Multiply a Matrix by a Scalar

A matrix can easily be doubled, tripled or multiplied by any value. The value you multiply the matrix by is called a scalar. The term scalar simply means a value that is not enclosed inside the matrix.

Fortunately, scalar multiplication is one of the easiest operations that you can perform on a matrix. You simply multiply each element, or value within the matrix, by the scalar, creating a new matrix with the same order, or dimensions,

as the original matrix. You place the results of the multiplication in the same positions in the new answer matrix as the elements in the original matrix.

You can multiply a matrix by both positive and negative scalars. When you are performing scalar multiplication with a negative value, make sure to change the signs in your results—positive numbers will become negative, while negative numbers will become positive.

Practice

1) Multiply the following matrix by 3 and write your results in a new matrix labelled 3A. You can check your answers on page 258.

2) Multiply the following matrix by –5 and write the results in a new matrix labelled –5A. You can check your answers on page 258.

$$A = \begin{bmatrix} -1 & 7 & -5 \\ 2 & 6 & 4 \\ 8 & -3 & -9 \end{bmatrix}$$

Multiplying a Matrix by a Positive Number

$$A = \begin{bmatrix} 1 & -5 & 9 \\ 2 & 3 & -6 \\ -4 & 8 & 7 \end{bmatrix}$$

$$2A = \begin{bmatrix} 2 \times 1 & 2 \times (-5) & 2 \times 9 \\ 2 \times 2 & 2 \times 3 & 2 \times (-6) \\ 2 \times (-4) & 2 \times 8 & 2 \times 7 \end{bmatrix}$$

$$2A = \begin{bmatrix} 2 & -10 & 18 \\ 4 & 6 & -12 \\ -8 & 16 & 14 \end{bmatrix}$$

1 To multiply a matrix by a positive number outside the matrix, multiply each number inside the matrix by the number outside the matrix.

- A number outside a matrix is called a scalar. In this example, the scalar is 2.
- In this example, since we are multiplying matrix A by the number 2, we call the new matrix 2A.

2 Write the results in a new matrix.

- The new matrix will have the same number of rows and columns as the original matrix.

- Make sure you write each result in the same location in the new matrix as the original location in the original matrix.

Note: When you multiply two numbers with different signs (+ or –), the result will always be a negative number. For example, 2 × (–4) equals –8.

Multiplying a Matrix by a Negative Number

$$B = \begin{bmatrix} 6 & 8 & -3 \\ -9 & -2 & 1 \\ 5 & 4 & -7 \end{bmatrix}$$

$$-3B = \begin{bmatrix} -3 \times 6 & -3 \times 8 & -3 \times (-3) \\ -3 \times (-9) & -3 \times (-2) & -3 \times 1 \\ -3 \times 5 & -3 \times 4 & -3 \times (-7) \end{bmatrix}$$

$$-3B = \begin{bmatrix} -18 & -24 & 9 \\ 27 & 6 & -3 \\ -15 & -12 & 21 \end{bmatrix}$$

1 To multiply a matrix by a negative number outside the matrix, multiply each number inside the matrix by the number outside the matrix.

- A number outside a matrix is called a scalar. In this example, the scalar is –3.
- In this example, since we are multiplying matrix B by the number –3, we call the new matrix –3B.

2 Write the results in a new matrix.

- The new matrix will have the same number of rows and columns as the original matrix.

- Make sure you write each result in the same location in the new matrix as the original location in the original matrix.

Note: When you multiply two numbers with the same sign (+ or –), the result will always be a positive number. For example, (–3) × (–9) equals 27.