

**EXAMPLE 3** Use matrix operations

Using the given matrices, evaluate the expression.

$$A = \begin{bmatrix} 4 & 3 \\ -1 & -2 \\ 2 & 0 \end{bmatrix}, B = \begin{bmatrix} -3 & 0 \\ 1 & -2 \end{bmatrix}, C = \begin{bmatrix} 1 & 4 \\ -3 & -1 \end{bmatrix}$$

a.  $A(B + C)$

b.  $AB + AC$

**Solution**

$$\begin{aligned} \text{a. } A(B + C) &= \begin{bmatrix} 4 & 3 \\ -1 & -2 \\ 2 & 0 \end{bmatrix} \left( \begin{bmatrix} -3 & 0 \\ 1 & -2 \end{bmatrix} + \begin{bmatrix} 1 & 4 \\ -3 & -1 \end{bmatrix} \right) \\ &= \begin{bmatrix} 4 & 3 \\ -1 & -2 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} -2 & 4 \\ -2 & -3 \end{bmatrix} = \begin{bmatrix} -14 & 7 \\ 6 & 2 \\ -4 & 8 \end{bmatrix} \end{aligned}$$

$$\begin{aligned} \text{b. } AB + AC &= \begin{bmatrix} 4 & 3 \\ -1 & -2 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} -3 & 0 \\ 1 & -2 \end{bmatrix} + \begin{bmatrix} 4 & 3 \\ -1 & -2 \\ 2 & 0 \end{bmatrix} \begin{bmatrix} 1 & 4 \\ -3 & -1 \end{bmatrix} \\ &= \begin{bmatrix} -9 & -6 \\ 1 & 4 \\ -6 & 0 \end{bmatrix} + \begin{bmatrix} -5 & 13 \\ 5 & -2 \\ 2 & 8 \end{bmatrix} = \begin{bmatrix} -14 & 7 \\ 6 & 2 \\ -4 & 8 \end{bmatrix} \end{aligned}$$

**MULTIPLICATION PROPERTIES** Notice in Example 3 that  $A(B + C) = AB + AC$ , which is true in general. This and other properties of matrix multiplication are summarized below.

**REVIEW PROPERTIES**

For help with properties of real numbers, see p. 2.

**CONCEPT SUMMARY***For Your Notebook***Properties of Matrix Multiplication**Let  $A$ ,  $B$ , and  $C$  be matrices and let  $k$  be a scalar.

**Associative Property of Matrix Multiplication**  $A(BC) = (AB)C$

**Left Distributive Property**  $A(B + C) = AB + AC$

**Right Distributive Property**  $(A + B)C = AC + BC$

**Associative Property of Scalar Multiplication**  $k(AB) = (kA)B = A(kB)$

**GUIDED PRACTICE** for Example 3

Using the given matrices, evaluate the expression.

$$A = \begin{bmatrix} -1 & 2 \\ -3 & 0 \\ 4 & 1 \end{bmatrix}, B = \begin{bmatrix} 3 & 2 \\ -2 & -1 \end{bmatrix}, C = \begin{bmatrix} -4 & 5 \\ 1 & 0 \end{bmatrix}$$

4.  $A(B - C)$

5.  $AB - AC$

6.  $-\frac{1}{2}(AB)$