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PRACTICE PAPER 03 (2023-24)

CHAPTER 03 MATRICES (ANSWERS)

SUBJECT: MATHEMATICS — **MAX. MARKS : 40**

CLASS : XII — **DURATION : $1\frac{1}{2}$ hrs**

General Instructions:

(i). **All** questions are compulsory.

(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.

(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.

(iv). There is no overall choice.

(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

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

(*a*) I (*b*) $2A$ (c) $3I$ (*d*) A

Ans: (*a*), as $(I + A)^2 - 3A = I^2 + IA + AI + A^2 - 3A = I + A + A + A - 3A = I$

2. The diagonal elements of a skew symmetric matrix are

(*a*) all zeroes (*b*) are all equal to some scalar $k(\neq 0)$

(*c*) can be any number (*d*) none of these

Ans: (*a*), as in skew symmetric matrix, $a_{ij} = -a_{ji}$

$\Rightarrow a_{ii} = -a_{ii} \Rightarrow 2a_{ii} = 0$

$\Rightarrow a_{ii} = 0$, i.e. diagonal elements are zeroes.

3. If $A = \begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix}$ and $A = A'$ then

(*a*) $x = 0, y = 5$ (*b*) $x = y$ (*c*) $x + y = 5$ (*d*) $x - y = 5$

Ans: (b) x= y

$A = A' \Rightarrow \begin{bmatrix} 5 & x \\ y & 0 \end{bmatrix} = \begin{bmatrix} 5 & y \\ x & 0 \end{bmatrix} \Rightarrow x = y$

4. If $2\begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix}$, then write the value of x and y.

(a) x = 3, y = 3 (b) x = 3, y = 2 (c) x = 2, y = 2 (d) x = 2, y = 3

Ans: (a) x = 3, y = 3

$$2\begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix} \Rightarrow \begin{bmatrix} 2 & 6 \\ 0 & 2x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2+y & 6 \\ 1 & 2x+2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix}$$

Comparing both matrices

$$2 + y = 5 \text{ and } 2x + 2 = 8 \Rightarrow y = 3 \text{ and } 2x = 6$$

$$\Rightarrow x = 3, y = 3.$$

5. A is a skew-symmetric matrix and a matrix B such that B’AB is defined, then B’AB is a:

(a) symmetric matrix (b) skew-symmetric matrix

(c) Diagonal matrix (d) upper triangular symmetric

Ans: (b) skew-symmetric matrix
A is a skew-symmetric matrix
⇒ A’ = -A
Consider (B’AB)’ = (AB)'(B’)’ = B’A'(B’)’
= B’A’B = B'(-A)B = -B’AB
As (B’AB) = -B’AB
Hence, B’AB is a skew-symmetric matrix.

6. If $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} 3 & 1 \\ 2 & 5 \end{bmatrix} = \begin{bmatrix} 7 & 11 \\ k & 23 \end{bmatrix}$, then write the value of k.

(a) 17 (b) -17 (c) 13 (d) -13

Ans:

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} 3 & 1 \\ 2 & 5 \end{bmatrix} = \begin{bmatrix} 3+4 & 1+10 \\ 9+8 & 3+20 \end{bmatrix} \Rightarrow \begin{bmatrix} 7 & 11 \\ 17 & 23 \end{bmatrix} = \begin{bmatrix} 7 & 11 \\ k & 23 \end{bmatrix} \Rightarrow k = 17$$

7. If $x\begin{bmatrix} 2 \\ 3 \end{bmatrix} + y\begin{bmatrix} -1 \\ 1 \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \end{bmatrix}$, find the value of x.

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

Ans: (c) 3

$$x\begin{bmatrix} 2 \\ 3 \end{bmatrix} + y\begin{bmatrix} -1 \\ 1 \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \end{bmatrix} \Rightarrow \begin{bmatrix} 2x-y \\ 3x+y \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \end{bmatrix}$$

By definition of equality of matrix as the given matrices are equal, their corresponding elements are equal. Comparing the corresponding elements, we get

$2x - y = 10$ …(i)

and $3x + y = 5$ …(ii)

Adding Eqs. (i) and (ii), we get $5x = 15 \Rightarrow x = 3$

8. The matrix A = $\begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix}$ is a symmetric matrix. Then the value of a and b respectively are:

(a) $\frac{-2}{3}, \frac{3}{2}$ (b) $\frac{-1}{2}, \frac{1}{2}$ (c) -2, 2 (d) $\frac{3}{2}, \frac{1}{2}$

Ans: (a) $\frac{-2}{3}, \frac{3}{2}$

Given, $A = \begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix} \Rightarrow A^T = \begin{bmatrix} 0 & 3 & 3a \\ 2b & 1 & 3 \\ -2 & 3 & -1 \end{bmatrix}$

Since A is symmetric matrix, *i.e.*, $A^T = A$

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

Comparing matrices, we get $2b = 3$ and $3a = -2$

$\Rightarrow a = -\frac{2}{3}, b = \frac{3}{2}$

For Q9 and Q10, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct answer out of the following choices.

(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 but R is true.

9. **Assertion (A):** Let A = $\begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 4 & 7 \end{bmatrix}$ and B = $\begin{bmatrix} 4 & 3 & 6 \\ 7 & 8 & 9 \\ 5 & 1 & 2 \end{bmatrix}$, then the product of the matrices A and B is not defined.

Reason (R): The number of rows in B is not equal to number of columns in A.
Ans: (a) Both A and R are true and R is the correct explanation of A.

10. **Assertion (A):** The matrix A = $\begin{bmatrix} 0 & -1 & -2 \\ 1 & 0 & -3 \\ 2 & 3 & 0 \end{bmatrix}$ is a skew symmetric matrix.

Reason (R): For the given matrix A we have A' = A.
Ans: (c) A is true but R is false.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Find the value of a, b, c and d from the equation: $\begin{bmatrix} a-b & 2a+c \\ 2a-b & 3c+d \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$

Ans: Given that $\begin{bmatrix} a-b & 2a+c \\ 2a-b & 3c+d \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$

By definition of equality of matrix as the given matrices are equal, their corresponding elements are equal. Comparing the corresponding elements, we get

$a - b = -1$ …(i)
$2a - b = 0$ …(ii)
$2a + c = 5$ …(iii)
and $3c + d = 13$ …(iv)

Subtracting Eq.(i) from Eq.(ii), we get $a = 1$
Putting $a = 1$ in Eq. (i) and Eq. (iii), we get
$1 - b = -1$ and $2 + c = 5$
$\Rightarrow b = 2$ and $c = 3$
Substituting $c = 3$ in Eq. (iv), we obtain
$3 \times 3 + d = 13 \Rightarrow d = 13 - 9 = 4$
Hence, $a = 1, b = 2, c = 3$ and $d = 4$.

12. Find X and Y, if X + Y = $\begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix}$ and X – Y = $\begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$.

Ans: $(X+Y)+(X-Y) = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix} + \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$

$\Rightarrow 2X = \begin{bmatrix} 8 & 8 \\ 0 & 8 \end{bmatrix} \Rightarrow X = \frac{1}{2}\begin{bmatrix} 8 & 8 \\ 0 & 8 \end{bmatrix}$

$\Rightarrow X = \begin{bmatrix} 4 & 4 \\ 0 & 4 \end{bmatrix}$

$Now, (X+Y)-(X-Y) = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix} - \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$

$$\Rightarrow 2Y = \begin{bmatrix} 2 & -4 \\ 0 & 10 \end{bmatrix} \Rightarrow X = \frac{1}{2}\begin{bmatrix} 2 & -4 \\ 0 & 10 \end{bmatrix}$$

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

13. Find the values of x, y and z, if $\begin{bmatrix} x+y+z \\ x+z \\ y+z \end{bmatrix} = \begin{bmatrix} 9 \\ 5 \\ 7 \end{bmatrix}$

Ans: $x + y + z = 9$ ………….. (1)
$x + z = 5,$ ………….. (2)
$y + z = 7,$ ………….. (3)
Subtracting (3) from (1) we get $x = 2$
Subtracting (2) from (1) we get $y = 4$
From equation (2), we get $z = 3$

14. Find the values of x and y from the following equation:

$$2\begin{bmatrix} x & 5 \\ 7 & y-3 \end{bmatrix} + \begin{bmatrix} 3 & -4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 14 \end{bmatrix}$$

Ans: $2\begin{bmatrix} x & 5 \\ 7 & y-3 \end{bmatrix} + \begin{bmatrix} 3 & -4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 14 \end{bmatrix}$

$$\Rightarrow \begin{bmatrix} 2x & 10 \\ 14 & 2y-6 \end{bmatrix} + \begin{bmatrix} 3 & -4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 14 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2x+3 & 6 \\ 15 & 2y-4 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 14 \end{bmatrix}$$

or $2x + 3 = 7$ and $2y - 4 = 14$
or $2x = 7 - 3$ and $2y = 18$
or $x = \frac{4}{2}$ and $y = \frac{18}{2}$
i.e. $x = 2$ and $y = 9$.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. If $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$, prove that $A^3 - 6A^2 + 7A + 2I = 0$

Ans: $A^2 = A.A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}\begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix} = \begin{bmatrix} 5 & 0 & 8 \\ 2 & 4 & 5 \\ 8 & 0 & 13 \end{bmatrix}$

$$A^3 = A^2.A = \begin{bmatrix} 5 & 0 & 8 \\ 2 & 4 & 5 \\ 8 & 0 & 13 \end{bmatrix}\begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix} = \begin{bmatrix} 21 & 0 & 34 \\ 12 & 8 & 23 \\ 34 & 0 & 55 \end{bmatrix}$$

$$\therefore A^3 - 6A^2 + 7A + 2I = \begin{bmatrix} 21 & 0 & 34 \\ 12 & 8 & 23 \\ 34 & 0 & 55 \end{bmatrix} - 6\begin{bmatrix} 5 & 0 & 8 \\ 2 & 4 & 5 \\ 8 & 0 & 13 \end{bmatrix} + 7\begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix} + 2\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$=\begin{bmatrix}21 & 0 & 34\\12 & 8 & 23\\34 & 0 & 55\end{bmatrix}-\begin{bmatrix}30 & 0 & 48\\12 & 24 & 30\\48 & 0 & 78\end{bmatrix}+\begin{bmatrix}7 & 0 & 14\\0 & 14 & 7\\14 & 0 & 21\end{bmatrix}+\begin{bmatrix}2 & 0 & 0\\0 & 2 & 0\\0 & 0 & 2\end{bmatrix}$$

$$=\begin{bmatrix}21-30+7+2 & 0-0+0+0 & 34-48+14+0\\12-12+0+0 & 8-24+14+2 & 23-30+7+0\\34-48+14+0 & 0-0+0+0 & 55-78+21+2\end{bmatrix}=\begin{bmatrix}0 & 0 & 0\\0 & 0 & 0\\0 & 0 & 0\end{bmatrix}=O$$

16. If $A=\begin{bmatrix}0 & -\tan\dfrac{\alpha}{2}\\ \tan\dfrac{\alpha}{2} & 0\end{bmatrix}$ and I is the identity matrix of order 2, show that

$$\text{I} + \text{A} = (\text{I} - \text{A})\begin{bmatrix}\cos\alpha & -\sin\alpha\\ \sin\alpha & \cos\alpha\end{bmatrix}$$

Ans: Let $A=\begin{bmatrix}0 & -x\\ x & 0\end{bmatrix}$ *where* $x=\tan\dfrac{\alpha}{2}$

Now, $\cos\alpha=\dfrac{1-\tan^2\dfrac{\alpha}{2}}{1+\tan^2\dfrac{\alpha}{2}}=\dfrac{1-x^2}{1+x^2}$ *and* $\cos\alpha=\dfrac{2\tan\dfrac{\alpha}{2}}{1+\tan^2\dfrac{\alpha}{2}}=\dfrac{2x}{1+x^2}$

$$RHS=(I-A)\begin{bmatrix}\cos\alpha & -\sin\alpha\\ \sin\alpha & \cos\alpha\end{bmatrix}$$

$$=\left(\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}-\begin{bmatrix}0 & -x\\x & 0\end{bmatrix}\right)\begin{bmatrix}\dfrac{1-x^2}{1+x^2} & -\dfrac{2x}{1+x^2}\\ \dfrac{2x}{1+x^2} & \dfrac{1-x^2}{1+x^2}\end{bmatrix}$$

$$=\begin{bmatrix}1 & x\\-x & 1\end{bmatrix}\begin{bmatrix}\dfrac{1-x^2}{1+x^2} & -\dfrac{2x}{1+x^2}\\ \dfrac{2x}{1+x^2} & \dfrac{1-x^2}{1+x^2}\end{bmatrix}=\begin{bmatrix}\dfrac{1-x^2+2x^2}{1+x^2} & \dfrac{-2x+x(1-x^2)}{1+x^2}\\ \dfrac{-x(1-x^2)+2x}{1+x^2} & \dfrac{2x^2+1-x^2}{1+x^2}\end{bmatrix}$$

$$=\begin{bmatrix}\dfrac{1+x^2}{1+x^2} & \dfrac{-2x+x-x^3}{1+x^2}\\ \dfrac{-x+x^3+2x}{1+x^2} & \dfrac{1+x^2}{1+x^2}\end{bmatrix}=\begin{bmatrix}1 & \dfrac{-x-x^3}{1+x^2}\\ \dfrac{x^3+x}{1+x^2} & 1\end{bmatrix}=\begin{bmatrix}1 & \dfrac{-x(1+x^2)}{1+x^2}\\ \dfrac{x(x^2+1)}{1+x^2} & 1\end{bmatrix}=\begin{bmatrix}1 & x\\-x & 1\end{bmatrix}$$

$$LHS=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}+\begin{bmatrix}0 & -x\\x & 0\end{bmatrix}=\begin{bmatrix}1 & x\\-x & 1\end{bmatrix}=RHS$$

17. Express the matrix $B=\begin{bmatrix}2 & -2 & -4\\-1 & 3 & 4\\1 & -2 & -3\end{bmatrix}$ as the sum of a symmetric and a skew symmetric matrix.

Ans: $B=\begin{bmatrix}2 & -2 & -4\\-1 & 3 & 4\\1 & -2 & -3\end{bmatrix}\Rightarrow B'=\begin{bmatrix}2 & -1 & 1\\-2 & 3 & -2\\-4 & 4 & -3\end{bmatrix}$

$$Let\ \ P=\frac{1}{2}(B+B')=\frac{1}{2}\begin{bmatrix}4 & -3 & -3\\ -3 & 6 & 2\\ -3 & 2 & -6\end{bmatrix}=\begin{bmatrix}2 & -3/2 & -3/2\\ -3/2 & 3 & 1\\ -3/2 & 1 & -3\end{bmatrix}$$

$$Now\ \ P'=\begin{bmatrix}2 & -3/2 & -3/2\\ -3/2 & 3 & 1\\ -3/2 & 1 & -3\end{bmatrix}=P$$

$Thus\ \ P=\frac{1}{2}(B+B')$ is a symmetric matrix.

$$Also, let\ \ Q=\frac{1}{2}(B-B')=\frac{1}{2}\begin{bmatrix}0 & -1 & -5\\ 1 & 0 & 6\\ 5 & -6 & 0\end{bmatrix}=\begin{bmatrix}0 & -1/2 & -5/2\\ 1/2 & 0 & 3\\ 5/2 & -3 & 0\end{bmatrix}$$

$$Now\ \ Q'=\begin{bmatrix}0 & 1/2 & 5/2\\ -1/2 & 0 & -3\\ -5/2 & 3 & 0\end{bmatrix}=-Q$$

$Thus\ \ Q=\frac{1}{2}(B-B')$ is a skew symmetric matrix.

$$Now, P+Q=\begin{bmatrix}2 & -3/2 & -3/2\\ -3/2 & 3 & 1\\ -3/2 & 1 & -3\end{bmatrix}+\begin{bmatrix}0 & -1/2 & -5/2\\ 1/2 & 0 & 3\\ 5/2 & -3 & 0\end{bmatrix}=\begin{bmatrix}2 & -2 & -4\\ -1 & 3 & 4\\ 1 & -2 & -3\end{bmatrix}=B$$

Thus, B is represented as the sum of a symmetric and a skew symmetric matrix.

SECTION – D

Questions 18 carry 5 marks.

18. Given A = $\begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}$ and B = $\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}$, verify that BA = 6I, how can we use the result to find the values of x, y, z from given equations x – y = 3, 2x + 3y + 4z = 17, y + 2z = 17

Ans: We have A = $\begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}$ and B = $\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}$

$$\text{Now, } AB=\begin{bmatrix}1 & -1 & 0\\ 2 & 3 & 4\\ 0 & 1 & 2\end{bmatrix}\begin{bmatrix}2 & 2 & -4\\ -4 & 2 & -4\\ 2 & -1 & 5\end{bmatrix}=\begin{bmatrix}2+4+0 & 2-2+0 & -4+4+0\\ 4-12+8 & 4+6-4 & -8-12+20\\ 0-4+4 & 0+2-2 & 0-4+10\end{bmatrix}$$

$$=\begin{bmatrix}6 & 0 & 0\\ 0 & 6 & 0\\ 0 & 0 & 6\end{bmatrix}=6\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$$

$$\Rightarrow AB = 61 \Rightarrow A^{-1} = \frac{1}{6}B$$

$$\Rightarrow A^{-1} = \frac{1}{6}\begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$$

The given system of linear equations can be written in matrix form as AX = B, where

$$A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} 3 \\ 17 \\ 7 \end{bmatrix}$$

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

$$\Rightarrow X = \frac{1}{6}\begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}\begin{bmatrix} 3 \\ 17 \\ 7 \end{bmatrix} \Rightarrow X = \frac{1}{6}\begin{bmatrix} 2\times3+2\times17-4\times7 \\ -4\times3+2\times17-4\times7 \\ 2\times3-1\times17+5\times7 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix} \Rightarrow x = 2, y = -1, z = 4$$

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. To promote the usage of house toilets in villages, especially for women, are organisations tried to generate awareness among the villagers through (i) house calls (ii) letters, and (iii) announcements.

The cost for each mode per attempt is given below.

(i) ₹ 50 (ii) ₹ 20 (iii) ₹ 40

The number of attempts made in villages X, Y, and Z is given below:

	(i)	(ii)	(iii)
X	400	300	100
Y	300	250	75
Z	500	400	150

Also, the chance of making toilets corresponding to one attempt of given modes is:

(i) 2% (ii) 4% (iii) 20%

Let A, B, and C be the cost incurred by organisation in three villages respectively.

Based on the above information answer the following questions:

(i) Form a required matrix on the basis of the given information. [1]

(ii) From a matrix, related to the number of toilets expected in villagers X, Y, and Z after the promotion campaign. [1]

(iii) What is the total amount spent by the organisation in all three villages X, Y, and Z? [2]

OR

(iii) What is the total no.of toilets expected after the promotion campaign? [2]

Solution:

(i) Here, ₹A, ₹B, and ₹C are the cost incurred by the organisation for villages X, Y, and Z respectively then, A and B will be given by the following matrix equation

$$\begin{bmatrix} 400 & 300 & 100 \\ 300 & 250 & 75 \\ 500 & 400 & 150 \end{bmatrix}\begin{bmatrix} 50 \\ 20 \\ 40 \end{bmatrix} = \begin{bmatrix} A \\ B \\ C \end{bmatrix}$$

(ii) $\begin{matrix} X \\ Y \\ Z \end{matrix}\begin{bmatrix} 400 & 300 & 100 \\ 300 & 250 & 75 \\ 500 & 400 & 150 \end{bmatrix}\begin{bmatrix} 2/100 \\ 4/100 \\ 20/100 \end{bmatrix}$ is the required matrix.

(iii) $\begin{bmatrix} A \\ B \\ C \end{bmatrix} = \begin{bmatrix} 400 & 300 & 100 \\ 300 & 250 & 75 \\ 500 & 400 & 150 \end{bmatrix}\begin{bmatrix} 50 \\ 20 \\ 40 \end{bmatrix} = \begin{bmatrix} 20000+6000+4000 \\ 15000+5000+3000 \\ 25000+8000+6000 \end{bmatrix} = \begin{bmatrix} 30000 \\ 23000 \\ 39000 \end{bmatrix}$

Total money spended = 30000 + 23000 + 39000

= 92000

OR

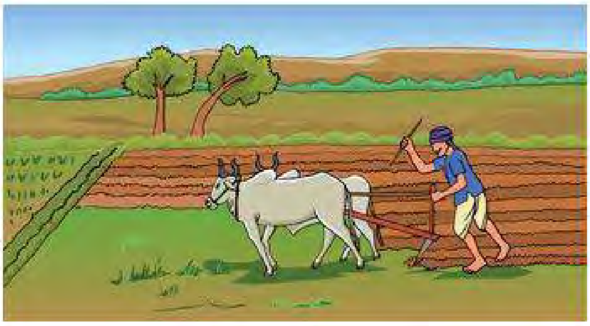
(iii) By part (ii),the required matrix for the expected number of toilets is

$$\begin{matrix} X \\ Y \\ Z \end{matrix}\begin{bmatrix} 400 & 300 & 100 \\ 300 & 250 & 75 \\ 500 & 400 & 150 \end{bmatrix}\begin{bmatrix} 2/100 \\ 4/100 \\ 20/100 \end{bmatrix} = \begin{matrix} X \\ Y \\ Z \end{matrix}\begin{bmatrix} 8+12+20 \\ 6+10+15 \\ 10+16+30 \end{bmatrix} = \begin{matrix} X \\ Y \\ Z \end{matrix}\begin{bmatrix} 40 \\ 31 \\ 56 \end{bmatrix}$$

∴ Total number of toilets expected in 3 villages

= 40 + 31 + 56 = 127

20. Two farmers Ankit and Girish cultivate only three varieties of pulses namely Urad, Masoor and Mung. The sale (in Rs.) of these varieties of pulses by both the farmers in the month of September and October are given by the following matrices A and B.



September sales (in Rs.)

$$A = \begin{pmatrix} Urad & Masoor & Mung \\ 10000 & 20000 & 30000 \\ 50000 & 30000 & 10000 \end{pmatrix}\begin{matrix} \\ Ankit \\ Girish \end{matrix}$$

October sales (in Rs.)

$$B = \begin{pmatrix} Urad & Masoor & Mung \\ 5000 & 10000 & 6000 \\ 20000 & 30000 & 10000 \end{pmatrix}\begin{matrix} \\ Ankit \\ Girish \end{matrix}$$

(i) Find the combined sales of Masoor in September and October, for farmer Girish. [1]

(ii) Find the combined sales of Urad in September and October, for farmer Ankit. [1]

(iii) Find a decrease in sales from September to October. [2]

OR

(iii) If both the farmers receive 2% profit on gross sales, then compute the profit for each farmer and for each variety sold in October. [2]

Ans:

(i) $A + B = \begin{bmatrix} 10000 & 20000 & 30000 \\ 50000 & 30000 & 10000 \end{bmatrix} + \begin{bmatrix} 5000 & 10000 & 6000 \\ 20000 & 10000 & 10000 \end{bmatrix}$

$= \begin{bmatrix} 15000 & 30000 & 36000 \\ 70000 & 40000 & 20000 \end{bmatrix}$

The combined sales of Masoor in September and October, for farmer Girish ₹40000.

(ii) $A + B = \begin{bmatrix} 10000 & 20000 & 30000 \\ 50000 & 30000 & 10000 \end{bmatrix} + \begin{bmatrix} 5000 & 10000 & 6000 \\ 20000 & 10000 & 10000 \end{bmatrix}$

$= \begin{bmatrix} 15000 & 30000 & 36000 \\ 70000 & 40000 & 20000 \end{bmatrix}$

The combined sales of Urad in September and October, for farmer Ankit is ₹15000.

(iii) $A - B = \begin{bmatrix} 10,000 & 20,000 & 30,000 \\ 50,000 & 30,000 & 10,000 \end{bmatrix} - \begin{bmatrix} 5000 & 10,000 & 6000 \\ 20,000 & 10,000 & 10,000 \end{bmatrix}$

$= \begin{bmatrix} 10,000-5000 & 20,000-10,000 & 30,000-6000 \\ 50,000-20,000 & 30,000-10,000 & 10,000-10,000 \end{bmatrix}$

$A - B = \begin{bmatrix} 5000 & 10,000 & 24,000 \\ 30,000 & 20,000 & 0 \end{bmatrix} \begin{matrix} \text{Ankit} \\ \text{Girish} \end{matrix}$

OR

Profit = 2% × sales on october

$= \frac{2}{100} \times B$

$= 0.02 \times \begin{bmatrix} 5000 & 10,000 & 6000 \\ 20,000 & 10,000 & 10,000 \end{bmatrix}$

$= \begin{bmatrix} 0.02 \times 5000 & 0.02 \times 10,000 & 0.02 \times 6000 \\ 0.02 \times 20,000 & 0.02 \times 10,000 & 0.02 \times 10,000 \end{bmatrix} = \begin{bmatrix} 100 & 200 & 120 \\ 400 & 200 & 200 \end{bmatrix} \begin{matrix} \text{Ankit} \\ \text{Girish} \end{matrix}$