

ALGEBRA

Learning Objectives :

1. Fundamental concepts
2. Fundamental operations (Related to Algebraic expressions)

Real time applications:

Mr. Hemanth buys 3 apples and 4 oranges every day. If apples cost Rs 6 each and orange cost Rs 2 each, Mr.Hemanth would pay Rs every day.

Here arithmetic has been used to construct a numerical expression. Let us find how much Mr.Hemanth spends on fruits every day.

However, the price of fruits changes every day. If an apple costs Rs x and an orange costs Rs y , then Mr Hemanth would pay Rs every day.

Algebra, a form of generalized arithmetic, is a method of calculation, by means of Variables representing quantities and signs representing the relations between these variables.

Here algebra has been used to construct an algebraic expression that gives us a general idea of what Mr. Hemanth is likely to spend on fruits every day.

1.FUNDAMENTAL CONCEPTS

§§ Algebraic Expression :

In the algebraic expression

- (i) There are two **literal symbols** or **variables** x and y , representing the price of an apple and an orange respectively.
- (ii) There are two **constants** 3 and 4, representing the number of apples and oranges bought every day, which do not change.

However, the **product** of a constant and variable is a **variable term**, the value of which changes with a change in the value of the variable. For instance $x = 6, 3x = 18$ and when $x = 5, 3x = 15$.

- (iii) In the variable term $3x$, 3 is known as the **numerical coefficient** of the variable x and x is known as the **variable coefficient** of the constant 3.

(iv) There are two variable terms $3x$ and $4y$, representing the amounts to be paid for buying 3 apples and 4 oranges.

(v) There is no constant term

Def : A combination of constants and variables, connected by any or all of the four fundamental operations $+$, $-$, \times and \div is called an algebraic expression.

Ex : $5x + 6y + 3$ is an algebraic expression.

Algebraic Expression	Variable terms	Constant terms
$4xy + 5$	$4xy$	5
$x^2 + 2xy + y^2$	$x^2, 2xy$ and y^2	None
$4x^3 + 3xy^2 + y^3 + 2$	$4x^3, 3xy^2$ and y^3	2

§§ Arithmetic (or) Numerical Expression and Numerical Statement :

A numerical expression is a collection of numbers connected by symbols of operation.

Ex : 1) $\frac{7}{10}$ of $50 + 5 - 10 \div \frac{1}{2}$ 2) $17 + 3 - \frac{5}{6} \times 8$

$\frac{7}{10}$ of $50 + 5 - 10 \div \frac{1}{2} = 20$ is an example of a **numerical statement**.

According to this **numerical statement**, when we simplify the above expression the result is 20.

Arithmetic		Algebra			
Digit	7	Literal / Variable	$3x$	Constant	30
Numeral	17	Variable term	$3x$	Constant term	30
Numerical Expression	$17 - 3$	Algebraic expression		$3x - 30$	
Numerical Statement	$17 - 3 = 14$	Algebraic statement		$3x - 30 = y$	

§§ 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.

integral powers is called a polynomial.

¶¶ Polynomial in one variable:-

An algebraic expression of the form $a+bx+cx^2+dx^3+\dots$ where a,b,c,d,\dots are constants and 'x' is a variable, is called a polynomial in x.

§§ Degree of polynomial in one variable:-

The highest power of the variable in a polynomial of one variable is called degree of the polynomial.

Eg:- i) $5x^3-3x^2+4x-8$ is polynomial of degree 3

ii) $4x^5-3x^2-1$ is a polynomial of degree 5

§§ Degree of polynomial in two or more variable:-

In case of polynomial in more than one variable, the sum of the powers of the variables in each is taken and the highest sum is the degree of the polynomial.

Eg:- i) $x^2y^3+xy^2+xy+8$

Degree of the polynomial 5.

§§ Equation :

A statement of equality involving one or more variables is called an equation (or) An equation is a statement in which two algebraic expressions are equal.

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.

¶¶ Rules for solving a Linear Equation :

The equality of a linear equation is not changed, when

- (1) the same number is added to both sides of the equation,
- (2) the same number is subtracted from both sides of the equation,
- (3) both sides of the equation are multiplied by the same non-zero number,
- (4) both sides of the equation are divided by the same non-zero number.

§§ Transposition :

Any term of an equation may be taken to the other side with its sign changed, without affecting the equality. This process is called transposition.

Ex : $4x + 1 = 3x - 8 \Rightarrow 4x - 3x = -8 - 1$

Here, the term involving 'x' from R.H.S has been transposed to L.H.S. and the constant term from L.H.S. has been transposed to R.H.S.

2.FUNDAMENTAL OPERATIONS ON ALGEBRAIC EXPRESSIONS

1. ADDITION

i) Addition of like terms:

The sum of two or more like terms is the like term whose numerical coefficient is the sum of the numerical coefficient of the given terms.

Ex:- i) $6x+3x = (6+3)x= 9x$

ii) $7xy - 2xy +3xy = (7-2+3)xy = 8xy$

ii) Addition of polynomial:

Step1: Arrange the terms of each of the given polynomials either alphabetically or in descending powers of some variable.

Step2: Arrange the given polynomial in the form of rows in such a way that the like terms occur in the some column.

Step3: Combine the like terms column wise add $3x^2+5x-4$, $2x+3-x^2$ and $8-3x+7x^2$

Solution:

$$\begin{array}{r}
 3x^2+5x-4 \\
 -x^2+2x+3 \\
 7x^2-3x+8 \\
 \hline
 9x^2+4x+7
 \end{array}$$

2. SUBTRACTION

i) Subtraction of like terms:

Subtraction of like terms can be performed in a manner exactly similar to that used in subtraction of integer.

Rule: Change the sign of term to be subtracted and add the new monomial to the one from which subtraction is to be made.

Ex:- i) Subtract $6a$ from $11a$ ii) subtract $-4a$ from $7a$

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$$\begin{array}{r}
 +11a \\
 \pm 6a \\
 \hline
 +5a \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 +7a \\
 \mp 4a \\
 \hline
 +11a \\
 \hline
 \hline
 \end{array}$$

ii) Column Method:

Rule: Write the expression to be subtracted below the other expression such that the like terms of the two expressions are in the same column, Now, change the sign of each term of the lower expression and add termwise.

Ex: Subtract $3p-8q+5r$ from $7q+10p-3r$

$$\begin{array}{r}
 10p+7q-3r \\
 3p \mp 8q \pm 5r \\
 \hline
 7p+15q-8r \\
 \hline
 \hline
 \end{array}$$

iii) Horizontal (or) Row Method:-

Rule: Change the sign of each term of the expression to be subtracted and then add.

Ex: Subtract $7x+3y-2z$ from $9x-2y+3z$.

$$\begin{aligned}
 \text{Sol: } & 9x-2y+3z-(7x+3y-2z) \\
 & = 9x-2y+3z-7x-3y+2z \\
 & = 2x-5y+5z
 \end{aligned}$$

3. MULTIPLICATION

Rule: The product of two factors with like signs is positive, and the product of two factors with unlike terms is negative.

$$\begin{aligned}
 \text{Ex:} & \text{- i) } (-2x)(3y) = -6xy \\
 & \text{ii) } (-3x)(-5x) = 15x^2
 \end{aligned}$$

If 'a' is any variable and m,n are positive integers, then $a^m \cdot a^n = a^{m+n}$ Eg:- $x^6 \cdot x^3 = x^{6+3} = x^9$

4. DIVISION

Write each term in its expanded form and then cancel the terms that are common to the numerator and the denominator.

Note:

Algebraic identities

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

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

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

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l) MCQ's with single correct answers type :

1. One - half of the sum of numbers a and b is.
 A) $\frac{1}{4} ab$ B) $\frac{1}{2} ab$ C) $\frac{1}{2} (a+b)$ D) $\frac{1}{2} (a-b)$
2. 9 less than the quotient of 8 by n is...
 A) $9 - \frac{8}{n}$ B) $\frac{8}{n} - 9$ C) $\frac{n}{8} - 9$ D) $9 - \frac{n}{8}$
3. The algebraic form of 'thrice x added to y squared' is...
 A) $3x+y$ B) $9x^2 + y$ C) $3x + y^2$ D) $3x^2 + y$
4. '16 times of x subtracted from the sum of twice y and thrice z' in symbolic form is
 A) $2y+3z-16x$ B) $2y+3z+16x$ C) $16x-2y+3z$ D) $16x-2y-3z$
5. "Area of a parallelogram is equal to the product of base length and height." is
 A) $A=bh$ B) $A=b+h$ C) $A=b - h$ D) $bA=h$
6. Literal coefficient of $-2a^2b^2c^2$ is...
 A) -2 B) $a^2b^2c^2$ C) abc D) $-2a^2b^2c^2$
7. Numerical coefficient of x in $\frac{-x}{2}$
 A) -x B) -1 C) -1/2 D) None
8. In a sequence of numbers first number is 2, second number is 3, third number is 4 and so on then the p^{th} number is...
 A) $p+1$ B) p C) -1 D) 2p
9. The number of terms in $3xy+4xy^2-7xy+5x^2y$ is...
 A) 4 B) 3 C) 2 D) 1
10. Which of the following is a monomial?
 A) $x+y+z$ B) $7y+z^2$ C) xyz D) $xy+z$

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11. The degree of $-12x^2y^2$ is...
 A) 2 B) 4 C) 3 D) 1
12. Like term of x among $3x^2$, $4xy$, $-7x$ and 9 is...
 A) $3x^2$ B) $4xy$ C) $-7x$ D) 9
13. The standard form of $9-4y^2+5y$ is...
 A) $5y-4y^2+9$ B) $-4y^2+5y+9$ C) $4y^2+5y-9$ D) $5y+9+4y^2$
14. Additive inverse of $3x-y$ is...
 A) $3x+y$ B) $y-3x$ C) $-3x-y$ D) None
15. By how much does 1 exceed $x-2y+3$?
 A) $x-2y-2$ B) $x+2y+2$ C) $-x+2y-2$ D) $-x-2y-2$

II) MCQ's with multi correct answer type :

◆ 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. Which of the following are binomials?
 A) x^2+2y^2 B) ab^2+4ab^2 C) $z+7$ D) ax^2+bx+c
2. Which of the following are like terms?
 A) $3x$, $-7x$ B) $16x$, $16y$ C) $9ab$, $-6b$ D) $-2x^3y$, $-x^3y$
3. $(a+2b+3c)+(a+b-c)=...$
 A) $2a+3b+2c$ B) $2(a+b+c)+b$ C) $2a-3b+2c$ D) $2(a-b+c)-b$
4. What should be added to $a^2+2ab+b^2$ to obtain $4ab+b^2$?
 A) $2ab-b^2$ B) $a(2b-a)$ C) $-a^2-2ab$ D) $-a^2+2ab$
5. If $x=1$, $y=2$ and $z=-3$ then $x^3+y^3+z^3=...$
 A) -18 B) 18 C) $3xyz$ D) $-3xyz$
6. Sum of m^2-4m+5 , $-2m^2+6m-6$, $-m^2+6m-6$ is
 A) $-2m^2+8m-7$ B) $2m^2+8$ C) $2m^2-8$ D) $-(2m^2-8m+7)$
7. $(a^2+b^2+2ab)+(a^2+b^2-2ab)=....$
 A) $4ab$ B) $2(a^2+b^2)$ C) $2a^2+2b^2$ D) $-4ab$
8. Subtract (a^2+a+1) from $a-a^2$.
 A) $2a^2+1$ B) $-2a^2-1$ C) $2\left(a^2 + \frac{1}{2}\right)$ D) $-2\left(a^2 + \frac{1}{2}\right)$
9. $(-2x) \times (-3yx) \times (-4y) = ...$
 A) $9x^2y^2$ B) $24x^2y^2$ C) $-24x^2y^2$ D) $-4(6x^2y^2)$
10. The degree of $4x^3y^2-3x^2y^4+2xy$ is...
 A) 5 B) 6 C) $\max(5,6)$ D) $\min(5,6)$

11. Which of the following are polynomials?

- A) x^2+x+1 B) $2x^3+x+2$ C) $\sqrt{x}+1$ D) $\frac{1}{x}+x+5$

12. $\frac{1-a+a^2}{1+a+a^2} = \dots$ if $a = 2$

- A) $\frac{-3}{7}$ B) $\frac{3}{7}$ C) $\frac{1-a}{1+a}$ D) $\frac{1+a}{3a+1}$

13. $\left(\frac{x^2}{x}\right) \div x^2 = \dots$

- A) x B) x^{-1} C) $1/x$ D) x^2

14. The factors of $y-y^2$ is...

- A) y B) y^2 C) $1-y$ D) $1+y$

15. Identify the trinomial

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

III) **Reasoning assertion 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.

Statement I : $6x^5 + 5x^4 + 3x^2 + \frac{4}{x} + 5$ is a polynomial of degree 5.

Statement II: Exponent of x is a negative integer, it is a multinomial.

- A) Both statement I and statement II are true.
 B) Both statement I and statement II are false.
 C) statement I s true and statment II is false.
 D) statement I s false and statment II is true.

IV) **Match the following :**

◆ 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.

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If the correct matches are A-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4×4 matrix should be as follows:

Column - I	Column - II
a) If $x = 2$, x is multiplied by 3 and is subtracted from the product of x raised to itself.	i) 6
b) If $x = 2$, x is multiplied by itself and twice it, then 3 is added and 8 is subtracted from the result.	ii) -2
c) If $x = 2$, x is multiplied by itself 5 times and 33 is subtracted from the product	iii) 3
d) If $x = 2$, x is multiplied by 5 and subtracted from 16	iv) -1
A) a-2,b-3,c-4,d-1	B) a-1,b-3,c-2,d-4
C) a-3,b-1,c-2,d-4	D) a-3,b-1,c-4,d-2

V) Comprehension answers 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** is correct. Choose the correct option.

If every term of an expression is a constant term such expression is called numerical expression. A combination of constants and variables connected by +, -, \times and \div is known as algebraic expression. Different types of algebraic expressions are monomial, binomial, trinomial etc.

i) which of the following is a numerical expression.

- A) $x+y$ B) $3-5+$ C) $3-5+\frac{1}{3} \times 6 \div 2$ D) $2x - z$

ii) Which of the following is an algebraic expression.

- A) $2x+3$ B) $3-5+\frac{1}{3} \times 6 \div 2$ C) $2x - z$ D) None

iii) Which of the following is a monomial.

- A) $2x+3$ B) $2+3$ C) $2xy$ D) None

iv) Which of the following is a trinomial.

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

VI) Solve the following :

1. Write the following in algebraic form using signs and symbols.

- i) x exceeds 16 by 7.
 ii) 5 less than the quotient of x by 5.
 iii) Divide the product of x and $3y$ by $2z$.

2. Write the following in exponential notation.
- i) $a \times a \times a \times c \times c \times c \times c \times d$ ii) $\frac{4}{9} \times \frac{4}{9} \times \frac{4}{9} \times \dots \times \frac{4}{9}$ (25 times)
- iii) $p \times p \times p \times \dots$ (x times)
3. Write the following in product form.
- i) $(x - y)^4$ ii) $\frac{3}{2} ab^2 c^3$ iii) $\left(p + \frac{1}{2}\right)^2$
4. Express the following numbers as a product of powers of prime factors.
- i) 729 ii) 512 iii) 441
5. Write the following having same power as single exponent.
- i) $\left(x - \frac{11}{2}\right)^2 \times \left(x - \frac{11}{2}\right)^4$ ii) $(p - q)^3 \times (p - q)^4 \times (p - q)$ iii) $(xy)^5 \div (x - y)^5$
6. Write each of the following as a single exponent using a^{m+n} and a^{m-n} formulae.
- i) $x^{p-q} \times x^{q-r} \times x^{r-p}$ ($x \neq 0$) ii) $\left(\frac{p}{q}\right)^3 \times \left(\frac{p}{q}\right)^4 \times \left(\frac{p}{q}\right)^{-7}$ (where $p, q \in \mathbb{R}$, $q \neq 0$)
- iii) $\frac{x^8 \cdot y^7}{x^3 \cdot y^2}$
7. What should be subtracted from the product of $(x - 3)(x^2 + 3x + 9)$ to get $(x^2 - 3x + 9)$.
8. Add the following algebraic expressions in Horizontal method.
- i) $a + 2b + 3c$ and $a - 3b - 4c$
- ii) $5x^2 + 7y - 6z^2$, $4y + 3x^2$, $9x^2 + 2z^2 - 9y$ and $2y - 2x^2$
9. Add the following algebraic expressions in vertical method.
- i) $2x^2y - 3x + 5$, $-9x^2y - 2x - 5$ ii) $4x^3 - x^2 + 6$; $2x^2 - 3x + 2$
10. Subtract the following algebraic expressions in horizontal method.
- i) $x^3 + 2x^2 + 6xy^2 - y^3$ from $y^3 - 3xy^2 - 4x^2y$
- ii) $-4x^2 + 6xy - x - y^2$ from $x^2 - 3xy + 7y^2 + 5$
11. Subtract the following algebraic expressions in vertical method.
- i) $(a^4 - 3a^3 - a^2 - 1)$, $(-2a^4 + 2a^3 + a^2 + 2)$
- ii) $2x + 5y - 6z + 2$, $2x - 3y + 4z$

12. Find the following products in their simplest form.
- i) $\left(\frac{-7}{5}x^2y\right)X\left(\frac{3}{2}xy^2\right)X\left(\frac{-6}{5}x^3y^2\right)$ ii) $(2m^2n - 4mn^2)X(6m + 7n)$
13. If $a = -2, b = -3, c = -4$ then find
- i) $\frac{(a+b+c)^3}{a^2+b^2+c^2}$ ii) $\frac{a^2+b^2-c^2}{ab+bc+ca}$
14. If $x = \frac{1}{2}, y = \frac{2}{3}$ and $z = \frac{3}{4}$ then find
- i) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z}$ ii) $4x^2 + 9y^2 - 16z^2$
15. Sri travelled $(x^2 - xy + y^2)$ hours by bus and $(x^2 + xy + y^2)$ hours by train. How much time did he travelled in all?
16. A bucket has $(m^4 + 8m^2n^2 + n^4)$ liters of milk out of which $(m^4 - 4m^2n^2 + n^4)$ liters of milk is used for making sweets. How much milk is now left in the bucket?
17. A student bought $(x^2 + x + 1)$ meters of yellow ribbon, $(x^2 - x + 1)$ meters of red ribbon and $(x^2 + x - 1)$ meters of blue ribbon for decorating a room. How many meters of ribbon did he buy?
18. Find the value of m given by $m = 2p - 1$. If ' p ' is a variable taking values 1,2,3,4 and 5. What kind of numbers you obtain form? If p is a variable taking values 6,7,8,9,10 would your description of values of m be still correct? Give reasons.
19. There are 3 sections A, B and C in a class. Total number of students in a class are $5x - 8y + 3z$. If the number of students in sections A and B are respectively $x + 2y - 3z$ and $2x - 3y + z$. Find the number of students in section C?
20. If $A = x^2 - x, B = \frac{x^3}{3} - \frac{x}{2}, C = x^3 + x^2 + x, D = x^3 + x$ then find the value of
- i) $(A - C) - (B - D)$ ii) $(A + C) - 2(B + D)$



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- I) 1. C 2. B 3. C 4. A 5. A 6. B 7. C 8. A 9. A 10. C
11. B 12. C 13. B 14. B 15. C

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|--------|----------|----------|----------|------------|----------|
| II) | 1. A, C | 2. A, D | 3. A, B | 4. A, B, D | 5. A, C |
| | 6. A, D | 7. B, C | 8. B, D | 9. C, D | 10. B, C |
| | 11. A, B | 12. B, D | 13. B, C | 14. A, C | 15. C |
| III) D | IV) A | V) i) B | ii) A | iii) C | iv) D |


LEARNER'S TASK
**BEGINNERS (Level - I)****1) MCQ's with single correct answer.**

- Twice of x added to y cube is
A) x^2+y^2 B) $x+y^3$ C) x^2-y^2 D) $2x+y^3$
- The numerical coefficient of $-2x^2y$ is
A) x^2y B) -1 C) 2 D) -2
- The coefficient of -p in $-2pq^2$ is
A) $-2q^2$ B) $2q$ C) $2q^2$ D) $-2p$
- The coefficient of -1 in xy^2 is
A) x B) y^2 C) $-xy^2$ D) xy^2
- The number of terms in Trinomial is
A) 1 B) 2 C) 3 D) 4
- Which of the following is binomial
A) $2x$ B) $3x^2+2x$ C) $3x+2y+4x$ D) $\frac{2}{x}+2$
- Which of the following are like terms
A) $2c, 4a$ B) $2x, 2x^2$ C) zx, xy D) $yz, -\frac{1}{2}yz$
- The degree of the polynomial $6x^5+6x^2+6$ is
A) 6 B) 3 C) 5 D) 2
- $3a^2 \cdot 2a^2 =$ ____
A) $6a^2$ B) $6a^3$ C) $5a^5$ D) $6a^4$
- In $x+2=9$ the L.H.S is
A) 9 B) $x+2$ C) x D) 7
- $x < 0$ means x is a number
A) +ve number B) -ve number C) Natural number D) Rational number

12. In algebra the variables in open-sentence are represented by
 A) a B) b C) x D) All
13. If $axb = bxa = 1$ then b is called of 'a'
 A) Additive Inverse B) Additive Identity
 C) Multiplicative Inverse D) Multiplicative Identity
14. Symbolic form of "x is multiplied by '2' and subtracted from 4" is
 A) $2x-4$ B) $4-2x$ C) $2x+4$ D) $x+4x$

◆ ■ ◆ **ACHIEVERS (Level - II)** ◆ ■ ◆

Solve the following :

1. separate the constants and the variables from each of the following.
 $6, 4y, -3x, \frac{5}{4}, \frac{4}{5}xy, az, 7p, 0, \frac{9x}{y}, \frac{3}{4x}, -\frac{xz}{3y}$
2. Group the like terms together.
 i) $4x, -3y, -x, \frac{2}{3}x, \frac{4}{5}y$ and y ii) $-ab^2, b^2a^2, 7b^2a, -3a^2b^2$ and $2ab^2$
3. State the number of terms in each of the following expressions.
 i) $2a - b$ ii) $3xa + \frac{a}{2}$ iii) $a \div b \times b + c$ iv) $2x + y + 8 \div y$
4. State whether true or false.
 i) xy and $-yx$ are like terms ii) x^2y and $-y^2x$ are like terms
 iii) a and $-a$ are like terms iv) $-yz$ and $2yz$ are unlike terms
5. For each expression given below, state whether it is a monomial or a binomial or a trinomial.
 i) xy ii) $xy+x$ iii) $2x \div y$ iv) $-a$ v) $ax^2 - x + 5$ vi) $-3bc+d$ vii) $1+x+y$
6. Write down the coefficient of x in the following monomials.
 i) x ii) $-x$ iii) $-3x$ iv) $-5ax$ v) $\frac{3}{2}xy$
7. Write the coefficients of :
 i) x in $-3xy^2$ ii) x in $-ax$ iii) y in $-y$ iv) y in $\frac{2}{a}y$

- 8.** Write the degree of each of the following polynomials:
- i) $x + x^2$ ii) $5x^2 - 7x + 2$ iii) $x^3 - x^8 + x^{10}$ iv) $8z^3 - 8y^3z^3 + y^2x^7$
 v) $4y^2 - 3x^3 + y^2x^7$ vi) $x^2 + 3x + 1$ vii) $x^2y^2 + 2x^2y + y^2 - 1$
 viii) $1 - 100x^{20}$ ix) $\frac{-1}{2}p^3q^2 + p^2 + q^2 - 1$ x) $p^2q^2 + 2pq^3 - p^2q + 7$
- 9.** Identify and write the like terms in each of the following.
- a) $\frac{-1}{2}x, 2x, -3x, y, z$ b) $-3x, y, 2z, x^2$ c) $3x, -4y, 2z, \frac{1}{9}x$
 d) $2x, 2y, 2z$ e) $-0.5x^2, 0.1y^2, 0.2x, \frac{-1}{7}x^2$ f) $-3x^2, 3a, 4xy, \frac{-1}{2}xy, 9a$
 g) $-9x, 4x^2, 3x^2, -1.5x, \frac{-11}{9}z$ h) $-4.5p, \frac{1}{2}p, -px, \frac{1}{9}x^2$
- 10.** Find the sum of the following monomials.
- a) $3a, 4y, 9a, 6z, -2y$ b) $4a, \frac{-1}{9}b, 7x, 8a$ c) $\frac{-1}{2}p, 3pq, 8p, 9q, -1$
 d) $8z, 3x^2, 4z^2, 9z, 1$ e) $3x^2, 4z, -3x^2, 0x^2$ f) $4x^8, 9x^2, \frac{-1}{2}x^8, \frac{x}{2}, 2$
- 11.** Find the sum of the binomials
- a) $3a - 5b, 6a + 2b$ b) $3x^2 + 4y^2, -9y^2 + 11z^2$
 c) $4p^2 + 5q^2, 6q^2 - 4p^2$ d) $8xy + 9x^2y^2, 11x^2y^2 - 2xy$
 e) $8pq - 11z, -7z + 11pq$ f) $9x - \frac{1}{2}y, 9x + \frac{1}{2}y$
- 12.** Write the algebraic expressions for the following statements.
- a) one fourth of product numbers p and q
 b) y is multiplied to 10 and then x is added to the product
 c) three times of x is added to 9 times of y
 d) square of p is added to cube of q
 e) double of x is subtracted from thrice of y
 d) 7 times of square of x is subtracted from cube of y
 e) -3 is multiplied to p and then added to half of q
 g) six times of square of x is multiplied to four times of square of y
 h) 4 times of x times of y
 i) three times of p multiplied to double of q
- 13.** Find the degree of the following algebraic expressions
- a) $x^2 + 3x + 1$ b) $xy + y^2 + x^3 + 1$ c) $x^2y^2 + 2x^2y + y^2 - 1$

d) $\frac{-1}{2}p^3q^2 + p^2 + q^2 - 1$ e) $p^2q^2 + 2pq^3 - p^2q + 7$ f) $\frac{-1}{2}x^3 - 9x^2y + \frac{1}{9}xy^2 + 11$

14. Which of the following are polynomials, give reasons.

a) $2x - \frac{1}{4}y^2 + 1$ b) $2x^3 - \frac{4}{x^2} + 9$ c) $x^{-2} + xy + y^0$

d) $p^2q^2 + p^0q^3 - 1$ e) $-\frac{1}{2}l^2m^2 - l^2 - m^2$ f) $a^{\frac{1}{4}} - b^3 - \frac{1}{2}$

15. Multiply the following:

i) 6 and $\frac{3}{2}x$ ii) $2\frac{1}{3}y$ and 9 iii) $5ab$ and $1\frac{3}{5}$

iv) $\frac{3}{8}xy$ and $3\frac{3}{7}$ v) $-\frac{2}{5}x$ and $\frac{5}{4}y$ vi) 0 and $-\frac{5}{6}xyz$

16. Divide: i) $2x^5 \div x^2$ ii) $6a^8 \div 3a^3$ iii) $20xy \div -5xy$ iv) $-24a^2b^2c^2 \div 6ab$

◆ ■ ◆ **EXPLORERS (Level - III)** ◆ ■ ◆

1) **MCQ's with multi correct answer type :**

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. The value of symbolic form of "x is added to it's reciprocal and the result is multiplied by 2" When x=2

A) $\frac{10}{2}$ B) 4 C) 5 D) 1

2. Present age of Ravi is x, 5-years after his age

A) 5-x B) 5+x C) x+5 D) None

3. A quadratic equation is one in which the highest power to which the variable is raised to

A) 2 B) 3 C) 8/4 D) 5

4. $2x-3=7$ is possible at x=?

A) 4 B) 5 C) $\frac{10}{2}$ D) -4

5. Which method could be used to solve the number sentence $4x=16$?

A) Add 4 to 4x and subtract 4 from 16
B) Subtract 4 from 4x and subtract 16 from 16

6. C) Divide 4x by 4 and divide 16 by 4 D) None
 If $\frac{x}{3} = -2$ then x=
 A) 3(2) B) 3(-2) C) -5 D) -6
7. $\frac{x}{2} + \frac{1}{3} = 5$ then x=
 A) $\frac{7}{3}$ B) $\frac{14}{3} \times 2$ C) $\frac{28}{3}$ D) $\frac{12}{5}$
8. Which of the following is in-equality statement
 A) $x+3=5$ B) $x+2=x+5$ C) $7+3=10$ D) $x+6<0$

II) Reasoning assertion 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.

Statement I : $(x^2 y^3)^n = x^{2n} . y^{3n}$

Statement II : $(ab)^m = a^m . b^m$ and $(a^m)^n = a^{mn}$

- A) Both statement I and statement II are true.
 B) Both statement I and statement II are false.
 C) statement I s true and statment II is false.
 D) statement I s false and statment II is true.

III) Match the following :

◆ 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-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4 × 4 matrix should be as follows:

Column - I	Column - II
a) Multinomial	i) x^2+x+1
b) Degree of $x+1$	ii) x^3+x^2+x+1
c) Trinomial	iii) 1
d) Bionomial	iv) $x+1$
A) a-2,b-3,c-4,d-1	B) a-1,b-3,c-2,d-4
C) a-2,b-3,c-1,d-4	D)a-3,b-1,c-4,d-2

IV) Comprehension answer 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** is correct. Choose the correct option.

1. An expression containing one or more monomials is called a polynomial. An expression containing one or more terms a multinomial. The highest of the degrees of all the terms of an expression is called degree of the expression.

i) Which of the following is a polynomial?

- A) $2 + 3$ B) $\frac{x}{3}$ C) $x^3 + 7x^2 + x + 1$ D) None

ii) Which of the following is a multinomial?

- A) $x^2 + x + 1$ B) $\frac{x^3}{3} + x^2 + 1$ C) x D) None

iii) The degree of $2x + 3$ is...

- A) 1 B) 2 C) 3 D) 5

iv) The degree of $2x^2y^2 + 5xy^5 + 7$ is...

- A) 4 B) 5 C) 6 D) 9

2. In a term of an algebraic expression, any of the factors with the sign of the term is called the co-efficient of the product of the other factors in that term.

i) The factors of $5xy$ are...

- A) x B) y C) 5 D) all

ii) The literal co-efficient of $15x$ is...

- A) 15 B) x C) $15x$ D) None

iii) Which of the following are similar terms?

- A) $xy, 2xy$ B) xy, zp C) $2x, 3y$ D) None

iv) The numerical coefficient of $-3xy$ is...

- A) 3 B) - 3 C) x D) y

◆ ■ ■ ◆ **RESEARCHERS (Level - IV)** ◆ ■ ■ ◆

1. If a, b, c, d are reals such that $a - 2005 = b + 2006 = c - 2007 = d + 2008$ then the greatest among a, b, c, d is.... [AMTI - 2007]

- A) a B) b C) c D) d

2. If $A + B = C, B + C = D; D + A = E$ then $A + B + C$ is [AMTI - 2009]

- A) E B) $D + E$ C) $E - D$ D) $B - D + C$

MATHEMATICS**ALGEBRA**

3. Additive inverse of $(9-3)x^2 + (2 - 4 + 6)xy + (5 - 1)y^2$ is.. [Ramanujan - 14]
 A) $-6x^2 + 4xy + 4y^2$ B) $-6x^2 - 4xy - 4y^2$
 C) $-6x^2 + 4xy - 4y^2$ D) $-6x^2 - 4xy + 4y^2$
4. If $x + \frac{1}{x} = 2$ then $x^{2014} + \frac{1}{x^{2014}} = \dots$ [Ramanujan - 14]
 A) 2 B) 1 C) 0 D) None
5. If $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = \frac{1}{x+y+z}$ then $(x+y)(y+z)(z+x) = \dots$ [Ramanujan - 14]
 A) 0 B) 1 C) -1 D) 1 or -1
6. Find the integer values of $a^2+b^2-8c = 6$? [Ramanujan - 14]
 A) (5,8,4) B) (2,9,10) C) (7,6,4) D) None
7. If $a^x \times a^y \times a^z = \sqrt{a^3}$ then $x+y+z = \dots$ [Ramanujan - 14]
 A) $\frac{2}{3}$ B) $\frac{1}{3}$ C) $\frac{3}{2}$ D) $\frac{3}{4}$

KEY**Φ Φ LEARNER'S TASK**

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