

**Question**Find  $AB$  and  $BA$  where

$$(i) A = \begin{pmatrix} -5 & 1 \\ 9 & -1 \end{pmatrix}; B = \begin{pmatrix} 3 & 3 \\ 1 & -3 \end{pmatrix}$$

$$(ii) A = \begin{pmatrix} 7 & 1 \\ -3 & 6 \\ 6 & -3 \end{pmatrix}; B = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

**Answer**

$$(i) AB = \begin{pmatrix} -5 & 1 \\ 9 & -1 \end{pmatrix} \begin{pmatrix} 3 & 3 \\ 1 & -3 \end{pmatrix} = \begin{pmatrix} -14 & -18 \\ 26 & 30 \end{pmatrix}$$

$$(ii) BA = \begin{pmatrix} 3 & 3 \\ 1 & -3 \end{pmatrix} \begin{pmatrix} -5 & 1 \\ 9 & -1 \end{pmatrix} = \begin{pmatrix} 12 & 0 \\ -32 & 4 \end{pmatrix}$$

so  $AB \neq BA$ 

$$(ii) AB = \begin{pmatrix} 7 & 1 \\ -3 & 6 \\ 6 & -3 \end{pmatrix} \begin{pmatrix} 1 \\ 3 \end{pmatrix} = \begin{pmatrix} 10 \\ 15 \\ -3 \end{pmatrix}$$

$$\underbrace{\quad}_{3 \times 2} \quad \underbrace{\quad}_{2 \times 1}$$

$$(iii) BA = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \begin{pmatrix} 7 & 1 \\ -3 & 6 \\ 6 & -3 \end{pmatrix}$$

$$\underbrace{\quad}_{2 \times 1} \quad \underbrace{\quad}_{3 \times 2}$$
Incompatible so  $BA$  does not exist!