

On the untimed midterm is a problem:

Find a 3×3 matrix M that maps FBI to CIA. It need NOT be invertible. (We use A is 0, B is 1, etc.)

Some students have asked if they can just give the matrix, or show how they got it, or what.

You must show the matrix and show the calculation that shows that FBI maps to CIA.

Example:

Lets say the problem was

Find a 3×3 invertible matrix M that maps AS to KQ. (We use A is 0, B is 1, etc.)

Then the following would be a fine answer:

SOLUTION

Let M be

$$\begin{pmatrix} 1 & 2 \\ 3 & 11 \end{pmatrix}$$

All of the math below is mod 26.

A is 0, S is 18 so we want to look at M applied to $(0, 18)$:

$$\begin{pmatrix} 1 & 2 \\ 3 & 11 \end{pmatrix} \begin{pmatrix} 0 \\ 18 \end{pmatrix}$$

has as its first entry

$$1 \times 0 + 2 \times 18 = 36 \equiv 10 \text{ which is K}$$

and as its second entry

$$3 \times 0 + 11 \times 18 = 198 \equiv 16 \text{ which is Q.}$$

Hence the matrix M maps AS to KQ, as promised!

END OF SOLUTION