ALGEBRAIC EXPRESSION

§§ **Algebraic Expression :** A combination of constants and variables, connected by any or all of the four fundamental operations +, –, × and ÷ is called an *algebraic expression.*

Ex : $2x-3y+4,\ 6xy+2y+\frac{7}{2}$, etc.

§§ **Various types of algebraic expressions :**

a) Monomial : An algebraic expression which contains only one term is called a monomial.

Ex : $5x, 4, 7x^3, -\frac{3x^2}{2}$ etc.

b) Binomial : An algebraic expression which contains two terms is called a binomial.

Ex : $4-3x,\ 5+7x, b+\frac{1}{b},\ 2a+3b$ etc.

c) Trinomial : An algebraic expression which contains three terms is called a trinomial.

Ex : $2a+3b-4c,\ x-5y+z,\ \frac{2}{3}+x-y$ etc.

d) Multinomial: An algebraic expression containing two or more terms is called a multinomial.

§§ **Constant term:** A term of the expression having no literal factor is called the constant term.

Ex : In the expression $2x-3y+\frac{3}{2}$, the constant term is $\frac{3}{2}$

§§ **Like terms :** Terms which have the same literal or variable factors are called *like* or *similar terms*. Otherwise they are called *unlike terms*.

Ex : (i) $2xy, -4xy, 7xy$ are like terms. (ii) $2a^2, 30a$ are unlike terms.

§§ **Power of a variable :** When a variable is multiplied by itself 'n' number of times, the product is called the n^{th} power of that variable

Product	Written as	Read as	Base	Exponent
$x \times x$	x^2	x squared	x	2
$x \times x \times x$	x^3	x cubed	x	3
$x \times x \times x \times x \times x$	x^5	x raised to the power 5	x	5
$a \times a \times a \times a \times a \times a$	a^6	a raised to the power 6	a	6
$x \times x \times x$……. n times	x^n	x raised to the power n	x	n

§§ **Polynomial :** An algebraic expression involving two or more variables with non - negative integral powers is called a polynomial in these variables.

Ex : $2x^3 + y^2 + 2z^2 + xy,\quad \frac{2}{5}ab + a^2b - 7 - a^2$

Note : A Polynomial should not have a term with a variable in its denominator.

Ex : $2x^2 + \frac{3}{x} + 7y + 8$ not a polynomial

§§ **Degree of a polynomial :** A polynomial with only one variable is known as a polynomial in one variable.

Ex : $2x + 3,\ x^2 + 3x - 4,\ a^3 - 3a^2 + a + 5$

The degree of a polynomial in **one variable** is the greatest exponent of its variable.

Polynomial in one variable	Variable with greatest exponent	Degree
$5x^3 + 7$	x^3	3
$19x - 6$	x^1	1
$a^3 - 3a^2 + a$	a^3	3

The degree of a monomial with **more than one** variable is the sum of the exponents of its literals.

Monomial in more than one variable	Sum of exponents of variables	Degree
$6xyz$	1 + 1 + 1	3
$-5x^3y^2z$	3 + 2 + 1	6
$2a^5b^3z$	5 + 3 + 1	9

The degree of a polynomial with more than one variable is the degree of the term with the highest degree.

Polynomial with more than one variable	Degree of terms respectively	Term with highest degree	Degree of Polynomial
$2x^2y+5x^2$	3 and 2	$2x^2y$	3
$3x^3y^2z + 3x^3y^3 + 4z^2$	6, 6 and 2	$3x^3y^2z$ and $3x^3y^3$	6
$a^3b^3 - 2c^4 + 3a^2b^2 - 7$	6, 4, 4 and 0	a^3b^3	6

Note :

i) The degree of an algebraic expression with only constants is '0'

Ex: 1) $3 = 3 \times 1 = 3 \times a^{\circ}$

2) $4 + 5 = (4 \times 1) + (5 \times 1)$

$= (4.\ x^{\circ}) + (5 \times x^{\circ})$

(ii) An algebraic expression P(*x*) of the form

P(*x*) = $a_0 + a_1 x + a_2 x^2 + ... + a_n x^n$, where $a_0, a_1, a_2, ...a_n$,$a_n \neq 0$ are real numbers and n

is a positive integer is called a polynomial in *x* over real numbers.

(a) $a_0, a_1 x, a_2 x^2, ...a_n x^n$ are called the terms of the polynomial.

(b) $a_0, a_1, a_2.....a_n$ are called coefficients of the respective terms.

(c) If $a_0, a_1, ...a_n$ are integers, then P(*x*) is called a polynomial with integer coefficients.

(d) If $a_0, a_1.....a_n$ are rational numbers, then P(*x*) is called a polynomial with rational coefficients.

§§ Types of Polynomials :

(i) Zero polynomial : If $a_0 = a_1 = a_2 = ...a_n = 0$, the polynomial is called a zero polynomial.

$(\because P(x) = 0 + 0.x + 0.x^2 + ... + 0.x^n = 0)$

(ii) Linear Polynomial : If *n* = 1, then P(*x*) = $a_0 + a_1 x,\ a_1 \neq 0$ is called a linear polynomial or polynomial of first degree.

Ex : $4x + 3,\ 2 - 3x$ etc.

(iii) Quadratic polynomial : If *n* = 2, then $P(x) = a_0 + a_1 x + a_2 x^2, \quad a_2 \neq 0$ is called a quadratic polynomial or polynomial of second degree.

Ex : $x^2 - x + 3,\ 2x^2 + 5x + 6$ etc.

(iv) Cubic Polynomial : If n = 3, then P(*x*) = $a_0 + a_1 x + a_2 x^2 + a_3 x^3,\ a_3 \neq 0$ is called a cubic polynomial (or) polynomial of third degree.

Ex : $x^3 + 3x^2 - 2x + 5,\ 2y^2 + 3y^3 - 2y + 8$ etc.

(v) Biquadratic polynomial : If *n* = 4, then $a_0 + a_1 x + a_2 x^2 + a_3 x^3 + a_4 x^4,\ a_4 \neq 0$ is called a biquadratic polynomial or fourth degree polynomial.

Ex : $x^4 + 7x^3 + 2x + 3,\ 3x^4 - 2x$

(vi) Zero of a polynomial : The number for which the value of a polynomial is zero, is called zero of the polynomial.

Ex : Let P(x) = x – 2

If we substitute x = 0, 1, 2, 3 in P(x), we get

P(0) = 0 – 2 = –2

P(1) = 1–2 = –1

P(2) = 2–2 = 0

P(3) = 3–2 = 1

If x = 2, then P(2) = 0 $\therefore$ We say 2 is a zero of the polynomial P(x)

Note :

a) A linear polynomial has one and only one zero

b) A constant polynomial has no zero

c) A zero polynomial has infinite number of zeroes.

d) Every real number is a zero of the zero polynomial P(x) = 0.

e) 0 can be a zero of a polynomial.

§§ **Homogeneous expression :** If all the terms in a compound expression have same degree, then that expression is called Homogeneous expression.

Ex : $4x^2 + 5xy + 7y^2, 5x^2y + 3xy^2$

¶¶ **Algebraic identities**

i. $(a+b)^2 = a^2 + 2ab + b^2$

ii. $(a-b)^2 = a^2 - 2ab + b^2$

iii. $a^2 - b^2 = (a+b)(a-b)$

iv. $(x+a)(x+b) = x^2 + (a+b)x + ab$

v. $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

vi. $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3 = a^3 + b^3 + 3ab(a+b)$

vii. $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3 = a^3 - b^3 - 3ab(a-b)$

viii. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

ix. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

x. $a^2 + b^2 = (a+b)^2 - 2ab = (a-b)^2 + 2ab$

§§ **Exponential form :** If 'x' is any number and m is any natural number, then we have $x \times x \times x \times .....m$ times = x^m. This is called an exponential form.

Here, x is called **base** and 'm' is called the **exponent** or **index** or **power** of the exponential expression x^m.

§§ <u>Laws of Exponents or Laws of Indices :</u>

For positive integral values of *m* and *n*

Law 1 : $a^m \times a^n = a^{m+n}$

Ex : $2^2 \times 2^3 = 2^{(2+3)} = 2^5 = 32$

Law 2 : $\frac{a^m}{a^n} = a^{m-n}$, where *m* > *n*

Ex : $\frac{4^5}{4^3} = 4^{(5-3)} = 4^2 = 16$

Law 3: $\frac{a^m}{a^n} = \frac{1}{a^{n-m}}$, where *m* < *n*

Ex : $\frac{4^3}{4^5} = \frac{1}{4^{(5-3)}} = \frac{1}{4^2} = \frac{1}{16}$

Law 4 : $(a^m)^n = a^{mn}$

Ex : $(5^2)^3 = 5^{2\times 3} = 5^6$

Law 5 : $a^{-n} = \frac{1}{a^n}$

Ex : $2^{-3} = \frac{1}{2^3}$

Law 6 : $a^0 = 1$

Ex : $3^0 = 1, \left(-\frac{1}{9}\right)^0 = 1$ etc.

Note : If *a* and *b* are two different numbers, then (i) $(ab)^n = a^n.b^n$ (ii) $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$, where '*n*' is a positive integer.

Note : The reciprocal of $\left(\frac{x}{y}\right)^k = \left(\frac{y}{x}\right)^k$, where k is a natural number.

§§ <u>Factorisation :</u> The process of writing an expression as the product of two or more expressions is called factorisation.

Ex : Factorize $3x^2 - 6xy$.

Sol : The terms of the expression $3x^2 - 6xy$ have a common factor 3*x.*

$\therefore 3x^2 - 6xy = 3x(x - y)$

§§ <u>Factors of multinomial :</u> If the product of two or more Algebraic expressions is equal to the given multinomial, then those expressions are called factors of the given multinomial.

Ex : Let $P(x) = x^2 - 2x$ = $x(x-2)$

$\therefore x$, $x - 2$ are called the factors of P(x)

Note : H.C.F of monomials = (H.C.F of numerical cofficients) x (H.C.F of variable cofficients)

§§ **Equation :** A statement of equality involving one or more variables is called an equation

Ex : (i) $2x - 4 = 6$ (ii) $x + 2 = 3y - 4$

§§ **Linear equation :** An equation involving one variable with highest power 1, is called a linear equation in that variable.

Ex : (i) $2x + 5 = 7$ (ii) 4y = 2

¶¶ **Solution of a linear equation :** When the value of the variable satisfies the given equation then that value is called the solution (root) of the given equation.

§§ **Linear inequation:** A statement of inequality between two expressions involving a single variable *x* with highest power 1, is called a *linear inequation*.

Ex : (i) $x + 2 < 7$ (ii) $y - 3 > 4$ (iii) $z \geq 4$

§§ **Properties of Inequations :**

Property 1 : Adding the same number to each side of an inequation does not change the inequality.

Ex: $x - 3 < 7 \Rightarrow x - 3 + 4 < 7 + 4 \Rightarrow x + 1 < 11$

Property 2 : Subtracting the same number from each side of an inequation does not change the inequality.

Ex : $2x + 3 < 9 \Rightarrow 2x + 3 - 4 < 9 - 4 \Rightarrow 2x - 1 < 5$

Property 3 : Multiplying each side of an inequation by the same positive number does not change the inequality.

Ex : $(2x+3) < 7 \Rightarrow (2x+3) \times 4 < 7 \times 4$

Property 4 : Multiplying each side of an inequation by the same negative number reverses the inequality.

Ex : (i) $x < 2 \Rightarrow -x > -2$ (ii) $x > -3 \Rightarrow -x < 3$

Property 5: Dividing each side of an inequation by the same positive number does not change the inequality.

Ex : $2x < 14 \Rightarrow \frac{2x}{2} < \frac{14}{2} \Rightarrow x < 7$

Property 6 : Dividing each side of an inequation by the same negative number reverses the inequality.

Ex : $2x < 14 \Rightarrow \frac{2x}{-2} > \frac{14}{-2} \Rightarrow -x > -7$

§§ **Square of a monomial :** A monomial which can be written as the square of another monomial is called a "perfect" or "exact" square.

Ex : 1). $a \times a = a^2$ is read as " *a* square' (or) "square of *a* "

2). $3xy \times 3xy = 9x^2y^2$

$\therefore 9x^2y^2$ is called the square of 3*xy*.

It is written as $(3xy)^2$.

§§ **Square root of a monomial :** If a monomial is a perfect square, then it can be expressed as a product of two equal factors. In such a case each of the equal factors is called a "square root" of the given monomial.

Ex : 1) $36a^2b^2 = 6ab \times 6ab$

$\therefore$ Square root of $36a^2b^2$ is 6*ab*

Ex : 2) $\frac{25}{16}x^4y^2 = \frac{5}{4}x^2y \times \frac{5}{4}x^2y$

$\therefore$ Square root of $\frac{25}{16}x^4y^2$ is $\frac{5}{4}x^2y$

EXAMPLES

√ **Example 1 :** If $x + y = 11$ and $xy = 30$, find the value of (i) $x^2 + y^2$ (ii) $x - y$

Sol : (i) Given $x + y = 11$

Squaring on both sides, $(x+y)^2 = 11^2$

$\Rightarrow x^2 + y^2 + 2xy = 121$

$\Rightarrow x^2 + y^2 + 2 \times 30 = 121$ $(\because xy = 30)$

$\Rightarrow x^2 + y^2 = 121 - 60$

$\Rightarrow x^2 + y^2 = 61$

(ii) we know that $(x-y)^2 = x^2 + y^2 - 2xy$

$= 61 - 2(30)$

$= 61 - 60$

= 61 – 60

$\Rightarrow (x-y)^2 = 1$

$\Rightarrow x - y = \pm\sqrt{1} = \pm 1$

ANS : i) 61 ; ii) ± 1

√ **Example 2 :** Find zeroes of the polynomial $P(x) = 0$.

Sol : The polynimial $P(x) = 0$ can be written as $P(x) = 0$. *x* (zero times *x*).

If we substitute any real number for *x* in P(*x*), the result is always zero.Hence, every real number is a zero of the polynomial P(*x*)= 0.

∴ A zero polynomial has infinite number of zeroes.

ANS : infinite number

√ **Example 3 :** If $\left(\frac{9}{4}\right)^x \cdot \left(\frac{8}{27}\right)^{x-1} = \frac{2}{3}$, then find the value of '*x*'.

Sol : Given , $\left(\frac{9}{4}\right)^x \cdot \left(\frac{8}{27}\right)^{x-1} = \frac{2}{3}$

$\Rightarrow \frac{9^x}{4^x} \times \frac{8^{x-1}}{27^{x-1}} = \frac{2}{3}$

$\Rightarrow \frac{(3^2)^x}{(2^2)^x} \times \frac{(2^3)^{x-1}}{(3^3)^{x-1}} = \frac{2}{3}$

$\Rightarrow \frac{3^{2x}}{2^{2x}} \times \frac{2^{3(x-1)}}{3^{3(x-1)}} = \frac{2}{3}$

$\Rightarrow \frac{2^{3x-3-2x}}{3^{3x-3-2x}} = \frac{2}{3}$ $\left(\because \frac{a^m}{a^n} = a^{m-n} = \frac{1}{a^{n-m}}\right)$

$\Rightarrow \frac{2^{(x-3)}}{3^{(x-3)}} = \frac{2}{3}$

$\Rightarrow \left(\frac{2}{3}\right)^{x-3} = \left(\frac{2}{3}\right)^1$

$\Rightarrow x - 3 = 1$

$\Rightarrow x = 1 + 3 = 4$

ANS : 4

√ **Example 4 :** If $x = 2^{1/3} - 2^{-1/3}$, then find the value of $2x^3 + 6x$.

Sol : Let $2^{1/3} = a$, then $2^{-1/3} = \frac{1}{2^{1/3}} = \frac{1}{a}$

Now, we have $x = a - \frac{1}{a}$

Now $2x^3 + 6x = 2\left(a - \frac{1}{a}\right)^3 + 6\left(a - \frac{1}{a}\right)$

$= 2\left[a^3 - \frac{1}{a^3} - 3a \times \frac{1}{a}\left(a - \frac{1}{a}\right)\right] + 6\left(a - \frac{1}{a}\right)$

$= 2\left[a^3 - \frac{1}{a^3} - 3\left(a - \frac{1}{a}\right) + 3\left(a - \frac{1}{a}\right)\right]$

$= 2\left[a^3 - \frac{1}{a^3}\right]$

$= 2\left[2 - \frac{1}{2}\right]$ $\left[\because a^3 = \left(2^{\frac{1}{3}}\right)^3 = 2\right]$

$= 2\left(\frac{3}{2}\right)$

$= 3$

ANS : 3

√ **Example 5 :** Factorize $x^2 - ax + bx - ab$.

Sol : Given expression $x^2 - ax + bx - ab$

Noticing that the first two terms contain a common factor *x*, and the last two terms contain a common factor b,

We arrange the first two terms in one bracket, and the last two in another. Thus,

$x^2 - ax + bx - ab = (x^2 - ax) + (bx - ab)$

$= x(x-a) + b(x-a)$

$= (x-a)$ taken *x* times plus $(x-a)$ taken b times

$= (x-a)$ taken $(x+b)$ times

$= (x-a)\ (x+b)$

ANS : $(x-a)\ (x+b)$

√ **Example 6:** Prove that $(a+b)^3 - (a-b)^2(a+b) = 4ab(a+b)$.

Sol : L.H.S $= (a+b)^3 - (a-b)^2(a+b)$

$= a^3 + b^3 + 3ab(a+b) - (a-b)^2(a+b)$

$= (a+b)(a^2 - ab + b^2) + 3ab(a+b) - (a-b)^2(a+b)$

$(\because a^3 + b^3 = (a+b)(a^2 - ab + b^2))$

$= (a+b)\left[(a^2 - ab + b^2) + 3ab - (a-b)^2\right]$

$= (a+b)\left[a^2 - ab + b^2 + 3ab - a^2 - b^2 + 2ab\right]$

$= (a+b)\left[4ab\right]$

= R.H.S

ANS : $(a+b)^3 - (a-b)^2(a+b) = 4ab(a+b)$

$\therefore$ L.H.S = R.H.S

√ **Example 7 :** If $x + \frac{1}{x} = 7$, find the value of : (i) $\left(x^2 + \frac{1}{x^2}\right)$ (ii) $\left(x^4 + \frac{1}{x^4}\right)$

Sol : (i) We have, $x + \frac{1}{x} = 7$

Squaring on both sides, we get $\left(x + \frac{1}{x}\right)^2 = 7^2$

$\Rightarrow x^2 + 2 \times x \times \frac{1}{x} + \frac{1}{x^2} = 49$

$\Rightarrow x^2 + 2 + \frac{1}{x^2} = 49$

$\Rightarrow x^2 + \frac{1}{x^2} = 49 - 2$

$\Rightarrow x^2 + \frac{1}{x^2} = 47$ ---------(1)

(ii) Again squaring both sides of (1) we get :

$$\left(x^2 + \frac{1}{x^2}\right)^2 = (47)^2$$

$\Rightarrow x^4 + 2 \times x^2 \times \frac{1}{x^2} + \frac{1}{x^4} = 2209$

$\Rightarrow \quad x^4 + 2 + \frac{1}{x^4} = 2209$

$\Rightarrow \quad x^4 + \frac{1}{x^4} = 2209 - 2$

$\Rightarrow \quad x^4 + \frac{1}{x^4} = 2207$

ANS : $x^2 + \frac{1}{x^2} = 47$ and $x^4 + \frac{1}{x^4} = 2207$

√ **Example 8:** Solve $-2 \le x \le 2, x \in Z$

Sol : Given problem contains two inequations, namely $-2 \le x$ and $x \le 2$

Now, $-2 \le x \Rightarrow x \ge -2$

$\therefore$ Any integer ≥ -2 is the solution

$\therefore x = -2, -1, 0, 1, 2, 3......$ is the solution of $x \ge -2$ ---------(1)

Now $x \le 2$

$\therefore$ Any integer ≤ 2 is the solution

$\therefore$ x = 2, 1, 0, -1, -2, -3,......is the solution of $x \le 2$ ---------(2)

From (1) & (2) the solutions of $-2 \le x \le 2,\ x \in z$ are the common numbers in (1) & (2)

$\therefore x = -2, -1, 0, 1, 2$ are the solutions.

ANS : $x = -2, -1, 0, 1, 2$

√ **Example 9 :** Solve $x - 40\%$ of x = 12

Sol : $x - 40\%$ of $x = 12$

$\Rightarrow x - \frac{40}{100}x = 12$

$\Rightarrow x - \frac{2}{5}x = 12$

$\Rightarrow \frac{5x - 2x}{5} = 12$

$\Rightarrow 5x - 2x = 12 \times 5$ (Multiplying both sides with 5)

$\Rightarrow 3x = 12 \times 5$

$\Rightarrow x = \frac{12 \times 5}{3}$ (Dividing both sides by 3)

$\therefore x = 20$ is the solution of the given equation.

ANS : 20

√ **Example 10:** The numbers x, y, z are proportional to 2, 3, 5. The sum of x, y and z is 100. If number *y* is given by the equation $y = ax - 10$, then find the value of '*a*'.

Sol : Given, the numbers *x, y, z* are proportional to 2, 3, 5.

$\Rightarrow \frac{x}{2} = \frac{y}{3} = \frac{z}{5}$

Let $\frac{x}{2} = \frac{y}{3} = \frac{z}{5} = k$

$\Rightarrow x = 2k, y = 3k, z = 5k$

Given condition is $x + y + z = 100$

$\Rightarrow 2k + 3k + 5k = 100$

$\Rightarrow 10k = 100$

$\Rightarrow k = 10$

$\therefore x = 20, y = 30, z = 50$

Given equation is $y = ax - 10$

$\Rightarrow 30 = 20a - 10$

$\Rightarrow 20a = 40$

$\Rightarrow a = \frac{40}{20} = 2$

$\therefore a = 2$

ANS : 2

√ **Example11:** If $kx^3 + 9x^2 + 4x - 10$ divided by $x + 3$ leaves a remainder 5, then find the value of *k*.

Sol : Given devidend = $kx^3 + 9x^2 + 4x - 10$

divisor = *x* + 3

remainder = 5

$x + 3 \,)\, kx^3 + 9x^2 + 4x - 10 \,(\, kx^2 + x(9 - 3k) + (9k - 23)$

$kx^3 + 3kx^2$

$0 + x^2(9 - 3k) + 4x$

$x^2(9 - 3k) + 3x(9 - 3k)$

$x(9k - 23) - 10$

$x(9k-23)+3(9k-23)$

$59-27k$

Since remainder = 5

$\Rightarrow 59-27k=5$

$\Rightarrow 27k=54$

$\Rightarrow k=\frac{54}{27}=2 \quad \therefore k=2$

ANS : 2

√ **Example 12 :** Fifteen years ago, Ramu was three times as old as his son. But now he is two times as old as his son. What is Ramu's age today ?

Sol : Let the Ramu's age today be '*x*'

and his son's age today be '*y*'

Given $x-15=3(y-15)$

$\Rightarrow x-15=3y-45$

$\Rightarrow x-3y=-30$ ----------(1)

Also we have *x* = 2*y*

$\Rightarrow x-2y=0$ ----(2)

Now (1) –(2) $\Rightarrow -y=-30 \quad \Rightarrow y=30$

$\therefore$ Son's age today is 30 years.

$\therefore$ Ramu's age today is 60 years.

ANS : Ramu's age = 60 Yr , His son's age = 30 Yr

TEACHING TASK

I) MCQ's with Only One Option:

1. Degree of the polynomial $\frac{x^3+x^4-x^6}{x^2}$ is ______

A) 1 B) 2 C) 3 D) 4

2. The degree of the constant polynomial is

A) 1 B) 2 C) 3 D) 0

3. Degree of the polynomial is $\left(3x-x^2\right)^2$ is

A) 6 B) 5 C) 4 D) 3

4. The difference of the degree of the polynomials $3x^2y^3 + 5xy^7 – x^6$ and $3x^5 – 4x^3 + 2$ is

A) 2 B) 3 C) 1 D) 0

5. How much is $a^4 + 4a^2b^2 + b^4$ more than $a^4 – 8a^2b^2 + b^4$?

A) 12ab B) $12a^2b$ C) $12ab^2$ D) $12a^2b^2$

6. How much is $a^4 – 4a^2b^2 + b^4$ less than $a^4 + 8a^2b^2 + b^4$?

A) 12ab B) $12a^2b$ C) $12ab^2$ D) $12a^2b^2$

7. What must be added to $x^3 + 3x – 8$ to get $3x^3 + x^2 + 67$

A) $2x^3 + x^2 – 3x + 14$ B) $2x^2 + x^2 + 14$

C) $2x^3 + x^2 – 6x – 14$ D) $2x^3 + x^2 – 14$

8. What must be subtracted from $x^3 – 3x^2 + 5x – 1$ to get $2x^3 + x^2 – 4x +27$

A) $–x^3 + 4x^2 – 9x + 3$ B) $x^3 + 4x^2 – 9x + 3$

C) $x^3 – 4x^2 + 9x – 3$ D) $–x^3 – 4x^2 + 9x – 3$

9. If $(3x-4)(5x+7)=15x^2-ax-28$ then a =

A) 1 B) –1 C) –2 D) 4

10. The value of the product $(3x^2-5x+6)$ and $(–8x^3)$ when x = 0 is

A) $\frac{1}{2}$ B) 2 C) 1 D) 0

11. $(x^2y – 1)(3 – 2x^2y)$ is

A) $5x^2y + 2x^4y^2 + 3$ B) $5x^2y – 2x^4y^2 – 3$

C) $5x^2y^2 – 2x^4y^2 – 3$ D) $5x^2y^4\ \ 2x^4y^4 – 3$

12. The simplified form of $\frac{1}{3}(6x^2+15y^2)(6x^2-15y^2)$ is

A) $12x^2 – 75y^2$ B) $12y^2 – 75x^4$ C) $12x^4 – 75y^4$ D) $5y^6 – 12x^4$

13. If $x-\frac{1}{x}=\sqrt{6}$ then $x^2+\frac{1}{x^2}$ =.................

A) 2 B) 4 C) 6 D) 8

14. If 2x+y=5, then 4x+2y=................

A) 5 B) 8 C) 9 D) 10

15. If divisor, quotient and remainder are $2x^2 – 6x + 7$, $3x – 2$ and $–6x + 5$ then the dividend.......

A) $6x^3+22x^2+27x+9$ B) $6x^3+22x^2-27x+9$

C) $6x^3-22x^2+27x-9$ D) $6x^3-22x^2+27x+9$

16. If $x^2 + 2x – 63$ is exactly divided by a divisor and quotient is x-7 then the divisor.........

A) x – 9 B) x – 7 C) x + 9 D) x + 3

17. The multipilcation of $2xy^2$, $(-3x^2y)$ is equal to ..... [NIMO-2016]

A) 6 B) x^3y^3 C) $-6x^3y^3$ D) $6x^3y^3$

18. If X = $3x^3+3x^2+3x+3$ and Y = $3x^2-3x+3$ then x-y = ... [c.v.raman-2016]

A) $3x^3$ B) $3x^3+6x^2+6x+6$ C) $6x^2+6x+6$ D) $3x^3+6x$

19. The sum of three expressions is $x^2+y^2+z^2$. If two of them are $4x^2-5y^2+3z^2$ and $-3x^2+4y^2-2z^2$, then the third expression is .... [NTSE - 2015]

A) $2X^2+2Z^2$ B) $2y^2$ C) $2x^2+2y^2$ D) $2y^2+2z^2$

20. The value of $(a^3-2a^2+4a-5)-(-a^3-8a+2a^2+5)$ is ..... [NTSE - 2016]

A) $2a^3+7a^2+6a-10$ B) $2a^3+7a^2+12a-10$

C) $2a^3-4a^2+12a-10$ D) $2a^3-4a^2+6a-10$

II) MCQ'S WITH ONE OR MORE THAN ONE OPTION

♦ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which **ONE or MORE** is correct. Choose the correct options*

1. Value of the polynomial $\frac{n^4}{4}+\frac{n^3}{2}+\frac{n^2}{4}$ at n = 4 is ________

A) 100 B) Divisible by 2 C) 110 D) Divisible by 4

2. The product of $-5x^2y$, $\frac{-2}{3}xy^2z$, $\frac{8}{15}xyz^2$ and $\frac{-1}{4}z$ is

A) $\frac{-5}{9}x^4y^4z^4$ B) $\frac{-4}{9}x^4y^4z^4$ C) $\frac{-4}{9}(xyz)^4$ D) $-(\frac{2}{3}x^2y^2z^2)^2$

3. $\frac{(4ab)^2}{-6a^2}\div\frac{(-a^3b)^2}{2b^2}$ =

A) $\frac{4b^2}{3a^2}$ B) $\frac{-16}{3a^2}$ C) $\frac{-16b^2}{3a^4}$ D) $\frac{-16}{3}(\frac{b}{a^2})^2$

4. If $16x^3+12x^2+18x+8$ is divided by 4x + 2 then the remainder and the quotient is

A) 1 B) 0 C) $4x^2-x+4$ D) $4x^2+x+4$

III) COMPREHENSION TYPE:

♦ *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

1. If x = -1.5 then find

(i) the value of $-2x^2+5x$ is ....

A) -12 B) -11 C) -10 D) -9

(ii) the value of $1.2x^3$

A) -40.5 B) -4.05 C) -405 D) -0.405

(iii) the value of $-5x^2+5.2x^2+1.5x^2-0.7x^2$ is ....

A) 2.525 B) 2.225 C) 2.25 D) 2.55

2. If the polynomial $9x^3-12x^2-6x+6$ is divided by (x-2) then

(i) the quotient is ....

A) $9x^2+6x+6$ B) $9x^2-6x+6$ C) $6x^2+9x+6$ D) $6x^2-9x+6$

(ii) the remainder is ....

A) 12 B) 18 C) 6 D) 3

(iii) the degree of quotient is ....

A) 0 B) 1 C) 2 D) 3

IV) MATRIX MATCHING :

1. Multiply the following polynomials with (x+2)

COLUMN - I	COLUMN - II
(i) X-2	P) x^3+3x^2+4x+4
(ii) x^2-x+2	Q) x^2-4x+4
(iii) x^2+x-2	R) x^3+x^2+4
(iv) x^2+x+2	S) x^2-4
	T) x^3+3x^2-4

A) i-S, ii-R, iii-T, iv-P B) i-R, ii-S, iii-T, iv-P

C) i-S, ii-T, iii-R, iv-P D) i-S, ii-P, iii-T, iv-R

2. Subtract the following polynomials from x^3+3x^2+4x+4

COLUMN - I	COLUMN - II
(i) 2X-3	P) x^3+2x^2+8x+8
(ii) x^2-x+4	Q) x^3-3x^2-4x+4
(iii) x^2-4x-4	R) x^3+2x^2+5x
(iv) $-X^3+4X-3$	S) x^3+3x^2+2x+1
	T) $2x^3+3x^2+7$

A) i-S, ii-Q, iii-T, iv-R B) i-S, ii-R, iii-P, iv-T

C) i-P, ii-Q, iii-T, iv-R D) i-S, ii-Q, iii-P, iv-R

V) SOLVE THE FOLLOWING :

1. If $(2008+x+2008)^{2008-2006+2007} = (2008-x-2008)^{2007-2006+2008}$, find the value of '$x$'.

2. Find the value of the expression $7x + 7x + \ldots$ (7terms) at $x=7$ in exponential form.

3. Find the sum of the zeroes of the polynomials $(2007x+2008)$ and $(2007x-2008)$.

4. Find the product of the zeroes of the polynomials $(ax+b)$ and $(bx-a)$.

5. Write the polynomial $x^7-2x^6+3x-8x^3+4x^5-3x^4+7$ in the standard form.

6. Are the algebraic expressions

a) $\frac{4}{7}p^4-7p^2-5$ b) $11x^3+4x^2+7\sqrt{x}+3$ c) $2x^3+\frac{4}{x^2}+9$

polynomials? Give reason.

7. Find the degree of the following algebraic expressions

a) $1+2x+x^2$ b) $xy+yz+zx$ c) $p^2q^2+2pq^3-p^2q+7$

d) m^4-n^2+8

8. If $ax-b$ is a zero polynomial, $a, b \in R$, then find the value of *a* and *b.*

9. If *a, b, c* are three smallest consecutive non negative integers, then find the value of $a^3+b^3+c^3-3abc$.

10. Show that the third proportional of 6, 6 is the root of the equation $5(x-3)-7(6-x)+3=24-3(8-x)$.

11. The sum of two numbers is the product of first four whole numbers. Find the numbers.

12. Whenever '*x*' is neither positive nor negative the value of the expression $3x-b$ is a smallest rational number, which is a whole number. What is the value of b.

13. Find the value of the algebraic expression $\frac{4xy}{7}+7z$, if *x* = additive identiy of whole numbers, y = multiplicative identiy of natural numbers and z = additive inverse of 7.

14. (i) Find the zero of the polynomial $\frac{1}{2}+\frac{2y}{3}+\frac{3}{4}+\frac{4y}{5}-\frac{5}{6}-\frac{6y}{7}$

(ii) Find the zero of the polynomial x^7-128.

15. If the two polynomials of degrees 2, *n* are multiplied and the degree of the resultant polynomial is 6, then find the value of '*n*' ?

LEARNER'S TASK

BEGINNERS (Level - I)

I) MCQ's with only one option is correct:

1. The degree of the polynomial $ax^n+bx^{n-1}+\ldots+px+q\,(a\neq 0)$ is _____

A) n B) n – 1 C) n + 1 D) 0

2. Number of zeros of the polynomial is equal to ______ of that polynomial

A) Degree B) Terms C) Exponent 4) No of variables

3. Value of the polynomial $p(x)=5x-\pi$ at $x=\frac{4}{5}$.

A) $4-\pi$ B) $5-\pi$ C) $-\pi$ D) π

4. Zero of any polynomial p(x) = cx + d is _______

A) $\frac{-c}{d}$ B) $\frac{-d}{c}$ C) $\frac{c}{d}$ D) $\frac{d}{c}$

5. Additive inverse of $x^2 - x + 2$ is _______

A) $-x^2 + x - 2$ B) $x^2 + x + 2$ C) $-x^2 - x + 2$ D) $-x^2 + x + 2$

6. Additive identity for any polynomial is

A) 0 B) 1 C) 2 D) 3

7. The additive Inverse of $2x^2-3x-1$ is

A) $-2x^2+3x+1$ B) $-(2x^2-3x-1)$ C) A and B D) $-2x^2+3x-1$

8. $\left(a^3 - 2a^2 + 4a - 5\right) - \left(-a^3 + 2a^2 - 8a + 5\right)$ = _______

A) $2a^3 - 4a^2 + 12a - 10$ B) $2a^3 - 4a^2 - 12a + 10$

C) $2a^3 + 4a^2 + 12a + 10$ D) $2a^3 - 4a^2 + 12a + 10$

9. Subtract $x^3 - xy^2 + 5x^2y - y^3$ from $-y^3 - 6x^2y - xy^2 + x^3$

A) $2y^3 - 8x^2y + 3xy^2 - 2x^3$ B) $2x^3 - 8xy^2 + x^2y - 2y^3$

C) $-11x^2y$ D) $-12x^2y$

10. If $(a + b)(a^2 - ab + b^2)$ =.................

A) $a^3 - b^3$ B) $(a-b)^3 + 3ab(a-b)$

C) $a^3 + b^3$ D) $a^3 + b^3 - 3a^2b - 3ab^2$

11. $(0.5x - y) \times (0.5x + y)$ =

A) $0.5x^2 - y^2$ B) $x^2 - 0.25y^2$ C) $0.5x - 0.25y^2$ D) $0.25x^2-y^2$

12. If $x^4 - 9x^3 - 2x^2 + 6x - 8$ is divided by $x - 3$ then the remainder is............

A) –180 B) –170 C) –160 D) –150

13. If $(84a^5x^3) \div (-12a^4x)$=...................

A) $-7ax^2$ B) $7a^2x$ C) $-7a^2x$ D) $7ax^2$

14. If $(5a^3b - 7ab^3) \div ab$=....................

A) $5a^2 - 7b^2$ B) $5a^2 + 7b^2$ C) $-5a^2 - 7b^2$ D) $5a^2 - 7b^2$

ACHIEVERS (Level - II)

SOLVE THE FOLLOWING :

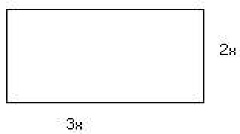
1. Identify and write the like terms in each of the following groups.

$a) 3a, 4xy, -yz, 2zy$ $b) 7p, 8pq, -5pq, -2p, 3p$ $c) m^2n^2, 2m^0n^2, 3m^2n, -9m^2n^2$

2. Find the degree of the following algebraic expressions.

$a) 1 + 2x + x^2$ $b) xy + yz + zx$ $c) m^4 - n^2 + 8$

3. Find the perimeter of the following rectangle



4. Are the following algebraic expressions are polynomials? Give reason.

a) $\frac{4}{7}p^4 - 7p^2 - 5$ b) $11x^3 + 4x^2 + 7\sqrt{x} + 3$ c) $a^{-1} + ab^2 - 1$

5. Find the values of the monomials when x=2,3,-1.5.

a)-1.2x^2 b) $\frac{1}{2}x^3$

6. Find the value of $\frac{7.83x7.8.3 - 1.17x1.17}{6.66}$

7. Simplify $-5x^2+5.2x^2+1.5x^2-0.7x^2$ and the find the value when x=0.5.

8. Find the value of $\frac{7ab+8bc-7ac}{abc+1}$, given that $a=5,\ b=3$ and $c=4$.

9. If $x = a^4 + a^3 + a^2 - 6,\ y = a^2 - 2a^3 - 2 + 3a$ and $z = 8 - 3a - 2a^2 + a^3$. Find the the value of $x+y+z$

10. What is the result when $-3x^3 + 2x^2 - 11x + 5$ is subtracted from zero ?

11. Multiply the following

$a) 2x+3y, 2x-3y$ $b) 5xy, 2xy+x+y+z$

12. Simplify the following

$a) (2a+3b)^2 + (3a-2b)^2$ $b) (x+\frac{1}{x})^2 + (x-\frac{1}{x})^2$

13. When $x=6$, find the numerical value of the sum of $(1-x-x^2)(2x^2-1)+(x-x^2)$.

14. If $A = 2x+3, B = 3x-5, C = x^2+3x-1$, find (i)A x (BxC) (ii) (AxB)xC

15. By using the distributive law of multiplication over addition find the product of $(2x-y)$ and $(2y+x)$.

16. Show that (i) $(a+b)^2 = a^2 + 2ab + b^2$ (ii) $(a+b)(a-b) = a^2 - b^2$

17. Divide $(4y^5+5y^4+11y^3-y^2+y+6)$ by (y^2-y+6)

18. Using divison shown that 3X+4 is a factor of $6X^2+29X+28$.

19. Find the remainder when $9x^3-12x^2-6x+6$ is divided by $3x+2$.

EXPLORERS (Level - III)

I) MCQ'S WITH ONE OR MORE THAN ONE OPTION IS CORRECT

♦ *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

1. Zeros of the polynomial $p(x)=x^2-2x$ is/are

A) 0 B) 1 C)2 D) 2, 3

2. Which of the following is/are not polynomials ?

A) $x+\frac{1}{x}$ B) x^2+2x+1 C) $x-\frac{1}{x}$ D) $x^2+\frac{1}{x}+2$

3. Which are the variables in the expression $3x^{5/2}-2x^2+6xyz-8z^3$?

A) x B) y C) z D) only x

4. On multiplication of $\left(3x-\frac{4}{5}y^2x\right)$ by $\frac{1}{2}xy$, the result is

A) $\frac{3}{2}x^2y+\frac{5}{2}x^2y^3$ B) $x^2y(\frac{3}{2}-\frac{2}{5}y^2)$

C) $\frac{3}{2}x^2y-\frac{2}{5}x^2y^3$ D) $\frac{5}{2}x^2y+\frac{3}{2}yx^2$

5. If $8x^3+6x^2-4x-12$ is divided by $2x-2$ then the quotient and remainder is.............

A) $4x^2-7x+5$ B) -2 C) $4x^2+7x+5$ D) 2

II) COMPREHENSION TYPE:

♦ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

1. Find the degree of the following polynomials

(i) $7x^2-3x+4$

A) 2 B) 1 C) 0 D) 7

(ii) $2x^2+3xy^2+4y^2$

A) 4 B) 3 C) 2 D) 1

(iii) $8x^2+9xy+7y^2$

A) 4 B) 3 C) 2 D) 1

2. If 4x+2y = 10 then

(i) 2x+y = ...

A) 5 B) 15 C) 20 D) 29

(ii) $8x^2+8xy+2y^2$ = ...

A) 25 B) 50 C) 45 D)100

(iii) $16x^2+16xy+4y^2$ = ...

A)25 B)50 C) 100 D) 75

III) MATRIX MATCHING:

♦ *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*
*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1. Find the additive inverse of the following

COLUMN - I	COLUMN - II
(i) $-x^2+x-2$	P) x^2+x+2
(ii) x^2+x-2	Q) $-x^2-x-2$
(iii) $-x^2-x+2$	R) $-x^2-x+2$
(iv) $-x^2-x-2$	S) x^2-x+2
	T) x^2+x-2

A) i-S, ii-R, iii-T, iv-P B) i-R, ii-S, iii-T, iv-P

C) i-S, ii-T, iii-R, iv-P D) i-S, ii-P, iii-T, iv-R

2. Divide the following polynomials with (x-2) and then find the remainder

COLUMN - I	COLUMN - II
(i) x^2-4	P) 16
(ii) X^3-4X^2+16	Q) 12
(iii) x^2+4x+4	R) 8
(iv) X^3-4X+4	S) 0
	T) 4

A) i-S, ii-Q, iii-T, iv-R B) i-S, ii-R, iii-P, iv-T

C) i-P, ii-Q, iii-T, iv-R D) i-S, ii-Q, iii-P, iv-R

KEY

ΦΦ TEACHING TASK :

I) 1. D 2. D 3. C 4. B 5. D 6. D 7. A 8. D 9. B 10. D
11. B 12. C 13.D 14.D 15. C 16. C 17.C 18. D 19. B 20. C

II) 1. A,B,C 2. B,C,D 3. C,D 4. B,D

III) 1. i-A, ii-B, iii-C 2. i-A, ii-B, iii-C

IV) 1. A 2. B

IV) 1) –2008 4) –1 5) $x^7-2x^6+4x^5-3x^4-8x^3+3x+7$ 7) a) 2

(b) 2 (c) 4 (d) 4 8) $a = 0,\ b = 0$ 9) 9 12) 0

13) 49 14) (i) $-\frac{525}{768}$ (ii) 2 15) 4

ΦΦ TEACHING TASK :

- **BEGINNERS :** 1. A 2. A 3. A 4. B 5. A 6. A 7.. A 8. A 9. C 10. C 11. D 12. B 13. A 14. A
- **EXPLORERS :** **I)** 1. A,C 2. A,C,D 3. A,B,C 4. B,C 5. C,D
  II) 1. i-A, ii-B, iii-C 2. i-A, ii-B, iii-C **III)** 1. A 2. B