CBSE 2025-26

Class 12 - Mathematics

Matrices

Important Question

Question No. 1 to 5 are based on the given text. Read the text carefully and answer the questions:

Consider 2 families A and B. Suppose there are 4 men, 4 women and 4 children in family A and 2 men, 2 women and 2 children in family B. The recommended daily amount of calories is 2400 for a man, 1900 for a woman, 1800 for children and 45 grams of proteins for a man, 55 grams for a woman and 33 grams for children.


1. The requirement of calories and proteins for each person in matrix form can be represented as

a. $$\begin{array}{cc} & \begin{matrix} Calories & Proteins \end{matrix} \\ \begin{matrix} Man \\ Woman \\ Children \end{matrix} & \begin{bmatrix} 2400 & 45 \\ 1900 & 55 \\ 1800 & 33 \end{bmatrix} \end{array}$$

b. $$\begin{array}{cc} & \begin{matrix} Calories & Proteins \end{matrix} \\ \begin{matrix} Man \\ Woman \\ Children \end{matrix} & \begin{bmatrix} 1900 & 55 \\ 2400 & 45 \\ 1800 & 33 \end{bmatrix} \end{array}$$

c. $$\begin{array}{cc} & \begin{matrix} Calories & Proteins \end{matrix} \\ \begin{matrix} Man \\ Woman \\ Children \end{matrix} & \begin{bmatrix} 1800 & 33 \\ 1900 & 55 \\ 2400 & 45 \end{bmatrix} \end{array}$$

d. $$\begin{array}{cc} & \begin{matrix} Calories & Proteins \end{matrix} \\ \begin{matrix} Man \\ Woman \\ Children \end{matrix} & \begin{bmatrix} 2400 & 33 \\ 1900 & 55 \\ 1800 & 45 \end{bmatrix} \end{array}$$

2. The requirement of calories of family A is
   a. 15800
   b. 15000
   c. 24000
   d. 24400
3. The requirement of proteins for family B is
   a. 266 grams
   b. 300 grams
   c. 332 grams
   d. 560 grams

4. If A and B are two matrices such that AB = B and BA = A, then $A^2 + B^2$ equals
   a. A + B

b. 2BA
c. 2AB
d. AB

5. If A = $(a_{ij})_{m \times n}$, B = $(b_{ij})_{n \times p}$ and C = $(c_{ij})_{p \times q}$, then the product (BC)A is possible only when
a. p = q
b. m = q
c. n = q
d. m = p

6. If A = $\begin{bmatrix} 2 & -1 & 3 \\ -4 & 5 & 1 \end{bmatrix}$ and B = $\begin{bmatrix} 2 & 3 \\ 4 & -2 \\ 1 & 5 \end{bmatrix}$ then
a. only BA is defined
b. only AB is defined
c. AB and BA both are not defined
d. AB and BA both are defined

7. If A = $\begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix}$ and A = A^T, then x is
a. x = 0, y = 5
b. none of these
c. x = y
d. x + y = 5

8. Out of the following matrices, choose that matrix which is a scalar matrix:
a. $\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$
b. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$
c. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
d. $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

9. If $A = \begin{bmatrix} \cos a & \sin a \\ -\sin a & \cos a \end{bmatrix}$ be such that A + A' = I, then a = ?.
a. $-\pi$
b. π
c. $\frac{\pi}{3}$
d. $\frac{2\pi}{3}$

10. State True or False:
i. AA' is always a symmetric matrix for any matrix A.
a. True
b. False
ii. If A and B are any two matrices of the same order, then (AB)' = A'B'.
a. True
b. False

11. Fill in the blanks:
a. Addition of matrices is defined if order of the matrices is _________.

b. If A and B are square matrices of the same order, then [k(A - B)]' = _________ where k is any scalar.

12. Match the column:

(a) Commutative Law Generally	(i) A.I = A = I.A
(b) Associative Law	(ii) A(B + C) = AB + AC
(c) Existence of multiplicative Identity	(iii) AB $\neq$ BA
(d) Distributive Law	(iv) (AB)C = A(BC)

13. If [x 2] $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$ = 2, find the value of x

14. If a matrix has 5 elements, then write all possible orders it can have.

15. Evaluate: $\begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 2 & 3 \end{bmatrix} \left(\begin{bmatrix} 1 & 0 & 2 \\ 2 & 0 & 1 \end{bmatrix} - \begin{bmatrix} 0 & 1 & 2 \\ 1 & 0 & 2 \end{bmatrix} \right)$

16. If $A = \begin{bmatrix} 2 & 4 \\ 5 & 6 \end{bmatrix}$, then Prove that A + A' is a symmetric matrix

17. If A = $\begin{bmatrix} 0 & -1 & 2 \\ 4 & 3 & -4 \end{bmatrix}$ then verify that: (kA)′ = (kA′).

18. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, prove that $A^n = \begin{bmatrix} 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \\ 3^{n-1} & 3^{n-1} & 3^{n-1} \end{bmatrix}$

Solution

1. (a) $\begin{array}{c|cc} & Calories & Proteins \\ \hline Man & 2400 & 45 \\ Woman & 1900 & 55 \\ Children & 1800 & 33 \end{array}$

   Explanation: Let F be the matrix representing the number of family members and R be the matrix representing the requirement of calories and proteins for each person. Then

   F = $\begin{array}{c} \\ Family\ A \\ Family\ B \end{array} \begin{array}{c} \begin{array}{ccc} Men & Women & Children \end{array} \\ \begin{bmatrix} 4 & 4 & 4 \\ 2 & 2 & 2 \end{bmatrix} \end{array}$

   R = $\begin{array}{c} \\ Man \\ woman \\ Children \end{array} \begin{array}{c} \begin{array}{cc} Calories & Proteins \end{array} \\ \begin{bmatrix} 2400 & 45 \\ 1900 & 55 \\ 1800 & 33 \end{bmatrix} \end{array}$

2. (d) 24400

   Explanation: The requirement of calories and proteins for each of the two families is given by the product matrix FR.

   FR = $\begin{bmatrix} 4 & 4 & 4 \\ 2 & 2 & 2 \end{bmatrix} \begin{bmatrix} 2400 & 45 \\ 1900 & 55 \\ 1800 & 33 \end{bmatrix}$

   = $\begin{bmatrix} 4(2400 + 1900 + 1800) & 4(45 + 55 + 33) \\ 2(2400 + 1900 + 1800) & 2(45 + 55 + 33) \end{bmatrix}$

   FR = $\begin{array}{c} \begin{array}{cc} Calories & Proteins \end{array} \\ \begin{bmatrix} 24400 & 532 \\ 12200 & 266 \end{bmatrix} \end{array} \begin{array}{c} \\ Family\ A \\ Family\ B \end{array}$

3. (a) 266 grams

   Explanation: 266 grams

4. (a) A + B

   Explanation: Since, AB = B ...(i) and BA = A ..(ii)

   $\therefore$ $A^2 + B^2 = A \cdot A + B \cdot B$

   = A(BA) + B(AB) [using (i) and (ii)]

   - (AB)A + (BA)B [Associative law]

   = BA + AB [using (i) and (ii)]

   = A + B

5. (b) m = q

   Explanation: $A = (a_{ij})_{m \times n}$, $B = (b_{ij})_{n \times p}$, $C = (c_{ij})_{p \times q}$

   $BC = (b_{ij})_{n \times p} \times (C_{ij})_{p \times q} = (d_{ij})_{n \times q}$

   $(BC)A = (d_{ij})_{n \times q} \times (a_{ij})_{m \times M}$

   Hence, (BC)A is possible only when m = q

6. (d) AB and BA both are defined

   Explanation: In given matrix

order of A = 2×3
order of B $= 3 \times 2$
AB will be defined if the number of column in A is equal to the number of rows in B
so, $(A_{2\times3})(B_{3\times2}) = AB_{2\times2}$
Similarly $(B_{3\times2})(A_{2\times3}) = BA_{3\times3}$
Thus, Both AB and BA are defined.

7. (c) x = y

   Explanation: A = A^T
   $\begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix} = \begin{bmatrix} 5 & y \\ x & 0 \end{bmatrix}$
   x = y
8. (c) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

   Explanation: $\because$ Scalar Matrix is a matrix whose all off-diagonal elements are zero and all on-diagonal elements are equal. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$
9. (c) $\frac{\pi}{3}$

   Explanation: L.H.S.: $A + A' = \begin{pmatrix} \text{cosa} & \sin a \\ -\sin a & \cos a \end{pmatrix} + \begin{pmatrix} \cos a & -\sin a \\ \sin a & \cos a \end{pmatrix}$
   $= \begin{pmatrix} \cos a + \cos a & \sin a - \sin a \\ -\sin a + \sin a & \cos a + \cos a \end{pmatrix}$
   $= \begin{pmatrix} 2\cos a & 0 \\ 0 & 2\cos a \end{pmatrix}$
   This will be equal to $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$
   When 2 cos a = 1
   $\cos a = \frac{1}{2}$
   a $= \frac{\pi}{3}$
10. State True or False:
    i. (a) True

       Explanation: True
    ii. (b) False

       Explanation: False
11. Fill in the blanks:
    a. same
    b. k(A' - B')
12. (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
13. Given:

    [x 2] $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$ = 2
    Here, we have to find the value of x
    Finding the produt of the two given matrices in the LHS of the equation (It is possible since the order of the first matrix is 1 x 2 and that of the second matrix is 2 x 1 , the resultant matrix is of order 1 x 1) we get
    [x 2] $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$ = 2
    $\Rightarrow$ [3x + 8] = 2
    $\Rightarrow$ 3x = 2 – 8

$\Rightarrow$ 3x = -6

$\Rightarrow$ x = -2

14. If a matrix has order m $\times$ n, then the total number of elements in the matrix is mn

According to the question, a matrix has 5 elements.

$\therefore$ possible order of this matrix are 5 $\times$ 1 and 1 $\times$ 5.

15. $\begin{bmatrix}1 & -1\\ 0 & 2\\ 2 & 3\end{bmatrix}\left(\begin{bmatrix}1 & 0 & 2\\ 2 & 0 & 1\end{bmatrix}-\begin{bmatrix}0 & 1 & 2\\ 1 & 0 & 2\end{bmatrix}\right)$

= $\begin{bmatrix}1 & -1\\ 0 & 2\\ 2 & 3\end{bmatrix}\left(\begin{bmatrix}1-0 & 0 & -1 & 2-2\\ 2-1 & 0 & -0 & 1-2\end{bmatrix}\right)$

= $\begin{bmatrix}1 & -1\\ 0 & 2\\ 2 & 3\end{bmatrix}\begin{bmatrix}1 & -1 & 0\\ 1 & 0 & 1\end{bmatrix}$

= $\begin{bmatrix}1-1 & -1+0 & 0+1\\ 0+2 & 0+0 & 0-2\\ 2+3 & -2+0 & 0-3\end{bmatrix}$

= $\begin{bmatrix}0 & -1 & 1\\ 2 & 0 & -2\\ 5 & -2 & -3\end{bmatrix}$

Hence,

$\begin{bmatrix}1 & -1\\ 0 & 2\\ 2 & 3\end{bmatrix}\left(\begin{bmatrix}1 & 0 & 2\\ 2 & 0 & 1\end{bmatrix}-\begin{bmatrix}0 & 1 & 2\\ 1 & 0 & 2\end{bmatrix}\right)=\begin{bmatrix}0 & -1 & 1\\ 2 & 0 & -2\\ 5 & -2 & -3\end{bmatrix}$.

16. P = A + A' $=\begin{bmatrix}2 & 4\\ 5 & 6\end{bmatrix}+\begin{bmatrix}2 & 5\\ 4 & 6\end{bmatrix}$

$P=\begin{bmatrix}4 & 9\\ 9 & 12\end{bmatrix}$

$P'=\begin{bmatrix}4 & 9\\ 9 & 12\end{bmatrix}$

P' = P

Therefore P = P'

Hence A+A' is symmetric.

17. We need to verify that, (kA)’ = kA’.

Take L.H.S: (kA)’

We know that,

$A=\begin{bmatrix}0 & -1 & 2\\ 4 & 3 & -4\end{bmatrix}$

Multiply k on both sides, (k is a scalar quantity)

$\mathrm{kA}=\mathrm{k}\times\begin{bmatrix}0 & -1 & 2\\ 4 & 3 & -4\end{bmatrix}$

$\Rightarrow \mathrm{kA}=\begin{bmatrix}\mathrm{k}\times 0 & \mathrm{k}\times -1 & \mathrm{k}\times 2\\ \mathrm{k}\times 4 & \mathrm{k}\times 3 & \mathrm{k}\times -4\end{bmatrix}$

$\Rightarrow \mathrm{kA}=\begin{bmatrix}0 & -\mathrm{k} & 2\mathrm{k}\\ 4\mathrm{k} & 3\mathrm{k} & -4\mathrm{k}\end{bmatrix}$

$\Rightarrow (\mathrm{kA})'=\begin{bmatrix}0 & 4\mathrm{k}\\ -\mathrm{k} & 3\mathrm{k}\\ 2\mathrm{k} & -4\mathrm{k}\end{bmatrix}$

Take R.H.S: kA’

If $A=\begin{bmatrix}0 & -1 & 2\\ 4 & 3 & -4\end{bmatrix}$

$\Rightarrow A'=\begin{bmatrix}0 & 4\\ -1 & 3\\ 2 & -4\end{bmatrix}$

Multiply k on both sides,

$\mathrm{kA}'=\mathrm{k}\begin{bmatrix}0 & 4\\ -1 & 3\\ 2 & -4\end{bmatrix}$

$\Rightarrow \mathrm{kA}'=\begin{bmatrix}\mathrm{k}\times 0 & \mathrm{k}\times 4\\ \mathrm{k}\times -1 & \mathrm{k}\times 3\\ \mathrm{k}\times 2 & \mathrm{k}\times -4\end{bmatrix}$

$\Rightarrow \mathrm{kA}'=\begin{bmatrix}0 & 4\mathrm{k}\\ -\mathrm{k} & 3\mathrm{k}\\ 2\mathrm{k} & -4\mathrm{k}\end{bmatrix}$

Note that, L.H.S = R.H.S.

Thus, (kA)’ = kA’.

18. For n = 1

$A^1=\begin{bmatrix}3^{1-1} & 3^{1-1} & 3^{1-1}\\ 3^{1-1} & 3^{1-1} & 3^{1-1}\\ 3^{1-1} & 3^{1-1} & 3^{1-1}\end{bmatrix}=\begin{bmatrix}3^0 & 3^0 & 3^0\\ 3^0 & 3^0 & 3^0\\ 3^0 & 3^0 & 3^0\end{bmatrix}=\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix}$

Result is true for n = 1

Let it be true for n = k

$A^k=\begin{bmatrix}3^{k-1} & 3^{k-1} & 3^{k-1}\\ 3^{k-1} & 3^{k-1} & 3^{k-1}\\ 3^{k-1} & 3^{k-1} & 3^{k-1}\end{bmatrix}$

Therefore $A^{k+1}=A.A^k$

$=\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix}\begin{bmatrix}3^{k-1} & 3^{k-1} & 3^{k-1}\\ 3^{k-1} & 3^{k-1} & 3^{k-1}\\ 3^{k-1} & 3^{k-1} & 3^{k-1}\end{bmatrix}$

$=\begin{bmatrix}3.3^{k-1} & 3.3^{k-1} & 3.3^{k-1}\\ 3.3^{k-1} & 3.3^{k-1} & 3.3^{k-1}\\ 3.3^{k-1} & 3.3^{k-1} & 3.3^{k-1}\end{bmatrix}$

$=\begin{bmatrix}3^k & 3^k & 3^k\\ 3^k & 3^k & 3^k\\ 3^k & 3^k & 3^k\end{bmatrix}$

Thus, result is true for n = k+1

Whenever it is true for n = k.

Hence proved.