PRACTICE PAPER 01 (2026-27) – ANSWER KEY WITH SOLUTIONS
CHAPTER 03 : MATRICES

SUBJECT: MATHEMATICS	**MAX. MARKS:** 40
CLASS: XII	**DURATION:** 1½ hrs

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. $A = [a_{ij}]$, $a_{ij} = i^2 - j^2$

Ans: (b) a skew-symmetric matrix

$a_{ji} = j^2 - i^2 = -a_{ij}$ for all i, j, so $A' = -A$ (and $a_{ii} = 0$).

2. Equality of matrices

Ans: (c) 20

$x + y = 6$ and $xy = 8$, so $x^2 + y^2 = (x + y)^2 - 2xy = 36 - 16 = 20$.

3. Order of B

Ans: (a) 4 × 3

Let B be $p \times q$, so B' is $q \times p$. AB' = $(4 \times 3)(q \times p)$ is defined only if $q = 3$. $B'A$ = $(q \times p)(4 \times 3)$ is defined only if $p = 4$. So B is 4×3.

4. A^{2026}

Ans: (d) −I

$A^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = -I$, so $A^4 = (-I)^2 = I$.

$2026 = 4 \times 506 + 2$, so $A^{2026} = (A^4)^{506} A^2 = I \cdot (-I) = -I$.

5. $(A + I)^2 - 3A$

Ans: (b) I

$(A + I)^2 = A^2 + 2A + I = A + 2A + I = 3A + I$ (using $A^2 = A$).

So $(A + I)^2 - 3A = I$.

6. $A' = A$ and $B' = -B$

Ans: (a) a symmetric matrix

$(AB - BA)' = B'A' - A'B' = (-B)A - A(-B) = -BA + AB = AB - BA$. So $AB - BA$ is symmetric.

7. Inverse of $\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$

Ans: (d) $\begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$, and the product in the other order is also I. (The matrix in option (a) is the transpose, not the inverse.)

8. $(ABC)^{-1}$

Ans: (c) $C^{-1}B^{-1}A^{-1}$

Applying $(XY)^{-1} = Y^{-1}X^{-1}$ twice: $(ABC)^{-1} = C^{-1}(AB)^{-1} = C^{-1}B^{-1}A^{-1}$.

9. Assertion–Reason

Ans: (d) A is false but R is true

A is false: for example $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} = O$, but neither matrix is O.

R is true for real numbers. So A is false and R is true.

10. Assertion–Reason

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

$A = \frac{1}{2}(A + A') + \frac{1}{2}(A - A')$, where the first part is symmetric and the second is skew-symmetric. R gives exactly this decomposition, so R explains A.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. $2\begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 10 \end{bmatrix}$

$\begin{bmatrix} 2+y & 6 \\ 1 & 2x+2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 10 \end{bmatrix}$. (1)

Equating entries: $2 + y = 5 \Rightarrow \mathbf{y = 3}$; $2x + 2 = 10 \Rightarrow \mathbf{x = 4}$. (1)

12. AB and BA

AB = (3 × 1)(1 × 3) is of order 3 × 3: $AB = \begin{bmatrix} 2 & -1 & 4 \\ 4 & -2 & 8 \\ 6 & -3 & 12 \end{bmatrix}$. (1)

BA = (1 × 3)(3 × 1) is of order 1 × 1: $BA = [2(1) + (-1)(2) + 4(3)] = [12]$.

AB and BA are of different orders (3 × 3 and 1 × 1), so $AB \neq BA$. (1)

13. Prove that $A + A'$ is symmetric

$(A + A')' = A' + (A')'$ (since $(X + Y)' = X' + Y'$) (1)

$= A' + A = A + A'$. Hence $(A + A')' = A + A'$, so $A + A'$ is symmetric. (1)

14. Find a, b

Let $X = \begin{bmatrix} a & b \\ -b & a \end{bmatrix}$. Then $X^2 = \begin{bmatrix} a^2 - b^2 & 2ab \\ -2ab & a^2 - b^2 \end{bmatrix}$. (1)

Equating with $\begin{bmatrix} -3 & 4 \\ -4 & -3 \end{bmatrix}$: $a^2 - b^2 = -3$ and $2ab = 4 \Rightarrow ab = 2$, so $b = 2/a$. Then $a^2 - 4/a^2 = -3 \Rightarrow a^4 + 3a^2 - 4 = 0 \Rightarrow (a^2 + 4)(a^2 - 1) = 0 \Rightarrow a^2 = 1$. As $a > 0$, **a = 1, b = 2**. (1)

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. $A = \begin{bmatrix} 1 & 2 \\ -2 & 1 \end{bmatrix}$; show $A^2 - 2A + 5I = O$ and find A^{-1}

$A^2 = \begin{bmatrix} 1-4 & 2+2 \\ -2-2 & -4+1 \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ -4 & -3 \end{bmatrix}$. (1)

$A^2 - 2A + 5I = \begin{bmatrix} -3-2+5 & 4-4 \\ -4+4 & -3-2+5 \end{bmatrix} = O$. (1)

From $A^2 - 2A = -5I$, we get $A(A - 2I) = -5I \Rightarrow A \cdot [(2I - A)/5] = I$. Hence $A^{-1} = (1/5)(2I - A) =$

$(1/5)\begin{bmatrix} 1 & -2 \\ 2 & 1 \end{bmatrix}$. (1)

(Check: $A \cdot A^{-1} = (1/5)\begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} = I$.)

16. Symmetric + skew-symmetric

$B' = \begin{bmatrix} 2 & 3 & 1 \\ 5 & -4 & 2 \\ -1 & 6 & 0 \end{bmatrix}$. Let $P = \tfrac{1}{2}(B + B')$ and $Q = \tfrac{1}{2}(B - B')$.

$P = \tfrac{1}{2}\begin{bmatrix} 4 & 8 & 0 \\ 8 & -8 & 8 \\ 0 & 8 & 0 \end{bmatrix} = \begin{bmatrix} 2 & 4 & 0 \\ 4 & -4 & 4 \\ 0 & 4 & 0 \end{bmatrix}$, which is symmetric ($P' = P$). (1)

$Q = \tfrac{1}{2}\begin{bmatrix} 0 & 2 & -2 \\ -2 & 0 & 4 \\ 2 & -4 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 & -1 \\ -1 & 0 & 2 \\ 1 & -2 & 0 \end{bmatrix}$, which is skew-symmetric ($Q' = -Q$). (1)

$P + Q = \begin{bmatrix} 2 & 5 & -1 \\ 3 & -4 & 6 \\ 1 & 2 & 0 \end{bmatrix} = B$. So $B = P + Q$. (1)

17. Induction: A^n for $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$

Let P(n): $A^n = \begin{bmatrix} 1 + 2n & -4n \\ n & 1 - 2n \end{bmatrix}$.

n = 1: RHS $= \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix} = A$, so P(1) is true. (1)

Assume P(k) is true: $A^k = \begin{bmatrix} 1 + 2k & -4k \\ k & 1 - 2k \end{bmatrix}$.

Then $A^{k+1} = A^k \cdot A = \begin{bmatrix} 3(1 + 2k) - 4k & -4(1 + 2k) + 4k \\ 3k + (1 - 2k) & -4k - (1 - 2k) \end{bmatrix} =$

$\begin{bmatrix} 3 + 2k & -4 - 4k \\ k + 1 & -1 - 2k \end{bmatrix} = \begin{bmatrix} 1 + 2(k + 1) & -4(k + 1) \\ k + 1 & 1 - 2(k + 1) \end{bmatrix}$. (1)

So P(k + 1) is true. By the principle of mathematical induction, P(n) is true for all $n \in \mathbb{N}$. (1)

SECTION – D

Question 18 carries 5 marks.

18. $A = \begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix}$

Let $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. $AB = I$ gives $\begin{bmatrix} 2a + c & 2b + d \\ 5a + 3c & 5b + 3d \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. (1)

$2a + c = 1$ and $5a + 3c = 0$: from the first, $c = 1 - 2a$, so $5a + 3 - 6a = 0 \Rightarrow a = 3$, $c = -5$. (1)

$2b + d = 0$ and $5b + 3d = 1$: $d = -2b$, so $5b - 6b = 1 \Rightarrow b = -1$, $d = 2$. So $B = \begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix}$.

(1)

Verify BA = I: $\begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix}\begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix} = \begin{bmatrix} 6-5 & 3-3 \\ -10+10 & -5+6 \end{bmatrix} = I$. So $B = A^{-1}$. (½)

$(A')^{-1} = (A^{-1})'$: $A' = \begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$ and $(A^{-1})' = \begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$. $A'(A^{-1})' = \begin{bmatrix} 6-5 & -10+10 \\ 3-3 & -5+6 \end{bmatrix} = I$ and $(A^{-1})'A' = \begin{bmatrix} 6-5 & 15-15 \\ -2+2 & -5+6 \end{bmatrix} = I$. Hence $(A')^{-1} = (A^{-1})'$. (1½)

OR

Let $X = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. Then $\begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}X = \begin{bmatrix} a+2c & b+2d \\ 3a+5c & 3b+5d \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix}$. (2)

$a + 2c = 1$, $3a + 5c = 3$: $a = 1 - 2c \Rightarrow 3 - 6c + 5c = 3 \Rightarrow c = 0$, $a = 1$.
$b + 2d = 0$, $3b + 5d = 1$: $b = -2d \Rightarrow -6d + 5d = 1 \Rightarrow d = -1$, $b = 2$. (2)
$X = \begin{bmatrix} 1 & 2 \\ 0 & -1 \end{bmatrix}$. **Verify:** $\begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 2-2 \\ 3 & 6-5 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix}$. (1)

SECTION – E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. Stationery company case study

$S = \begin{bmatrix} 40 & 60 & 10 \\ 50 & 30 & 20 \end{bmatrix}$, $P = \begin{bmatrix} 45 \\ 12 \\ 80 \end{bmatrix}$, $C = \begin{bmatrix} 38 \\ 9 \\ 65 \end{bmatrix}$.

(i) Order of S = 2 × 3, order of P = 3 × 1, order of SP = 2 × 1. (1)

(ii) Revenue $= SP = \begin{bmatrix} 40(45) + 60(12) + 10(80) \\ 50(45) + 30(12) + 20(80) \end{bmatrix} = \begin{bmatrix} 3320 \\ 4210 \end{bmatrix}$. Revenue: Branch 1 = ₹3320, Branch 2 = ₹4210. (1)

(iii) Profit = S(P − C), where $P - C = \begin{bmatrix} 7 \\ 3 \\ 15 \end{bmatrix}$. $S(P - C) = \begin{bmatrix} 40(7) + 60(3) + 10(15) \\ 50(7) + 30(3) + 20(15) \end{bmatrix} = \begin{bmatrix} 610 \\ 740 \end{bmatrix}$. (1)

Profit: Branch 1 = ₹610, Branch 2 = ₹740. (1)

OR

(iii) New sales = S + T, where $T = \begin{bmatrix} 10 & 10 & 10 \\ 10 & 10 & 10 \end{bmatrix}$. Revenue = (S + T)P = SP + TP. (1)

TP $= \begin{bmatrix} 10(45+12+80) \\ 10(45+12+80) \end{bmatrix} = \begin{bmatrix} 1370 \\ 1370 \end{bmatrix}$. So revenue $= \begin{bmatrix} 3320 \\ 4210 \end{bmatrix} + \begin{bmatrix} 1370 \\ 1370 \end{bmatrix} = \begin{bmatrix} 4690 \\ 5580 \end{bmatrix}$. Branch 1 = ₹4690, Branch 2 = ₹5580. (1)

20. Code case study, $E = \begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$, $D = \begin{bmatrix} 3 & -2 \\ -1 & 1 \end{bmatrix}$

(i) M = 13, A = 1, T = 20, H = 8, so $M = \begin{bmatrix} 13 & 1 \\ 20 & 8 \end{bmatrix}$. (1)

(ii) $C = EM = \begin{bmatrix} 13+40 & 1+16 \\ 13+60 & 1+24 \end{bmatrix} = \begin{bmatrix} 53 & 17 \\ 73 & 25 \end{bmatrix}$. (1)

(iii) $ED = \begin{bmatrix} 3-2 & -2+2 \\ 3-3 & -2+3 \end{bmatrix} = I$ and $DE = \begin{bmatrix} 3-2 & 6-6 \\ -1+1 & -2+3 \end{bmatrix} = I$, so $D = E^{-1}$. (1)

Decoding: $DR = \begin{bmatrix} 3(32)-2(44) & 3(37)-2(53) \\ -32+44 & -37+53 \end{bmatrix} = \begin{bmatrix} 8 & 5 \\ 12 & 16 \end{bmatrix}$, i.e. H, E, L, P. The word is **HELP**. (1)

OR

(iii) $E' = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$ and $(E^{-1})' = D' = \begin{bmatrix} 3 & -1 \\ -2 & 1 \end{bmatrix}$. (1)

$E'D' = \begin{bmatrix} 3-2 & -1+1 \\ 6-6 & -2+3 \end{bmatrix} = I$ and $D'E' = \begin{bmatrix} 3-2 & 3-3 \\ -2+2 & -2+3 \end{bmatrix} = I$. So $(E')^{-1} = D' = (E^{-1})'$. (1)

— End of Solutions —