

## Section 6.2 Operations with Matrices

**Objective:** In this lesson you learned how to add, subtract, and multiply two matrices, and multiply a matrix by a real number.

Course Number

Instructor

Date

### Important Vocabulary

Define each term or concept.

**Scalar multiple**

**Zero matrix**

**Additive identity**

**Matrix multiplication**

**Identity matrix of order  $n$**

### I. Equality of Matrices (Page 445)

Name three ways that a matrix may be represented.

- 1)
- 2)
- 3)

Two matrices are equal if they have the same order and \_\_\_\_\_ are equal.

#### *What you should learn*

How to decide whether two matrices are equal

### II. Matrix Addition and Scalar Multiplication

(Pages 446–449)

To add two matrices of the same order, . . .

#### *What you should learn*

How to add and subtract matrices and multiply matrices by real numbers

To multiply a matrix  $A$  by a scalar  $c$ , . . .

**Example 1:** Let  $A = \begin{bmatrix} 2 & 5 \\ -3 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} -1 & 4 \\ 2 & -5 \end{bmatrix}$ .

Find (a)  $A + B$  and (b)  $-2B$

Let  $A$ ,  $B$ , and  $C$  be  $m \times n$  matrices and let  $c$  and  $d$  be scalars.  
Give an example of each of the following properties of matrix addition and scalar multiplication:

- 1) Commutative Property of Matrix Addition: \_\_\_\_\_
- 2) Associative Property of Matrix Addition: \_\_\_\_\_
- 3) Associative Property of Scalar Multiplication: \_\_\_\_\_
- 4) Scalar Identity: \_\_\_\_\_
- 5) Distributive Property (two forms): \_\_\_\_\_  
\_\_\_\_\_

If  $A$  is an  $m \times n$  matrix and  $O$  is the  $m \times n$  zero matrix, then

$A + O =$  \_\_\_\_\_.

### III. Matrix Multiplication (Pages 450–452)

When multiplying an  $m \times n$  matrix  $A$  by an  $n \times p$  matrix  $B$ , to obtain the entry in the  $i$ th row and  $j$ th column of  $AB$ , . . .

***What you should learn***  
How to multiply two matrices

**Example 2:** If  $A$  is a  $3 \times 5$  matrix and  $B$  is a  $6 \times 3$  matrix, find the order, if possible, of the product (a)  $AB$ , and (b)  $BA$ .

**Example 3:** Find the product  $AB$ , if

$$A = \begin{bmatrix} 2 & -1 & 7 \\ 0 & 6 & -3 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 0 \\ -2 \\ 3 \end{bmatrix}$$

List four properties of Matrix Multiplication:

If  $A$  is an  $n \times n$  matrix, the identity matrix  $I$  of order  $n$  has the property that \_\_\_\_\_ and \_\_\_\_\_.

#### IV. Applications of Matrix Operations (Pages 453–454)

Matrix multiplication can be used to represent a system of linear equations. The system

$$\begin{cases} a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = b_1 \\ a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = b_2 \\ a_{31}x_1 + a_{32}x_2 + a_{33}x_3 = b_3 \end{cases}$$

can be written as the matrix equation \_\_\_\_\_, where  $A$  is the coefficient matrix of the system and  $X$  and  $B$  are column matrices.

**What you should learn**  
How to use matrix operations to model and solve real-life problems

**Example 4:** Consider the following system of linear equations.

$$\begin{cases} 2x_1 - x_2 + 3x_3 = -11 \\ x_1 - 3x_3 = -1 \\ -x_1 + 4x_2 + 2x_3 = 2 \end{cases}$$

Write this system as a matrix equation  $AX = B$ , and then use Gauss-Jordan elimination on the augmented matrix  $[A : B]$  to solve for the matrix  $X$ .

**Additional notes****Homework Assignment**

Page(s)

Exercises