Term-I

CHAPTER 3

MATRICES

Syllabus

- ***Concept, notation, order, equality, types of matrices: zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices : Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices Invertible matrices (Here, all matrices will have real entries).***

STAND ALONE MCQs (1 Mark each)

Q. 1. If $[x \;\; 1]\begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix} = 0$, then x equals

(A) 0 **(B)** –2

(C) –1 **(D)** 2

[CBSE Delhi Set - II 2020]

Ans. Option (D) is correct.

Explanation:

$$\begin{bmatrix} x & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix} = [0 \;\; 0]$$

$$\Rightarrow \quad \begin{bmatrix} x-2 & 0 \end{bmatrix} = [0 \;\; 0]$$

$$\Rightarrow \quad x - 2 = 0 \quad \text{[By def. of equality]}$$

$$\Rightarrow \quad x = 2$$

Q. 2. If $A = [2 \;\; -3 \;\; 4]$, $B = \begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix}$, $X = [1 \;\; 2 \;\; 3]$ and $Y = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$, then $AB + XY$ equals

(A) [28] **(B)** [24]

(C) 28 **(D)** 24

[CBSE OD Set - I 2020]

Ans. Option (A) is correct.

Explanation :

Given, $A = [2 \;\; -3 \;\; 4]$,

$$B = \begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix},$$

$$X = [1 \;\; 2 \;\; 3],$$

$$Y = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$$

$$AB + XY = [2 \;\; -3 \;\; 4]\begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix} + [1 \;\; 2 \;\; 3]\begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$$

$$= [6 - 6 + 8] + [2 + 6 + 12]$$

$$= [8] + [20]$$

$$= [28]$$

Q. 3. Suppose P and Q are two different matrices of order $3 \times n$ and $n \times p$, then the order of the matrix $P \times Q$ is ?

(A) $3 \times p$ **(B)** $p \times 3$

(C) $n \times n$ **(D)** 3×3

[CBSE SQP 2019-20]

Ans. Option (A) is correct.

Q. 4. $A = [a_{ij}]_{m\times n}$ is a square matrix, if

(A) $m < n$ **(B)** $m > n$

(C) $m = n$ **(D)** None of these

Ans. Option (C) is correct.

Explanation : It is known that a given matrix is said to be a square matrix if the number of rows is equal to the number of columns.
Therefore,
$A = [a_{ij}]_{m\times n}$ is a square matrix, if $m = n$.

Q. 5. Which of the given values of x and y make the following pair of matrices equal

$$\begin{bmatrix} 3x+7 & 5 \\ y+1 & 2-3x \end{bmatrix}, \begin{bmatrix} 0 & y-2 \\ 8 & 4 \end{bmatrix}$$

(A) $x = \frac{-1}{3}, y = 7$ **(B)** Not possible to find

(C) $y = 7, x = \frac{-2}{3}$ **(D)** $x = \frac{-1}{3}, y = \frac{-2}{3}$

Ans. Option (B) is correct.

Explanation : It is given that

$$\begin{bmatrix} 3x+7 & 5 \\ y+1 & 2-3x \end{bmatrix} = \begin{bmatrix} 0 & y-2 \\ 8 & 4 \end{bmatrix}$$

Equating the corresponding elements, we get

$$3x + 7 = 0$$
$$\Rightarrow \quad x = -\frac{7}{3}$$
$$5 = y - 2$$
$$\Rightarrow \quad y = 7$$
$$y + 1 = 8$$
$$\Rightarrow \quad y = 7$$
$$2 - 3x = 4$$
$$\Rightarrow \quad x = -\frac{2}{3}$$

We find that on comparing the corresponding elements of the two matrices, we get two different values of x, which is not possible.
Hence, it is not possible to find the values of x and y for which the given matrices are equal.

Q. 6. The number of all possible matrices of order 3×3 with each entry 0 or 1 is :

(A) 27 **(B)** 18

(C) 81 **(D)** 512

Ans. Option (D) is correct.

Explanation : The given matrix of the order 3×3 has 9 elements and each of these elements can be either 0 or 1.

Now, each of the 9 elements can be filled in two possible ways.
Therefore, by the multiplication principle, the required number of possible matrices is $2^9 = 512$.

Q. 7. Assume X, Y, Z, W and P are matrices of order $2 \times n$, $3 \times k$, $2 \times p$, $n \times 3$ and $p \times k$, respectively. The restriction on n, k and p so that $PY + WY$ will be defined are :

(A) $k = 3, p = n$ **(B)** k is arbitrary, $p = 2$

(C) p is arbitrary, $k = 3$ **(D)** $k = 2, p = 3$

Ans. Option (A) is correct.

Explanation : Matrices P and Y are of the orders $p \times k$ and $3 \times k$, respectively. Therefore, matrix PY will be defined if $k = 3$. Consequently, PY will be of the order $p \times k$. Matrices W and Y are of the orders $n \times 3$ and $3 \times k$ respectively.
Since the number of columns in W is equal to the number of rows in Y, matrix WY is well-defined and is of the order $n \times k$. Matrices PY and WY can be added only when their orders are the same.
However, PY is of the order $p \times k$ and WY is of the order $n \times k$. Therefore, we must have $p = n$.
Thus, $k = 3$ and $p = n$ are the restrictions on n, k, and p so that $PY + WY$ will be defined.

Q. 8. Assume X, Y, Z, W and P are matrices of order $2 \times n$, $3 \times k$, $2 \times p$, $n \times 3$ and $p \times k$, respectively. If $n = p$, then the order of the matrix $7X - 5Z$ is:

(A) $p \times 2$ **(B)** $2 \times n$

(C) $n \times 3$ **(D)** $p \times n$

Ans. Option (B) is correct.

Explanation: Matrix X is of the order $2 \times n$. Therefore, matrix $7X$ is also of the same order. Matrix Z is of the order $2 \times p$, *i.e.*, $2 \times n$ [Since $n = p$] Therefore, matrix $5Z$ is also of the same order. Now, both the matrices $7X$ and $5Z$ are of the order $2 \times n$. Thus, matrix $7X - 5Z$ is well-defined and is of the order $2 \times n$.

Q. 9. If $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$, then $A + A' = I$, then the value of α is:

(A) $\frac{\pi}{6}$ **(B)** $\frac{\pi}{3}$

(C) π **(D)** $\frac{3\pi}{2}$

Ans. Option (B) is correct.

Explanation:

Given that, $A = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$

Also $A + A' = I$

$$\Rightarrow \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} + \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2\cos\alpha & 0 \\ 0 & 2\cos\alpha \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Equating corresponding entries, we have

$$\Rightarrow \quad 2\cos\alpha = 1$$

$$\Rightarrow \quad \cos\alpha = \frac{1}{2}$$

$$\Rightarrow \quad \cos\alpha = \cos\frac{\pi}{3}$$

$$\therefore \quad \alpha = \frac{\pi}{3}$$

Q. 10. Matrices A and B will be inverse of each other only if

(A) $AB = BA$ **(B)** $AB = BA = 0$

(C) $AB = 0, BA = I$ **(D)** $AB = BA = I$

Ans. Option (D) is correct.

Explanation : We know that if A is a square matrix of order m, and if there exists another square matrix B of the same order m, such that $AB = BA = I$, then B is said to be the inverse of A.
In this case, it is clear that A is the inverse of B.
Thus, matrices A and B will be the inverse of each other only if $AB = BA = I$.

Q. 11. The matrix $P = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ is a

(A) square matrix **(B)** diagonal matrix

(C) unit matrix **(D)** None of these

Ans. Option (A) is correct.

Explanation : We know that, in a square matrix number of rows is equal to the number of columns. So, the matrix $P = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ is a square matrix.

Q. 12. If A and B are symmetric matrices of same order, then $AB - BA$ is a:

(A) Skew-symmetric matrix

(B) Symmetric matrix

(C) Zero matrix

(D) Identity matrix

Ans. Option (A) is correct.

Explanation : Given that,
A and B are symmetric matrices.

$$\Rightarrow \quad A = A' \text{ and } B = B'$$

$$\text{Now, } (AB - BA)' = (AB)' - (BA)' \qquad \ldots(i)$$

$$\Rightarrow \quad (AB - BA)' = B'A' - A'B'$$

[By reversal law]

$$\Rightarrow \quad (AB - BA)' = BA - AB \qquad \text{[From Eq. (i)]}$$

$$\Rightarrow \quad (AB - BA)' = -(AB - BA)$$

$\Rightarrow (AB - BA)$ is a skew-symmetric matrix.

Q. 13. If the matrix A is both symmetric and skew-symmetric, then

(A) A is a diagonal matrix

(B) A is a zero matrix

(C) A is a square matrix

(D) None of these

Ans. Option (B) is correct.

Explanation : If A is both symmetric and skew-symmetric, then we have,

$$A' = A \text{ and } A' = -A$$

$$\Rightarrow \quad A = -A$$

$$\Rightarrow \quad A + A = 0$$

$$\Rightarrow \quad 2A = 0$$

$$\Rightarrow \quad A = 0$$

Therefore, A is a zero matrix.

Q. 14. The matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ is a

(A) identity matrix

(B) symmetric matrix

(C) skew-symmetric matrix

(D) None of these

Ans. Option (B) is correct.

Explanation: $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

$$\therefore \quad A' = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 4 \end{bmatrix} = A$$

So, the given matrix is a symmetric matrix.
[Since, in a square matrix A, if $A' = A$, then A is called symmetric matrix.]

Q. 15. The matrix $\begin{bmatrix} 0 & -5 & 8 \\ 5 & 0 & 12 \\ -8 & -12 & 0 \end{bmatrix}$ is a

(A) diagonal matrix

(B) symmetric matrix

(C) skew symmetric matrix

(D) scalar matrix

Ans. Option (C) is correct.

Explanation: We know that, in a square matrix, if $b_{ij} = 0$ when $i \neq j$ then it is said to be a diagonal matrix. Here, $b_{12}, b_{13}.... \neq 0$ so the given matrix is not a diagonal matrix.

Now, $$B = \begin{bmatrix} 0 & -5 & 8 \\ 5 & 0 & 12 \\ -8 & -12 & 0 \end{bmatrix}$$

$$B' = \begin{bmatrix} 0 & 5 & -8 \\ -5 & 0 & -12 \\ 8 & 12 & 0 \end{bmatrix}$$

$$= -\begin{bmatrix} 0 & -5 & 8 \\ 5 & 0 & 12 \\ -8 & -12 & 0 \end{bmatrix}$$

$$= -B$$

So, the given matrix is a skew-symmetric matrix, since we know that in a square matrix B, if $B' = -B$, then it is called skew-symmetric matrix.

Q. 16. If A is matrix of order $m \times n$ and B is a matrix such that AB' and $B'A$ are both defined, then order of matrix B is

(A) $m \times m$ **(B)** $n \times n$

(C) $n \times m$ **(D)** $m \times n$

Ans. Option (D) is correct.

Explanation : Let, $A = [a_{ij}]_{m \times n}$ and $B = [b_{ij}]_{p \times q}$

$\therefore \quad B' = [b_{ji}]_{q \times p}$

Now, AB′ is defined, so $n = q$ and $B'A$ is also defined, so $p = m$

$\therefore$ Order of $B' = [b_{ji}]_{n \times m}$

And order of $B = [b_{ji}]_{m \times n}$

ASSERTION AND REASON BASED MCQs (1 Mark each)

Directions : In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false and R is True

Q. 1. Assertion (A): If A is a square matrix such that $A^2 = A$, then $(I + A)^2 - 3A = I$

Reason (R): AI = IA = A

Ans. Option (A) is correct.

Explanation: AI = IA = A is true.

Hence R is true.

Given $A^2 = A$,

$$\therefore \quad (I+A)^2 - 3A = I^2 + 2IA + A^2 - 3A$$

$$= I + 2A + A - 3A$$

$$= I$$

Hence A is true.

R is the correct explanation for A.

Q. 2. Assertion (A): $\begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix}$ is a scalar matrix.

Reason (R): If all the elements of the principal diagonal are equal, it is called a scalar matrix.

Ans. Option (C) is correct.

Explanation: In a scalar matrix the diagonal elements are equal and the non-diagonal elements are zero. Hence R is false.

A is true since the diagonal elements are equal and the non-diagonal elements are zero.

Q. 3. Assertion (A): $(A + B)^2 \neq A^2 + 2AB + B^2$.

Reason (R): Generally $AB \neq BA$

Ans. Option (A) is correct.

Explanation: For two matrices A and B, generally $AB \neq BA$.

i.e., matrix multiplication is not commutative.

$\therefore$ R is true

$$(A+B)^2 = (A+B)(A+B)$$

$$= A^2 + AB + BA + B^2$$

$$\neq A^2 + 2AB + B^2$$

$\therefore$ A is true

R is the correct explanation for A.

Q. 4. A and B are two matrices such that both AB and BA are defined.

Assertion (A): $(A + B)(A - B) = A^2 - B^2$

Reason (R): $(A + B)(A - B) = A^2 - AB + BA - B^2$

Ans. Option (D) is correct.

Explanation: For two matrices A and B, even if both AB and BA are defined, generally $AB \neq BA$.

$(A + B)(A - B) = A^2 - AB + BA - B^2$.

Since $AB \neq BA$, $(A + B)(A - B) \neq A^2 - B^2$.

Hence R is true and A is false.

Q. 5. Let A and B be two symmetric matrices of order 3.

Assertion (A): A(BA) and (AB)A are symmetric matrices.

Reason (R): AB is symmetric matrix if matrix multiplication of A with B is commutative.

Ans. Option (B) is correct.

Explanation: Generally $(AB)' = B'A'$
If $AB = BA$, then $(AB)' = (BA)' = A'B' = AB$
Since $(AB)' = AB$, AB is a symmetric matrix.
Hence R is true.

$$A(BA) = (AB)A = ABA$$
$$(ABA)' = A'B'A' = ABA.$$

$A(BA)$ and $(AB)A$ are symmetric matrices. Hence A is true.
But R is not the correct explanation for A.

Q. 6. Assertion (A): If the matrix $P = \begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & 3 \end{bmatrix}$ is a symmetric matrix, then $a = \frac{-2}{3}$ and $b = \frac{3}{2}$.

Reason (R): If P is a symmetric matrix, then $P' = -P$.

Ans. Option (C) is correct.

Explanation: If P is a symmetric matrix, then $P' = P$.
Hence R is false.
As P is a symmetric matrix, $P' = P$

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

$\therefore$ By equality of matrices, $a = \frac{-2}{3}$ and $b = \frac{3}{2}$.
Hence A is true.

Q. 7. Assertion (A): If A is a symmetric matrix, then $B'AB$ is also symmetric.

Reason (R): $(ABC)' = C'B'A'$

Ans. Option (A) is correct.

Explanation: For three matrices A, B and C, if ABC is defined then $(ABC)' = C'B'A'$.
Hence R is true.
Given that A is symmetric $\Rightarrow A' = A$
$(B'AB)' = B'A'(B')' = B'AB$.
Hence A is true.
R is the correct explanation for A.

Q. 8. Assertion (A): If A and B are symmetric matrices, then $AB - BA$ is a skew symmetric matrix

Reason (R): $(AB)' = B'A'$

Ans. Option (A) is correct.

Explanation: $(AB)' = B'A' \Rightarrow$ R is true.
Given that A and B are symmetric matrices.
$\therefore A' = A$ and $B' = B$
$(AB - BA)' = (AB)' - (BA)'$
$= B'A' - A'B' = BA - AB$
Since $(AB - BA)' = -(AB - BA)$,
$AB - BA$ is skew symmetric.
Hence A is true.
R is the correct explanation for A.

CASE-BASED MCQs

Attempt any four sub-parts from each question. Each sub-part carries 1 mark.

I. Read the following text and answer the following questions on the basis of the same:

A manufacture produces three stationery products Pencil, Eraser and Sharpener which he sells in two markets. Annual sales are indicated below

Market	Products (in numbers)		
	Pencil	Eraser	Sharpener
A	10,000	2,000	18,000
B	6,000	20,000	8,000

If the unit Sale price of Pencil, Eraser and Sharpener are ₹2.50, ₹1.50 and ₹1.00 respectively, and unit cost of the above three commodities are ₹2.00, ₹1.00 and ₹ 0.50 respectively, then, **[CBSE QB 2021]**

Q. 1. Total revenue of market A

(A) ₹ 64,000 **(B)** ₹ 60,400

(C) ₹ 46,000 **(D)** ₹ 40600

Ans. Option (C) is correct.

Explanation: Total revenue of

$$= [10{,}000 \quad 2{,}000 \quad 18{,}000] \begin{bmatrix} 2.50 \\ 1.50 \\ 1.00 \end{bmatrix}$$

$$= [2.50 \times 10{,}000 + 1.50 \times 2{,}000 + 1.00 \times 18{,}000]$$

$$= [46{,}000]$$

Q. 2. Total revenue of market *B*

(A) ₹ 35,000 **(B)** ₹ 53,000

(C) ₹ 50,300 **(D)** ₹ 30,500

Ans. Option (B) is correct.

Explanation: Total revenue of market B

$$= [6{,}000 \quad 20{,}000 \quad 8{,}000] \begin{bmatrix} 2.50 \\ 1.50 \\ 1.00 \end{bmatrix}$$

$$= [2.50 \times 6{,}000 + 1.50 \times 20{,}000 + 1.00 \times 8{,}000]$$

$$= [53{,}000]$$

Q. 3. Cost incurred in market *A*

(A) ₹ 13,000 **(B)** ₹ 30,100

(C) ₹ 10,300 **(D)** ₹ 31,000

Ans. Option (D) is correct.

Explanation: Cost incurred in market A

$$= [10{,}000 \quad 2{,}000 \quad 18{,}000] \begin{bmatrix} 2.00 \\ 1.00 \\ 0.50 \end{bmatrix}$$

$$= [2.00 \times 10{,}000 + 1.00 \times 2{,}000 + 0.50 \times 18{,}000]$$

$$= [31{,}000]$$

Q. 4. Profits in market A and B respectively are

(A) (₹15,000, ₹17,000) **(B)** (₹17,000, ₹15,000)

(c) (₹51,000, ₹71,000) **(D)** (₹10,000, ₹20,000)

Ans. Option (A) is correct.

Explanation: Cost incurred in market B

$$= [6{,}000 \quad 20{,}000 \quad 8{,}000] \begin{bmatrix} 2.00 \\ 1.00 \\ 0.50 \end{bmatrix}$$

$$= [2.00 \times 6{,}000 + 1.00 \times 20{,}000 + 0.50 \times 8{,}000]$$

$$= [36{,}000]$$

Profit of market A & B = total revenue of A and B – Cost increased in market A and B

$$\begin{bmatrix} A \\ B \end{bmatrix} = \begin{bmatrix} 46{,}000 \\ 50{,}000 \end{bmatrix} - \begin{bmatrix} 31{,}000 \\ 36{,}000 \end{bmatrix}$$

$$= \begin{bmatrix} 15{,}000 \\ 17{,}000 \end{bmatrix}$$

i.e., (₹15,000, ₹17,000)

Q. 5. Gross profit in both markets

(A) ₹23,000 **(B)** ₹20,300

(C) ₹32,000 **(D)** ₹30,200

Ans. Option (C) is correct.

Explanation:

Gross profit in both markets = Profit in A + Profit in B

= 15,000 + 17,000

= ₹32,000

II. Read the following text and answer the following questions on the basis of the same:

Amit, Biraj and Chirag were given the task of creating a square matrix of order 2.

Below are the matrices created by them. *A*, *B*, *C* are the matrices created by Amit, Biraj and Chirag respectively.

$$A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix} B = \begin{bmatrix} 4 & 0 \\ 1 & 5 \end{bmatrix} C = \begin{bmatrix} 2 & 0 \\ 1 & -2 \end{bmatrix}$$

If $a = 4$ and $b = -2$, **[CBSE QB 2021]**

Q. 1. Sum of the matrices *A*, *B* and *C*, $A+(B+C)$ is

(A) $\begin{bmatrix} 1 & 6 \\ 2 & 7 \end{bmatrix}$ **(B)** $\begin{bmatrix} 6 & 1 \\ 7 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} 7 & 2 \\ 1 & 6 \end{bmatrix}$ **(D)** $\begin{bmatrix} 2 & 1 \\ 7 & 6 \end{bmatrix}$

Ans. Option (C) is correct.

Explanation:

$$A + (B + C) = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix} + \left(\begin{bmatrix} 4 & 0 \\ 1 & 5 \end{bmatrix} + \begin{bmatrix} 2 & 0 \\ 1 & -2 \end{bmatrix} \right)$$

$$= \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix} + \begin{bmatrix} 6 & 0 \\ 2 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 7 & 2 \\ 1 & 6 \end{bmatrix}$$

Q. 2. $(A^T)^T$ is equal to

(A) $\begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$ **(B)** $\begin{bmatrix} 2 & 1 \\ 3 & -1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ **(D)** $\begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix}$

Ans. Option (A) is correct.

Explanation:

$$(A^T) = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$$

$$(A^T)^T = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$$

Q. 3. $(bA)^T$ is equal to

(A) $\begin{bmatrix} -2 & -4 \\ 2 & -6 \end{bmatrix}$ **(B)** $\begin{bmatrix} -2 & 2 \\ -4 & -6 \end{bmatrix}$

(C) $\begin{bmatrix} -2 & 2 \\ -6 & -4 \end{bmatrix}$ **(D)** $\begin{bmatrix} -6 & -2 \\ 2 & 4 \end{bmatrix}$

Ans. Option (B) is correct.

Explanation:

$$bA = -2A = \begin{bmatrix} -2 & -4 \\ 2 & -6 \end{bmatrix}$$

$$(bA)^T = \begin{bmatrix} -2 & 2 \\ -4 & -6 \end{bmatrix}$$

Q. 4. AC − BC is equal to

(A) $\begin{bmatrix} -4 & -6 \\ -4 & 4 \end{bmatrix}$ **(B)** $\begin{bmatrix} -4 & -4 \\ 4 & -6 \end{bmatrix}$

(C) $\begin{bmatrix} -4 & -4 \\ -6 & 4 \end{bmatrix}$ **(D)** $\begin{bmatrix} -6 & 4 \\ -4 & -4 \end{bmatrix}$

Ans. Option (C) is correct.

Explanation:

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

$$= \begin{bmatrix} 4 & -4 \\ 1 & -6 \end{bmatrix}$$

$$BC = \begin{bmatrix} 4 & 0 \\ 1 & 5 \end{bmatrix}\begin{bmatrix} 2 & 0 \\ 1 & -2 \end{bmatrix}$$

$$= \begin{bmatrix} 8 & 0 \\ 7 & -10 \end{bmatrix}$$

$$AC - BC = \begin{bmatrix} 4 & -4 \\ 1 & -6 \end{bmatrix} - \begin{bmatrix} 8 & 0 \\ 7 & -10 \end{bmatrix}$$

$$= \begin{bmatrix} -4 & -4 \\ -6 & 4 \end{bmatrix}$$

Q. 5. $(a + b)B$ is equal to

(A) $\begin{bmatrix} 0 & 8 \\ 10 & 2 \end{bmatrix}$ **(B)** $\begin{bmatrix} 2 & 10 \\ 8 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 8 & 0 \\ 2 & 10 \end{bmatrix}$ **(D)** $\begin{bmatrix} 2 & 0 \\ 8 & 10 \end{bmatrix}$

Ans. Option (C) is correct.

Explanation:

$$(a+b)B = (4-2)\begin{bmatrix} 4 & 0 \\ 1 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 8 & 0 \\ 2 & 10 \end{bmatrix}$$

III. Read the following text and answer the following questions on the basis of the same:

Three schools DPS, CVC and KVS decided to organize a fair for collecting money for helping the flood victims. They sold handmade fans, mats and plates from recycled material at a cost of ₹25, ₹100 and ₹50 each respectively. The numbers of articles sold are given as **[CBSE QB 2021]**



School /Article	DPS	CVC	KVS
Handmade fans	40	25	35
Mats	50	40	50
Plates	20	30	40

Q. 1. What is the total money (in Rupees) collected by the school DPS?

(A) 700 **(B)** 7,000

(C) 6,125 **(D)** 7,875

Ans. Option (B) is correct.

Explanation: The funds collected by the schools can be obtained by matrix multiplication :

$$\begin{bmatrix} 40 & 50 & 20 \\ 25 & 40 & 30 \\ 25 & 50 & 40 \end{bmatrix}\begin{bmatrix} 25 \\ 100 \\ 50 \end{bmatrix} = \begin{bmatrix} 7000 \\ 6125 \\ 7875 \end{bmatrix}$$

Funds collected by school DPS = 7000
Funds collected by school, CVC = 6125
Funds collected by school KVS = 7875

Q. 2. What is the total amount of money (in ₹) collected by schools CVC and KVS?

(A) 14,000 **(B)** 15,725

(C) 21,000 **(D)** 13,125

Ans. Option (A) is correct.

Explanation: Total amount of money collected by school

= 6125 + 7875
= 14000

Q. 3. What is the total amount of money collected by all three schools DPS, CVC and KVS?

(A) ₹15,775 **(B)** ₹14,000

(C) ₹21,000 **(D)** ₹17,125

Ans. Option (C) is correct.

Explanation: Total amount of money collected by all school DPS, CVC and KVS

= 7000 + 7875 + 6125
= 21000

Q. 4. If the number of handmade fans and plates are interchanged for all the schools, then what is the

total money collected by all schools?

(A) ₹18,000 (B) ₹6,750

(C) ₹5,000 (D) ₹21,250

Ans. Option (D) is correct.

Q. 5. How many articles (in total) are sold by three schools?

(A) 230 (B) 130

(C) 430 (D) 330

Ans. Option (D) is correct.

IV. Read the following text and answer the following questions on the basis of the same:

On her birthday, Seema decided to donate some money to children of an orphanage home. If there were 8 children less, everyone would have got ₹10 more. However, if there were 16 children more, everyone would have got ₹10 less. Let the number of children be x and the amount distributed by Seema for one child be y (in ₹).

[CBSE QB 2021]

Q. 1. The equations in terms of x and y are

(A) $5x-4y=40$, $5x-8y=-80$ (B) $5x-4y=40$, $5x-8y=80$

(C) $5x-4y=40$, $5x+8y=-80$ (D) $5x+4y=40$, $5x-8y=-80$

Ans. Option (A) is correct.

Explanation: According to question,

$$(x-8)(y+10) = xy$$

$$\Rightarrow \quad xy+10x-8y-80 = xy$$

$$\Rightarrow \quad 5x-4y = 40 \quad \text{...(i)}$$

and $$(x+16)(y-10) = xy$$

$$\Rightarrow \quad xy-10x+16y-160 = xy$$

$$\Rightarrow \quad 5x-8y = -80 \quad \text{...(ii)}$$

Q. 2. Which of the following matrix equations represent the information given above?

(A) $\begin{bmatrix}5 & 4\\ 5 & 8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ -80\end{bmatrix}$

(B) $\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ 80\end{bmatrix}$

(C) $\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ -80\end{bmatrix}$

(D) $\begin{bmatrix}5 & 4\\ 5 & -8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ -80\end{bmatrix}$

Ans. Option (C) is correct.

Explanation: Given equations are;

$$5x-4y = 40$$

$$5x-8y = -80$$

$$\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ -80\end{bmatrix}$$

Q. 3. The number of children who were given some money by Seema, is

(A) 30 (B) 40

(C) 23 (D) 32

Ans. Option (D) is correct.

Explanation: Since,

$$\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}40\\ -80\end{bmatrix}$$

Let $$A=\begin{bmatrix}5 & -4\\ 5 & -8\end{bmatrix}, X=\begin{bmatrix}x\\ y\end{bmatrix}$$

$$B=\begin{bmatrix}40\\ -80\end{bmatrix}$$

$\therefore$ $$AX = B$$

$$X = A^{-1}B \quad \text{...(iii)}$$

$$|A| = 5(-8)-(-4)\times 5$$

$$= -40+20$$

$$= -20$$

$$adj(A)=\begin{bmatrix}-8 & -5\\ 4 & 5\end{bmatrix}^T$$

$$=\begin{bmatrix}-8 & 4\\ -5 & 5\end{bmatrix}$$

$$A^{-1}=\frac{Adj(A)}{|A|}$$

$$=\frac{1}{-20}\begin{bmatrix}-8 & 4\\ -5 & 5\end{bmatrix}$$

$$=\begin{bmatrix}\frac{2}{5} & \frac{-1}{5}\\ \frac{1}{4} & \frac{-1}{4}\end{bmatrix}$$

$$X = A^{-1}B$$

$$=\begin{bmatrix}\frac{2}{5} & \frac{-1}{5}\\ \frac{1}{4} & \frac{-1}{4}\end{bmatrix}\begin{bmatrix}40\\ -80\end{bmatrix}$$

$$=\begin{bmatrix}\frac{2}{5}\times 40-\frac{1}{5}\times(-80)\\ \frac{1}{4}\times 40-\frac{1}{4}\times(-80)\end{bmatrix}$$

$$=\begin{bmatrix}16+16\\ 10+20\end{bmatrix}$$

$$=\begin{bmatrix}32\\ 30\end{bmatrix}$$

$\therefore$ $$\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}32\\ 30\end{bmatrix}$$

$$x = 32$$
$$y = 30$$

Hence, 32 children were given some money by Seema.

Q. 4. How much amount is given to each child by Seema?

(A) ₹32 **(B)** ₹30
(C) ₹62 **(D)** ₹26

Ans. Option (B) is correct.

Explanation: ₹ 30 is given to each child by Seema [$\because y = 30$]

Q. 5. How much amount Seema spends in distributing the money to all the students of the Orphanage?

(A) ₹609 **(B)** ₹960
(C) ₹906 **(D)** ₹690

Ans. Option (B) is correct.

Explanation: Total amount Seema spends in distributing the money to all the students of the orphanage

$$= x \times y$$
$$= 32 \times 30$$
$$= ₹960$$

V. Read the following text and answer the following questions on the basis of the same:

Two farmers Ramakishan and Gurucharan Singh cultivate only three varieties of rice namely Basmati, Permal and Naura. The sale (in ₹) of these varieties of rice by both the farmers in the month of September and October are given by the following matrices A and B **[CBSE QB 2021]**

September sales (in Rupees)

$$A = \begin{bmatrix} 10,000 & 20,000 & 30,000 \\ 50,000 & 30,000 & 10,000 \end{bmatrix} \begin{matrix} \text{Ramakrishan} \\ \text{Gurcharan} \end{matrix}$$

October sales (in Rupees)

$$B = \begin{bmatrix} 5,000 & 10,000 & 6,000 \\ 20,000 & 10,000 & 10,000 \end{bmatrix} \begin{matrix} \text{Ramakrishan} \\ \text{Gurcharan} \end{matrix}$$

Q. 1. The total sales in September and October for each farmer in each variety can be represented as _____.

(A) A + B **(B)** A – B
(C) A > B **(D)** A < B

Ans. Option (A) is correct.

Explanation: Combined sales in September and October for each farmer in each variety is given by

$A + B =$

Basmati	Permal	Naura	
15,000	30,000	36,000	Ramkrishan
70,000	40,000	20,000	Gurcharan singh

Q. 2. What is the value of A_{23}?

(A) 10,000 **(B)** 20,000
(C) 30,000 **(D)** 40,000

Ans. Option (A) is correct.

Explanation: $A_{23} = 10,000$

Q. 3. The decrease in sales from September to October is given by _____.

(A) A + B **(B)** A – B
(C) A > B **(D)** A < B

Ans. Option (B) is correct.

Explanation: Change in sales from September to October is given by

$A - B =$

Basmati	Permal	Naura	
5000	10,000	24,000	Ramkishan
30,000	20,000	0	Gurcharan Singh

Q. 4. If Ramkishan receives 2% profit on gross sales, compute his profit for each variety sold in October.

(A) ₹100, ₹200 and ₹120
(B) ₹100, ₹200 and ₹130
(C) ₹100, ₹220 and ₹120
(D) ₹110, ₹200 and ₹120

Ans. Option (A) is correct.

Explanation:

$$2\% \text{ of } B = \frac{2}{100} \times B$$
$$= 0.02 \times B$$
$$= 0.02$$

Basmati	Permal	Naura	
5000	10,000	6000	Ramkishan
20,000	10,000	10,000	Gurcharn Singh

Thus, in October Ramkishan receives ₹ 100, ₹ 200 and ₹ 120 as profit in the sale of each variety of rice, respectively.

Q. 5. If Gurucharan receives 2% profit on gross sales, compute his profit for each variety sold in September.

(A) ₹100, ₹200, ₹120 **(B)** ₹1000, ₹600, ₹200
(C) ₹400, ₹200, ₹120 **(D)** ₹1200, ₹200, ₹120

Ans. Option (B) is correct.

Explanation:

$$2\% \text{ of } A = \frac{2}{100} \times A$$
$$= 0.02 \times A$$
$$= 0.02$$

$$\begin{matrix} & \text{Basmati} & \text{Permal} & \text{Naura} & \\ \end{matrix}$$
$$\begin{bmatrix} 10{,}000 & 20{,}000 & 30{,}000 \\ 50{,}000 & 30{,}000 & 10{,}000 \end{bmatrix} \begin{matrix} \text{Ramkishan} \\ \text{Gurcharn Singh} \end{matrix}$$

$$\begin{matrix} & \text{Basmati} & \text{Permal} & \text{Naura} & \\ \end{matrix}$$
$$= \begin{bmatrix} 200 & 400 & 600 \\ 1000 & 600 & 200 \end{bmatrix} \begin{matrix} \text{Ramkishan} \\ \text{Gurcharn Singh} \end{matrix}$$

Thus, in September Gurucharan receives ₹ 1000, ₹ 600 and ₹ 200 as Profit in the sale of each variety of rice, respectively.

VI. Read the following text and answer the following questions on the basis of the same:

There are three families *A*, *B* and *C*. The number of members in these families are given in the table below.

	Men	Women	Children
Family *A*	3	2	1
Family *B*	2	4	2
Family *C*	4	3	2

The daily expenses of each man, woman and child are respectively ₹200, ₹100 and ₹50.

Q. 1. The total daily expense of family *A* is _____.

(A) 850 **(B)** 900

(C) 1,200 **(D)** 2,950

Ans. Option (A) is correct.

Explanation: Expense of family *A*

$$= [3 \quad 2 \quad 1] \begin{bmatrix} 200 \\ 100 \\ 50 \end{bmatrix} = [850]$$

Q. 2. The total daily expense of family *C* is _____.

(A) 850 **(B)** 900

(C) 1,200 **(D)** 2,950

Ans. Option (C) is correct.

Explanation: Expense of family *C*

$$= [4 \quad 3 \quad 2] \begin{bmatrix} 200 \\ 100 \\ 50 \end{bmatrix} = [1200]$$

Q. 3. The combined daily expense of all the women is _____.

(A) 850 **(B)** 900

(C) 1,200 **(D)** 2,950

Ans. Option (B) is correct.

Explanation: Combined expense of women

$$= [2 \quad 4 \quad 3] \begin{bmatrix} 100 \\ 100 \\ 100 \end{bmatrix} = [900]$$

Q. 4. The family with highest expense is _____.

(A) *A*

(B) *B*

(C) *C*

(D) All have same expense

Ans. Option (C) is correct.

Explanation: Most expensive family is *C* with an expense of ₹1200.

Q. 5. The combined expense of men in family A and children in family *C* is _____.

(A) 600 **(B)** 700

(C) 800 **(D)** 900

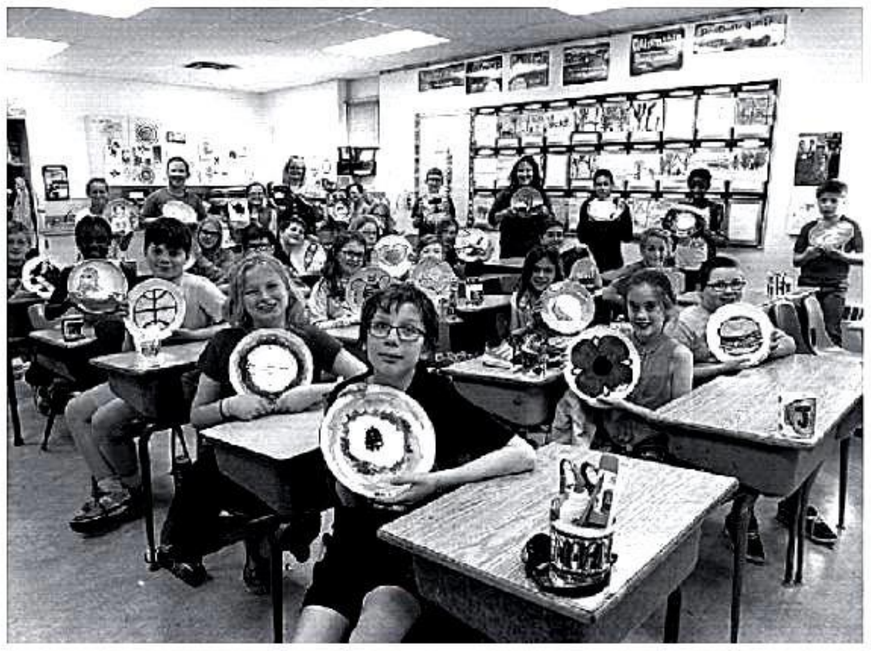
Ans. Option (B) is correct.

Explanation: $[3 \quad 2] \begin{bmatrix} 200 \\ 50 \end{bmatrix} = [700]$

VII. Read the following text and answer the following questions on the basis of the same:

Three schools SNT, SNP and TKM organised a mela for collecting funds for helping the rehabilitation of flood victims. They sold hand-made fans, mats and plates from recycled material at a cost of ₹25, ₹100 and ₹50 each. The number of articles sold are given below.

	SNT	SNP	TKM
Fans	40	25	35
Mats	50	40	50
Plates	20	30	40



Q. 1. Funds collected by SNT is _____.

(A) ₹7000 **(B)** ₹6125

(C) ₹7875 **(D)** ₹21000

Ans. Option (A) is correct.

Explanation:

Fund raised by SNT = ₹7000

$$[40 \quad 50 \quad 20]\begin{bmatrix}25\\100\\50\end{bmatrix} = [7{,}000]$$

Q. 2. Funds collected by SNP is _____.

(A) ₹7000 **(B)** ₹6125

(C) ₹7875 **(D)** ₹21000

Ans. Option (B) is correct.

Explanation:

$$[25 \quad 40 \quad 30]\begin{bmatrix}25\\100\\50\end{bmatrix} = [6{,}125]$$

Fund raised by SNP = ₹6,125

Q. 3. The total fund raised by all the three schools together is _____.

(A) ₹7000 **(B)** ₹6125

(C) ₹7875 **(D)** ₹21000

Ans. Option (D) is correct.

Explanation:

$$[35 \quad 50 \quad 40]\begin{bmatrix}25\\100\\50\end{bmatrix} = [7{,}875]$$

Fund raised by TKM = ₹7,875

Total amount raised = 7,000 + 6,125 + 7,875

= ₹21,000

Q. 4. The total fund raised by selling fans is _____

(A) ₹4,000 **(B)** ₹2,000

(C) ₹2,500 **(D)** ₹35,000

Ans. Option (C) is correct.

Explanation:

[40 + 25 + 35] [25] = [2,500]

Fund raised by selling fans = ₹2,500

Q. 5. TKM collected ₹ _____ by selling plates.

(A) 4000 **(B)** 2000

(C) 2500 **(D)** 3500

Ans. Option (B) is correct.

Explanation:

[40] [50] = [2000]

TKM collected ₹2000 by selling plates.