

**EXAMPLE 2** Find the product of two matrices

Find  $AB$  if  $A = \begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix}$  and  $B = \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix}$ .

**Solution**

Because  $A$  is a  $2 \times 2$  matrix and  $B$  is a  $2 \times 2$  matrix, the product  $AB$  is defined and is a  $2 \times 2$  matrix.

**STEP 1** Multiply the numbers in the first row of  $A$  by the numbers in the first column of  $B$ , add the products, and put the result in the first row, first column of  $AB$ .

$$\begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix} \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix} = \begin{bmatrix} 1(5) + 4(9) & \\ & \end{bmatrix}$$

**STEP 2** Multiply the numbers in the first row of  $A$  by the numbers in the second column of  $B$ , add the products, and put the result in the first row, second column of  $AB$ .

$$\begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix} \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix} = \begin{bmatrix} 1(5) + 4(9) & 1(-7) + 4(6) \\ & \end{bmatrix}$$

**STEP 3** Multiply the numbers in the second row of  $A$  by the numbers in the first column of  $B$ , add the products, and put the result in the second row, first column of  $AB$ .

$$\begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix} \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix} = \begin{bmatrix} 1(5) + 4(9) & 1(-7) + 4(6) \\ 3(5) + (-2)(9) & \end{bmatrix}$$

**STEP 4** Multiply the numbers in the second row of  $A$  by the numbers in the second column of  $B$ , add the products, and put the result in the second row, second column of  $AB$ .

$$\begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix} \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix} = \begin{bmatrix} 1(5) + 4(9) & 1(-7) + 4(6) \\ 3(5) + (-2)(9) & 3(-7) + (-2)(6) \end{bmatrix}$$

**STEP 5** Simplify the product matrix.

$$\begin{bmatrix} 1(5) + 4(9) & 1(-7) + 4(6) \\ 3(5) + (-2)(9) & 3(-7) + (-2)(6) \end{bmatrix} = \begin{bmatrix} 41 & 17 \\ -3 & -33 \end{bmatrix}$$

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For the matrices  $A$  and  $B$  in Example 2, notice that the product  $BA$  is not the same as the product  $AB$ .

$$BA = \begin{bmatrix} 5 & -7 \\ 9 & 6 \end{bmatrix} \begin{bmatrix} 1 & 4 \\ 3 & -2 \end{bmatrix} = \begin{bmatrix} -16 & 34 \\ 27 & 24 \end{bmatrix} \neq AB$$

In general, matrix multiplication is *not* commutative.

 **GUIDED PRACTICE** for Example 2

3. Find  $AB$  if  $A = \begin{bmatrix} -3 & 3 \\ 1 & -2 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 5 \\ -3 & -2 \end{bmatrix}$ .

**AVOID ERRORS**

Order is important when multiplying matrices. To find  $AB$ , write matrix  $A$  on the left and matrix  $B$  on the right.