NCERT Solutions for Class-XII Maths

Chapter-1
Exercise- 3.4
NCERT Math Class 12

1. Find the inverse of each of the matrices, if it exists.

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

1. Let $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$

We know that A = IA

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

$$\Rightarrow \begin{bmatrix} 1 & -1 \\ 0 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A \qquad (R_2 \to R_2 - 2R_1)$$

$$\Rightarrow \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -\frac{2}{5} & \frac{1}{5} \end{bmatrix} A \qquad (R_2 \to \frac{1}{2} R_2)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} \frac{3}{5} & \frac{1}{5} \\ -\frac{2}{5} & \frac{1}{5} \end{bmatrix} A \qquad (R_1 \to R_1 + 2R_2)$$

$$\therefore A^{-1} = \begin{bmatrix} \frac{3}{5} & \frac{1}{5} \\ -\frac{2}{5} & \frac{1}{5} \end{bmatrix}$$

2. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$$

2. First of all we need to check whether the matrix is invertible or not. For that-
For the inverse of a matrix A to exist,
Determinant of A $\neq 0$
Here $|A| = (2)(1) - (1)(1) = 1$
So the matrix is invertible.

Now to find the inverse of the matrix,
We know $AA^{-1} = I$
Let's make augmented matrix-
$\rightarrow [\ A : I\ ]$

$$\rightarrow \begin{bmatrix} 2 & 1 & 1 & 0 \\ & & \vdots & \\ 1 & 1 & 0 & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1 - R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & 1 & -1 \\ & & \vdots & \\ 1 & 1 & 0 & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow R_2 - R_1$

$$\rightarrow \begin{bmatrix} 1 & 0 & 1 & -1 \\ & & \vdots & \\ 0 & 1 & -1 & 2 \end{bmatrix}$$

The matrix so obtained is of the form –
$\rightarrow [\ I : A^{-1}\ ]$
Hence inverse of the given matrix-

$$\rightarrow \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

3. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix}$$

3. Let $A = \begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix}$

We know that A = IA

$$\therefore \begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$$

$$\Rightarrow \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A \qquad (R_2 \rightarrow R_2 - 2R_1)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix} A \qquad (R_1 \rightarrow R_1 - 2R_2)$$

$$\therefore A^{-1} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix}$$

4. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 2 & 3 \\ 5 & 7 \end{bmatrix}$$

4. First of all we need to check whether the matrix is invertible or not. For that-
For the inverse of a matrix A to exist,

Determinant of A ≠ 0
Here |A| = (2)(7) – (5)(3) = -1
So the matrix is invertible.

Now to find the inverse of the matrix,
We know $AA^{-1} = I$
Let's make augmented matrix-
→ [A : I]

$$\rightarrow \left[\begin{matrix} 2 & 3 \\ 5 & 7 \end{matrix} \;\vdots\; \begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}\right]$$

Apply row operation- $R_2 \rightarrow R_2 - \frac{5}{2}R_1$

$$\rightarrow \left[\begin{matrix} 2 & 3 \\ 0 & -\frac{1}{2} \end{matrix} \;\vdots\; \begin{matrix} 1 & 0 \\ -\frac{5}{2} & 1 \end{matrix}\right]$$

Apply row operation- $R_1 \rightarrow R_1/2$

$$\rightarrow \left[\begin{matrix} 1 & \frac{3}{2} \\ 0 & -\frac{1}{2} \end{matrix} \;\vdots\; \begin{matrix} \frac{1}{2} & 0 \\ -\frac{5}{2} & 1 \end{matrix}\right]$$

Apply row operation- $R_1 \rightarrow R_1 + 3R_2$

$$\rightarrow \left[\begin{matrix} 1 & 0 \\ 0 & -\frac{1}{2} \end{matrix} \;\vdots\; \begin{matrix} -7 & 3 \\ -\frac{5}{2} & 1 \end{matrix}\right]$$

Apply row operation- $R_2 \rightarrow -2R_2$

$$\rightarrow \left[\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix} \;\vdots\; \begin{matrix} -7 & 3 \\ 5 & -2 \end{matrix}\right]$$

The matrix so obtained is of the form –
→ [I : A^{-1}]
Hence inverse of the given matrix-

$$\rightarrow \begin{bmatrix} -7 & 3 \\ 5 & -2 \end{bmatrix}$$

5. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix}$$

5. Let $A = \begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix}$

We know that A = IA

$$\therefore \begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$$

$$\Rightarrow \begin{bmatrix} 1 & \frac{1}{2} \\ 7 & 4 \end{bmatrix} = \begin{bmatrix} \frac{1}{2} & 0 \\ 0 & 1 \end{bmatrix} A \qquad \left(R_1 \to \frac{1}{2} R_1\right)$$

$$\Rightarrow \begin{bmatrix} 1 & \frac{1}{2} \\ 0 & \frac{1}{2} \end{bmatrix} = \begin{bmatrix} \frac{1}{2} & 0 \\ -\frac{7}{2} & 1 \end{bmatrix} A \qquad (R_2 \to R_2 - 7R_1)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 1 & \frac{1}{2} \end{bmatrix} = \begin{bmatrix} 4 & 3 \\ -\frac{7}{2} & 1 \end{bmatrix} A \qquad (R_1 \to R_1 - R_2)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ -7 & 2 \end{bmatrix} A \qquad (R_2 \to 2R_2)$$

$$\therefore A^{-1} = \begin{bmatrix} 4 & -1 \\ -7 & 2 \end{bmatrix}$$

6. Find the inverse of each of the matrices, if it exists.

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

6. First of all we need to check whether the matrix is invertible or not. For that-

For the inverse of a matrix A to exist,

Determinant of A ≠ 0

Here |A| = (2)(3) – (1)(5) = 1

So the matrix is invertible.

Now to find the inverse of the matrix,

We know $AA^{-1} = I$

Let's make augmented matrix-

→ [A : I]

$$\to \left[\begin{matrix} 2 & 5 \\ 1 & 3 \end{matrix} \vdots \begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}\right]$$

Apply row operation- $R_2 \to R_2 - \frac{1}{2} R_1$

$$\to \left[\begin{matrix} 2 & 5 \\ 0 & \frac{1}{2} \end{matrix} \vdots \begin{matrix} 1 & 0 \\ -\frac{1}{2} & 1 \end{matrix}\right]$$

Apply row operation- $R_1 \to R_1/2$

$$\rightarrow \begin{bmatrix} 1 & \frac{5}{2} & \vdots & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & \vdots & -\frac{1}{2} & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1 - 5R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & \vdots & 3 & -5 \\ 0 & \frac{1}{2} & \vdots & -\frac{1}{2} & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow 2R_2$

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

The matrix so obtained is of the form –

$\rightarrow [\ I : A^{-1}\ ]$

Hence inverse of the given matrix-

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

7. Find the inverse of each of the matrices, if it exists.

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

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

We know that A = AI

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

$$\Rightarrow \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} = A \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} \qquad (C_1 \rightarrow C_1 - 2C_2)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} = A \begin{bmatrix} 1 & -1 \\ -2 & 3 \end{bmatrix} \qquad (C_2 \rightarrow C_2 - C_1)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = A \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix} \qquad (C_1 \rightarrow C_2 - C_2)$$

$$\therefore A^{-1} = \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix}$$

8. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 4 & 5 \\ 3 & 4 \end{bmatrix}$$

8 First of all we need to check whether the matrix is invertible or not. For that-

For the inverse of a matrix A to exist,
Determinant of A $\neq 0$
Here $|A| = (4)(4) - (5)(3) = 1$
So the matrix is invertible.

Now to find the inverse of the matrix,
We know $AA^{-1} = I$
Let's make augmented matrix-
$\rightarrow [\ A : I\ ]$

$$\rightarrow \begin{bmatrix} 4 & 5 & \vdots & 1 & 0 \\ 3 & 4 & \vdots & 0 & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow R_2 - \frac{3}{4}R_1$

$$\rightarrow \begin{bmatrix} 4 & 5 & \vdots & 1 & 0 \\ 0 & \frac{1}{4} & \vdots & -\frac{3}{4} & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1/4$

$$\rightarrow \begin{bmatrix} 1 & \frac{5}{4} & \vdots & \frac{1}{4} & 0 \\ 0 & \frac{1}{4} & \vdots & -\frac{3}{4} & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1 - 5R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & \vdots & 4 & -5 \\ 0 & \frac{1}{4} & \vdots & -\frac{3}{4} & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow 4R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & \vdots & 4 & -5 \\ 0 & 1 & \vdots & -3 & 4 \end{bmatrix}$$

The matrix so obtained is of the form –
$\rightarrow [\ I : A^{-1}\ ]$
Hence inverse of the given matrix-

$$\rightarrow \begin{bmatrix} 4 & -5 \\ -3 & 4 \end{bmatrix}$$

9. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 3 & 10 \\ 2 & 7 \end{bmatrix}$$

9. Let $A = \begin{bmatrix} 3 & 10 \\ 2 & 7 \end{bmatrix}$

We know that A = IA

$$\therefore \begin{bmatrix} 3 & 10 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$$

$$\Rightarrow \begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A \qquad (R_1 \to R_1 - R_2)$$

$$\Rightarrow \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -2 & 3 \end{bmatrix} A \qquad (R_2 \to R_2 - 2R_1)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & -10 \\ -2 & 3 \end{bmatrix} A \qquad (R_1 \to R_1 - 3R_2)$$

$$\therefore A^{-1} = \begin{bmatrix} 7 & -10 \\ -2 & 3 \end{bmatrix}$$

10. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 3 & -1 \\ -4 & 3 \end{bmatrix}$$

10. First of all we need to check whether the matrix is invertible or not. For that-

For the inverse of a matrix A to exist,

Determinant of A ≠ 0

Here |A| = (3)(2) – (-1)(-4) = 2

So the matrix is invertible.

Now to find the inverse of the matrix,

We know $AA^{-1} = I$

Let's make augmented matrix-

→ [A : I]

$$\rightarrow \begin{bmatrix} 3 & -1 & \vdots & 1 & 0 \\ -4 & 2 & \vdots & 0 & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow R_2 + \frac{4}{3} R_1$

$$\rightarrow \begin{bmatrix} 3 & -1 & \vdots & 1 & 0 \\ 0 & \frac{2}{3} & \vdots & \frac{4}{3} & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1/3$

$$\rightarrow \begin{bmatrix} 1 & -\frac{1}{3} & \vdots & \frac{1}{3} & 0 \\ 0 & \frac{2}{3} & \vdots & \frac{4}{3} & 1 \end{bmatrix}$$

Apply row operation- $R_1 \rightarrow R_1 + \frac{1}{2} R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & & 1 & \frac{1}{2} \\ 0 & \frac{2}{3} & \text{M} & \frac{4}{3} & 1 \end{bmatrix}$$

Apply row operation- $R_2 \rightarrow \frac{3}{2} R_2$

$$\rightarrow \begin{bmatrix} 1 & 0 & & 1 & \frac{1}{2} \\ & & \text{M} & & \\ 0 & 1 & & 2 & \frac{3}{2} \end{bmatrix}$$

The matrix so obtained is of the form –
$\rightarrow [\ I : A^{-1}\ ]$
Hence inverse of the given matrix-

$$\rightarrow \begin{bmatrix} 1 & \frac{1}{2} \\ 2 & \frac{3}{2} \end{bmatrix}$$

11. Find the inverse of each of the matrices, if it exists.
$\begin{bmatrix} 2 & -6 \\ 1 & -2 \end{bmatrix}$

11. Let $A = \begin{bmatrix} 2 & -6 \\ 1 & -2 \end{bmatrix}$

We know that A = IA

$$\therefore \begin{bmatrix} 2 & -6 \\ 1 & -2 \end{bmatrix} = A \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix} = A \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} \qquad (C_2 \rightarrow C_2 + 3C_1)$$

$$\Rightarrow \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix} = A \begin{bmatrix} -2 & 3 \\ -1 & 1 \end{bmatrix} \qquad (C_1 \rightarrow C_1 - C_2)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = A \begin{bmatrix} -1 & 3 \\ -\frac{1}{2} & 1 \end{bmatrix} \qquad (C_1 \rightarrow \frac{1}{2} C_1)$$

$$\therefore A^{-1} = \begin{bmatrix} -1 & 3 \\ -\frac{1}{2} & 1 \end{bmatrix}$$

12. Find the inverse of each of the matrices, if it exists.

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

12. First of all we need to check whether the matrix is invertible or not. For that-
For the inverse of a matrix A to exist,
Determinant of A ≠ 0
Here |A| = (6)(1) – (-2)(-3) = 0
So the matrix is not invertible.
∴ the inverse of the given matrix does not exist.

13. Find the inverse of each of the matrices, if it exists

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

13. Let $A = \begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$

We know that A = IA

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

$$\Rightarrow \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} A \qquad (R_1 \to R_1 + R_2)$$

$$\Rightarrow \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} A \qquad (R_2 \to R_2 + R_1)$$

$$\Rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix} A \qquad (R_1 \to R_1 + R_2)$$

$$\therefore A^{-1} = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$$

14. Find the inverse of each of the matrices, if it exists.

$$\begin{bmatrix} 2 & 1 \\ 4 & 2 \end{bmatrix}$$

14. First of all we need to check whether the matrix is invertible or not. For that-
For the inverse of a matrix A to exist,
Determinant of A ≠ 0
Here |A| = (2)(2) – (1)(4) = 0
So the matrix is not invertible.
∴ the inverse of the given matrix does not exist.

15. $\begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix}$

15. First of all we need to check whether the matrix is invertible or not. For that-

For the inverse of a matrix A to exist,

Determinant of $A \neq 0$

Here $|A| = [\,(2)\,\{2\times2 - 3\times(-2)\} - (-3)\,\{2\times 2 - 3\times3\} + (3)\,\{2\times(-2) - 2\times3\}\,]$

$= [2\,\{4-(-6)\} + 3\,\{4-9\} + 3\,\{-4-6\}\,]$

$= [2(10) + 3(-5) + 3(-10)]$

$=[20-15-30]$

$= -25$

So the matrix is invertible.

Now to find the inverse of the matrix,

We know $AA^{-1} = I$

Let's make augmented matrix-

$\rightarrow [\,A : I\,]$

$$\rightarrow \left[\begin{array}{ccc|ccc} 2 & -3 & 3 & 1 & 0 & 0 \\ 2 & 2 & 3 & 0 & 1 & 0 \\ 3 & -2 & 2 & 0 & 0 & 1 \end{array}\right]$$

Apply row operation- $R_1 \rightarrow \frac{1}{2} R_1$

$$\rightarrow \left[\begin{array}{ccc|ccc} 1 & -\frac{3}{2} & \frac{3}{2} & \frac{1}{2} & 0 & 0 \\ 2 & 2 & 3 & 0 & 1 & 0 \\ 3 & -2 & 2 & 0 & 0 & 1 \end{array}\right]$$

Apply row operation- $R_2 \rightarrow R_2 - 2R_1$

$$\rightarrow \left[\begin{array}{ccc|ccc} 1 & -\frac{3}{2} & \frac{3}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 5 & 0 & -1 & 1 & 0 \\ 3 & -2 & 2 & 0 & 0 & 1 \end{array}\right]$$

Apply row operation- $R_3 \rightarrow R_3 - 3R_1$

$$\rightarrow \left[\begin{array}{ccc|ccc} 1 & -\frac{3}{2} & \frac{3}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 5 & 0 & -1 & 1 & 0 \\ 0 & \frac{5}{2} & -\frac{5}{2} & -\frac{3}{2} & 0 & 1 \end{array}\right]$$

Apply row operation- $R_2 \rightarrow \frac{1}{5} R_2$

$$\rightarrow \left[\begin{array}{ccc:ccc} 1 & -\frac{3}{2} & \frac{3}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 1 & 0 & -\frac{1}{5} & \frac{1}{5} & 0 \\ 0 & \frac{5}{2} & -\frac{5}{2} & -\frac{3}{2} & 0 & 1 \end{array}\right]$$

Apply row operation- $R_1 \rightarrow R_1 + \frac{3}{2} R_2$

$$\rightarrow \left[\begin{array}{ccc:ccc} 1 & 0 & \frac{3}{2} & \frac{1}{5} & \frac{3}{10} & 0 \\ 0 & 1 & 0 & -\frac{1}{5} & \frac{1}{5} & 0 \\ 0 & \frac{5}{2} & -\frac{5}{2} & -\frac{3}{2} & 0 & 1 \end{array}\right]$$

Apply row operation- $R_3 \rightarrow R_3 - \frac{5}{2} R_2$

$$\rightarrow \left[\begin{array}{ccc:ccc} 1 & 0 & \frac{3}{2} & \frac{1}{5} & \frac{3}{10} & 0 \\ 0 & 1 & 0 & -\frac{1}{5} & \frac{1}{5} & 0 \\ 0 & 0 & -\frac{5}{2} & -1 & -\frac{1}{2} & 1 \end{array}\right]$$

Apply row operation- $R_3 \rightarrow -\frac{2}{5} R_3$

$$\rightarrow \left[\begin{array}{ccc:ccc} 1 & 0 & \frac{3}{2} & \frac{1}{5} & \frac{3}{10} & 0 \\ 0 & 1 & 0 & -\frac{1}{5} & \frac{1}{5} & 0 \\ 0 & 0 & 1 & \frac{2}{5} & \frac{1}{5} & -\frac{2}{5} \end{array}\right]$$

Apply row operation- $R_1 \rightarrow R_1 - \frac{3}{2} R_3$

$$\rightarrow \left[\begin{array}{ccc:ccc} 1 & 0 & 0 & -\frac{2}{5} & 0 & \frac{3}{5} \\ 0 & 1 & 0 & -\frac{1}{5} & \frac{1}{5} & 0 \\ 0 & 0 & 1 & \frac{2}{5} & \frac{1}{5} & -\frac{2}{5} \end{array}\right]$$

The matrix so obtained is of the form –
$\rightarrow [\ I : A^{-1}\ ]$
Hence inverse of the given matrix-

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

16. Find the inverse of each of the matrices, if it exists.

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

16. Let $A = \begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix}$

We know that A = IA

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

Applying $R_2 \rightarrow R_2 + 3R_1$ and $R_3 \rightarrow R_3 - 2R_1$, we have:

$$\begin{bmatrix} 1 & 3 & -2 \\ 0 & 9 & -11 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} A$$

Applying $R_1 \rightarrow R_1 + 3R_3$ and $R_2 \rightarrow R_2 + 8R_3$, we have:

$$\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & 21 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ -13 & 1 & 8 \\ -2 & 0 & 1 \end{bmatrix} A$$

Applying $R_3 \rightarrow R_3 + R_2$, we have:

$$\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & 21 \\ 0 & 0 & 25 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ -13 & 1 & 8 \\ -15 & 1 & 9 \end{bmatrix} A$$

Applying $R_3 \rightarrow \frac{1}{25} R_3$, we have:

$$\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & 21 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ -13 & 1 & 8 \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix}$$

Applying $R_1 \to R_1 - 10R_3$, and $R_2 \to R_2 - 21R_3$, we have:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$$

$$\therefore A^{-1} = \begin{bmatrix} 1 & -\frac{2}{5} & -\frac{3}{5} \\ -\frac{2}{5} & \frac{4}{25} & \frac{11}{25} \\ -\frac{3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix}$$

17. Find the inverse of each of the matrices, if it exists.

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

17. Let $A = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$

We know that A = IA

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

Applying $R_1 \to \frac{1}{2} R_1$, we have:

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

Applying $R_2 \to R_2 - 5R_1$, we have:

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

Applying $R_3 \to R_3 - 5_2$, we have:

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

Applying $R_3 \to 2R_3$, we have:

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

Applying $R_1 \to R_1 + \frac{1}{2}R_3$, and $R_2 \to R_2 - \frac{5}{2}R_3$, we have

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix} A$$

$$\therefore A^{-1} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix}$$

18. 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. $AB = BA = I$

18. Here it is given that A & B are inverse of each other.

$\therefore A^{-1} = B$ -(i)

Also $B^{-1} = A$ -(ii)

From definition of inverse matrix, we know that-

$\to AA^{-1} = I$

$\because A^{-1} = B$ {from eq(i)}

$\to AB = I$ -(iii)

Similarly, $BB^{-1} = I$

$\because B^{-1} = A$ {from eq(ii)}

$\to BA = I$ -(iv)

So $AB = BA = I$ {from eq(iii) and eq(iv)}

Hence option D is the correct answer.