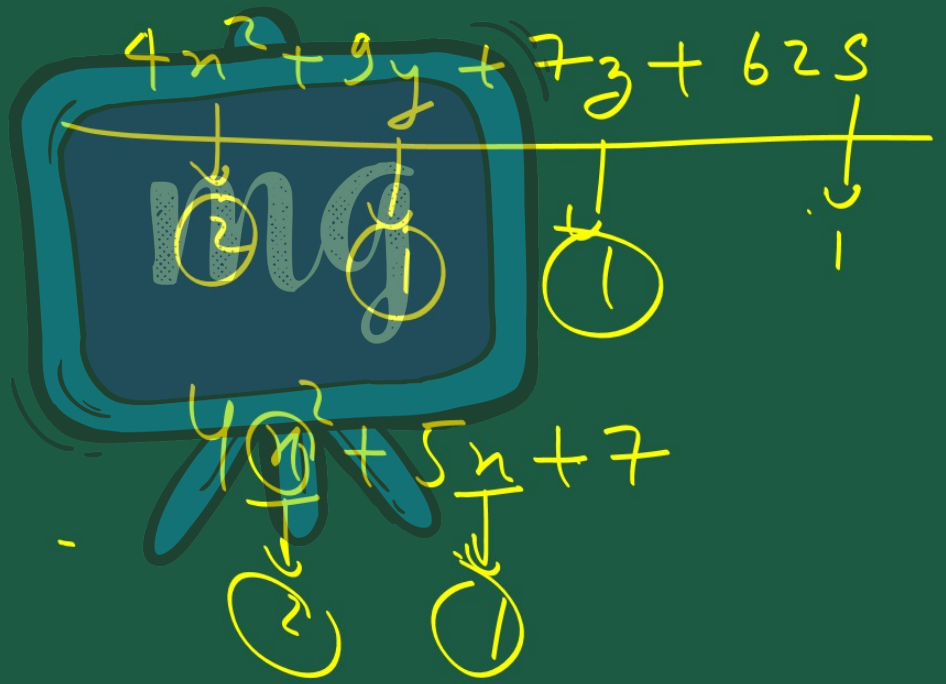
Exponential value of variable = Whole Number

$x^{0} + y^{5} + z^{37}$



Under CSR Support by ipca | Foundation

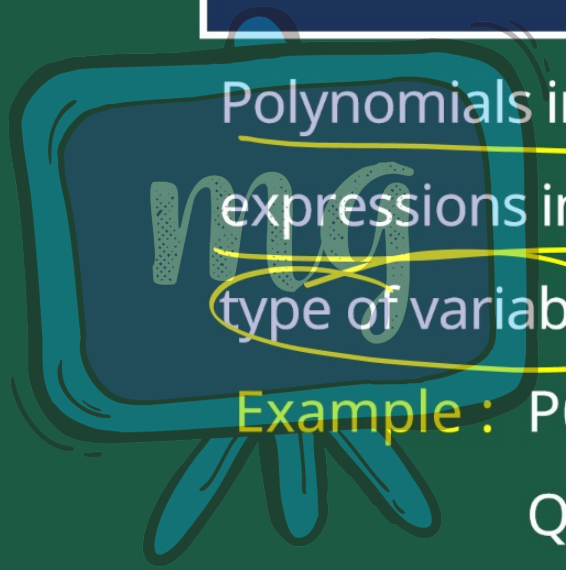
missiongyan LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

POLYNOMIAL IN ONE VARIABLE



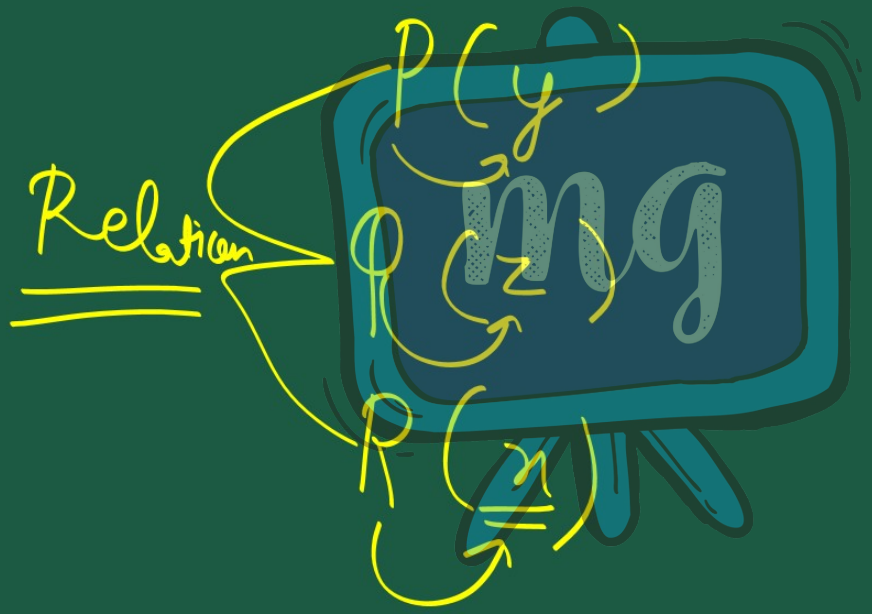
Polynomials in one variable are expressions in which there is only one type of variable in the entire expression.

Example : $P(x) = x^2 + 2x + 1$

$Q(y) = 2y^2 + 1$

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

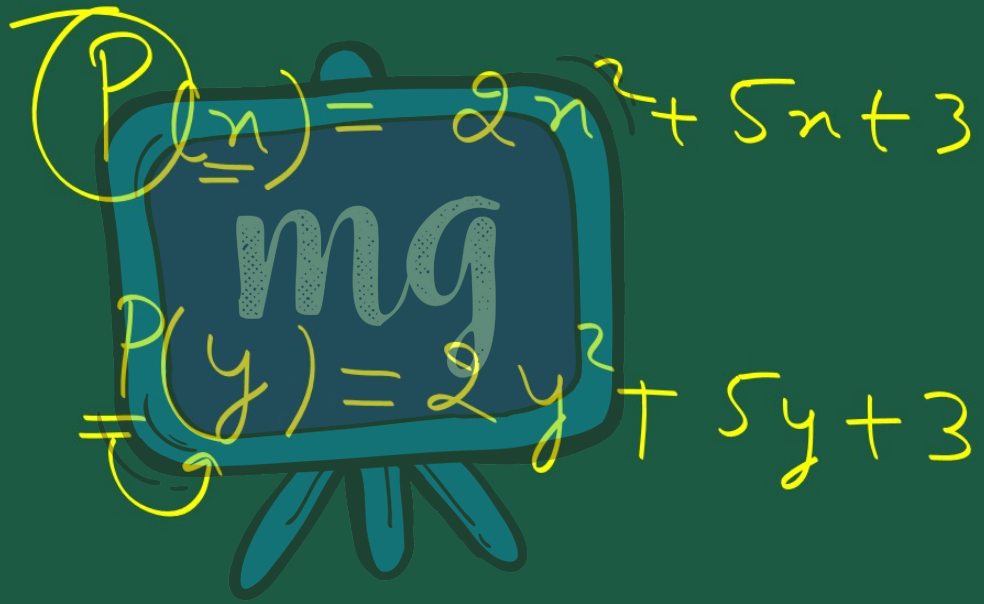
$2n^2 + 5n + 3$



P → $2 \times (\text{Variable})^2 + 5 \times (\text{Variable}) + 3$

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

GENERAL FORM OF POLYNOMIAL

General form of a polynomial in one variable

$$f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \ldots. + a_1 x + a_0$$

Where $a_n, a_{n-1}, a_{n-2}, \ldots\ldots, a_1, a_0$ are real numbers and n is a non-negative integer

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



$a_1 x + a_0$

$2x + 3$

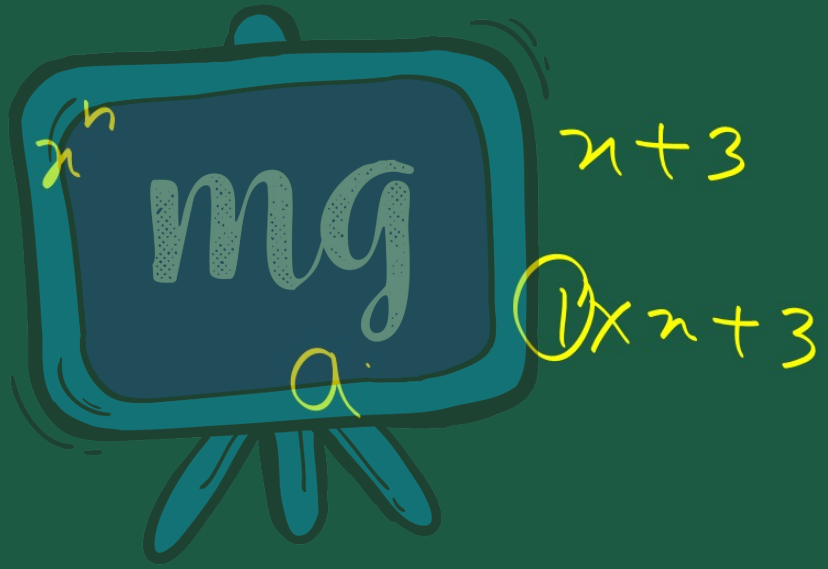
$x^1 +$

$a_1 = 2$

$a_0 = 3$

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

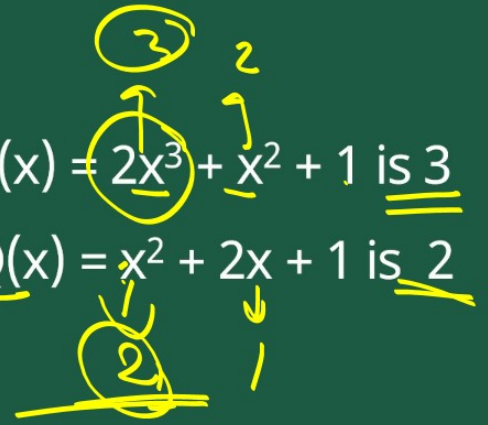
DEGREE OF POLYNOMIAL

If P(x) is a polynomial then the highest exponential value of variable x in the polynomial P(x) is called the degree of the polynomial.

Example :

Degree of polynomial $P(x) = 2x^3 + x^2 + 1$ is 3

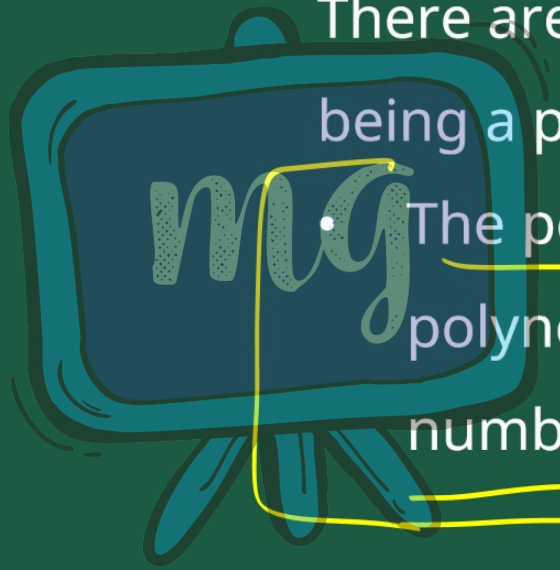
Degree of polynomial $Q(x) = x^2 + 2x + 1$ is 2



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

Note



There are some restrictions to being a polynomial:

- The powers of variables in a polynomial should be a whole number.

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

$a^m = \frac{1}{a^{-m}}$

or

$\frac{1}{a^m} = a^{-m}$

$\frac{1}{x} = x^{-1}$

$\frac{1}{x^2} = x^{-2}$

- An expression with a variable as the denominator is not a polynomial.

Example : $\frac{1}{x}, \frac{1}{x^2} + 1, \frac{1}{x-1}$

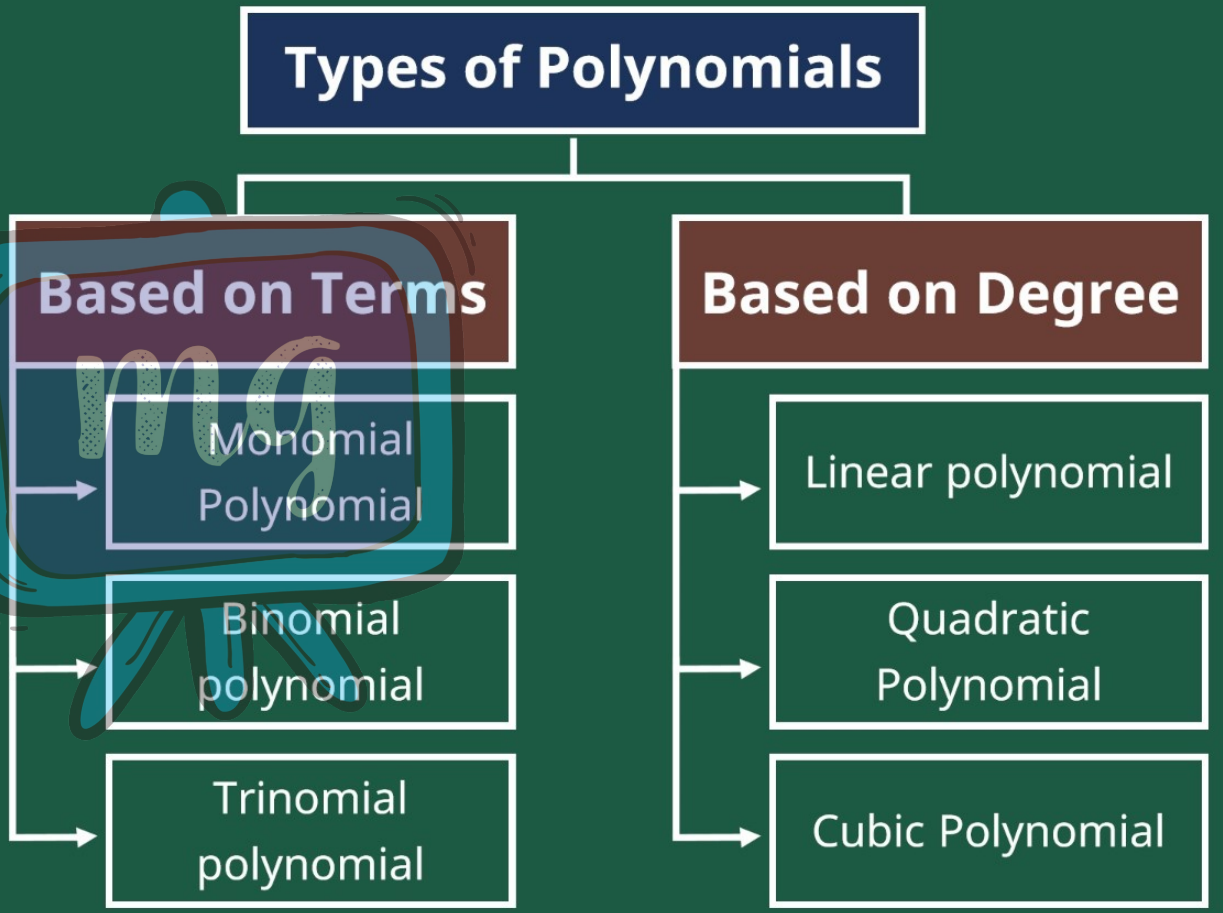
- An expression in which the degree of any variable is negative is not a polynomial.

Example : $x^{-2}, 3x^3 + x^{-2}$

3 2

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



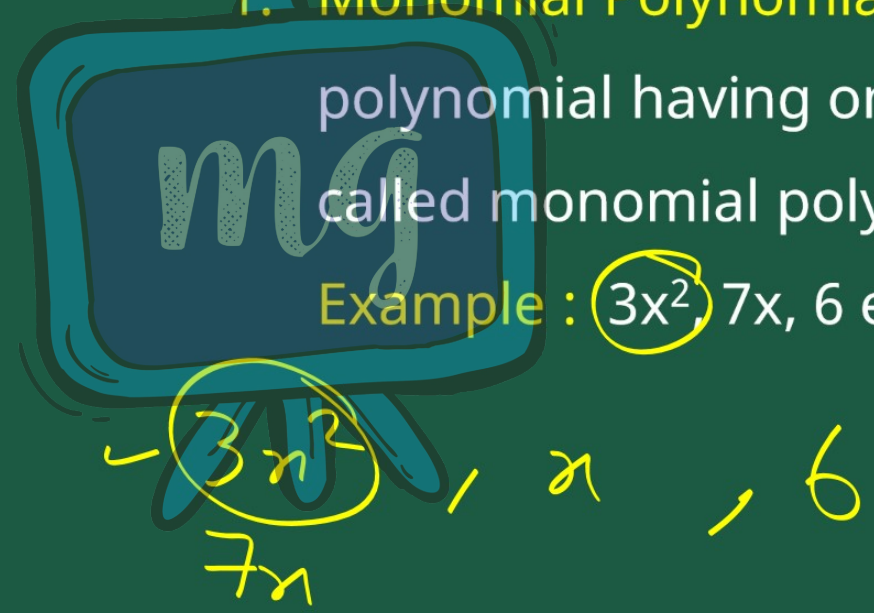
Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

A. BASED ON TERMS

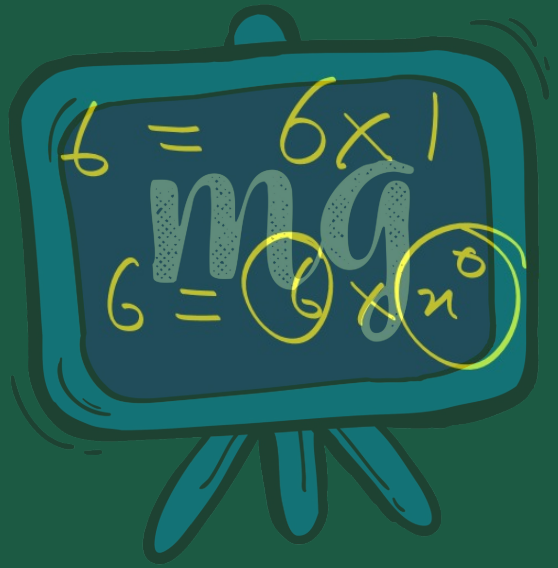
1. Monomial Polynomial :– A polynomial having only one term is called monomial polynomial.

Example : $3x^2$, 7x, 6 etc.



Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER



$a^0 = 1$

$n^0 = 1$

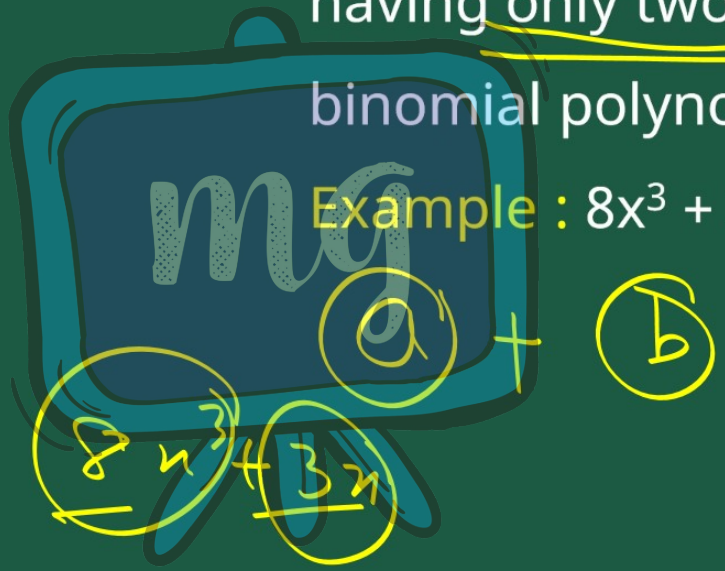
OG whole Numbers

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

2. Binomial Polynomial :– Polynomial having only two terms is called binomial polynomial.

Example : $8x^3 + 3x$, $7x - 4$ etc.

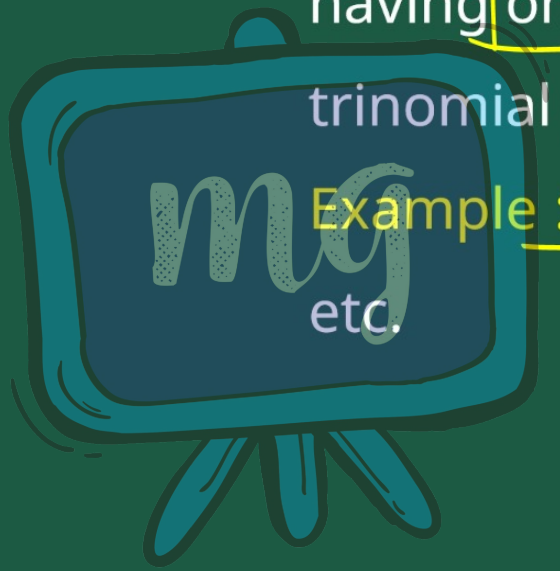


Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

3. Trinomial polynomial :– Polynomial having only three terms is called trinomial polynomial.

Example : $3x^2 + 7x - 4$, $x^2 + 2x + 2$ etc.



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

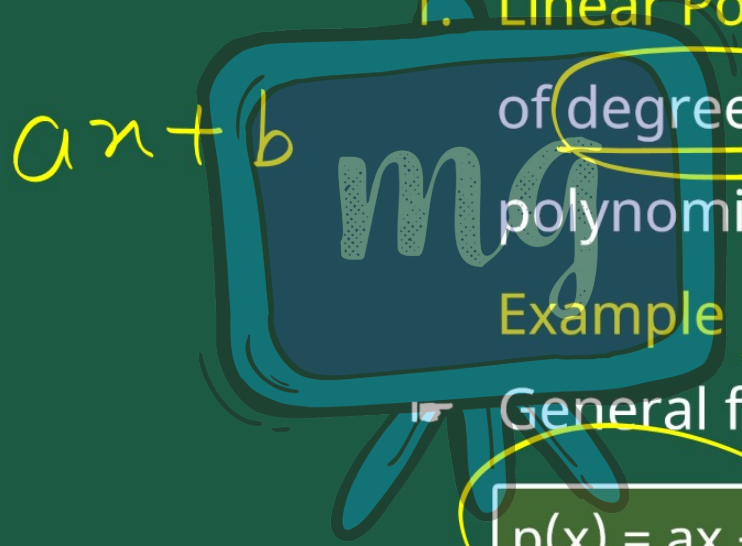
B. BASED ON DEGREE

1. Linear Polynomial :– A polynomial of degree one is called linear polynomial.

   Example : $7x - 4$, $5x - 9$

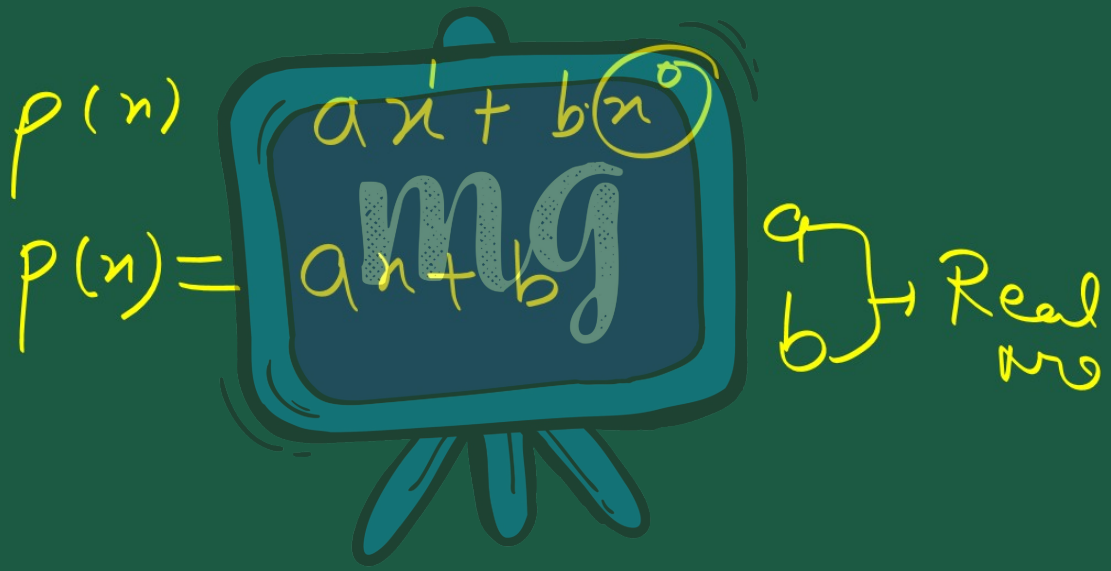
   ☞ General form of linear polynomial :

   $p(x) = ax + b$, where $a, b \in R$ and $a \neq 0$



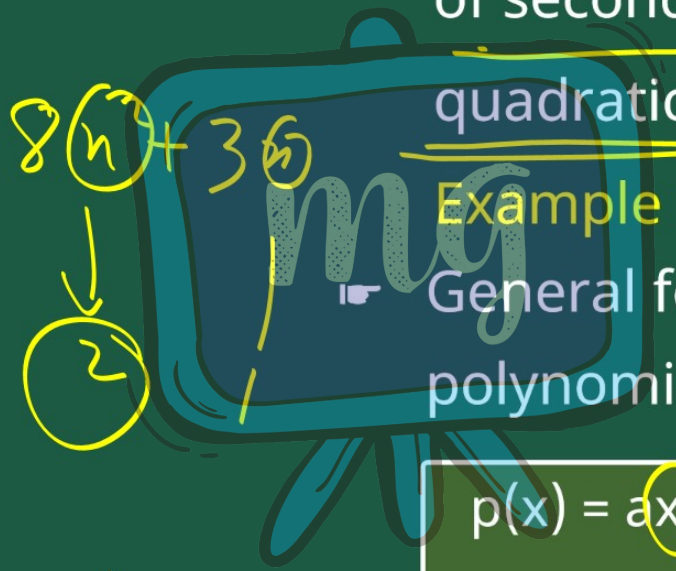
Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



2. **Quadratic Polynomial :–** Polynomial of second degree is called quadratic polynomial.

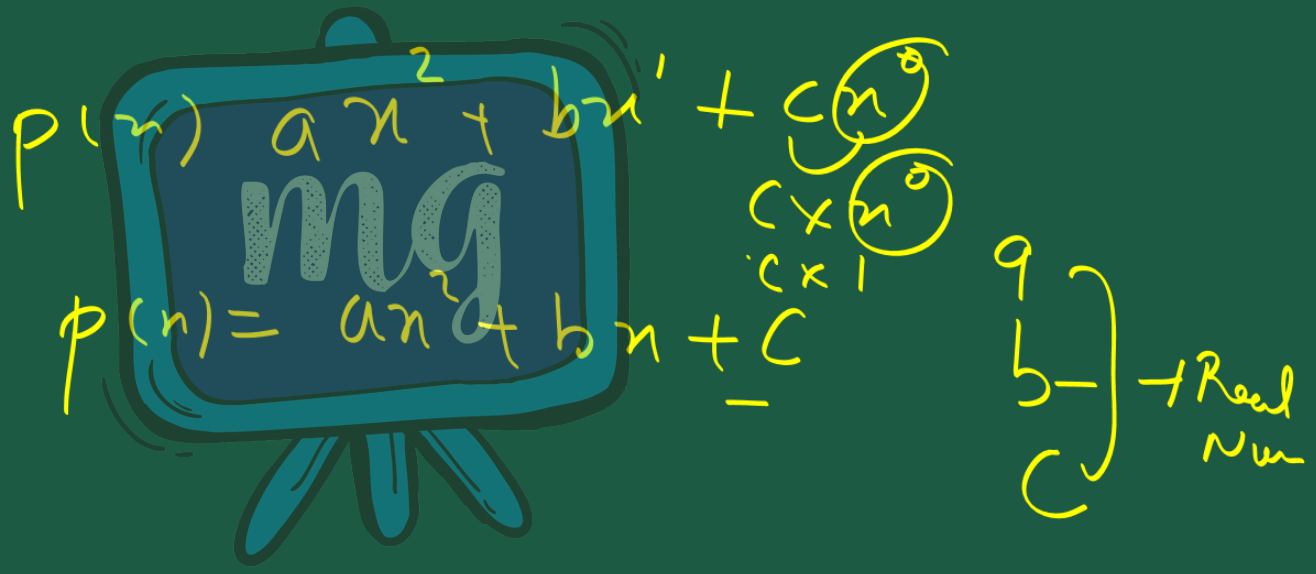
Example : $8x^2 + 3x$, $7x^2 - 4x + 9$

☛ General form of quadratic polynomial :

$$p(x) = ax^2 + bx + c, \text{ where } a, b, c \in R \text{ and } a \neq 0.$$

Under CSR Support by
ipca | Foundation

missiongyan
LET'S LEARN TOGETHER

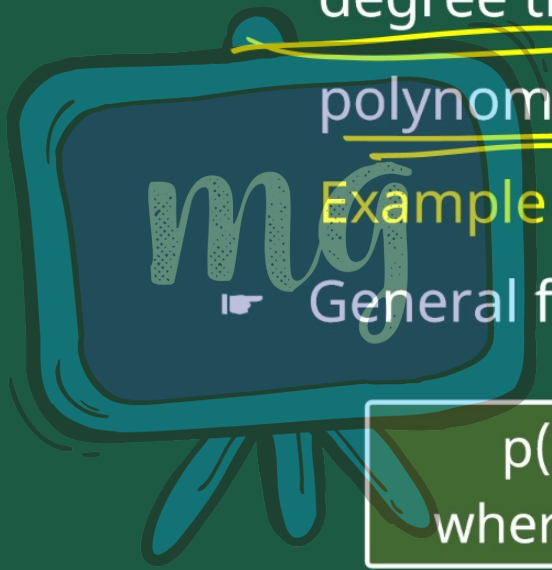


Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

3. Cubic Polynomial :– Polynomial of degree three is called cubic polynomial.

Example : $x^3 + x - 1$, $2x^3 + 3x^2 - x - 9$



☛ General form of cubic polynomial :

$$p(x) = ax^3 + bx^2 + cx + d,$$
where $a, b, c, d \in R$ and $a \neq 0$.

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

$p(x) \quad ax^3 + bx^2 + cx^1 + dx^0$

$= ax^3 + bx^2 + cx + d$

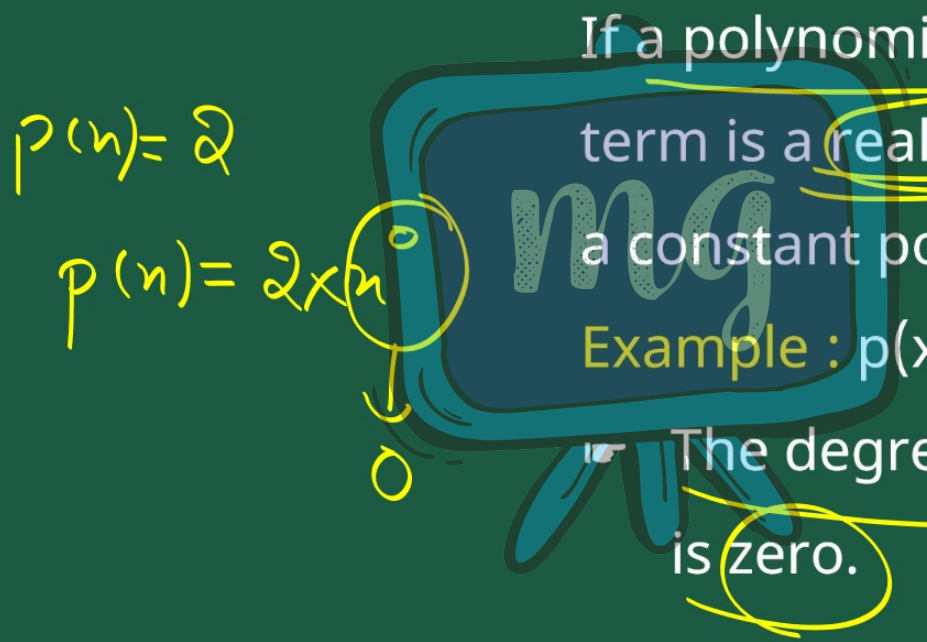
$a \neq 0$

a, b, c, d → Real Numbers

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

CONSTANT POLYNOMIAL



If a polynomial has one term and that term is a real number, then it is called a constant polynomial.

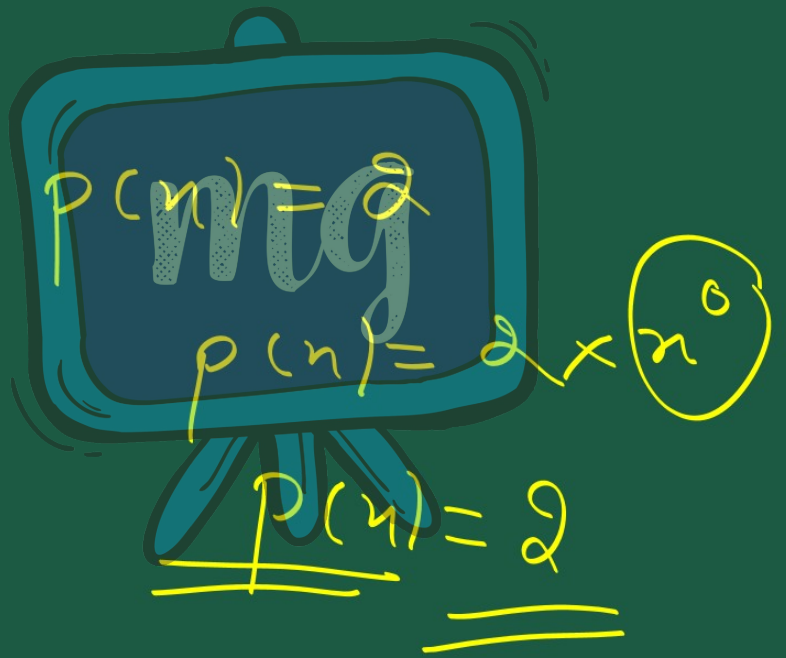
Example : p(x) = 2, Q(x) = –3

☛ The degree of a constant polynomial is zero.

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

$n^0 = 1$



Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

ZERO POLYNOMIAL

A polynomial whose all coefficients are zero is called zero polynomial.

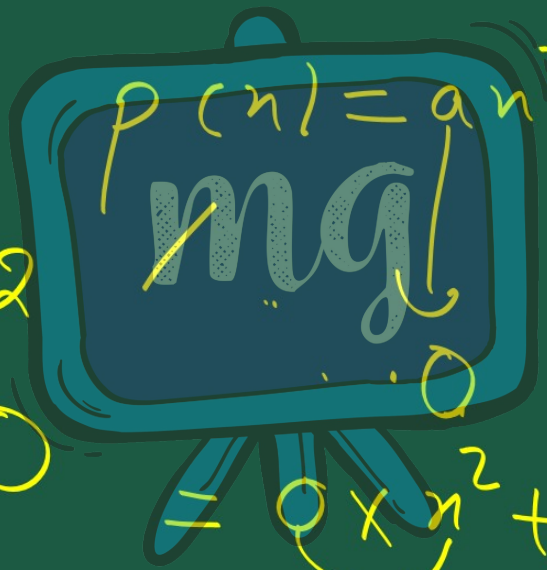
Example : p(x) = 0

p(n)=0

☛ The degree of the zero polynomial is undefined.

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER



$p(n) = an^2 + bn + c$

$2 + 0 = 2$

$0 + 0 = 0$

$p(n) = 0$

$= 0 \times n^2 + 0 \times n + 0$

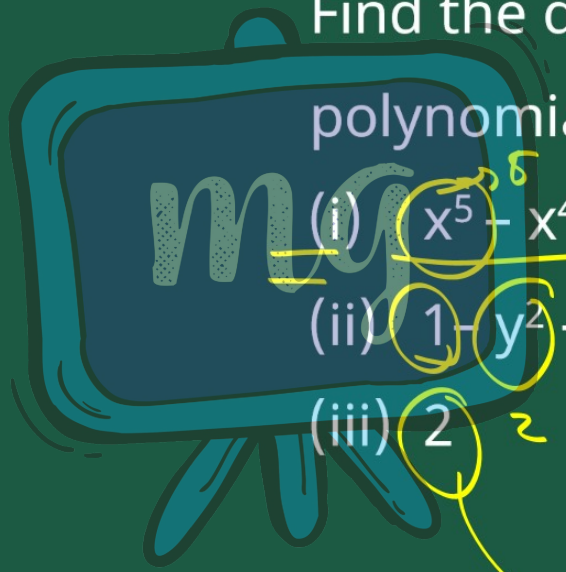
$= 0 + 0 + 0 = 0$

Under CSR Support by ipca | Foundation

missiongyan LET'S LEARN TOGETHER

Example – 1

Find the degree of each of the polynomials given below:



(i) $x^5 - x^4 + 3$

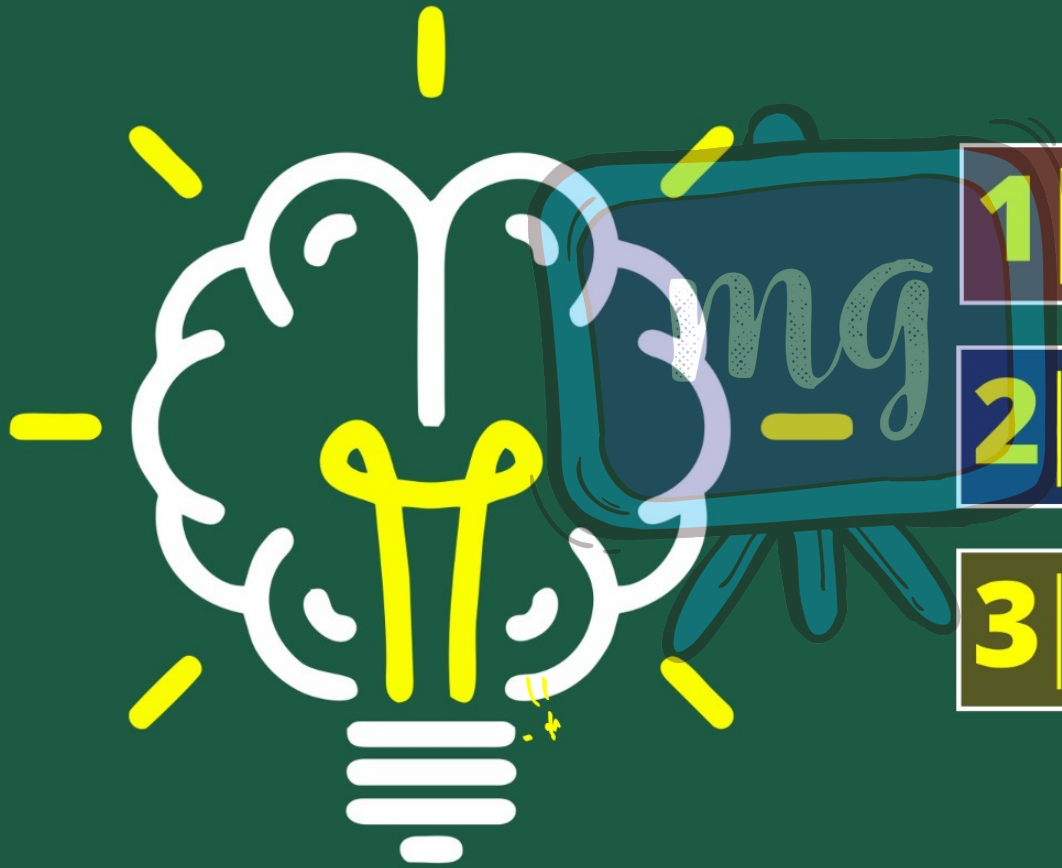
(ii) $1 - y^2 - y^3 + 2y^8$

(iii) 2

Under CSR Support by ipca | Foundation

LEARNING OUTCOMES

missiongyan LET'S LEARN TOGETHER



1. Polynomial
2. Types of Polynomials
3. Degree of Polynomial

Under CSR Support by ipca | Foundation

ASSESSMENT

missiongyan



1 Which of the following is not a polynomial:

A $f(x) = 2$

B $f(x) = 0$

C $f(x) = x^2 + x + 1$

D $f(x) = \sqrt{x} + 1$

$\sqrt{x} + 1$

$= x^{\frac{1}{2}} + 1$

$\frac{1}{2}$ ∉ Whole Number

Under CSR Support by ipca | Foundation

ASSESSMENT

missiongyan LET'S LEARN TOGETHER



2 What type of polynomial is $2x^2 + 1$:

A Linear

B Quadratic

C Triad

D Constant

ASSESSMENT



3 The degree of given polynomial $x^2+\sqrt{3}x+1$ is :

A 0

B 1

C 2

D 3