<u>Bell Work:</u>
<u>Solve the system.</u>

1.) $3x + y = 5$

$-2x + 4y = -8$

From Last Time

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ALGEBRA 3

Day 26

Objective:

To apply knowledge of solving systems of equations to solving systems of inequalities (3.3)

To solve a system using a matrix

Review: 3.3 Solving Systems of Inequalities

- The process remains the same as yesterday with a small twist.
- Just like graphing single inequalities, we must shade on either side of the line.
- We are no longer looking for simply where the single point is that overlaps, but rather the entire shaded regions that overlap!

- Bonus: Our calculators can do it for us again!

Graph to Solve the Inequality:

1.) $y - 4x \leq 1$

$-2y > 6x - 4$

2.) $2y - 4x > 2$

$-2y + 4x < -2$

3.6 Solving Systems Using Matrices

- **Matrix:** a rectangular array of numbers
- **Matrix Element (entry):** the numbers that make up the rows and columns of a matrix
- **Dimensions:** rows by columns

Example 1 of Identifying a Matrix Element:

$$\boldsymbol{A} = \begin{bmatrix} \mathbf{5} & \mathbf{10} & \mathbf{0} \\ \mathbf{9} & \mathbf{0.25} & \mathbf{-3} \end{bmatrix}$$

Matrix A has 2 rows and 3 columns and is read as a 2x3 matrix ("two by three")

$\text{writ}ten\ as$: $A_{2\times 3}$

If I asked you to identify a_{12} I am asking for the element in row 1 and column 2. a_{12} is the element 10.

What is the element: a_{23}? a_{11}? a_{21}?

Using Matrices to Represent Systems of Equations

1.) $2x - y = 4$

$x + 3y = 11$

$$\begin{bmatrix} 2 & -1 & 4 \\ 1 & 3 & 11 \end{bmatrix}$$

2.) $x + y + 2z = 3$

$2x + y + 3z = 7$

$-x - 2y = 10$

$$\begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 3 \\ -1 & -2 & 0 \end{bmatrix} \begin{bmatrix} 3 \\ 7 \\ 10 \end{bmatrix}$$

Solving a System Using a Matrix

You use similar steps to solve using a matrix that you use for elimination.

We call each step a **row operation**.

Goal when using of Row Operations is to get the matrix into the form:

$$\begin{bmatrix} 1 & 0 & a \\ 0 & 1 & b \end{bmatrix} \quad or \quad \begin{bmatrix} 1 & 0 & 0 & a \\ 0 & 1 & 0 & b \\ 0 & 0 & 1 & c \end{bmatrix}$$

These types of matrices are known as **Identity Matrices**, 1 on the diagonal and 0 everywhere else. They are known as identity matrices because they identify the variable.

$$\begin{aligned} x &= a \\ y &= b \end{aligned} \qquad\qquad \begin{aligned} x &= a \\ y &= b \\ z &= c \end{aligned}$$

KEY CONCEPT: Row Operation

Switch any two rows $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ becomes $\begin{bmatrix} 4 & 5 & 6 \\ 1 & 2 & 3 \end{bmatrix}$

Multiply any row by a constant

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \text{ becomes } \begin{bmatrix} 1 & 2 & 3 \\ 4 * \mathbf{3} & 5 * \mathbf{3} & 6 * \mathbf{3} \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 12 & 15 & 18 \end{bmatrix}$$

Add one row to another

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \text{ becomes } \begin{bmatrix} 1 + \mathbf{4} & 2 + \mathbf{5} & 3 + \mathbf{6} \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} 5 & 7 & 9 \\ 4 & 5 & 6 \end{bmatrix}$$

Combine any of these Steps

What is the solution of the following system?

$$x + 4y = -1$$
$$2x + 5y = 4$$

$\begin{bmatrix} 1 & 4 & -1 \\ 2 & 5 & 4 \end{bmatrix} \rightarrow$ -2(1 4 -1) Multiply Row 1 by -2.

$\underline{+ \quad 2 \ \ 5 \ \ 4}$ Add answer to Row 2.

0 -3 6 Replace Row 2 with sum.

$\begin{bmatrix} 1 & 4 & -1 \\ 0 & -3 & 6 \end{bmatrix} \rightarrow$ $-\frac{1}{3}$(0 -3 6) Multiply Row 2 by $-\frac{1}{3}$

$\begin{bmatrix} 1 & 4 & -1 \\ 0 & 1 & -2 \end{bmatrix} \rightarrow$ 1 4 -1 Multiply Row 2 by -4.

-4 (0 1 -2) Add answer to Row 1.

Replace Row 1 with sum.

$\begin{bmatrix} 1 & 0 & 7 \\ 0 & 1 & -2 \end{bmatrix} \rightarrow$ We created the Identity Matrix, so x=7 and y=-2

The Solution is (7, -2).

Note: Reduced Row Echelon Form is the name we give the matrix when it represents the solution. You'll see this as rref on your calculators.

For Next Time

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