Lesson 1: Adding and Subtracting Matrices
Algebra 2 B Unit 5: Matrices

Objective: Add and subtract matrices and solve matrix equations
Materials: *Course Materials are not available as of this time as this User has not been assigned to any Courses. Please check back once the User has been placed into a Course.*
Note: This lesson should take 2 days.

Organizing and Analyzing Data

A recreational hockey league has six teams. The season lasts several months, with a break near the midway point. The records for each team before and after the break are shown below.

Record Before the Break			
Team	**Wins**	**Losses**	**Ties**
Ice Kings	8	2	1
Wildcats	5	4	2
Polar Bears	9	2	0
Blizzards	3	7	1
Snow Leopards	4	6	1
Phantoms	1	9	1

Record After the Break			
Team	**Wins**	**Losses**	**Ties**
Ice Kings	5	4	0
Wildcats	2	6	1
Polar Bears	7	1	1
Blizzards	4	5	0
Snow Leopards	6	3	0
Phantoms	2	7	0

How can you find the total number of wins, losses, and ties for each team? If the data

are organized in tables, it is easy to use a matrix to represent each half of the season. Then, you can add the matrices to create a new matrix that represents the whole season.

In this lesson, you will learn how to add and subtract matrices. You will also learn how to write and use matrix equations to solve problems, and extend your understanding of properties of operations to include matrix addition and subtraction.

Objective

- Add and subtract matrices and solve matrix equations

Key Words

- corresponding elements
- equal matrices
- matrix equation
- zero matrix

Tip: You will have two days to complete this lesson.

Teaching Guide

Click on the link below to access the Matrices Teaching Guide.

Matrices Teaching Guide

Matrix Addition and Subtraction
A matrix is a rectangular array of numbers. It is written in brackets. The numbers that make up a matrix are matrix elements. For example, in matrix A below, the elements are 1, 2, 3, and 4.

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Each element in a matrix can be named by its row and column positions. For example, the number 1 in the matrix above is in position a_{11} because it is located in the first row and the first column of matrix A. What is the position of the number 3?

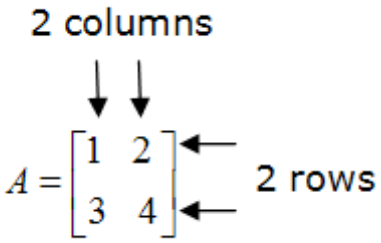
Click on the Show Answer button below to check your answer.

Show Answer

Answer:

a_{21}

You can describe a matrix in terms of its dimensions, or number of rows and columns. For example, matrix A is a 2×2 matrix, because it has 2 rows and 2 columns.



Just as with referencing an element's position in the matrix, the number of rows is given first, followed by the number of columns.
What are the dimensions of the matrices below?

a) $\begin{bmatrix} 4 & 2 & 6 \\ 3 & 5 & 9 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 7 \\ 2 & 4 \\ 8 & 5 \end{bmatrix}$

Click on the Show Answer button below to check your answers.

Show Answer

Answers:

a. 2×3
b. 3×2

Matrix Addition and Subtraction

If two matrices have the same dimensions, you can add or subtract the elements that are in the same position in each matrix. The sums or differences of these corresponding elements make up a new matrix that will be the same size as the two matrices being added or subtracted.

Add and subtract matrices X and Y.

$$X = \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} \qquad Y = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix}$$

$$X + Y = \begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} + \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix} = \begin{bmatrix} 2+1 & 4+3 \\ 6+5 & 8+7 \end{bmatrix} = \begin{bmatrix} 3 & 7 \\ 11 & 15 \end{bmatrix}$$

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

A matrix equation is an equation in which one or more variables is a matrix. You can use the addition and subtraction properties of equality to isolate the unknown matrix, and then add or subtract the elements in the two matrices to solve the matrix equation as shown below.

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

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

Click on the link below to complete the Solve It! activity for Chapter 12, Lesson 1 from the PowerAlgebra website. You will review the dimensions of a matrix and how to name elements of a matrix. You will also learn how to add and subtract matrices with the same dimensions.

Solve It!

Click on the link below to watch the "Example 1: Tables Without Labels – Football" Discovery Education™ *streaming* movie. Look for an example of matrix addition as a

way to add data in tables.

After viewing the movie, explain how adding matrices is similar to adding numbers.

Example 1: Tables Without Labels – Football

Click on the Show Answer button to check your answer.

Show Answer

Answer:
Answers may vary, but should be similar to:

Adding matrices is similar to adding numbers because to add matrices you need to add corresponding elements, just as to add numbers you need to add corresponding digits.

Read and take notes on pp. 756–759 in *Algebra 2*. You will see examples of matrix addition and subtraction, as well as how to use a matrix equation to solve a problem. You will also learn about the zero matrix—a matrix in which each element is 0—and equal matrices—matrices with the same dimensions and equal corresponding elements. Be sure to include in your notes the properties of matrix addition.

Click on the link below to access the online textbook.

Algebra 2

Complete the following activities.

1. Click on the link below to access and complete the 12-1 Think About a Plan worksheet. You will use matrices and matrix equations to solve problems.

   12-1 Think About a Plan

2. Complete problems 25 and 26 on p. 761 in *Algebra 2*.

3. Review some of the skills you will need for this unit, such as solving systems of equations, with the Get Ready! on p. 753 in *Algebra 2*. You may refer to the lessons indicated if you require additional guidance to solve the problems.

4. Think back to the problem presented on the Getting Started page. Use matrix addition to find the total number of wins, losses, and ties for each team.

Record Before the Break			
Team	**Wins**	**Losses**	**Ties**
Ice Kings	8	2	1
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Polar Bears	9	2	0
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Extension: Game Theory is a branch of mathematics that deals with strategies in decision-making. It uses games as models to simplify complex situations. Some of these games, particularly zero-sum games in which one player's gain must equal another player's loss, can be represented by matrices.

Learn more about Game Theory. Click on the link below to watch the "Game Theory" BrainPOP® movie.

Game Theory

Click on the link below to access the online textbook.

Algebra 2

Discussion

In this unit, you will participate in a discussion based on the following question:

- How can you use matrices to model and solve real-world problems?

Provide mathematical examples to support your opinions. You may use tables to organize and present your thoughts. You are encouraged to think about this question as you progress through the unit.

Click on the link below to view the Discussion Guidelines and Rubric.

Discussion Guidelines and Rubric

Click on the link below to access the Matrices Discussion.

Matrices Discussion

Complete the following review activities.

1. Practice concepts from this lesson. Click on the link below to complete the Self-Assessment 12-1 activity from the PowerAlgebra website.

   Self-Assessment 12-1

2. In your math writing journal, complete problem 27 on p. 761 in *Algebra 2*. Name the entry "Adding and Subtracting Matrices."

Click on the link below to access the online textbook.

Algebra 2

Lesson Answers

Click on the link below to check your answer to question 4 from the Activity page.

Activity: Question 4 Answer

Click on the link below to check your answers to the 12-1 Think About a Plan worksheet.

12-1 Think About a Plan Answers

Adding and Subtracting Matrices

Multiple Choice

Find the sum or difference.

1.

$$\begin{bmatrix} -3 & 0 \\ 5 & -7 \end{bmatrix} + \begin{bmatrix} -4 & 2 \\ -1 & 8 \end{bmatrix}$$

(1 point)

○ $\begin{bmatrix} -1 & 2 \\ -4 & 1 \end{bmatrix}$

- ○ $\begin{bmatrix} -7 & -2 \\ 4 & -15 \end{bmatrix}$
- ○ $\begin{bmatrix} -7 & 2 \\ 4 & 1 \end{bmatrix}$
- ○ $\begin{bmatrix} -7 & 2 \\ 4 & -1 \end{bmatrix}$

2.

$$\begin{bmatrix} -5 & 2 & 0 \\ -5 & 9 & 9 \end{bmatrix} - \begin{bmatrix} -1 & 3 & 3 \\ 7 & 4 & 7 \end{bmatrix}$$

(1 point)

- ○ $\begin{bmatrix} -4 & -1 & -3 \\ 12 & -5 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -4 & -1 & 3 \\ -12 & 5 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -4 & -1 & -3 \\ -12 & 5 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -4 & 1 & -3 \\ -12 & 5 & 2 \end{bmatrix}$

3.

If $A = \begin{bmatrix} -2 & 2 & 0 \\ -5 & 7 & 9 \end{bmatrix}$, $C = \begin{bmatrix} -1 & -1 & -2 \\ -7 & 3 & 2 \end{bmatrix}$, and $A - B = C$, what is B?

(1 point)

- ○ $\begin{bmatrix} -1 & 1 & -2 \\ -7 & 3 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -1 & -1 & -2 \\ 7 & -3 & 2 \end{bmatrix}$
- ○ $\begin{bmatrix} -1 & 3 & 2 \\ 2 & 4 & 7 \end{bmatrix}$
- ○ $\begin{bmatrix} -1 & 3 & 2 \\ 2 & -4 & 7 \end{bmatrix}$

4.

$$\begin{bmatrix} -2 & 0 \\ 7 & 6 \end{bmatrix} + \begin{bmatrix} 2 & 0 \\ -7 & -6 \end{bmatrix}$$

(1 point)

- ○ $\begin{bmatrix} 4 & 0 \\ -14 & -12 \end{bmatrix}$
- ○ $\begin{bmatrix} -9 & -6 \\ 9 & 6 \end{bmatrix}$
- ○ $\begin{bmatrix} -4 & 0 \\ 14 & 12 \end{bmatrix}$
- ○ $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

Find the values of the variables.

5.

$$\begin{bmatrix} -8+t & 0 \\ 8 & -12 \end{bmatrix} = \begin{bmatrix} -5 & 0 \\ 8 & -2y-2 \end{bmatrix}$$

(1 point)

- ○ $t = 5, y = 3$
- ○ $t = 13, y = 5$
- ○ $t = 3, y = 7$
- ○ $t = 3, y = 5$

Activity: Question 4 Answer

$$\begin{bmatrix} 8 & 2 & 1 \\ 5 & 4 & 2 \\ 9 & 2 & 0 \\ 3 & 7 & 1 \\ 4 & 6 & 1 \\ 1 & 9 & 1 \end{bmatrix} + \begin{bmatrix} 5 & 4 & 0 \\ 2 & 6 & 1 \\ 7 & 1 & 1 \\ 4 & 5 & 0 \\ 6 & 3 & 0 \\ 2 & 7 & 0 \end{bmatrix} = \begin{bmatrix} 8+5 & 2+4 & 1+0 \\ 5+2 & 4+6 & 2+1 \\ 9+7 & 2+1 & 0+1 \\ 3+4 & 7+5 & 1+0 \\ 4+6 & 6+3 & 1+0 \\ 1+2 & 9+7 & 1+0 \end{bmatrix} = \begin{bmatrix} 13 & 6 & 1 \\ 7 & 10 & 2 \\ 16 & 3 & 1 \\ 7 & 12 & 1 \\ 10 & 9 & 1 \\ 3 & 16 & 1 \end{bmatrix}$$