

# 5.8.27

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## Question:

The students of a class are made to stand in rows. If 3 students are extra in a row, there would be 1 row less. If 3 students are less in a row, there would be 2 rows more. Find the number of students in the class using matrices.

**Solution:** To find the total number of students, we first define our variables and set up a system of linear equations. Let  $x$  be the number of rows and  $y$  be the number of students per row. The total number of students is  $xy$ .

From the problem statement, we derive two equations:

$$(x - 1)(y + 3) = xy \implies 3x - y = 3$$

$$(x + 2)(y - 3) = xy \implies -3x + 2y = 6$$

We can solve this system using an augmented matrix and Gaussian elimination. We begin by creating an augmented matrix  $(A \mid B)$  for this system.

The augmented matrix for this system is:

$$(A \mid B) = \left( \begin{array}{cc|c} 3 & -1 & 3 \\ -3 & 2 & 6 \end{array} \right) \quad (1)$$

The goal is to use elementary row operations to transform the left side of the augmented matrix into row-echelon form. We perform the operation  $R_2 \rightarrow R_2 + R_1$ :

$$\left( \begin{array}{cc|c} 3 & -1 & 3 \\ -3 + 3 & 2 + (-1) & 6 + 3 \end{array} \right) \quad (2)$$

After performing the operation, the matrix becomes:

$$\left( \begin{array}{cc|c} 3 & -1 & 3 \\ 0 & 1 & 9 \end{array} \right) \quad (3)$$

From this row-echelon form, we can use back-substitution. The second row gives us the equation  $0x + 1y = 9$ , which means  $y = 9$ .

Substituting  $y = 9$  into the first row's equation,  $3x - y = 3$ :

$$3x - 9 = 3$$

$$3x = 12$$

$$x = 4$$

We have found there are  $x = 4$  rows and  $y = 9$  students per row.

The total number of students is  $x \times y = 4 \times 9 = 36$ .