CHAPTER-4

DETERMINANTS

01 MARK TYPE QUESTIONS

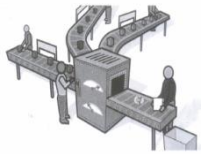
Q. NO	QUESTION	MARK
1.	If $\begin{vmatrix} 3x & 3 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 2 & 4 \\ -3 & 9 \end{vmatrix}$, then x=? a. -2 b.3√2 c.2√2 d.2	1
2.	At a Party, there were some sandwiches of the same size, Alia took 1 slice of a sandwich. Now to find the area of the sandwich which is taken by Alia? (Using the concept of determinants)  a. 5 c.m^2 b. 1 c.m^2 C. 2 c.m^2 4. 4 c.m^2	1
3.	For what value of x, the following matrix is singular? $\begin{bmatrix} 3-x & 2 \\ x+1 & 3 \end{bmatrix}$ a. 4/2 b. 7/2 c. 7/5 d. 9/5	1
4.	A matrix A of order 3 x 3 has determinant 8. What is the value of |4A| a. 613 b. 421 c. 512 d. 291	1
5.	A Boy Monty brought 2 Bags, 1 Pen and 3 pencils and Paid 25 rupees, In same shop Nihar bought 3 bags, 2 pens & 1 Pencil and Paid 40 rupees and Pabitra brought 1 Bag, 3 pens & 2 Pencil and paid 30 rupees. Now construct the matrix formation.	1

	  a $\begin{bmatrix}2 & 1 & 3\\3 & 1 & 1\\1 & 2 & 3\end{bmatrix}$ b. $\begin{bmatrix}2 & 1 & 3\\2 & 3 & 1\\3 & 1 & 2\end{bmatrix}$ c. $\begin{bmatrix}2 & 1 & 3\\3 & 2 & 1\\1 & 3 & 2\end{bmatrix}$ d. $\begin{bmatrix}2 & 3 & 1\\3 & 1 & 2\\2 & 1 & 3\end{bmatrix}$	
6.	Write the value of $\begin{vmatrix} cos40 & sin50 \\ sin40 & cos50 \end{vmatrix}$ a.0 b. 1 C. 2 d. None of the above	1
7.	Find values of K if area of triangle is 9 sq. units and vertices are (4, k), (2,0), (3,1) a. K= 16 b. K = 8 c. k= 7 d. k = -16	1
8.	Assertion & Reason based questions (i) Assertion: A square matrix is called determinant. R= Reason: A matrix has order 3 X 3, which is known as square matrix a. Both A and R are individually true and R is the correct explanation of A b. Both A and R are individually true & R is not the correct explanation of A c. A is true but R is false d. A is false but R is true	1
9.	Rita went to market and bought 2 Kurtis and 1 jean, and Preeti also went to market and bought 1 Kurti and 3 jeans Solve the above question using determinant method	1

	 (I) The order of the above matrix. a. 3 X 3 b. 2 X 2 c. 2 X 1 d. 1 X 2	
10.	Find the determinant of above matrix a. |A|= 3 b. |A| = 4 c. |A| = 5 d. |A|= 7	1
11.	Let A be a square matrix of order 3×3 such that $\|A\| = 2$, then the value of $\|4A\|$? (a) 128 (b) 64 (c) 8 (d) 16	1
12.	The co-factor of a_{32} in the determinant $\begin{vmatrix} 2 & 0 & 1 \\ 5 & 3 & 8 \\ 3 & 2 & 1 \end{vmatrix}$ is ? (a) 11 (b) -11 (c) 12 (d) 10	1
13.	If $\begin{bmatrix} 3p & -6 \\ 1 & 2 \end{bmatrix}$ is a singular matrix, then the value of 'p' is (a) 2 (b) 3 (c) 0 (d) 1	1
14.	If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$, then the value of $\|adj.A\|$ is ? (a) 2^4 (b) 2^6 (c) 2^3 (d) 2^{12}.	1
15.	If $A = \begin{bmatrix} 1 & 2 \\ 3 & 8 \end{bmatrix}$, then $\|A^T\| = ?$ (a) 2 (b) -2 (c) $\frac{1}{2}$ (d) $\frac{-1}{2}$	1
16.	If A is a skew symmetric matrix of order 3, then the value of $\|A\|$ is ? (a) 1 (b) 3 (c) 2 (d) 0	1

17.	The system of equations $2x+y-3z=5;\ 3x-2y+2z=5\ ;\ 5x-3y-z=16$ is ? (a) consistent (b) consistent with a unique solution (c) consistent with infinitely many solutions (d) has its solution lying along x-axis in 3D space	1
18.	Let matrix B be the adjoint of a square matrix A, I be the identity matrix of same order as A. If k $(\neq 0)$ is the determinant of the matrix A, then what is AB equal to? (a) I (b) kI (c) k^2I (d) $(1/k)I$	1
19.	If $(p,q),(r,s)\ and\ (t,u)$ are the vertices of ΔABC and Δ denotes the area of ΔABC then $\begin{vmatrix} p & r & t \\ q & s & u \\ 1 & 1 & 1 \end{vmatrix}^2$ is equal to ? (a) $2\Delta^2$ (b) $4\Delta^2$ (c) 2Δ (d) 4Δ	1
20.	If A is a square matrix of order 3 and det A =5 then what is the determinant of $2A^{-1}$? (a) $\frac{1}{10}$ (b) $\frac{2}{5}$ (c) $\frac{8}{5}$ (d) $\frac{1}{40}$	1
21.	A is a square matrix of order 3 and $\lvert A\rvert$ = 6 ,what be the value of $\lvert 3\ adj\ A\rvert$. (a) 972 (b) 216 (c) 36 (d) 27	1
22.	If $\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$,then the possible value(s) of x is /are (a) 3 (b) $\sqrt{3}$ (c) - $\sqrt{3}$ (d) $\sqrt{3}$ &-$\sqrt{3}$	1
23.	If A and B are two non - singular matrices of same order ,then (a) AB is non singular (b) AB is singular (c) $(AB)^{-1} = A^{-1}B^{-1}$ (d) AB is not invertible	1
24.	If A is a square matrix of order 3 such that A (adj A) = $\begin{bmatrix} -2 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{bmatrix}$,then $\lvert\ adj\ A\rvert$ is equal to (a) -2 (b) -4 (c) 4 (d) -8	1
25.	The matrix $\begin{bmatrix} -2 & -1 & 3 \\ k & 0 & 7 \\ -1 & 1 & 4 \end{bmatrix}$ is not invertible for (a) k= -1 (b) k = 1 (c) k = 0 (d) k ∈ R –{1}	1
26.	Three points P(2x,x+3) ,Q(0,x) and R(x+3,x+6) are collinear ,then x is (a) 0 (b) 2 (c) 3 (d) 1	1
27.	If x = -4 is a root of $\begin{bmatrix} x & 2 & 3 \\ 1 & x & 1 \\ 3 & 2 & x \end{bmatrix}$ = 0 then the sum of other two root is (a) 4 (b) -3 (c) 2 (d) 5	1
28.	If A is a non singular square matrix of order 3 such that $\lvert adjA\rvert$ = 64 then the value of $\lvert A\rvert$ is	1

	(a) 8 (b) –8 (c) 8, -8 (d) 4	
29.	If A and B are square matrices of the order 3 ,such that $\|A\| = 2$ and AB = 2I , Then the value of $\|B\|$. (a) 2 (b) 1 (c) 4 (d) 8	1
30.	If $A = (a_{ij})$ is a square matrix of order 3 and A_{ij} is the cofactor of a_{ij} , then $\|A\|$ is given by (A) $a_{11}A_{31} + a_{12}A_{32} + a_{13}A_{33}$ (B) $a_{11}A_{11} + a_{12}A_{21} + a_{13}A_{31}$ (C) $a_{21}A_{11} + a_{22}A_{12} + a_{23}A_{13}$ (D) $a_{11}A_{11} + a_{21}A_{21} + a_{31}A_{31}$	1
31.	If the points (2, -3), (k, -1) and (0, 4) are collinear, then find the value of 4k. (a) 4 (b) 7/140 (c) 47 (d) 40/7	1
32.	If A is a singular matrix, then A(adjA) is (a) null matrix (b) scalar matrix (c). identity matrix (d) none of these	1
33.	If A and B are invertible matrices, then which of the following is not correct? (a) adj A = $\|A\|.A^{-1}$ (b) det (A) $^{-1}$ = [det (A)]$^{-1}$ (c) $(AB)^{-1} = B^{-1}A^{-1}$ (d) $(A + B)^{-1} = B^{-1} + A^{-1}$	1
34.	If A is a skew- symmetric matrix of order 3 and $\|A\| = x, then\ (2023)^x$ is equal to (a) 2023 (b) $\frac{1}{2023}$ (c) $(2023)^x$ (d) 1	1
35.	Which of the following is not true (A). If A= $[a_{ij}]$ is a diagonal matrix of order n≥2,then $\|A\| = a_{11}.\ a_{22} \ldots . a_{nn}$ (B).If A and B are square matrix of same order, then $\|AB\| = \|A\|\|B\|$ (C).If A is a square matrix of order n then $\|kA\| = k^n\|A\|$ (D). If A and B are square matrix of same order, then $\|A + B\| = \|A\| + \|B\|$	1
36.	A system of linear equations AX = B is said to be inconsistent, if the system of equations has (a) Trivial Solution (b) Infinite Solutions (c) No Solution (d) Unique Solutions	1
37.	If $A = (a_{ij})$ be a square matrix of order 3 and $\|A\| = -7$, then the value of $a_{11}A_{31} + a_{12}A_{32} + a_{13}A_{33}$, where A_{ij} is the cofactor of a_{ij}, is 7 (b) -7 (c) 0 (d) 1	1
38.	If $A = \begin{bmatrix} x & 4 \\ 3 & x \end{bmatrix}$ and $\|A^3\| = 64$, then the value of x is ± 2 (b) ± 4 (c) ± 8 (d) ± 1	1
39.	If A is an invertible matrix, then which of the following is not true (a) $(A^{-1})^2 = (A^2)^{-1}$ (b) $(A^t)^{-1} = (A^{-1})^t$ (c) $\|A\| \neq 0$ (d) $\|A^{-1}\| = \|A\|^{-1}$	1
40.	A= $\begin{bmatrix} \mathbf{1} & \mathbf{-1} & \mathbf{2} \\ \mathbf{0} & \mathbf{2} & \mathbf{-3} \\ \mathbf{3} & \mathbf{-2} & \mathbf{4} \end{bmatrix}$,find the co-factors of elements of A.	1
41.	If $\|A\| = \begin{vmatrix} 2 & 5 \\ 3 & -2 \end{vmatrix}$ then find $\|A^{-1}\|$.	1
42.	If A and B are square matrices of order 3 such that $\|A\| = -1$, $\|B\| = 3$, then find the value of $\|2AB\|$.	1
43.	Let A be a square matrix of order 3 × 3 and k is a scalar,then find $\|kA\|$.	1
44.	Let A be a non-angular square matrix of order 3 × 3,then find $\|A\ .\ adj\ A\|$.	1

45.	If A is a skew-symmetric matrix of order 3,then find the value of |A|.	1
46.	Let A = $[a_{ij}]$ be a square matrix of order 3×3 . Find the value of $a_{11}A_{21} + a_{12}A_{22} + a_{13}A_{23}$ where A_{ij} is the cofactor of element a_{ij} .	1
47.	If A is a square matrix of order 2 such that A^2=2A, then find the value of |A|.	1
48.	A company produces three products every day. Their production on a certain day is 45 tons. It is found that the production of the third product exceeds the production of the first product by 8 tons while the total production of the first and third product is twice the production of the second product.  Using the concepts of matrices and determinants, answer the following question. If x, y and z respectively denote the quantity (in tons) of first, second and third product produced, then which of the following is true? (a) x + y + z = 45 (b) x + 8 = z (c) -2y+z=0 (d) all of these	1
49.	How many solutions does the system of equations x + 2y=11 , -2x-4y=22 have?	1
50.	Which of the following is not correct? (a) $\|A\| = \|A^T\|$, where A = $[a_{ij}]_{3\times3}$ (b) $\|kA\| = k^3\|A\|$, where A = $[a_{ij}]_{3\times3}$ (c) If A is a skew-symmetric matrix of odd order, then $\|A\| = 0$. (d) $\begin{vmatrix} p+q & r+s \\ t+u & v+w \end{vmatrix} = \begin{vmatrix} p & r \\ t & v \end{vmatrix} + \begin{vmatrix} q & s \\ u & w \end{vmatrix}$	1
51.	If A is a invertible matrix, then which of the following is not true (a) $(A^2)^{-1} = A^{-2}$ (b) $\|A^{-1}\| = \|A\|^{-1}$ (c) $(A^T)^{-1} = (A^{-1})^T$ (d) $\|A\| \neq 0$	1
52.	The system of linear equations $x + y + z = 2$ $2x + y - z = 3$ $3x + 2y + kz = 4$ has a unique solution if (a) $k \neq 0$ (b) (b) $-1 < k < 1$ (c) $-2 < k < 2$ $k = 0$	1
53.	For any 2× 2 matrix, if A (adj A) = $\begin{bmatrix} 10 & 0 \\ 10 & 10 \end{bmatrix}$, then $\|A\| =$ (a) 20 (b) 100 (c) 10 (d) 0	1
54.	Which of the following is not correct in a given determinant of A, where A = $[a_{ij}]_{3\times3}$ (a) Order of minor is less than order of the det (A) (b) Minor of an element can never be equal to cofactor of the same element (c) Value of a determinant is obtained by multiplying elements of a row or column by corresponding cofactors	1

	(d) Order of minors and cofactors of elements of A is same	
55.	The existence of the unique solution of the system of equations: $x + y + z = \beta$ $5x - y + \mu z = 10$ $2x + 3y - z = 6$ depends on μ only (b) β only (c) μ and β both (d)neither μ nor β	1
56.	If $\begin{bmatrix} 1 & -\tan\theta \\ tan\,\theta & 1 \end{bmatrix}\begin{bmatrix} 1 & tan\,\theta \\ -\tan\theta & 1 \end{bmatrix}^{-1} = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$, then (a) $a = 1, b = 1$ (b) $a = \cos 2\theta, b = \sin 2\theta$ (c) $b = \cos 2\theta$, a= $\sin 2\theta$ None of these	1
57.	Let A = $\begin{bmatrix} 1 & \sin\theta & 1 \\ -\sin\theta & 1 & \sin\theta \\ -1 & -\sin\theta & 1 \end{bmatrix}$, where $0 \leq \theta \leq 2\pi$. Then (a) Det(A) = 0 (b) (b) Det(A) $\in (2, \infty)$ (c) (c) Det(A) $\in$ (2,4) (d) Det(A) $\in$ [2, 4]	1
58.	If A and B are invertible matrices, which of the following statement is not correct (a) Adj A = $\lvert A\rvert A^{-1}$ (b) Det (A^{-1}) = $(DetA)^{-1}$ (c) $(A + B)^{-1} = A^{-1} + B^{-1}$ $(AB)^{-1} = B^{-1}A^{-1}$	1
59.	If A is an invertible matrix of order 3, then which of the following is not true (a) $\lvert adjA\rvert = \lvert A\rvert^2$ (b) $(A^{-1})^{-1} = A$ (c) If BA = CA, then B $\neq C$, where B and C are square matrices of order 3. $(AB)^{-1} = B^{-1}A^{-1}$, where B= $[b_{ij}]_{3\times3}$ and $\lvert B\rvert \neq 0$.	1
60.	1. If A is a Singular Matrix then A(adjA) is (a) Scalar matrix (b) Null matrix (c) Identity matrix (d) None of these	1
61.	If P is a square matrix of order 3,such that P(adjoint P) =10I , then the determinant of adjoint P is equal to (a) 0 (b)1 (c) 10 (d) None of these	1
62.	If A is a square matrix of order 3 and det A=7 what is the value of det (adjoint A) ? (a) 39 (b) 49 (c) 30 (d) None of these	1
63.	If A is a non- singular matrix of order 3 and determinant value of A is 3 then determinant value of (2A) is (a) 24 (b) 12 (c) 40 (d) None of these	1
64.	The sum of the products of elements of any row with the co-factors of corresponding elements is equal (a) Adjoint of the matrix (b) 0 (c)1 (d) Value of the determinant	1

65.	The area of a triangle with vertices (-3,2), (5,4), (k,-6) is 42 sq units . What is the value of k? (a) 6 (b) 5 (c) 7 (d) None of these	1
66.	If A is a square matrix such that square of A = I then inverse of A is (a) A (b) 2A (c) A/2 (d) None of these	1
67.	If $\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$ then x is equal to: a)6 b) ±6 c)-1 d)-6	1
68.	If A(3,4), B(-7, 2) and C(x, y) are collinear, then: a) x+5y+17=0 b) x+5y+13=0 c)x-5y+17=0 d) none of these	1
69.	Which of the following is a correct statement? a) Determinant is a square matrix b) Determinant is a number associated to a matrix c) Determinant is a number associated with the order of the matrix d) Determinant is a number associated to a square matrix	1

ANSWERS:

Q. NO	ANSWER	MARKS
1.	b	1
2.	b	1
3.	c	1
4.	c	1
5.	c	1
6.	a	1
7.	d	1
8.	a	1
9.	b	1
10.	c	1
11.	(a)	1
12.	(b)	1
13.	(d)	1
14.	(b)	1
15.	(a)	1
16.	(d)	1
17.	(b)	1
18.	(b)	1
19.	(b)	1
20.	(c)	1
21.	(a)	1
22.	(a)	1
23.	(a)	1
24.	(c)	1
25.	(b)	1
26.	(d)	1
27.	(a)	1
28.	(c)	1
29.	(c)	1
30.	d	1
31.	d	1
32.	a	1
33.	d	1
34.	d	1
35.	D	1
36.	c	1
37.	c	1
38.	b	1
39.	a	1
40.	The co-factors of elements of A are 2, 9, -6, 0, -2, -1, -1, 3, 2.	1
41.	$\|A\| = \begin{vmatrix} 2 & 5 \\ 3 & -2 \end{vmatrix} = -19$	½

	$\|A^{-1}\|=1/\|A\|=-1/19$	½
42.	$\|2AB\|=8\|A\|\|B\| =8x(-1)x3=-24$.	½ +½
43.	$\|kA\|=k^3 \|A\|$	1
44.	$\|A$. adj $A\|=\|A\|^3 \|I\|=\|A\|^3$	1
45.	$A'=-A \Rightarrow \|A'\|= \|-A\|=(-1)^3 \|A\|=- \|A\|$ But $\|A'\|= \|A\|$ $\Rightarrow \|A\|=- \|A\| \Rightarrow \|A\|=0$	½ ½
46.	$a_{11} A_{21}+ a_{12}A_{22}+ a_{13} A_{23}$ =0	1
47.	$\|A^2\|=\|2A\| \Rightarrow \|A\|\|A\|=2^2 \|A\| \Rightarrow$ $\|A\| =0$ Or $\|A\| =4$.	½ ½
48.	(a) $x + y + z = 45$	
49.	$x + 2y=11$, $-2x-4y=22$ $\begin{pmatrix} 1 & 2 \\ -2 & -4 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix}=\begin{pmatrix} 11 \\ 22 \end{pmatrix}$ i e AX=B Det A=0, but det $\begin{pmatrix} 11 & 22 \\ -2 & -4 \end{pmatrix}$ and det $\begin{pmatrix} 1 & 2 \\ 11 & 22 \end{pmatrix}$ both zero So $x + 2y=11$, $-2x-4y=22$ have infinite solutions.	
50.	(d)	1
51.	(a)	1
52.	(a)	1
53.	(c)	1
54.	(b)	1
55.	(a)	1
56.	(b)	1
57.	(d)	1
58.	(c)	1
59.	(c)	1
60.	b	1
61.	c	1
62.	b	1
63.	a	1
64.	d	1
65.	c	1
66.	a	1
67.	b	1
68.	c	1
69.	d	1

CHAPTER-4

DETERMINANTS

02 MARK TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	If W is an imaginary cube root of unity, find the value of $\begin{vmatrix} W^2 & W & 1 \\ 1 & W^2 & W \\ W & 1 & W^2 \end{vmatrix}$	2
2.	If $\Delta = \begin{vmatrix} 2 & 1 & 3 \\ 4 & 5 & 6 \\ 3 & 2 & 1 \end{vmatrix}$ Write the cofactors of a_{21} , a_{22} a_{31} a_{33}	2
3.	Prove that $\begin{vmatrix} x+5 & x & x \\ x & x+5 & x \\ x & x & x+5 \end{vmatrix} = 75x^2 + 125x$	2
4.	**If A is an invertible matrix of order 2, then det is equal (A^{-1}) to**	2
5.	If $\Delta = \begin{vmatrix} 2 & 1 & 3 \\ 4 & 5 & 6 \\ 3 & 2 & 1 \end{vmatrix}$ Write the cofactors of a_{21} , a_{22} a_{31} a_{33}	2
6.	If A is a symmetric matrix and B is skew-symmetric matrix such that $A-B=\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then find $\lvert 2A \rvert$.	2
7.	If A is any matrix such that $A^5 = I$, then find the value of $\lvert A^{-1} \rvert$.	2
8.	Evaluate the determinant $\begin{vmatrix} \log_4 9 & \log_3 8 \\ \log_4 3 & \log_3 512 \end{vmatrix}$.	2
9.	If A is a square matrix of order 3 and $\lvert A \rvert = 4$, then find $\lvert adj.(2A) \rvert$	2
10.	If A and B are invertible matrices of order 3 such that $\lvert A \rvert = 2$ and $\left\lvert (AB)^{-1} \right\rvert = \frac{-1}{6}$,then find $\lvert B \rvert$.	2
11.	If the Matrix A = $\begin{bmatrix} 1 & -1 & 2 \\ 3 & 1 & -2 \\ 1 & 0 & 3 \end{bmatrix}$, find $\lvert adjA \rvert$ without computing adj A.	2
12.	If the matrix $\begin{bmatrix} x+4 & x & x \\ x & x+4 & x \\ x & x & x+4 \end{bmatrix}$ is singular, find x.	2
13.	If A = $\begin{bmatrix} -1 & 2 & 0 \\ -1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$,show that $A^{-1} = A^2$	2
14.	Find the value(s) of k if the area of the triangle with vertices (-2,0), (0,4) and (0 ,k) is 4 square unit.	2
15.	If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$, be such that $A^{-1} = kA$, then find the value of k.	2
16.	Barun visited three places Kolkata , Bhubaneswar and Bangalore with his younger Karan. He observed on map that the three places make a straight line. Karan wrote these places as points	2

	$(2x, x+3), (0, x)$ *and* $(x+3, x+6)$.  Find the coordinates of Kolkata and Bangalore	
17.	A square matrix A is invertible if A is non singular. If $A = \begin{bmatrix} 2 & p & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{bmatrix}$, then find the value of p so that A^{-1} exists.	2
18.	The place of Peace and reconciliation, also known as the pyramid of peace and Accord is a 62- meter high pyramid in Mursultan, the capital of Kazakistan, that serves as anon-demonstrational national spiritual centre and an event house. It has 25 equal smaller equilateral triangles as shown in figure.  If the vertices of one triangle are (0, 0), (3, $\sqrt{3}$) and (3, $-\sqrt{3}$), then find the of the triangle. Also find the area of one face of the Pyramid	2
19.	It is well known that for a square matrix, $AA^{-1} = A^{-1}A = I$ and $AI = IA = A$. Now find the matrix P satisfying the matrix equation $P\begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$,	2
20.	If A(3,4) ,B(7,2) ,C (x, y) are collinear, then write the equation of the line passing through A, B, C.	2
21.	Find the Value of $\begin{vmatrix} \cos 15 & \sin 15 & 0 \\ \sin 15 & \cos 15 & 0 \\ 0 & 0 & 1 \end{vmatrix}$	2
22.	Write the value of $\Delta = \begin{vmatrix} x+y & y+z & z+x \\ z & x & y \\ -3 & -3 & -3 \end{vmatrix}$	2
23.	Given A= $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ Find A^{-1}.	2
24.	Evaluate the product AB where	2

	$A = \begin{vmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{vmatrix}$ and $B = \begin{vmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{vmatrix}$	
25.	Suppose A is any 3× 3 non-singular matrix and $(A - 3I)(A - 5I) = O$, where $I = I_3$ and $O = O_3$. If $\alpha A + \beta A^{-1}$=4I, then what will be value of $\alpha + \beta$.	2
26.	If $If\ A = \begin{bmatrix} -4 & -1 \\ 3 & 1 \end{bmatrix}$, then what will be the determinant of the matrix $(A^{2016} - 2A^{2015} - A^{2014})$.	2
27.	Given that $A = [a_{ij}]$ is a square matrix of order 3 and $\|A\| = -7$, then find the value of $\sum_{i=1}^{3} a_{i2}A_{i2}$.	2
28.	Let A be a square matrix of order 3 such that A (adj A) = 2I, where I is the identity matrix. Write the value of $\|adjA\|$.	2
29.	Let $\theta = \frac{\pi}{5}$ and $A = \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$. If $B = A + A^4$, then find the value of Det(B).	2
30.	Find the value of y if $\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2y & 4 \\ 6 & y \end{vmatrix}$	2
31.	Find the equation of the line joining (1, 2) and (3,6) using determinants.	2
32.	Verify A(adj. A) =(adj. A)A = (det A). I for A= $\begin{bmatrix} 2 & 3 \\ -4 & -6 \end{bmatrix}$	2
33.	What is the inverse of the matrix $\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$?	2
34.	If we find positive integral power of a symmetric matrix then we get which type of matrix- Symmetric or Skew symmetric?	2

ANSWERS:

Q. NO	ANSWER	MARKS
1.	$\begin{vmatrix} w^2 & w & 1 \\ 1 & w^2 & w \\ w & 1 & w^2 \end{vmatrix}$ $R_1 \longrightarrow R_1 + R_2 + R_3$ $\begin{vmatrix} w^2+w+1 & w & 1 \\ 1+w^2+w & w^2 & w \\ w+1+w^2 & 1 & w^2 \end{vmatrix}$ So we know that $w^2 + w + 1 = 0$ $\begin{vmatrix} 0 & w & 1 \\ 0 & w^2 & w \\ 0 & 1 & w^2 \end{vmatrix} = 0$	2
2.	$\begin{vmatrix} w^2 & w & 1 \\ 1 & w^2 & w \\ w & 1 & w^2 \end{vmatrix}$ $R_1 \longrightarrow R_1 + R_2 + R_3$ $\begin{vmatrix} w^2+w+1 & w & 1 \\ 1+w^2+w & w^2 & w \\ w+1+w^2 & 1 & w^2 \end{vmatrix}$ So we know that $w^2 + w + 1 = 0$ $\begin{vmatrix} 0 & w & 1 \\ 0 & w^2 & w \\ 0 & 1 & w^2 \end{vmatrix} = 0$	2
3.	L.H.S $\begin{vmatrix} x+5 & x & x \\ x & x+5 & x \\ x & x & x+5 \end{vmatrix}$ $C_1 \rightarrow C_1 + C_2 + C_3$ $\begin{vmatrix} 3x+5 & x & x \\ 3x+5 & x+5 & x \\ 3x+5 & x & x+5 \end{vmatrix}$ Taking common (3x+5) from C_1 $(3x+5)\begin{vmatrix} 1 & x & x \\ 1 & x+5 & x \\ 1 & x & x+5 \end{vmatrix}$ $R_2 \rightarrow R_2 - R_1, R_3 \rightarrow R_3 - R_1$ $=(3x+5)\begin{vmatrix} 1 & x & x \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{vmatrix}$ Expand R_3 $(3x+5)5(5x) = 25x(3x+5)$ $= 75x^2 + 125x$ = R.H.S	2

4.	A is invertible $AA^{-1} = I$ det (AA^{-1}) = det (I) det A.(det A^{-1}) = det ($\sqrt{2}$) $\left[\left\|AB\right\| = \left\|A\right\|\left\|B\right\|\right]$ det $A^{-1} = \frac{1}{\det A}$ $\left\{\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix} = 0 \;\; i.e. \left\|I\right\| = 1\right\}$	2
5.	$\begin{vmatrix} x+5 & x & x \\ x & x+5 & x \\ x & x & x+5 \end{vmatrix}$ $C_1 \to C_1 + C_2 + C_3$ $\begin{vmatrix} 3x+5 & x & x \\ 3x+5 & x+5 & x \\ 3x+5 & x & x+5 \end{vmatrix}$ Taking common (3x+5) from C_1 (3x+5) $\begin{vmatrix} 1 & x & x \\ 1 & x+5 & x \\ 1 & x & x+5 \end{vmatrix}$ $R_2 \to R_2 - R_1, R_3 \to R_3 - R_1$ =(3x+5) $\begin{vmatrix} 1 & x & x \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{vmatrix}$ Expand R_3 (3x+5)5(5x) =25x(3x+5) $=75x^2+125x$ = R.H.S	2
6.	$A^T = A, B^T = -B$ and $A - B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \Rightarrow (A-B)^T = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}^T$ $\Rightarrow A^T - B^T = A + B = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} \Rightarrow A + B + A - B = \begin{bmatrix} 2 & 5 \\ 5 & 8 \end{bmatrix} \Rightarrow 2A = \begin{bmatrix} 2 & 5 \\ 5 & 8 \end{bmatrix}$ $\therefore \left\|2A\right\| = 16 - 25 = -9$	2
7.	$A^5 = I \;\Rightarrow A^{-1}.A^5 = A^{-1}.I \Rightarrow A^4 = A^{-1}$ $\Rightarrow \left\|A^{-1}\right\| = \left\|A^4\right\| = \left\|A\right\|^4 = 1^4 = 1$	2
8.	$\log_4 9 = \frac{\log 9}{\log 4}; \log_3 8 = \frac{\log 8}{\log 3}; \log_4 3 = \frac{\log 3}{\log 4}; \log_3 512 = \frac{\log 512}{\log 3}$ $\begin{vmatrix} \log_4 9 & \log_3 8 \\ \log_4 3 & \log_3 512 \end{vmatrix} = \log_4 9.\log_3 512 - \log_4 3.\log_3 8 = \frac{\log 9}{\log 4}.\frac{\log 512}{\log 3} - \frac{\log 3}{\log 4}.\frac{\log 8}{\log 3}$ $= \frac{2\log 3}{2\log 2}.\frac{9\log 2}{\log 3} - \frac{\log 3}{2\log 2}.\frac{3\log 2}{\log 3} = = 9 - \frac{3}{2} = \frac{15}{2}$	2
9.	$\because \left\|adj.A\right\| = \left\|A\right\|^{n-1} \;\therefore \left\|adj.(2A)\right\| = \left\|2A\right\|^{3-1} = \left\|2A\right\|^2 = \left(2^3\left\|A\right\|\right)^2 = \left(2^3.4\right)^2 = 2^{10}$	2
10.	$\left\|(AB)^{-1}\right\| = \frac{-1}{6} \Rightarrow \frac{1}{\left\|AB\right\|} = \frac{-1}{6} \Rightarrow \frac{1}{\left\|A\right\|.\left\|B\right\|} = \frac{-1}{6} \Rightarrow \frac{1}{2.\left\|B\right\|} = \frac{-1}{6} \Rightarrow \frac{1}{\left\|B\right\|} = \frac{-1}{3}$	2

11.	Here Determinant A = $\begin{bmatrix}1 & -1 & 2\\ 3 & 1 & -2\\ 1 & 0 & 3\end{bmatrix}$ = 1(2-2) + 3(1+3) = 12 A is no singular Adj A = (12) * (12) = 144	2
12.	Use the determinant expansion and expand the matrix ,find the value of x using simple equation. x = -4/3	2
13.	By definition of matrix b is inverse of A if AB = I = BA .Here we have to show that A^2 is inverse of A there it is sufficient to shoe that A^2 A = I = AA^2 i.e. A^3 = I	2
14.	The absolute value of ½ $\begin{bmatrix}-2 & 0 & 1\\ 0 & 4 & 1\\ 0 & k & 1\end{bmatrix}$ = 4 The absolute value of ½ (-2)(4-k) = 4 Solving above ,we get k = 8 and 0	2
15.	Here $\lvert A\rvert = -19, adjA = \begin{bmatrix}-2 & -3\\ -5 & 2\end{bmatrix}$, $A^{-1} = \frac{1}{\lvert A\rvert} adjA$ $\therefore A^{-1} = \frac{-1}{19}\begin{bmatrix}-2 & -3\\ -5 & 2\end{bmatrix} \Rightarrow \frac{-1}{19}\begin{bmatrix}-2 & -3\\ -5 & 2\end{bmatrix} = \begin{bmatrix}2k & 3k\\ 5k & -2k\end{bmatrix} \Rightarrow k = \frac{1}{19}$	2
16.	As points are on a straight line $\therefore \begin{vmatrix}2x & x+3 & 1\\ 0 & x & 1\\ x+3 & x+6 & 1\end{vmatrix} = 0 \Rightarrow -12x + 3(x+3) = 0 \Rightarrow x = 1$ Therefore co-ordinates of Kolkata are (2,4) and Bangalore are (4,8)	2
17.	A^{-1} exist if $\lvert A\rvert \neq 0 \Rightarrow \begin{vmatrix}2 & p & -3\\ 0 & 2 & 5\\ 1 & 1 & 3\end{vmatrix} \neq 0 \Rightarrow p \neq \frac{-8}{5}$	2
18.	Area of a triangle = $\frac{1}{2}\begin{vmatrix}0 & 0 & 1\\ 3 & \sqrt{3} & 1\\ 3 & -\sqrt{3} & 1\end{vmatrix} = 3\sqrt{3} sq.unit$ ∴ area of one of the face of the Pyramid = $25 \times 3\sqrt{3} = 75\sqrt{3}$ sq. unit	2
19.	$\begin{vmatrix}-3 & 2\\ 5 & -3\end{vmatrix} = -1, \therefore \begin{bmatrix}-3 & 2\\ 5 & -3\end{bmatrix}^{-1} = \frac{1}{-1}\begin{bmatrix}-3 & -2\\ -5 & -3\end{bmatrix} = \begin{bmatrix}3 & 2\\ 5 & 3\end{bmatrix}$ $\therefore P = \begin{bmatrix}1 & 2\\ 2 & -1\end{bmatrix}\begin{bmatrix}-3 & 2\\ 5 & -3\end{bmatrix}^{-1} = \begin{bmatrix}13 & 8\\ 1 & 1\end{bmatrix}$	2
20.	A(3,4) ,B(7,2) ,C (x, y) are collinear so ½ $\begin{vmatrix}3 & 4 & 1\\ 7 & 2 & 1\\ x & y & 1\end{vmatrix} = 0$ 4(y-4)+2(x-3)= 0 2x+4y =22 is the equation of line passing through A(3,4) ,B(7,2).	1 1
21.	$Cos^2 15° - sin^2 15°$ =cos 30° =√3/2	1 ½ ½
22.	$\Delta = (x+y)(-3x+3y)$-(y+z)(-3z+3y)+(z+x)(-3z+3x)=3(y^2-x^2-y^2+z^2-z^2+x^2)==0	1 1
23.	$\lvert A\rvert$=10 ,	½

	Adj A$=\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$ $\Rightarrow A^{-1}=\frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$	1 ½
24.	$A=\begin{vmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{vmatrix}=2+4+0=6$ and $B=\begin{vmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{vmatrix}$=12+24+0=36 AB=216	½ 1 ½
25.	Given, $(A-3I)\,(A-5I)=O$ Or, $A^2-8A+15I=O$ Post multiplying by A^{-1} on both sides , we have, $\frac{1}{2}A+\frac{15}{2}A^{-1}=4I$ ……(i) Comparing (i) with $\alpha A+\beta A^{-1}=4I$, $\alpha=\frac{1}{2}$ and $\beta=\frac{15}{2}$ $\alpha+\beta=8.$	2
26.	We have, $A^2=\begin{bmatrix} 13 & 3 \\ -9 & -2 \end{bmatrix}$ $\lvert A\rvert=-1$ $\lvert A^{2016}-2A^{2015}-A^{2014}\rvert=\lvert A^{2014}\rvert\lvert A^2-2A-I\rvert$ $=-25.$	2
27.	$\lvert A\rvert=-7$ $\sum_{i=1}^{3}a_{i2}A_{i2}=Determinant\ of\ the\ matrix\ A\ expanded\ along\ C_2$ $=\lvert A\rvert$ $=-7$	2
28.	Since, $A.(adj\ A)=\lvert A\rvert I$ So, $A.$(adj A) = 2I Or, $\lvert A\rvert=2$ Now, $\lvert adj\ A\rvert=\lvert A\rvert^{n-1}$ Or, $\lvert adj\ A\rvert=2^{3-1}$ = 4	2
29.	$A^2=\begin{bmatrix} \cos 2\theta & \sin 2\theta \\ -\sin 2\theta & \cos 2\theta \end{bmatrix}$ $A^4=\begin{bmatrix} \cos 4\theta & \sin 4\theta \\ -\sin 4\theta & \cos 4\theta \end{bmatrix}$ $B=A+A^4$ $\lvert B\rvert=2+2\cos 3\theta$ $=\frac{5-\sqrt{5}}{2}\in(1,2)$	2

30.	.+√3, -√3	2
31.	2x-y=0	2
32.	Verification	2
33.	$\begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$	2
34.	symmetric	2

CHAPTER-4

DETERMINANTS

03 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Area of a triangle whose vertices are (x_1,y_1),(x_2, y_2) and (x_3, y_3) is given by the determinant $\Delta=\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ Since, area is a positive quantity, so we always take the absolute value of the determinant Δ. Also, the area of the triangle formed by three collinear points is zero. Based on the above information, answer the following questions (i) Find the area of the triangle whose vertices are (-2, 6), (3, -6) and (1, 5). (a) 30 sq. units (b) 35 sq. units (c) 40 sq. units (d) 15.5 sq. units ii. If the area of a triangle ABC, with vertices A (1, 3), B (O, 0) and C (k, 0) is 3 sq. units, then a value of k is (a) 2 (b) 3 (c) 4 (d) 5	3
2.	A Boy Monty brought 2 Bags, 1 Pen and 3 pencils and Paid 25 rupees, in same shop Nihar bought 3 bags, 2 pens & 1 Pencil and Paid 40 rupees and Pabitra brought 1 Bag, 3 pens & 2 Pencil and paid 30 rupees. Multiply by matrix method	3
3.	Using the property of determinants and without expanding, prove that: $\begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix} = 0$.	3
4.	If $A=\begin{bmatrix} 4 & 2 & 5 \\ 2 & 0 & 3 \\ -1 & 1 & 0 \end{bmatrix}$, then find the determinant of $3AA^{-1}$.	3
5.	Find the matrix X such that $\begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix} X \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix}$	3
6.	Find the inverse of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\propto & sin\propto \\ 0 & sin\propto & -cos\propto \end{bmatrix}$.	3
7.	Find the adjoint of the matrix A = $\begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ and hence show that A(adj A) = $\lvert A\rvert$ I_3 .	3
8.	Let $A = \begin{bmatrix} 2 & 3 \\ 1 & ,2 \end{bmatrix}, B = \begin{bmatrix} 4 & -6 \\ -2 & 4 \end{bmatrix}$. Then compute AB. Hence solve the equation 2x + y = 4, 3x +2y = 1	3
9.	The monthly incomes of two brothers Sirish and Srijan are in the ratio 3:4 and the monthly expenditures are in the ratio 5:7. Each brother saves Rs. 15000 per month..	3

	 Using matrix find their monthly income	
10.	On his birthday Rahul decided to donate some money to the children of an orphanage home. If there were 8 children less, everyone would have got Rs. 10 more. However if there were16 children more, everyone would have got Rs. 10 less.  Using matrix method the number of children and amount ditrbuted by Rahul.	3
11.	Show that the points (a + 5, a – 4), (a – 2, a + 3) and (a, a) do not lie on a straight line for any value of a.	3
12.	A school wants to awards its students for the values of Honesty, Regularity and Hard work with a total cash award of Rs. 6000. Three times the award money for Hard work added to that given for Honesty amounts to Rs. 11000. The award money given for Honesty and Hard work together is double the one given for Regularity. Represent the above situation algebraically and justify can we find the award money for each value, using matrix method?	3
13.	Two schools A and B want to award their selected students on the values of sincerity, truthfulness and helpfulness. The school A wants to award Rs. x each, Rs. y each and Rs. z each for three respective values to 3, 2 and 1 students respectively with a total award money of Rs. 2200. School B wants to spend Rs. 3100 to award its 4, 1 and 3 students on the respective values (by giving the same award money to the three values as before). If the total 53amount for one prize on each value is Rs. 1200, using matrices, find the award money for each value.	3
14.	If $B = \begin{bmatrix} 5 & 2\alpha & 1 \\ 0 & 2 & 1 \\ \alpha & 3 & -1 \end{bmatrix}$ is the inverse of a 3× 3 matrix A, then find the sum of all values of α for which $\lvert A\rvert+1 = 0$.	3
15.	Let $(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$. Show that $[F(\alpha)]^{-1} = F(-\alpha)$.	3
16.	Gautam buys 4 pens, 3 bags and 2 instrument box and pays a sum of Rs.60. From the same shop, Vikram buys 2 pens, 4 bag and 6 instrument boxes and pays a sum of Rs.90. Also, Ankur buys 6 pen, 2 bags and 3 instrument boxes and pays a sum of Rs. 90.	3

	Based on the above information, answer the following questions. (i) Convert the given above situation into a matrix equation of the form AX = B. (ii) Find$\|A\|$. (iii) FindA^{-1}.	
17.	Solve using matrix method 2x-y = 1, 3x+2y=5	3
18.	If A = $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ show that A^2-5A+7I = O . Hence Find A^{-1}.	3
19.	Using cofactors of element of third columns evaluate $\begin{vmatrix} 1 & x & yz \\ 1 & y & zx \\ 1 & z & xy \end{vmatrix}$	3

ANSWERS:

Q. NO	ANSWER	MARKS
1.	According to statement 3p+2q+r=3000 2p+4q+3r=3500 P+q+r=1500 Converting the system of equations in matrix form , we get $\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}\begin{bmatrix}X\\ Y\\ Z\end{bmatrix}=\begin{bmatrix}3000\\ 3500\\ 1500\end{bmatrix}$ i.e AX=B Where A=$\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}$ X=$\begin{bmatrix}X\\ Y\\ Z\end{bmatrix}$ B=$\begin{bmatrix}3000\\ 3500\\ 1500\end{bmatrix}$ $\|A\|=\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}$ =3(4-3)-2(2-1)+1(6-4) =3×1-2×1+1×2=3-2+2=3 3≠0 X =A^{-1}B $A^{-1}=\frac{\text{adjA}}{\|A\|}$ adjA= [cofactors of A]^T cofactors of A =$\begin{bmatrix}1 & 1 & -2\\ -1 & 2 & -1\\ 2 & -7 & 8\end{bmatrix}$ adjA=$\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}$ $A^{-1}=\frac{\text{adjA}}{\|A\|}=\frac{\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}}{3}=\frac{1}{3}\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}$ X=A^{-1}B $=\begin{bmatrix}\frac{1}{3} & \frac{-1}{3} & \frac{2}{3}\\ \frac{1}{3} & \frac{2}{3} & \frac{-7}{3}\\ \frac{-2}{3} & \frac{-1}{3} & \frac{8}{3}\end{bmatrix}\begin{bmatrix}3000\\ 2300\\ 1500\end{bmatrix}$ $=\begin{bmatrix}1000-1100+1000\\ 1000+2200-3500\\ 2000-1100+4000\end{bmatrix}=\begin{bmatrix}900\\ -300\\ 900\end{bmatrix}$ p=900, q=-300, z=900	3
2.	Let the cost of 1 bag =x And the cost of 1 pen =y ⇒3x+4y=257 ⇒4x+3y=324 Equation (1) × 4: 12x+16y=257×4	3

	Equation (2) × 3: 12x+9y=324×3 Subtract two equations; ⇒7y=56 ⇒y=8 ⇒x=75 ⇒total cost of 1 bag and 10 pens=x+10y=75+80=155	
3.	$\begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix}$ Applying the Sum Property of determinants, we have $\begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix}$ = $\begin{vmatrix} x & a & x \\ y & b & y \\ z & c & z \end{vmatrix} + \begin{vmatrix} x & a & a \\ y & b & b \\ z & c & c \end{vmatrix}$ We know, if two rows or columns of a determinant are identical, then the value of the determinant is zero. Since, the two columns in both the determinants are identical, thus its determinant would be zero. $\Rightarrow \begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix}$ =0+0 $\Rightarrow \begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix}$ =0	3
4.	As $AA^{-1} = I \Rightarrow \left\|3AA^{-1}\right\| = \left\|3I\right\| = 9\left\|I\right\| = 9$	3
5.	$\begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix} X \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix}$ $X \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix}^{-1} \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix} = \frac{1}{15-14} adj. \begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix} . \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix}$ $= \begin{bmatrix} 5 & -2 \\ -7 & 3 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix} = \begin{bmatrix} -16 & 3 \\ 24 & -5 \end{bmatrix}$	3
6.	$Let\ \|A\| = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\propto & sin\propto \\ 0 & sin\propto & -cos\propto \end{bmatrix}$ $= 1(-\cos^2\propto - \sin^2\propto) = -(\cos^2\propto + \sin^2\propto) = -1$ $\Rightarrow A^{-1}$ exist. $A^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\propto & sin\propto \\ 0 & sin\propto & -cos\propto \end{bmatrix}$	3

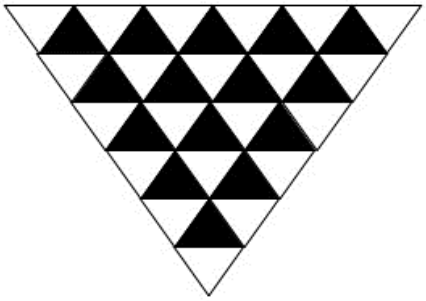
7.	Adj A= $\begin{bmatrix}-3 & 6 & 6\\ -6 & 3 & -6\\ -6 & -6 & 3\end{bmatrix}$ Determinant A = 27 For correct proof	2 1
8.	$AB=\begin{bmatrix}2 & 0\\ 0 & 2\end{bmatrix}=2I, \Rightarrow A\left(\frac{1}{2}B\right)=I \Rightarrow A^{-1}=\frac{1}{2}B=\frac{1}{2}\begin{bmatrix}4 & -6\\ -2 & 4\end{bmatrix}=\begin{bmatrix}2 & -3\\ -1 & 2\end{bmatrix}$ Given system of equations is PX=Q, where $P=\begin{bmatrix}2 & 1\\ 3 & 2\end{bmatrix}=A^T$; $X=\begin{bmatrix}x\\ y\end{bmatrix}$; $Q=\begin{bmatrix}4\\ 1\end{bmatrix}$ $\therefore X=P^{-1}Q=(A^T)^{-1}Q=(A^{-1})^{\mathrm{T}}Q=\begin{bmatrix}7\\ -10\end{bmatrix}$ $\therefore x=7, y=-10$	3
9.	Let monthly income of Sirish and Srijan be 3x and 4x and their expenditure are 5y and 7y respectively ∴ 3x - 5y = 15000, 4x - 7y = 15000 AX=B, where A = $\begin{bmatrix}3 & -5\\ 4 & -7\end{bmatrix}$, $X=\begin{bmatrix}x\\ y\end{bmatrix}$, $B=\begin{bmatrix}15000\\ 15000\end{bmatrix}$ $A^{-1}=\begin{bmatrix}7 & -5\\ 4 & -3\end{bmatrix}$, $\therefore X=A^{-1}B=\begin{bmatrix}7 & -5\\ 4 & -3\end{bmatrix}\begin{bmatrix}15000\\ 15000\end{bmatrix}=\begin{bmatrix}30000\\ 15000\end{bmatrix}$, ∴ income of Sirish = Rs. 90000, income of Srijan = Rs.120000	3
10.	Let number of children be x and amount for each student be Rs. Y So, $(x-8)(y+10)=xy \Rightarrow 5x-4y=40$ $(x+16)(y-10)=xy \Rightarrow 5x-8y=-80$ AX=B, where A = $\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}$, $X=\begin{bmatrix}x\\ y\end{bmatrix}$, $B=\begin{bmatrix}40\\ -80\end{bmatrix}$ $A^{-1}=\frac{-1}{20}\begin{bmatrix}-8 & 4\\ -5 & 5\end{bmatrix}$, $\therefore X=A^{-1}B=\begin{bmatrix}32\\ 30\end{bmatrix}$ No. of students = 32, Amount given to each students = Rs 30	3
11.	Area of the triangle with the points (a + 5, a – 4), (a – 2, a + 3) and (a, a) as vertices is ½ $\begin{vmatrix}a+5 & a-4 & 1\\ a-2 & a+3 & 1\\ a & a & 1\end{vmatrix}$ = ½ [3a+15+2a-8-5a]=7/2 , non-zero value independent of a So points (a + 5, a – 4), (a – 2, a + 3) and (a, a) are not collinear.	1 1 1
12.	Let x, y and z be the award money for Honesty, Regularity and Hard work. Then X+y+z=6000 3z+x=11000 z+x-2y=0 The equations can be presented as AX=B where A=$\begin{pmatrix}1 & 1 & 1\\ 1 & 0 & 3\\ 1 & -2 & 1\end{pmatrix}$,X=$\begin{pmatrix}x\\ y\\ z\end{pmatrix}$,B=$\begin{pmatrix}6000\\ 11000\\ 0\end{pmatrix}$ Det A=6 so the above equations have solutions.	3
13.	3x+2y+z=2200 ; 4x+y+3z=3100 ; x+y+z= 1200 A=$\begin{bmatrix}3 & 2 & 1\\ 4 & 1 & 3\\ 1 & 1 & 1\end{bmatrix}$; B=$\begin{bmatrix}2200\\ 3100\\ 1200\end{bmatrix}$; X=$\begin{bmatrix}x\\ y\\ z\end{bmatrix}$ $A^{-1}=1/5.\begin{bmatrix}2 & 1 & -5\\ 1 & -2 & 5\\ -3 & 1 & 5\end{bmatrix}$	½ ½ 1+½

	So x=300,y=400,z=500	½
14.	Here, $\|B\| = \|A^{-1}\| = -1$ $or, \begin{vmatrix} 5 & 2\alpha & 1 \\ 0 & 2 & 1 \\ \alpha & 3 & -1 \end{vmatrix} = -1$ Or, $2\alpha^2 - 2\alpha - 24 = 0$ Sum of all values of $\alpha = 1$	3
15.	We have, $[F(\alpha)]^{-1} = \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix} = F(-\alpha).$	3
16.	Let the cost of 1 pen, 1 bag and 1 instrument box be x, y and z respectively. Then, $4x + 3y + 2z = 60$ $2x + 4y + 6z = 90$ $6x + 2y + 3z = 70$ The above equations can be written as, $AX = B$ Where $A = \begin{bmatrix} 4 & 3 & 2 \\ 2 & 4 & 6 \\ 6 & 2 & 3 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 60 \\ 90 \\ 70 \end{bmatrix}$ Now, $\|A\| = 50 \neq 0$ So, $A^{-1} = \frac{1}{50}\begin{bmatrix} 0 & -5 & 10 \\ 30 & 0 & -20 \\ -20 & 10 & 10 \end{bmatrix}$,	3
17.	x=1 y=1	3
18.	For verification Finding $A^{-1} = 1/7\begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$	2 1
19.	Value =(x-y)(y-z)(z-x)	3

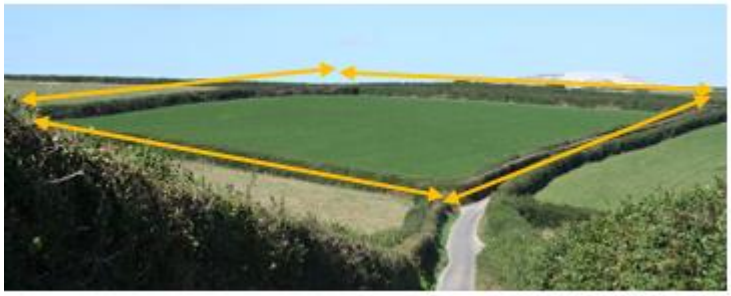
CHAPTER-4

DETERMINANTS

04 MARK TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	Two schools X and Y want to award their selected students on the values of Hard work, Honesty and Punctuality. The school X wants to award Rupees P each, Rupees q each and Rupees r each for the three respective values to its 3,2 and 1 students respectively with a total award money of Rupees 3000/- School wants to spend rupees 3500/- to award in 2,4 & 3 students on the respective values. The total amount of awards for one prize on each value is Rupees 1500/-. Using the concept of Determinants & matrices, Answer the following questions I) what is the award money for punctuality? a. 500 b. 300 c. 900 d. 1000 II) What is the award money for hard work? a. 200 b. 900 c.800 d. 500	4
2.	**Show that, using properties of determinants.** $\begin{vmatrix} 1+a^2-b^2 & 2ab & -2b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix} = (1+a^2+b^2)^3$	4
3.	 A triangular floral design is made up of 36 smaller equilateral triangles as shown in the figure. *Using the above information and the concept of determinants, answer the following questions.* (i) If the vertices of one of the smaller equilateral triangle are $(3,1),(9,3)$ and $(5,3)$, then the area of such triangle is (a) 4 sq. u (b) 6 sq. u (c) 10 sq. u (d) 8 sq. u (ii) What is the area of design? (a) 72 sq.u (b) 104 sq.u (c) 144 sq. u (d) 10 sq.u (iii) If the vertices of one of the smaller equilateral triangle are $(0,0),(3,\sqrt{3})$ $(3,-\sqrt{3})$, then the altitude of such triangle is ? (a) 4 u (b) 6 u (c) 3 u (d) 8 u (iv) If $(2,4),(2,6)$ are two vertices of smaller triangle and its area is $3\sqrt{3}$ sq. units , then the third vertex will lie on the line (a) $x+y=5$ (b) $x-y=5$ (c) $x=2\pm3\sqrt{3}$ (d) $2x+y=3$	4

4.	A missile launched to hit its target follows a parabolic path. Its velocity at any instant 't' is given by $v(t) = at^2 + bt + c, 0 \le t \le 100,$ where a,b and c are constants. It has been found that the velocity at time t=3, t=6 and t=9 seconds are respectively 64,133 and 208 miles per second. If $\begin{bmatrix} 9 & 3 & 1 \\ 36 & 6 & 1 \\ 81 & 9 & 1 \end{bmatrix}^{-1} = \frac{1}{18}\begin{bmatrix} 1 & -2 & 1 \\ -15 & 24 & -9 \\ 54 & -54 & 18 \end{bmatrix}$, then answer the following questions. (i) Find the value of b+c. (ii) Find $v(t)$. (iii) Calculate the speed at time t=15 seconds. (iv) At what time the missile acquires a speed of 784 miles/sec?	4
5.	Chandrayaan 3 is the third lunar exploration mission undertaken by the Indian Space Research Organisation (ISRO). It aims to further expand our understanding of the Moon's surface by deploying a Lander and a rover. During its launch stage, it's follows a definite trajectory and velocity of the rocket can be expressed as a function of time(t) as follows:  **v(t) = 140at² + 3bt - 130c – M** where a, b and c are constants of unknown values and M accounts for the mass of the rocket which satisfies $4a + b - 2c + 58 = 0$ $2a + b - c + 35 = 0$ $-7a - 2b + 4c = 113$ Use the value of AB to solve the above system of equations and obtain the value of a, b and c.	4
6.	A trust invested some money in two type of bonds . The first bond pays 10% interest and second bond pays 12% interest. The trust received Rs 2400 as interest . However, if trust had interchanged money in bonds they would have got Rs 100 less. Let the amount invested in first type and second type of bond be Rs x and Rs y. Based on the above information ,answer the following questions; (i) Write the equations in terms of x and y representing the given information. (ii) Write the matrix equation representing the given information. Find the amount invested by trust in first and second bond respectively.	4
7.	Manjit wants to donate a rectangular plot of land for a school in his village. When he was asked to give dimensions of the plot, he told that if its length is decreased by 50 m and breadth is increased by 50 m, then its area will remain same, but if length is decreased by10 m and breadth is decreasedby 20m, then its area will decreasey5300 m^2	4

	 Based on the information given above, answer the following questions : i) The value of x(length of rectangular field)is (a) 150 m b) 400 m c) 200 m d) 320 m ii) The value of y (breadth of rectangular field) is (a) 150 m b)200 m c) 430 m d) 350 m iii) How much is the area of rectangular field? a) 60000 sq m b)30000 sq m c) 3000 sq m d) 30000 m iv) The equations in terms of x and y are a. x+y =50, 3x-y = 550 b.x-y=50, 2x+y=550 c. x+y= 50, 2x+ y=550 d.x+y= 50, 2x+y=550	
8.	A factory produces three products every day. Their production on a particular day is 45 tones. It is found that production of third product exceeds the production of first product by 8 tons while production of first and third products is twice the production of second product.  1. If x, y and z respectively denotes the quantity (in tons) of first, second and third products produced, then construct the system of equation and write it in matrix form. 2. If $\begin{bmatrix}1 & 1 & 1\\1 & 0 & -2\\1 & -1 & 1\end{bmatrix}^{-1} = \frac{1}{6}\begin{bmatrix}2 & 2 & 2\\3 & 0 & -3\\1 & -2 & 1\end{bmatrix}$, then find the inverse of $\begin{bmatrix}1 & 1 & 1\\1 & 0 & -1\\1 & -2 & 1\end{bmatrix}$ 3. Find x : y : z	.4
9.	Three shopkeepers Ram Lal, Shyam Lal, and Ghansham are using polythene bags, handmade bags (prepared by prisoners), and newspaper envelopes as carrying bags. It is found that the shopkeepers Ram Lal, Shyam Lal, and Ghansham are using (20,30,40), (30,40,20), and (40,20,30) polythene bags, handmade bags, and newspaper envelopes respectively. The shopkeeper's Ram Lal, Shyam Lal, and Ghansham spent ₹250, ₹270, and ₹200 on these carry bags respectively. 1. What is the cost of one polythene bag? 2. What is the cost of one handmade bag? 3. What is the cost of one newspaper bag?	4

	Keeping in mind the environmental conditions, which shopkeeper is better?	
10.	A manufacturer makes three types of toys A, B and C. Three machines are needed for this purpose and the time (in minutes) required for each toy on the machines is given below: **Types of Toys** / **Machines**: I, II, III A: 20, 10, 10 B: 10, 20, 30 C: 5, 25, 15 The machines I, II and III are available for a maximum of 3 hours, 2 hours and 2 hours 30 minutes respectively. How can you find no of the three types of toys to be produced using determinants?	4
11.	Let A be a matrix such that A$\begin{bmatrix}1 & 2\\0 & 3\end{bmatrix}$ is a scalar matrix and $\lvert 3A\rvert$=108 then what will be the value ofA^2.	4
12.	If $\begin{bmatrix}1 & 1\\0 & 1\end{bmatrix}\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}\begin{bmatrix}1 & 3\\0 & 1\end{bmatrix}\dots\begin{bmatrix}1 & n-1\\0 & 1\end{bmatrix}=\begin{bmatrix}1 & 78\\0 & 1\end{bmatrix}$, then find the inverse of the matrix $\begin{bmatrix}1 & n\\0 & 1\end{bmatrix}$.	4
13.	Three friends Rahul, Ravi and Rakesh went to a vegetable market to purchase vegetables. Rahul Purchased 1kg of each Potato,,Onion and Brinjalfor a total of Rs. 21. Ravi purchased 4kg Potato,3kgOnion and 2kgBrinjal for a total of Rs. 60. Rakesh purchased 6kg Potato,2kg Onion and 3kg Brinjal for a total of Rs. 70. (i) If cost of potato, onion and brinjal are Rs. X, Y and Z respectively then convert above situation into system of linear equation. (ii) Convert the sytem of equations in (i) in the form of AX=B. (iii) Find the cost of potato ,onion and brinjal.	4
14.	Gautam buys 5 pens , 3 bags and 1 instruments box and pays a sum of Rs 160. Vikram buys 2 pens , 1 bag and 3 instrument boxes and pays a sum of Rs. 190. Ankur buys 1 pen, 2 bags and 4 instrument boxes and pays a sum of Rs. 250. (i) convert the given above situation into system of Linear equations. (ii) Find IAI (iii) Find A^{-1}	4

ANSWERS:

Q. NO	ANSWER	MARKS
1.	According to statement 3p+2q+r=3000 2p+4q+3r=3500 p+q+r=1500 Converting the system of equations in matrix form, we get $\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}\begin{bmatrix}X\\ Y\\ Z\end{bmatrix}=\begin{bmatrix}3000\\ 3500\\ 1500\end{bmatrix}$ i.e AX=B Where A=$\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}$ X=$\begin{bmatrix}X\\ Y\\ Z\end{bmatrix}$ B=$\begin{bmatrix}3000\\ 3500\\ 1500\end{bmatrix}$ |A|=$\begin{bmatrix}3 & 2 & 1\\ 2 & 4 & 3\\ 1 & 1 & 1\end{bmatrix}$ =3(4-3)-2(2-1)+1(6-4) =3×1-2×1+1×2=3-2+2=3 3≠0 X =A^{-1}B $A^{-1}=\frac{\text{adjA}}{\|A\|}$ adjA= [cofactors of A]^T cofactors of A =$\begin{bmatrix}1 & 1 & -2\\ -1 & 2 & -1\\ 2 & -7 & 8\end{bmatrix}$ adjA=$\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}$ $A^{-1}=\frac{\text{adjA}}{\|A\|}=\frac{\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}}{3}=\frac{1}{3}\begin{bmatrix}1 & -1 & 2\\ 1 & 2 & -7\\ -2 & -1 & 8\end{bmatrix}$ X=A^{-1}B $=\begin{bmatrix}\frac{1}{3} & \frac{-1}{3} & \frac{2}{3}\\ \frac{1}{3} & \frac{2}{3} & \frac{-7}{3}\\ \frac{-2}{3} & \frac{-1}{3} & \frac{8}{3}\end{bmatrix}\begin{bmatrix}3000\\ 2300\\ 1500\end{bmatrix}$ $=\begin{bmatrix}1000-1100+1000\\ 1000+2200-3500\\ 2000-1100+4000\end{bmatrix}=\begin{bmatrix}900\\ -300\\ 900\end{bmatrix}$ p=900, q=-300, z=900	4
2.	$R_1 \to R_1 + b.R_3$	4

	$L.H.S = \begin{vmatrix} 1+a^2+b^2 & 0 & -b(1+a^2+b^2) \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix}$ **Taking common $(1 + a^2 + b^2)$ from R_1** $= 1+a^2+b^2 \begin{vmatrix} 1 & 0 & -b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix}$ $R_1 \to R_1 - a.R_3$ $= 1+a^2+b^2 \begin{vmatrix} 1 & 0 & -b \\ 0 & 1+a^2+b^2 & a(1+a^2+b^2) \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix}$ **Taking $(1 + a^2 + b^2)$ common from R_2** $= 1+a^2+b^2 \begin{vmatrix} 1 & 0 & -b \\ 0 & 1 & a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix}$ **Expending entry R_1** $= (1+a^2+b^2)^2[1(1-a^2-b^2+2a^2)-b(-2b)]$ $= (1+a^2+b^2)^2[1+a^2-b^2+2b^2]$ $= (1+a^2+b^2)^2(1+a^2+b^2)$ $= (1+a^2+b^2)^3$	
3.	(i) (a) 4 sq units (ii) (c) 144 sq. units (ii) (c) 3 units (iv) (c) $x = 2 \pm 3\sqrt{3}$	4
4.	$v(3) = 64, v(6) = 64 \, and \, v(6) = 133$ $\Rightarrow 9a + 3b + c = 64; 36a + 6b + c = 133 \, and \, 81a + 9b + c = 208$ In matrix form $\begin{bmatrix} 9 & 3 & 1 \\ 36 & 6 & 1 \\ 81 & 9 & 1 \end{bmatrix} . \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 64 \\ 133 \\ 208 \end{bmatrix} \Rightarrow A.X = B \Rightarrow X = A^{-1}B$ $= \frac{1}{18} \begin{bmatrix} 1 & -2 & 1 \\ -15 & 24 & -9 \\ 54 & -54 & 18 \end{bmatrix} \begin{bmatrix} 64 \\ 133 \\ 208 \end{bmatrix} = \begin{bmatrix} 1/3 \\ 20 \\ 1 \end{bmatrix} \Rightarrow a = 1/3; b = 20 \, and \, c = 1$ (i) $\Rightarrow b + c = 21$ (ii) $v(t) = \frac{1}{3}t^2 + 20t + 1$ (iii) $v(15) = 376 \, miles / \sec$ (iv) 27 seconds.	4
5.	$A = \begin{bmatrix} 4 & 1 & -2 \\ 2 & 1 & -1 \\ -7 & -2 & 4 \end{bmatrix}$ X = $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$ B= $\begin{bmatrix} -58 \\ -35 \\ 113 \end{bmatrix}$ So,X = A^{-1} B Solving the above condition a= -3 ,b= -12 ,c = 17	4
6.	(i) As per given information : 10x/100 + 12y/100 = 2800	4

	12x/100 + 10y/100 = 2700 After simplifying the equations are 5x +6y = 140000, 6x +5y = 135000 (ii) Let A = $\begin{bmatrix}5 & 6\\6 & 5\end{bmatrix}$,X = $\begin{matrix}x\\y\end{matrix}$ and B $\binom{140000}{135000}$ (iii) Given system cn be written as AX = B Where $[A]$ = $\begin{bmatrix}5 & 6\\6 & 5\end{bmatrix}$ = 25-36=-11 ⇨ A^{-1} exist. Now, X = A^{-1} B After solving we get , x = 10000 and y = 15000	
7.	i b ii a iii b iv b	4
8.	4. By given information $x+y+z=45,\ -x+z=8,\ x-2y+z=0$ In matrix form $\begin{bmatrix}1 & 1 & 1\\1 & 0 & -2\\1 & -1 & 1\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}45\\8\\0\end{bmatrix}$ 5. We know that $(A')^{-1}=(A^{-1})'$ $\therefore \begin{bmatrix}1 & 1 & 1\\1 & 0 & -1\\1 & -2 & 1\end{bmatrix}^{-1}=\frac{1}{6}\begin{bmatrix}2 & 3 & 1\\2 & 0 & -2\\2 & -3 & 1\end{bmatrix}$ 6. $\begin{bmatrix}x\\y\\z\end{bmatrix}=\frac{1}{6}\begin{bmatrix}2 & 3 & 1\\2 & 0 & -2\\2 & -3 & 1\end{bmatrix}\begin{bmatrix}45\\8\\0\end{bmatrix}=\frac{1}{6}\begin{bmatrix}66\\90\\114\end{bmatrix}=\begin{bmatrix}11\\15\\19\end{bmatrix}$ $\therefore x:y:z=11:15:19$	4
9.	Let the cost of one polythene bag, one handmade bag, one newspaper bag be R x,y, z respectively. Then 20x+30y+40z=250 i e 2x+3y+4z=25 30x+40y+20z=270 i e 3x+4y+2z=27 40x+20y+30z=200 i e 4x+2y+3z=20 These can be written as AX=B where A= $\begin{pmatrix}2 & 3 & 4\\3 & 4 & 2\\4 & 2 & 3\end{pmatrix}$,X =$\begin{pmatrix}x\\y\\z\end{pmatrix}$,B=$\begin{pmatrix}25\\27\\20\end{pmatrix}$ Det A=16-3-40=-27, Adj A=$\begin{pmatrix}8 & -1 & -10\\-1 & -16 & 8\\-10 & 8 & -1\end{pmatrix}$, A^{-1} =Adj A / det A X=A^{-1} B=1/(-27)$\begin{pmatrix}8 & -1 & -10\\-1 & -16 & 8\\-10 & 8 & -1\end{pmatrix}\begin{pmatrix}25\\27\\20\end{pmatrix}=\begin{pmatrix}1\\11\\2\end{pmatrix}$ X=1,y=11,z=2 1. cost of one polythene bag=Rs 1 2. cost of one handmade bag=Rs 11 3. cost of one newspaper bag=Rs 2 newspaper bag is better for environment.	1 1 1 1
10.	Let no of the three types of toys be x, y, z. 20x+10y+5z=180, 10x+20y+25z=120,10x+30y+15z=120	½ ½

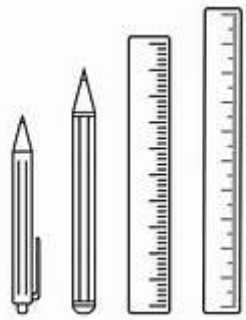
	AX=B where A=$\begin{pmatrix} 20 & 10 & 5 \\ 10 & 20 & 25 \\ 10 & 30 & 15 \end{pmatrix}$, B=$\begin{bmatrix} 180 \\ 120 \\ 120 \end{bmatrix}$; X=$\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ detA=-1500 Adj A=$\begin{pmatrix} -450 & 0 & 150 \\ 100 & 250 & -450 \\ 100 & -500 & 300 \end{pmatrix}$, A^{-1} =Adj A / det A X=A^{-1} B= 1/(-1500) $\begin{pmatrix} -450 & 0 & 150 \\ 100 & 250 & -450 \\ 100 & -500 & 300 \end{pmatrix}\begin{bmatrix} 180 \\ 120 \\ 120 \end{bmatrix} = \begin{bmatrix} 42 \\ 40 \\ 40 \end{bmatrix}$ So x=42,y=40,z=40	½ ½ 1 1
11.	Let, $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ According to the given condition, $\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 0 & 3 \end{bmatrix} = \begin{bmatrix} \gamma & 0 \\ 0 & \gamma \end{bmatrix}$ for some scalar γ. Or, $a = \gamma,\ \ 2c + 3d = \gamma,\ \ c = 0,\ \ 2a + 3b = 0$ Therefore, $a = \gamma, b = \frac{-2\gamma}{3},\ c = 0,\ d = \frac{\gamma}{3}$ $\lvert 3A \rvert = 108$ Or, $\lvert A \rvert = 12$ Also, $\lvert A \rvert = \frac{\gamma^2}{3}$ So, $\frac{\gamma^2}{3} = 12$ Or, $\gamma = \pm 6$ Therefore, $A = \begin{bmatrix} 6 & -4 \\ 0 & 2 \end{bmatrix}$ When $\gamma = 6$ $A^2 = \begin{bmatrix} 36 & -32 \\ 0 & 4 \end{bmatrix}$	4
12.	Given, $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} \cdots \begin{bmatrix} 1 & n-1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 78 \\ 0 & 1 \end{bmatrix}$ Or, $\begin{bmatrix} 1 & 1+2+3+\cdots+(n-1) \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 78 \\ 0 & 1 \end{bmatrix}$ Or, $\frac{n(n-1)}{2} = 78$ Or, $n = 13$ as $n \neq -12$ $\begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 13 \\ 0 & 1 \end{bmatrix} = A(Say)$ Therefore, $A^{-1} = \begin{bmatrix} 1 & -13 \\ 0 & 1 \end{bmatrix}$	4

13.	(i) x +y+z= 21 , 4x+3y+2z=60 ,6x+2y+3z=70 $(ii)\begin{bmatrix}1 & 1 & 1\\ 4 & 3 & 2\\ 6 & 2 & 3\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix}=\begin{bmatrix}21\\ 60\\ 70\end{bmatrix}$ (iv) x= Rs 5 , y= Rs 8 ,z= Rs. 8	1 1 2
14.	(i) 5x +3y+z= 160 , 2x+y+3z=190 ,x+2y+4z=250 (ii) IAI= -22 (iii) $A^{-1}=\frac{1}{22}\begin{bmatrix}2 & 10 & -8\\ 5 & -19 & 13\\ -3 & 7 & 1\end{bmatrix}$	1 1 2

CHAPTER-4

DETERMINANTS

05 MARKS TYPE QUESTIONS

Q. NO	QUESTION	MARK
1.	**Show that** $\begin{vmatrix} 1 & x & x^2 \\ x^2 & 1 & x \\ x & x^2 & 1 \end{vmatrix} = (1-x^3)^2$	5
2.	$\begin{vmatrix} x & x^2 & yz \\ y & y^2 & zx \\ z & z^2 & xy \end{vmatrix}$ =(x-y) (y-z) (z-x) (xy+yz+zx).	5
3.	Given $A = \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$, find AB and use it to solve the system of equations: $x - y + z = 4; x - 2y - 2z = 9 \; and \; 2x + y + 3z = 1.$	5
4.	Radhika buys 5 pencils, 3 rulers and 1bottle and pays a sum of ₹160. Amit buys 2 pencils, 1 ruler and 3 bottles for ₹190. Also Ankit buys 1 pencil, 2 rulers and 4 bottles for ₹ 250. Express the above in matrix form and find the cost of each article.  	5
5.	Solve the following system of equations , using matrix method; $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4 \; ; \; \frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1 \; ; \; \frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$	5
6.	A square matrix A is invertible if A is non singular and $A^{-1} = \frac{1}{\lvert A \rvert} adjA$ If $A = \begin{bmatrix} 2 & 3 & 4 \\ 1 & -1 & 0 \\ 0 & 1 & 2 \end{bmatrix}$, find A^{-1}. Using A^{-1} solve the system of equations $x - y = 3 \; ; 2x + 3y + 4z = 17; \; y + 2z = 7$	5
7.	The management committee of GOKUL DHAM SOCIETY decided to award some of its members (say x) for honesty, some (say y) for helping others and some others(say z) for supervising the workers to keep the colony neat and clean. The sum of all the awardees is 12. Three times of the sum of awardees for cooperation and supervision added to two times the number of awardees for honesty is 33. The sum of number of awardees for honesty and supervision is twice the number of awardees for helping	5

Find the number of awardees for each honesty, cooperation and supervision.
Also find the value of 2x + 3y + 5z

8. Solve the system of equations: 5

x+y+z=6000 ;x+3z=11000 ; x-2y+z= 0

9. Solve the following equations by using matrix method 5

$\frac{1}{u}+\frac{1}{v}+\frac{1}{w}=12, \frac{3}{v}+\frac{3}{w}+\frac{2}{u}=33, \frac{1}{u}+\frac{1}{w}=\frac{2}{v}$

10. Two factories decided to award their employees for three values of (a) adaptable to new techniques, (b) careful and alert in difficult situations and (c) keeping calm in tense situations, at the rate of Rs. x, y and z per person respectively. The first factory decided to honour respectively 2, 4 and 3 employees with a total prize money of Rs.29000. The second factory decided to honour respectively 5, 2 and 3 employees with the prize money of Rs.30500. If the three prizes per person together cost Rs. 9500, then 5

(i) Represent the above situation by a matrix equation and form linear equations using matrix multiplication.
(ii) Solve these equations using matrices.
(iii) Which values are reflected in the questions?

11. A mixture is to be made of three foods A, B, C. The three foods A, B, C contain nutrients P.Q, R as shown below: 5

Food	Ounces per pound of Nutrient		
	P	Q	R
A	1	2	5
B	3	1	1
C	4	2	1

How to form a mixture which will have 8 ounces of P, 5 ounces of Q and 7 ounces of R?

12. If $A=\begin{bmatrix}2 & -3 & 5\\ 3 & 2 & -4\\ 1 & 1 & -2\end{bmatrix}$ find A^{-1}. Hence solve the given equations $2x-3y+5z=11;$ 5

$$3x+2y-4z=-5;$$

$$x+y-2z=-3.$$

13.	Given that A = $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ and B = $\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$, find AB and use it to solve the system of equations: x – y + z = 4; x – 2y – 2z = 9; 2x + y +3z = 1	5

ANSWERS:

Q. NO	ANSWER	MARKS
1.	$C_1 \to C_1 + C_2 + C_3$ $= \begin{vmatrix} 1+x+x^2 & x & x^2 \\ 1+x+x^2 & 1 & x \\ 1+x+x^2 & x^2 & 1 \end{vmatrix}$ $= (1+x+x^2)\begin{vmatrix} 1 & x & x^2 \\ 1 & 1 & x \\ 1 & x^2 & 1 \end{vmatrix}$ $R_1 \to R_1 - R_3 \quad R_2 \to R_2 - R_3$ $= (1+x+x^2)\begin{vmatrix} 0 & x-x^2 & x^2-1 \\ 0 & 1-x^2 & x-1 \\ 1 & x^2 & 1 \end{vmatrix}$ $= (1+x+x^2)\begin{vmatrix} 0 & x(1-x) & -(1-x)(1+x) \\ 0 & (1-x)(1+x) & -(1-x) \\ 1 & x^2 & 1 \end{vmatrix}$ Taking $(1-x)$ common from R_1 and R_2 $= (1+x+x^2)(1-x)^2\begin{vmatrix} 0 & x & -(1+x) \\ 0 & 1+x & -1 \\ 1 & x^2 & 1 \end{vmatrix}$ Expending along C^1 $= (1+x+x^2)(1-x)^2[-x+(1+x)^2]$ $= (1+x+x^2)(1-x)^2(-x+1+x^2+2x)$ $= (1-x)(1+x+x^2)(1-x)(1+x+x^2)$ $= (1-x^3)^2$	5
2.	$R_1 \to R_1 - R_3, \quad R_2 \to R_2 - R_3$ $= \begin{vmatrix} (x-z) & (x^2-z^2) & yz-xy \\ y-z & y^2-z^2 & zx-xy \\ z & z^2 & xy \end{vmatrix}$ $= (x-z)(y-z)\begin{vmatrix} 1 & x+z & -(y) \\ 1 & y+z & -x \\ z & z^2 & xy \end{vmatrix}$ $R_1 \to R_1 - R_2$ $= (x-z)(y-z)\begin{vmatrix} 0 & x-y & x-y \\ 1 & y+z & -x \\ z & z^2 & xy \end{vmatrix}$	5

	$=(x-z)(y-z)(x-y)\begin{vmatrix}0 & 1 & 1\\ 1 & y+z & -x\\ z & z^2 & xy\end{vmatrix}$ $=(x-z)(y-z)(x-y)\left[-1(xy+zx)+1\left(z^2-y^2-z^2\right)\right]$ $=(x-z)(y-z)(x-y)\left[-xy-zx-yz\right]$ $=(x-y)(y-z)(z-x)(xy+yz+zx)$	
3.	$A=\begin{bmatrix}-4 & 4 & 4\\ -7 & 1 & 3\\ 5 & -3 & -1\end{bmatrix}\quad B=\begin{bmatrix}1 & -1 & 1\\ 1 & -2 & -2\\ 2 & 1 & 3\end{bmatrix}$ $AB=8I\ \Rightarrow B^{-1}=\frac{1}{8}A$ The given system of equation in matrix form is $BX=C$ where $X=\begin{bmatrix}x\\ y\\ z\end{bmatrix}$ *and* $C=\begin{bmatrix}4\\ 9\\ 1\end{bmatrix}$ $\Rightarrow B^{-1}=\frac{1}{8}\begin{bmatrix}-4 & 4 & 4\\ -7 & 1 & 3\\ 5 & -3 & -1\end{bmatrix}.\begin{bmatrix}4\\ 9\\ 1\end{bmatrix}=\frac{1}{8}\begin{bmatrix}24\\ -16\\ -8\end{bmatrix}=\begin{bmatrix}3\\ -2\\ -1\end{bmatrix}\Rightarrow x=3; y=-2\ \&\ z=-1$	5
4.	Let the cost of the three articles be ₹ x, ₹ y and ₹z respectively. $5x+3y+z=160; 2x+y+3z=190$ *and* $x+2y+4z=250$ In matrix form the equations can be represented as $\begin{bmatrix}5 & 3 & 1\\ 2 & 1 & 3\\ 1 & 2 & 4\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix}=\begin{bmatrix}160\\ 190\\ 250\end{bmatrix}\Rightarrow x=10, y=20\,and\ z=50$	5
5.	Let $\frac{1}{x}=a$, $\frac{1}{y}=b$, $\frac{1}{z}=c$,then the given system of equation become 2a+3b+10c = 4 4a–6b +5c = 1 6a + 9b – 20c= 2 This system of equation can be written as Ax = B Here, A = $\begin{bmatrix}2 & 3 & 10\\ 4 & -6 & 5\\ 6 & 9 & -20\end{bmatrix}$ X = $\begin{bmatrix}x\\ y\\ z\end{bmatrix}$ and B = $\begin{bmatrix}4\\ 1\\ 2\end{bmatrix}$ Now, $\lvert A\rvert$ = 2(120-45) -3(-80-30) +10(36+36) = 150+30+720 =1200 ⇨ A^{-1} exist. adj(A) = $\begin{bmatrix}75 & 150 & 75\\ 110 & -100 & 30\\ 72 & 0 & -24\end{bmatrix}$ A^{-1} = 1/1200 $\begin{bmatrix}75 & 150 & 75\\ 110 & -100 & 30\\ 72 & 0 & -24\end{bmatrix}$ Now , X = $A^{-1}B$ Putting the values ,we get , x= 2 ,y = 3 , z = 5	5

6.	$\|A\| = -6 \neq 0,\ A^{-1} = \frac{1}{\|A\|} adjA = \frac{1}{-6}\begin{bmatrix} -2 & -2 & 4 \\ -2 & 4 & 4 \\ 1 & -2 & -5 \end{bmatrix}$ System of equation is as AX = B, where $A = \begin{bmatrix} 2 & 3 & 4 \\ 1 & -1 & 0 \\ 0 & 1 & 2 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} 17 \\ 3 \\ 7 \end{bmatrix}$ $X = A^{-1}B = \frac{1}{-6}\begin{bmatrix} -2 & -2 & 4 \\ -2 & 4 & 4 \\ 1 & -2 & -5 \end{bmatrix}\begin{bmatrix} 17 \\ 3 \\ 7 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}$ $\therefore x = 2, y = -1, z = 4$	5
7.	x+ y +z = 12; 2x + 3y + 3z = 33; x – 2y + z = 0 therefore the system of equation can be written as AX = B, where $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 3 \\ 1 & -2 & 1 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} 12 \\ 33 \\ 0 \end{bmatrix}$ $\|A\| = 3, \quad \therefore A^{-1} = \frac{1}{3}\begin{bmatrix} 9 & -3 & 0 \\ 1 & 0 & -1 \\ -7 & 3 & 1 \end{bmatrix}$ $X = A^{-1}B = \frac{1}{3}\begin{bmatrix} 9 & -3 & 0 \\ 1 & 0 & -1 \\ -7 & 3 & 1 \end{bmatrix}\begin{bmatrix} 12 \\ 33 \\ 0 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix}$ $\therefore x = 3, y = 4, z = 5$ $2x + 3y + 5z = 6 + 12 + 25 = 43$	5
8.	x+y+z=6000 ;x+3z=11000 ; x-2y+z= 0 AX=B A=$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 3 \\ 1 & -2 & 1 \end{bmatrix}$; B=$\begin{bmatrix} 6000 \\ 11000 \\ 0 \end{bmatrix}$; X=$\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ Det A=6 Adj A= $\begin{bmatrix} 6 & -3 & 3 \\ 2 & 0 & -2 \\ -2 & 3 & -1 \end{bmatrix}$ $A^{-1} = 1/6.\begin{bmatrix} 6 & -3 & 3 \\ 2 & 0 & -2 \\ -2 & 3 & -1 \end{bmatrix}$ $X=A^{-1}B=\begin{bmatrix} 500 \\ 2000 \\ 3500 \end{bmatrix}$ So x=500,y=2000,z=3500	½ ½ ½ 1 ½ ½ +1 ½
9.	Let $x=\frac{1}{u}$, $y=\frac{1}{v}$,$z=\frac{1}{w}$ We have x+y+z=12, 3y+3z+2x=33, x+z=2y i.e. AX=B	½ ½ ½+½

	where A = $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 3 \\ 1 & -2 & 1 \end{bmatrix}$ & $\lvert A \rvert$ = 3 Now, AdjA = $\begin{bmatrix} 9 & -3 & 0 \\ 1 & 0 & -1 \\ -7 & 3 & 1 \end{bmatrix}$ So, X = $A^{-1}B = \frac{Adj\,A}{\lvert A \rvert}B$ thus X = $\frac{1}{3}\begin{bmatrix} 9 \\ 12 \\ 15 \end{bmatrix}$, $\therefore x = 3,\ y = 4,\ z = 5$	½+½ 1 1
10.	According to the question, $2x + 3y + 4z = 29000$ $5x + 2y + 3z = 30500$ $x + y + z = 9500$ The above equations can be written as, $AX = B$ Where $A = \begin{bmatrix} 2 & 3 & 4 \\ 5 & 2 & 3 \\ 1 & 1 & 1 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 29000 \\ 30500 \\ 9500 \end{bmatrix}$ Therefore , $X = A^{-1}B$ Solving We get, $x = 2750, \quad y = 3500, \ z = 3250.$	5
11.	Let x pounds of food A, y pounds of food B and z pounds of food C be needed to form the mixture. According to the question, $x + 3y + 4z = 8$ $2x + y + 2z = 5$ $5x + y + z = 7$ The above equations can be written as, $AX = B$ Where $A = \begin{bmatrix} 1 & 3 & 4 \\ 2 & 1 & 2 \\ 5 & 1 & 1 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, $B = \begin{bmatrix} 8 \\ 5 \\ 7 \end{bmatrix}$ Now, $\lvert A \rvert = 11 \neq 0$ So, $A^{-1} = \frac{1}{11}\begin{bmatrix} -1 & 1 & 2 \\ 8 & -19 & 6 \\ -3 & 14 & -5 \end{bmatrix}$, Solving We get,	5

	$x = 1, \quad y = 1, \ z = 1.$	
12.	.$\|A\|$= 2(-4+4) - (-3)(-6+4)+5(3-2) = 2.0+3(-2)+5.1 = 0-6+5 = $-1 \neq 0 \therefore A^{-1}$exists. Then,adj A = $\begin{bmatrix} 0 & 2 & 1 \\ -1 & -9 & -5 \\ 2 & 23 & 13 \end{bmatrix}^T = \begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix}$ $\therefore A^{-1} = \frac{\mathbf{1}}{\|\boldsymbol{A}\|}$ **adj A** $= \frac{\mathbf{1}}{\mathbf{-1}} \begin{bmatrix} 0 & -1 & 2 \\ 2 & -9 & 23 \\ 1 & -5 & 13 \end{bmatrix} = \begin{bmatrix} 0 & 1 & -2 \\ -2 & 9 & -23 \\ -1 & 5 & -13 \end{bmatrix}$ The given system of equations can be written as a single matrix equation $\begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix}$ i.e. $AX = B$ $\Longrightarrow X = A^{-1}B = \begin{bmatrix} 0 & 1 & -2 \\ -2 & 9 & -23 \\ -1 & 5 & -13 \end{bmatrix} \begin{bmatrix} 11 \\ -5 \\ -3 \end{bmatrix} = \begin{bmatrix} 0.11 + 1.(-5) + (-2).(-3) \\ -2.11 + 9.(-5) + (-23).(-3) \\ -1.11 + 5.(-5) + (-13).(-3) \end{bmatrix}$ $= \begin{bmatrix} 0 - 5 + 6 \\ -22 - 45 + 69 \\ -11 - 25 + 39 \end{bmatrix}$ $\Longrightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} \quad \therefore x = 1, \ y = 2, \ z = 3.$	1 1 1 1 1
13.	AB = $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ $= \begin{bmatrix} -4 + 4 + 8 & 4 - 8 + 4 & -4 - 8 + 12 \\ -7 + 1 + 6 & 7 - 2 + 3 & -7 - 2 + 9 \\ 5 - 3 - 2 & -5 + 6 - 1 & 5 + 6 - 3 \end{bmatrix}$ $= \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix} = 8 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = 8 \ I_3$ $\Rightarrow (\frac{A}{8}) \ B = I \qquad \Rightarrow B^{-1} = \frac{A}{8}$ $\Rightarrow B^{-1} = \frac{1}{8} \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ The given system of equations can be written as a single matrix equation $\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 9 \\ 1 \end{bmatrix}$ i.e. B X = C$\Rightarrow$ X = B^{-1} C = $\frac{1}{8} \begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 4 \\ 9 \\ 1 \end{bmatrix} = \frac{1}{8} \begin{bmatrix} 24 \\ -16 \\ -8 \end{bmatrix}$ $\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ -2 \\ -1 \end{bmatrix} \Rightarrow$ x =2, y = -2, z= -1	2 1 2

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