NCERT - Exercise 3.4

Using elementary transformations, find the inverse of each of the matrices, if it exists in questions 1 to 17..

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

SOLUTION .:

Let us take $A = \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$ We know that, A = IA $\Rightarrow \begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$ Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 1 & -1 \\ 0 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A$

Applying $R_2 \to \frac{1}{5}R_2$ $\begin{bmatrix} 0 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \frac{-2}{5} & \frac{1}{5} \end{bmatrix} A$

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

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

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

SOLUTION .:

Let us take $A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$

We know that, A = IA $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - R_1$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix} A$

Hence, $A^{-1} = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$

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

SOLUTION .:

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

We know that, A = IA

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

Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - 3R_2$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix} A$ Hence, $A^{-1} = \begin{bmatrix} 7 & -3 \\ -2 & 1 \end{bmatrix}$

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

SOLUTION .:

Let us take $A = \begin{bmatrix} 2 & 3 \\ 5 & 7 \end{bmatrix}$

We know that, A = IA ⇒ $\begin{bmatrix} 2 & 3 \\ 5 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 2 & 3 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -1 \\ -2 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - R_1$ $\begin{bmatrix} 1 & 2 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 3 & -1 \\ -5 & 2 \end{bmatrix} A$

Applying $R_2 \to -R_2$ $\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -1 \\ 5 & -2 \end{bmatrix} A$

Applying $R_1 \to R_1 - 2R_2$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -7 & 3 \\ 5 & -2 \end{bmatrix} A$

Hence, $A^{-1} = \begin{bmatrix} -7 & 3 \\ 5 & -2 \end{bmatrix}$

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix}$

We know that, A = IA ⇒ $\begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$ Applying $R_2 \to R_2 - 3R_1$ $\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -3 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ -3 & 1 \end{bmatrix} A$

Applying$R_2 \to R_2 - R_1$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ -7 & 2 \end{bmatrix} A$ Hence, $A^{-1} = \begin{bmatrix} 4 & -1 \\ -7 & 2 \end{bmatrix}$

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

SOLUTION .:

Let us take $A = \begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$ We know that, A = IA ⇒ $\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - R_1$ $\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix} A$

Applying $R_1 \to R_1 - 2R_2$

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

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

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$

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We know that, A = IA

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

Applying $R_2 \to R_2 - R_1$ $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix} A$ Hence, $A^{-1} = \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix}$

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

SOLUTION .:

Let us take A= $\begin{bmatrix} 4 & 5 \\ 3 & 4 \end{bmatrix}$

We know that, A = IA $\Rightarrow \begin{bmatrix} 4 & 5 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 1 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 3R_1$ $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -3 & 4 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 4 & -5 \\ -3 & 4 \end{bmatrix} A$

Hence, $A^{-1} = \begin{bmatrix} 4 & -5 \\ -3 & 4 \end{bmatrix}$

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 3 & 10 \\ 2 & 7 \end{bmatrix}$ We know that, A = IA $\Rightarrow \begin{bmatrix} 3 & 10 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$ $\begin{bmatrix} 1 & 3 \\ 2 & 7 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -2 & 3 \end{bmatrix} A$

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

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

10. $\begin{bmatrix} 3 & -1 \\ -4 & 2 \end{bmatrix}$

SOLUTION .:

Let us take A = $\begin{bmatrix} 3 & -1 \\ -4 & 2 \end{bmatrix}$ We know that, A = IA $\Rightarrow \begin{bmatrix} 3 & -1 \\ -4 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 + R_2$ $\begin{bmatrix} -1 & 1 \\ -4 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to -R_1$ $\begin{bmatrix} 1 & -1 \\ -4 & 2 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 + 4R_1$ $\begin{bmatrix} 1 & -1 \\ 0 & -2 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ -4 & -3 \end{bmatrix} = A$

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Applying $R_2 \to -R_2 \begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ 4 & 3 \end{bmatrix} = A$

Applying $R_2 \to \frac{1}{2}R_2 \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ 2 & \frac{3}{2} \end{bmatrix} A$

Applying $R_1 \to R_1 + R_2 \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & \frac{1}{2} \\ 2 & \frac{3}{2} \end{bmatrix} A$

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

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 2 & -6 \\ 1 & -2 \end{bmatrix}$

We know that, A = IA ⇒ $\begin{bmatrix} 2 & -6 \\ 1 & -2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2 \begin{bmatrix} 1 & -4 \\ 1 & -2 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - R_1 \begin{bmatrix} 1 & -4 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix} A$

Applying $R_1 \to R_1 + 2R_2 \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} -1 & 3 \\ -1 & 2 \end{bmatrix} A$

Applying $R_2 \to \frac{1}{2}R_2 \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -1 & 3 \\ \frac{-1}{2} & 1 \end{bmatrix} A$

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

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 6 & -3 \\ -2 & 1 \end{bmatrix}$

We know that, A = IA $\begin{bmatrix} 6 & -3 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 + 3R_2 \begin{bmatrix} 0 & 0 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix} A$

We have all zeroes in the first row of the left hand side matrix of the above equation. $\therefore A^{-1}$ does not exist.

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

SOLUTION .:

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

We know that, A = IA ⇒ $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

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Applying $R_1 \to R_1 + R_2$ $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 + R_1$ $\begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} A$

Applying $R_1 \to R_1 + R_2$ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix} A$

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

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 2 & 1 \\ 4 & 2 \end{bmatrix}$ We know that, A = IA $\Rightarrow$ $\begin{bmatrix} 2 & 1 \\ 4 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_1$ $\begin{bmatrix} 2 & 1 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -2 & 1 \end{bmatrix} A$

We have all zeroes in the second row of the left hand side matrix of the above equation. Therefore, A^{-1}does not exist.

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix}$

We know that, A = IA $\Rightarrow$ $\begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$, we get $\begin{bmatrix} 0 & -5 & 0 \\ 2 & 2 & 3 \\ 2 & -2 & 2 \end{bmatrix} = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_3 \to R_3 - R_2$, we get $\begin{bmatrix} 0 & -5 & 0 \\ 2 & 2 & 3 \\ 1 & -4 & -1 \end{bmatrix} = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_3$, we get $\begin{bmatrix} 0 & -5 & 0 \\ 0 & 10 & 5 \\ 1 & -4 & -1 \end{bmatrix} = \begin{bmatrix} 1 & -1 & 0 \\ 0 & 3 & -2 \\ 0 & -1 & 1 \end{bmatrix} A$

Applying $R_1 \leftrightarrow R_3$,we get $\begin{bmatrix} 1 & -4 & -1 \\ 0 & 10 & 5 \\ 0 & -5 & 0 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 1 \\ 0 & 3 & -2 \\ 1 & -1 & 0 \end{bmatrix} A$

Applying $R_3 \leftrightarrow R_2$, we get $\begin{bmatrix} 1 & -4 & -1 \\ 0 & -5 & 0 \\ 0 & 10 & 5 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 1 \\ 1 & -1 & 0 \\ 0 & 3 & -2 \end{bmatrix} A$

Applying $R_3 \to R_3 + 2R_2$,we get $\begin{bmatrix} 1 & -4 & -1 \\ 0 & -5 & 0 \\ 0 & 0 & 5 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 1 \\ 1 & -1 & 0 \\ 2 & 1 & -2 \end{bmatrix} A$

Applying $R_2 \to -R_2$,we get $\begin{bmatrix} 1 & -4 & -1 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 1 \\ -1 & 1 & 0 \\ 2 & 1 & -2 \end{bmatrix} A$

Applying $R_2 \to \frac{1}{5}R_2$and $R_3 \to \frac{1}{5}R_3$, we get $\begin{bmatrix} 1 & -4 & -1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -1 & 1 \\ \frac{-1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & \frac{-2}{5} \end{bmatrix} A$

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Applying $R_1 \to R_1 + 4R_2$,we get $\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{4}{5} & -\frac{1}{5} & 1 \\ -\frac{1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & \frac{-2}{5} \end{bmatrix} A$

Applying $R_1 \to R_1 + R_3$,we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} \frac{-2}{5} & 0 & \frac{3}{5} \\ \frac{-1}{5} & \frac{1}{5} & 0 \\ \frac{2}{5} & \frac{1}{5} & \frac{-2}{5} \end{bmatrix}$

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

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

SOLUTION .:

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

We know that, A = IA ⇒ $\begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 + 3R_1$,we get $\begin{bmatrix} 1 & 3 & -2 \\ 0 & 9 & -11 \\ 2 & 5 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_3 \to R_3 - 2R_1$,we get $\begin{bmatrix} 1 & 3 & -2 \\ 0 & 9 & -11 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 + 3R_3$,wet get $\begin{bmatrix} 1 & 0 & 10 \\ 0 & 9 & -11 \\ 0 & -1 & 4 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ 3 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix} A$

Interchanging $R_2$and R_3we get $\begin{bmatrix} 1 & 0 & 10 \\ 0 & -1 & 4 \\ 0 & 9 & -11 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ -2 & 0 & 1 \\ 3 & 1 & 0 \end{bmatrix} A$

Applying $R_3 \to R_3 + 9R_2$, we get $\begin{bmatrix} 1 & 0 & 10 \\ 0 & -1 & 4 \\ 0 & 0 & 25 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ -2 & 0 & 1 \\ -15 & 1 & 9 \end{bmatrix} A$

Applying $R_2 \to -R_2$, we get $\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & -4 \\ 0 & 0 & 25 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ 2 & 0 & -1 \\ -15 & 1 & 9 \end{bmatrix} A$

Applying $R_3 \to \frac{1}{25}R_3$,we get $\begin{bmatrix} 1 & 0 & 10 \\ 0 & 1 & -4 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -5 & 0 & 3 \\ 2 & 0 & -1 \\ \frac{-15}{25} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$

Applying $R_1 \to R_1 - 10R_3$, we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -4 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & \frac{-2}{5} & \frac{-3}{5} \\ 2 & 0 & -1 \\ \frac{-3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$

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Applying $R_2 \to R_2 + 4R_3$,we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & \frac{-2}{5} & \frac{-3}{5} \\ \frac{-2}{5} & \frac{4}{25} & \frac{11}{25} \\ \frac{-3}{5} & \frac{1}{25} & \frac{9}{25} \end{bmatrix} A$

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

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

SOLUTION .:

Let us take A = $\begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$ We know that, A = IA ⇒ $\begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Interchanging $R_1$and R_2, we get

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

Applying $R_1 \to R_1 - 2R_2$,we get $\begin{bmatrix} 1 & 1 & 2 \\ 2 & 0 & -1 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_1$,we get $\begin{bmatrix} 1 & 1 & 2 \\ 0 & -2 & -5 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ 5 & -2 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_2 \to -R_2$, we get $\begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 5 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ -5 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_2 \to R_2 - R_3$,we get $\begin{bmatrix} 1 & 1 & 2 \\ 0 & 1 & 2 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 0 \\ -5 & 2 & -1 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_1 \to R_1 - R_2$,we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 2 \\ 0 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 3 & -1 & 1 \\ -5 & 2 & -1 \\ 0 & 0 & 1 \end{bmatrix} A$

Applying $R_3 \to R_3 - R_2$,we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -1 & 1 \\ -5 & 2 & -1 \\ 5 & -2 & 2 \end{bmatrix} A$

Applying $R_2 \to R_2 - 2R_3$,we get $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{bmatrix} A$

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

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) $AB = BA = I$

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SOLUTION .:

(D) Matrices A and B will be inverse of each other only if, AB = BA -1.

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