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ALGEBRA

1. General form of linear equation in two variables x and y is
   $ax + b\,y + c = 0$ where at-least one of $a,\ b$ is non-zero and $a,\ b,\ c$ are real numbers.
2. A linear equation in two variables represent a straight line in $x\ \ y$ plane.
3. General form of linear equation in three variable

$$a_1x + b_1\,y + c_1z + d_1 = 0$$
$$a_2x + b_2\,y + c_2z + d_2 = 0$$
$$a_3x + b_3\,y + c_3z + d_3 = 0$$

4. Solving of linear equations in three variables

   Step : 1: By taking any two equations from the given three, first multiply by some suitable non-zero constant to make the co-efficient of the one variable (either x or y or z) numerically equal.

   Step : 2: Eliminate one of the variables whose co-efficients are numerically equal from the equations.

   Step : 3: Eliminate the same variable from another pair

   Step :4 : Now we have two equations in two variables.

   Step :5 : Solve them using any method (Eliminating method, substitution method, cross multiplication method)

   Step :6 : The remaining variable is then found by substituting in any one of the given equations.
5. A system of linear equations in three variables will be according to the following cases:

   (i) Unique solution

   (ii) Infinitely many solution

   (iii) No solution
6. If you obtain a false equation such as $0 = 1$ in any of the steps then the system has no solution.
7. If you do not obtain a false solution but obtain an identity such as $0 = 0$

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then the system has infinitely many solutions.

8. To find G C D of two given polynomials $f(x)$ and $g(x)$

   Step : 1 : First divide $f(x)$ by $g(x)$ to obtain $f(x) = g(x)q(x) + r(x)$

   $$\deg |r(x)| < \deg |g(x)|$$

   Step : 2: If the remainder $r(x)$ is non-zero divide $g(x)$ by $r(x)$ to obtain

   $$g(x) = r(x)q(x) + r_1(x)$$
   $$\deg |r_1(x)| < \deg |r(x)|$$

   If the remainder $r_1(x)$ is zero, the $r(x)$ is the required G C D.

   Step :3 : If $r_1(x)$ is non-zero then continue the process until we get zero as remainder.

   The divisor will be the G C D.

9. $L\ C\ M$

   The L C M of two or more algebraic expressions is the expression of lowest degree (or power) such that the expressions exactly divide it

10. $L\ C\ M \times G\ C\ D =$ the product of two given numbers.

11. Rational Expressions

    An expression is called a rational expression if it is of the form $\frac{p(x)}{q(x)}$ where $p(x)$ and $q(x)$ are polynomials and $q(x) \neq 0$

12. A rational expression is the ration of two polynomials.

13. Excluded Value

    A value that makes a rational expression (in its lowest form) undefined is called an Excluded Value

14. To find excluded value

    The rational expression in its lowest form say $\frac{p(x)}{q(x)}$ Consider the denominator $q(x) = 0$

15. The roots of the quadratic Equation $ax^2 + b\,x + c = 0$ $(a \neq 0)$ are given

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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16. If α and β are the roots of the quadratic Equation $ax^2 + b\,x + c = 0$

$$\alpha + \beta = \frac{-\,Co\ efficient\ of\ x}{Co\ efficient\ of\ x^2} = -\frac{b}{a}$$

$$\alpha\,\beta = \frac{Constant\ term}{Co\ efficient\ of\ x^2} = \frac{c}{a}$$

17. General form of the quadratic Equation when the roots are given

$$x^2 - (sum\ of\ the\ roots)x + (product\ of\ the\ roots\ ) = 0$$

18. Nature of Roots of a quadratic Equation

Values of Discriminant $\Delta = b^2 - 4ac$	Nature of roots
$\Delta > 0$	Real and unequal
$\Delta = 0$	Real and equal
$\Delta > 0$	No Real root

19. Matrix

A matrix is a rectangular array of elements. The horizontal arrangements are called rows and vertical arrangements are called columns.

20. Order of Matrix

If a matrix A has m number of rows and n number of columns, then the order of matrix A is (Number of rows) X (Number of columns)

i.e. $m \times n$

21. General form of a matrix A with m rows and n columns

$$A = \begin{pmatrix} a_{11} & a_{12} \ldots a_{1j} \ldots. & a_{1n} \\ a_{21} & a_{22} \ldots a_{2j} \ldots & a_{2n} \\ a_{m1} & a_{m2} \ldots. \quad a_{mj} & \ldots..a_{mn} \end{pmatrix}$$

22. Row Matrix (row vector)

A matrix is said to be a row matrix if it has only one row and any number of columns.

In general $A = (a_{11} \quad a_{12} \ldots.. \quad a_{1n})$ is a row matrix of order $1 \times n$

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23. Column Matrix

A matrix is said to be a column matrix if it has only one column and any number of rows.

In general $A = \begin{pmatrix} a_{11} \\ a_{21} \\ \vdots \\ a_{m1} \end{pmatrix}$ is a column matrix of order $m \times 1$

24. Square Matrix

A matrix in which the number of rows is equal to the number of columns is called a square matrix

In general $\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$ is a square matrix of order 2×2

25. In a square matrix, the elements of the form $a_{11}, a_{22}, a_{33} \ldots$ i.e. a_{ij} are called leading diagonal elements.

Eg: $\begin{pmatrix} 1 & 3 \\ 4 & 5 \end{pmatrix}$ 1 and 5 are leading elements.

26. Diagonal Matrix

A square matrix, all of whose elements, except those in the leading diagonal are zero is called a diagonal matrix

Eg: $\begin{pmatrix} 7 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & 5 \end{pmatrix}$

27. Scalar Matrix

A diagonal matrix in which all the leading diagonal elements are equal is called scalar matrix

Eg: $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} k & 0 & 0 \\ 0 & k & 0 \\ 0 & 0 & k \end{pmatrix}$

28. Identity (or) Unit matrix

A square matrix in which elements in the leading diagonal are all “1” and rest are all zero is called an identity matrix (or) Unit matrix

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Eg: $I_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} I_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

29. Zero matrix (or) Null matrix

A matrix is said to the a zero matrix or null matrix if all its elements are zero

Eg: $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}_{2\times 2} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}_{2\times 3}$

30. Transpose of a matrix

The matrix which is obtained by interchanging the elements in rows and columns of a given matrix A is called transpose of A

It is denoted by A^T

Eg: $A = \begin{pmatrix} 5 & 3 \\ 2 & 8 \\ -4 & 1 \end{pmatrix}_{3\times 2}$ $A^T = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}_{2\times 3}$

31. If order of A is $m \times n$ then order of A^T is $n \times m$

32. $(A^T)^T = A$

33. Triangular Matrix

a) Lower Triangular Matrix

A square matrix in which all the entries above the leading diagonal are zero is called a lower triangular matrix

Eg: $\begin{pmatrix} 4 & 0 & 0 \\ 5 & -7 & 0 \\ 9 & 2 & 3 \end{pmatrix}$

b) Upper Triangular Matrix

A square matrix in which all the entries below the leading diagonal are zero is called a upper triangular matrix

Eg: $\begin{pmatrix} 3 & -5 & 4 \\ 0 & 2 & 8 \\ 0 & 0 & 9 \end{pmatrix}$

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34. Equal Matrices

Two matrices A and B are said to be equal if and only if they have the same order and each element of matrix A is equal to the corresponding element of matrix B

i.e. $a_{i\ j} = b_{i\ j},\ \ \forall\, i,\ j$

35. The negative of a matrix

The negative of a matrix $A_{m\times n}$ denoted by $-A_{m\times n}$ is the matrix formed by replacing each element in the matrix $A_{m\times n}$ with its additive invewrse.

36. Addition and Subtraction of Matrices

Two matrices can be added or subtracted if they have the same order. To add or subtract two matrices simply add or subtract the corresponding elements.

37. Multiplication of Matrix by a Scalar

We can multiply the elements of the given matrix A by a non-zero number k to obtain a new matrix kA whose elements are multiplied by k

The matrix kA is called Scalar multiplication of A

i.e. $A = \left(a_{i\ j}\right)_{m\times n} \forall\ i = 1,2,3,\dots m\ \ and\ j = 1,2,3,\dots n$

$$kA = \left(k\ a_{i\ j}\right)_{m\times n}$$

38. Commutative property of matrix addition $A + B = B + A$

39. Associative property of matrix addition $A + (B + C) = (A + B) + C$

40. Associative property of scalar multiplication $(pq)A = p(qA)$

41. Scalar Identity property where I is the unit matrix $I\,A = A$

42. Distributive property of scalar and two matrices

$$p(A + B) = pA + pB$$

43. Distributive property of two scalars with a matrix

$$(p + q)A = pA + qA$$

44. Additive Identity $A + 0 = 0 + A = A$

‘0” is the additive identity

45. Additive Inverse $A + (-A) = (-A) + A = 0$

$(-A)$ is the additive inverse of A

46. Matrix multiplication is not commutative $AB \neq BA$

47. Matrix multiplication is distributive over matrix addition

(i) $A(B+C) = AB + AC$

(ii) $(A+B)C = AC + BC$

48. Matrix multiplication is always associative $(AB)C = A(BC)$

49. Multiplication of a matrix by a unit matrix $AI = I\,A = A$

50. If x and y are two real number such that $xy = 0$ then either $x = 0$ or $y = 0$ But this condition may not be true with respect to two matrices .

51. $AB = 0$ does not necessarily imply that $A = 0$ or $B = 0$ or both

$$A, B = 0$$

52. If $A and\ B$ are any two non-zero matrices, then

$$(A+B)^2 \neq A^2 + 2\,A\,B + B^2$$

53. If $AB = BA$ then $(A+B)^2 = A^2 + 2\,A\,B + B^2$