Step-1

(a) $BA = 4A$

Multiply with A^{-1} on both side

We have

$$\Rightarrow (BA).A^{-1} = (4A)A^{-1}$$
$$\Rightarrow B\left(A.A^{-1}\right) = 4\left(AA^{-1}\right)$$

Since by associative property

$$\Rightarrow B.I = 4.I$$
$$\Rightarrow \boxed{B = 4I}$$

Step-2

(b) $BA = 4B$

$B.A = 4B$, if $\boxed{B = 0}$

Step-3

(c) BA has row 1 and 3 of A are reversed and row 2 unchanged.

B must be $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$

Example:-

$$BA = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 5 & 6 & 7 \end{pmatrix}$$
$$= \begin{pmatrix} 5 & 6 & 7 \\ 3 & 4 & 5 \\ 1 & 2 & 3 \end{pmatrix}$$

Step-4

(d) all rows of BA are the same as row 1of A

B must be $\begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}$

Let $A = \begin{pmatrix} 5 & 6 & 7 \\ 3 & 4 & 5 \\ 1 & 2 & 3 \end{pmatrix}$

$$BA = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}\begin{pmatrix} 5 & 6 & 7 \\ 3 & 4 & 5 \\ 1 & 2 & 3 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix}$$

Hence all the rows of BA same as row 1 of A.