LESSON 4-2

Success for English Language Learners

Multiplying Matrices

Steps for Success

Step I Introduce the lesson and the concept of multiplying matrices together, using the following suggestions.

- Discuss the definitions of the vocabulary words *matrix product, square matrix, main diagonal,* and *multiplicative identity matrix*. Point out the rule of multiplying matrices together and reinforce the idea that columns are vertical and rows are horizontal.
- Give examples of a square matrix and the main diagonal of a square matrix. Have students draw a square matrix and label the main diagonal. Then have them add their own definitions of each word to their drawing.

Step II To ensure that students understand the process of multiplying matrices together, follow these steps while reviewing the examples in the text.

- In Example 1A, point out how the inner dimensions of the matrix are shown in red. Explain that since the inner dimensions are equal, the matrices *P* and *Q* can be multiplied together. Therefore, the dimensions of the matrix product, or the result of multiplying the two matrices, are the same as the outer dimensions, shown in black print.
- Point out that in Example 1B, the inner dimensions of matrices *R* and *X*, also shown in red, are not equal. Thus, the two matrices cannot be multiplied together.
- Have students color-code their matrices as they practice multiplying two or more matrices together. Also encourage students to use graph or lined paper to ensure that they properly align the correct numerals and entries in the product matrix as they multiply two or more matrices together.

Step III Ask English Language Learners to complete the worksheet for this lesson.

- Point out that Example 2B in the student textbook is supported by Problem 1 on the worksheet. Work with students to check the dimensions of the product. Check the answer in the text.

Making Connections

- Students may have created matrices using a spreadsheet or a word processing document. Remind students that matrices are often called tables. If possible, have students use a computer to create two matrices that can be multiplied together.

Name ____ Date ____________ Class _____________

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Problem 1

Find the product, if possible.

$$B = \begin{bmatrix} 5 & 1 \\ -2 & 7 \\ 6 & 0 \end{bmatrix} \qquad A = \begin{bmatrix} 0 & 4 & 9 \\ -3 & 3 & 2 \end{bmatrix}$$

3 rows

3 columns

$$B = \begin{bmatrix} 5 & 1 \\ -2 & 7 \\ 6 & 0 \end{bmatrix} \qquad A = \begin{bmatrix} 0 & 4 & 9 \\ -3 & 3 & 2 \end{bmatrix}$$

The inner dimensions are equal. These matrices can be multiplied together.

Check the dimensions. B is $3 \times \mathbf{2}$, and A is $\mathbf{2} \times 3$, so the product is defined and is 3×3.

The dimensions of the matrix product are equal to the outer dimensions of the matrices being multiplied.

$$BA = \begin{bmatrix} 5(0) + 1(-3) & 5(4) + 1(3) & 5(9) + 1(2) \\ -2(0) + 7(-3) & -2(4) + 7(3) & -2(9) + 7(2) \\ 6(0) + 0(-3) & 6(4) + 0(3) & 6(9) + 0(2) \end{bmatrix} = \begin{bmatrix} -3 & 23 & 47 \\ -21 & 13 & -4 \\ 0 & 24 & 54 \end{bmatrix}$$

3×3

Think and Discuss

1. Why it is possible to multiply matrices B and A together?

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2. Why is AB different from BA?

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Lesson 2-5

1. If the sign is "or equal to," the boundary line is included.
2. The boundary would be vertical.

Lesson 2-6

1. $1f(x) = 2x - 1$
2. It would be a compression.

Lesson 2-7

1. It would have a greater negative slope.
2. Closer to -1.

Lesson 2-8

1. There would be no solution.
2. $2x + 1 > 5$ OR $2x + 1 < -5$

Lesson 2-9

1. The vertex should be 2 units up.
2. The slope would increase times 30 and the vertex would be $(0, -60)$.

CHAPTER 3

Lesson 3-1

1. The lines will intersect at $(2, 4)$.
2. One solution, $(2, 4)$.
3. The slopes are equal.

Lesson 3-2

1. I should get the same answer.
2. Because only one point solves both equations simultaneously.
3. Because equations are added together to eliminate a variable.

Lesson 3-3

1. Quadrants II, III, and IV
2. No, because one of the boundary lines is not included in the region.
3. an obtuse angle

Lesson 3-4

1. It does not maximize the objective function.
2. If the last constraint is removed, the feasible region has vertices at $(0, 0)$, $(0, 300)$, and $(500, 0)$. C is maximized at $(500, 0)$.

Lesson 3-5

1. $(4, 0, 0)$, $(0, 3, 0)$, and $(0, 0, 6)$
2. The equation says that 3 times the x-coordinate plus 4 times the y-coordinate plus 2 times the z-coordinate equals 12 for any point on the plane.

Lesson 3-6

1. That is (z, x, y), which is different from (x, y, z) because the coordinates are ordered.
2. It is independent because the system has one solution only.

CHAPTER 4

Lesson 4-1

1. The entry at c_{22} is 0.0075 and it is the cost per square inch of a 4-inch paper box.
2. c_{32}
3. 4×2

Lesson 4-2

1. Because the number of columns in the first matrix is the same as the number of rows in the second matrix.
2. The matrices of the products have different dimensions.

Lesson 4-3

1. The coordinates in the product matrix are those of the reflected image of *JKL.*
2. It is reflected across the y-axis.