GRADE XII
Question Bank (MATHEMATICS)
Chapter-4 Determinants

1 Marks:

1. Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ be a square matrix such that $adj\, A = A$. Then, $a + b + c + d$ is equal to **[BOARD 2024]**

   a) 2a b) 2b c) 2c d) 0

2. If A and B are two square matrices of order 2 and $|A| = 2$ and $|B| = 5$ then $|-3AB|$ is **[BOARD 2024 & 2025]**

   a) -90 b) -30 c) 30 d) 90

3. If $A = [a_{ij}]$ is a 3×3 diagonal matrix such that $a_{11} = 1, a_{22} = 5$ and $a_{33} = -2$ then $|A|$ is **[BOARD 2025]**

   a) 0 b) -10 c) 10 d) 1

4. If A is a square matrix of order 3 and $|A| = 6$ then the value of $|adj\, A|$ is **[BOARD 2023 & 2025]**

   a) 6 b) 36 c) 27 d) 216

5. If A is a square matrix of order 2 and $|A| = 4$ then the value of $|adj\, A|$ is **[BOARD 2025]**

   a) 16 b) 64 c) 256 d) 512

6. If $|A| = 2$, where A is a 2×2 matrix then $|4A^{-1}|$ equals **[BOARD 2023]**

   a) 4 b) 2 c) 8 d) $\frac{1}{32}$

7. If A is a square matrix of order 3 such that $|A| = 9$ then $|9A^{-1}|$ is **[BOARD 2025]**

   a) 9 b) 9^2 c) 9^3 d) 9^4

8. Let A be a 3×3 matrix such that $|adj\, A| = 64$. Then $|A|$ is equals **[BOARD 2023]**

   a) 8 only b) -8 only c) 64 d) ± 8

9. If A is a square matrix of order 3 such that the value of $|adj\, A| = 8$ then the value of $|A^T|$ is **[BOARD 2024]**

   a) $\sqrt{2}$ b) $-\sqrt{2}$ c) 8 d) $2\sqrt{2}$

10. If $\left|\frac{A^{-1}}{2}\right| = \frac{1}{k|A|}$, where A is a 3×3 matrix, then the value of k is **[BOARD 2023]**

    a) $\frac{1}{8}$ b) 8 c) 2 d) $\frac{1}{2}$

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11. If $|A| = |kA|$, where A is a square matrix of order 2, then sum of all possible values of k is **[BOARD 2023]**

a) 1 b) -1 c) 2 d) 0

12. If $A = kB$, where A and B are two square matrices of order n and k is a scalar then **[BOARD 2025]**

a) $|A| = k|B|$ b) $|A| = k^n|B|$ c) $|A| = k + |B|$ d) $|A| = |B|^k$

13. If $\begin{bmatrix} 4+x & x-1 \\ -2 & 3 \end{bmatrix}$ is a singular matrix then the value of x is **[BOARD 2025]**

a) 0 b) 1 c) -2 d) -4

14. If $\begin{bmatrix} x & 2 \\ 3 & x-1 \end{bmatrix}$ is a singular matrix, then the product of all possible values of x is **[BOARD 2023]**

a) 6 b) -6 c) 0 d) -7

15. If $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 3 & 1 \\ 3 & a & 1 \end{bmatrix}$ is non-singular matrix and $a \in A$, then the set A is **[BOARD 2023]**

a) R b) $\{0\}$ c) $\{4\}$ d) $R - \{4\}$

16. For which value of x, are the determinants $\begin{vmatrix} 2x & -3 \\ 5 & x \end{vmatrix}$ and $\begin{vmatrix} 10 & 1 \\ -3 & 2 \end{vmatrix}$ equal? **[BOARD 2023]**

a) ± 3 b) -3 c) ± 2 d) 2

17. If $\begin{vmatrix} 2x & 5 \\ 12 & x \end{vmatrix} = \begin{vmatrix} 6 & -5 \\ 4 & 3 \end{vmatrix}$ then the value of x is **[BOARD 2025]**

a) 3 b) 7 c) ± 7 d) ± 3

18. The value of the cofactor of the element of second row and third column in the matrix $\begin{bmatrix} 4 & 3 & 2 \\ 2 & -1 & 0 \\ 1 & 2 & 3 \end{bmatrix}$ is **[BOARD 2023]**

a) 5 b) -5 c) -11 d) 11

19. If $A.(adj\ A) = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ then the value of $|A| + |adj\ A|$ is equal to **[BOARD 2023]**

a) 12 b) 9 c) 3 d) 27

20. If $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 3 & 4 \\ 1 & 4 & 3 \end{bmatrix}$ then the value of $|A^{-1}|$ is **[BOARD 2024]**

a) -1 b) 1 c) 0 d) 2

21. If $A = \begin{bmatrix} -2 & 0 & 0 \\ 1 & 2 & 3 \\ 5 & 1 & -1 \end{bmatrix}$ then the value of $|A\ (adj\ A)|$ is **[BOARD 2024]**

a) 100 I b) 10 I c) 10 d) 1000

22. $\begin{vmatrix} x+1 & x-1 \\ x^2+x+1 & x^2-x+1 \end{vmatrix}$ is equal to **[BOARD 2024]**

a) $2x^3$ b) 2 c) 0 d) $2x^3 - 2$

23. The value of $\begin{vmatrix} x+y & y+z & z+x \\ z & x & y \\ 1 & 1 & 1 \end{vmatrix}$ is **[BOARD 2023]**

a) 0 b) 1 c) $x + y + z$ d) $2(x + y + z)$

24. The value of $\begin{vmatrix} 2 & 7 & 1 \\ 1 & 1 & 1 \\ 10 & 8 & 1 \end{vmatrix}$ is **[BOARD 2023]**

a) 47 b) -79 c) 49 d) -51

25. The value of $\begin{vmatrix} 6 & 0 & -1 \\ 2 & 1 & 4 \\ 1 & 1 & 3 \end{vmatrix}$ is **[BOARD 2023]**

a) 10 b) 8 c) 7 d) -7

26. If $\begin{vmatrix} \alpha & 3 & 4 \\ 1 & 2 & 1 \\ 1 & 4 & 1 \end{vmatrix} = 0$, then the value of α is **[BOARD 2023]**

a) 1 b) 2 c) 3 d) 4

27. If $\begin{vmatrix} -a & b & c \\ a & -b & c \\ a & b & -c \end{vmatrix} = kabc$, then the value of k is **[BOARD 2024]**

a) 0 b) 1 c) 2 d) 4

28. If $\begin{vmatrix} 1 & 3 & 1 \\ k & 0 & 1 \\ 0 & 0 & 1 \end{vmatrix} = \pm 6$ then the value of k is **[BOARD 2024]**

a) 2 b) -2 c) ± 2 d) ∓ 2

29. If $\begin{vmatrix} -1 & 2 & 4 \\ 1 & x & 1 \\ 0 & 3 & 3x \end{vmatrix} = -57$ the product of the possible values of x is **[BOARD 2025]**

a) -24 b) -16 c) 16 d) 24

30. If a_{ij} and A_{ij} represent the $(ij)^{th}$ element and its cofactor of $\begin{bmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{bmatrix}$ respectively, then the value of $a_{11}A_{21} + a_{12}A_{22} + a_{13}A_{23}$ is **[BOARD 2024]**

a) 0 b) -28 c) 114 d) -114

31. If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ then A^{-1} is **[BOARD 2024 & 2025]**

a) $\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$ b) $30\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$ c) $\frac{1}{30}\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ d) $\frac{1}{30}\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$

32. Given that $A^{-1} = \frac{1}{7}\begin{bmatrix} 2 & 1 \\ -3 & 2 \end{bmatrix}$ then matrix A is **[BOARD 2024]**

a) $7\begin{bmatrix} 2 & -1 \\ -3 & 2 \end{bmatrix}$ b) $\begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$ c) $\frac{1}{7}\begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$ d) $\frac{1}{49}\begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$

33. If inverse of matrix $\begin{bmatrix} 7 & -3 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$ is the matrix $\begin{bmatrix} 1 & 3 & 3 \\ 1 & \lambda & 3 \\ 1 & 3 & 4 \end{bmatrix}$ then the value of λ is **[BOARD 2024]**

a) -4 b) 1 c) 3 d) 4

34. If $(a, b), (c, d)$and (e, f) are the vertices of ΔABC and Δ denotes the area of triangle ABC, then $\begin{vmatrix} a & c & e \\ b & d & f \\ 1 & 1 & 1 \end{vmatrix}^2$ is equal to **[BOARD 2023]**

a) $2\Delta^2$ b) $4\Delta^2$ c) 2Δ d) 4Δ

35. Let A be the area of triangle having vertices $(x_1, y_1), (x_2, y_2)$ and (x_3, y_3). Which of the following is correct? **[BOARD 2023]**

a) $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm A$ c) $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm \frac{A}{2}$

b) $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \pm 2A$ d) $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}^2 = A^2$

36. If the area of a triangle with vertices $(2, -6), (5, 4)$ and $(k, 4)$ is 35 sq. units then k is **[BOARD 2023]**

a) 12 b) -2 c) -12, -2 d) 12, -2

2 Marks:

1. Using matrices and determinants, find the values of k for which the piar of equations $5x - ky = 2$ and $7x - 5y = 3$ has a unique solution. **[BOARD 2025]**

3 Marks:

1. Using determinants, find the area of ΔPQR with vertices $P(3,1), Q(9,3)\ and\ R(5,7)$. Also, find the equation of line PQ using determinants. **[BOARD 2023]**
2. Show that the determinant $\begin{vmatrix} x & \sin\theta & \cos\theta \\ -\sin\theta & -x & 1 \\ \cos\theta & 1 & x \end{vmatrix}$ is independent of θ.

[BOARD 2023]

5 Marks:

1. If $A = \begin{bmatrix} 1 & \cot x \\ -\cot x & 1 \end{bmatrix}$ then show that $A'A^{-1} = \begin{bmatrix} -\cos 2x & -\sin 2x \\ \sin 2x & -\cos 2x \end{bmatrix}$. **[BOARD 2024]**
2. If $A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$ and $B^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$ find $(AB)^{-1}$. **[BOARD 2023]**
3. If $A = \begin{bmatrix} 5 & 0 & 4 \\ 2 & 3 & 2 \\ 1 & 2 & 1 \end{bmatrix}$ and $B^{-1} = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$ find $(AB)^{-1}$. Also find $|(AB)^{-1}|$.

[BOARD 2024]

4. If $A = \begin{bmatrix} -1 & a & 2 \\ 1 & 2 & x \\ 3 & 1 & 1 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1 & -1 & 1 \\ -8 & 7 & -5 \\ b & y & 3 \end{bmatrix}$ then find the value of $(a + x) - (b + y)$.

[BOARD 2024]

5. If A is a 3×3 invertible matrix, show that for any scalar $k \neq 0, (kA)^{-1} = \frac{1}{k}A^{-1}$.

   Hence calculate $(3A)^{-1}$, where $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$. **[BOARD 2025]**

6. If $A = \begin{bmatrix} 3 & 2 \\ 5 & -7 \end{bmatrix}$ then find A^{-1} and use it to solve the following system of equations: **[BOARD 2023]**

$$3x + 5y = 11$$

$$2x - 7y = -3$$

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7. Solve the following system of equations by matrix method: **[BOARD 2023]**

$$x + 2y + 3z = 6$$
$$2x - y + z = 2$$
$$3x + 2y - 2z = 3$$

8. Solve the following system of equations using matrices: **[BOARD 2024]**

$$\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$$
$$\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$$
$$\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$$

9. If $A = \begin{bmatrix} -3 & -2 & -4 \\ 2 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 & 0 \\ -2 & -1 & -2 \\ 0 & -1 & 1 \end{bmatrix}$ then find AB and use it to solve the following system of equations: **[BOARD 2023]**

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

10. 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. Hence solve the system of linear equations: **[BOARD 2025]**

$$x - y + z = 4$$
$$x - 2y - 2z = 9$$
$$2x + y + 3z = 1$$

11. Given $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ 1 & 1 & 2 \end{bmatrix}$ find A^{-1}. Use it to solve the following system of equations:

[BOARD 2024 & 2025]

$$x + y + z = 1$$
$$2x + 3y + 2z = 2$$
$$x + y + 2z = 4$$

12. If matrix $A = \begin{bmatrix} 3 & 2 & 1 \\ 4 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix}$ find A^{-1} and hence solve the following system of linear equations: **[BOARD 2023]**

$$3x + 2y + z = 2000$$
$$4x + y + 3z = 2500$$
$$x + y + z = 900$$

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13. Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 6 & 7 & 8 \\ 6 & 7 & -8 \end{bmatrix}$ find A^{-1} and hence solve the following system of linear equations: **[BOARD 2023]**

$$x + y + z = 5000$$
$$6x + 7y + 8z = 35800$$
$$6x + 7y - 8z = 7000$$

14. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix}$ find A^{-1} and hence solve the following system of linear equations: **[BOARD 2023 & 2024]**

$$x + y + z = 6$$
$$x + 2z = 7$$
$$3x + y + z = 12$$

15. Find the inverse of the matrix $A = \begin{bmatrix} 1 & -1 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix}$. Using the inverse A^{-1}, solve the system of linear equations: **[BOARD 2023]**

$$x - y + 2z = 1$$
$$2y - 3z = 1$$
$$3x - 2y + 4z = 3$$

16. Use the product of matrices $\begin{pmatrix} 1 & 2 & -3 \\ 3 & 2 & -2 \\ 2 & -1 & 1 \end{pmatrix}\begin{pmatrix} 0 & 1 & 2 \\ -7 & 7 & -7 \\ -7 & 5 & -4 \end{pmatrix}$ to solve the following system of equations: **[BOARD 2024]**

$$x + 2y - 3z = 6$$
$$3x + 2y - 2z = 3$$
$$2x - y + z = 2$$

17. A furniture workshop produces three types of furniture – chairs, tables and beds each day. On a particular day the total number of furniture pieces produced is 45. It was also found that production of beds exceeds that of chairs by 8, while the total production of beds and chairs together is twice the production of tables. Determine the units of each type of furniture using matrix method. **[BOARD 2025]**

18. An amount of Rs 10,000 is put into three investments at the rate of 10%, 12% and 15% per annum. The combined annual income of all three investments is Rs 1310, however combined annual income of the first and the second

investments is Rs 190 short of the income of the third. Use matrix method and find the investment amount in each at the beginning of the year.

[BOARD 2025]

19. Three students run on a racing track such that their speeds add up to 6 km/hr. However, double the speed of the third runner added to the speed of the first results in 7 km/hr. If thrice the speed of the first runner is added to the original speeds of the other two, the result is 12 km/hr. Using matrix method, find the original speed of each runner. **[BOARD 2025]**
20. A school wants to allocate students into three clubs: Sports, Music and Drama, under following conditions: **[BOARD 2025]**
    - The number of students in Sports club should be equal to the sum of the number of students in Music and Drama club.
    - The number of students in Music club should be 20 more than half the number of students in Sports club.
    - The total number of students to be allocated in all three clubs are 180.

    Find the number of students allocated to different clubs, using matrix method.

Case Based Questions:

1. A scholarship is a sum of money provided to a student to help him or her pay for education. Some students are granted scholarships based on their academic achievements, while others are rewarded based on their financial needs.

Every year a school offers scholarships to girl children and meritorious achievers based on certain criteria. In the session 2022 – 23, the school offered monthly scholarship of Rs 3,000 each to some girl students and Rs 4,000 each to meritorious achievers in academics as well as sports. In all, 50 students were

given the scholarships and monthly expenditure incurred by the school on scholarships was Rs 1,80,000. **[BOARD 2024]**

Based on the above information, answer for the following:

(i) Express the given information algebraically using matrices. **1**

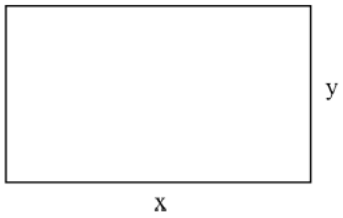
(ii) Check whether the system of matrix equations so obtained is consistent or not. **1**

(iii) (a) Find the number of scholarships of each kind given by the school, using matrices. **2**

(OR)

(b) Had amount of scholarships given to each girl child and meritorious student been interchanged, what would be the monthly expenditure incurred by the school? **2**

2. An architect is developing a plot of land for a commercial complex. When asked about the dimensions of the plot, he said that if the length is decreased by 25 m and the breadth is increased by 25 m, then its area increases by 625 m^2. If the length is decreased by 20 m and the breadth is increased by 10 m, then its area decreases by 200 m^2. **[BOARD 2024]**



Based on the above information, answer for the following:

(i) Formulate the linear equations in x and y to represent the given information. **2**

(ii) Find the dimensions of the plot of land by matrix method. **2**

3. Three students Neha, Rani and Sam go to a market to purchase stationary items. Neha buys 4 pens, 3 notepad and 2 erasers and pays Rs 60. Rani buys 2 pens, 4 notepads and 6 erasers for Rs 90. Sam pays Rs 70 for 6 pens, 2 notepads and 3 erasers. **[BOARD 2025]**

Based on the above information, answer for the following:

(i) Form the equations required to solve the problem of finding the price of each item and express it in the matrix form $AX = B$. **1**

(ii) Find $|A|$ and confirm if it is possible to find A^{-1}. **1**

(iii) (a) Find A^{-1}, if possible and write the formula to find X. **2**

(OR)

(b) Find $A^2 - 8I$, where I is an identity matrix. **2**

4. Gautam buys 5 pens, 3 bags and 1 instrument box and pays a sum of Rs 160. From the shop, Vikram buys 2 pens, 1 bag and 3 instrument boxes and pays a sum of Rs 190. Also Ankur buys 1 pen, 2 bags and 4 instrument boxes and pays a sum of Rs 250. **[BOARD 2023]**

Based on the above information, answer for the following:

(i) Convert the given above situation into a matrix equation of the form $AX = B$. **1**

(ii) Find $|A|$. **1**

(iii) (a) Find A^{-1}. **2**

(OR)

(b) Determine $P = A^2 - 5A$. **2**