

1. To begin, we will use the standard alphabet code below to convert a message in letters into numbers, using a zero for a blank.

blank	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

Write the message THIS IS FUN using this code.

2. We can use any square matrix whose elements are positive integers and whose inverse exists as our encoding matrix. For this example, we will use $A = \begin{bmatrix} 3 & 5 \\ 1 & 2 \end{bmatrix}$.

Divide the numbers in your answer to #1 into groups of two and use these groups to form the **columns** of a matrix B with two rows and as many columns as are needed. If necessary, add a zero at the end to fill out the last column.

3. Use matrix multiplication to find matrix C, where $C = AB$. You can use your calculator for this if you like. This is now the encoded message.



4. Someone receiving the encoded message would have to decode it. This requires finding the original matrix B. Note that

$$C = AB$$

$$A^{-1}C = A^{-1}AB$$

$$A^{-1}C = IB$$

$$A^{-1}C = B$$

So, to find the original matrix B, we must find $A^{-1}C$. Using your calculator, find $A^{-1}C$ for matrices A and C above and then convert the numbers back to letters using the standard alphabet code. You should get the message THIS IS FUN.

5. Let matrix A be defined by $A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 3 & 1 & 1 \end{bmatrix}$. The following message was encoded using a standard

alphabet code and matrix A:

44 52 51 20 16 24 56 38 77 29 44 29 29 34 29 34 46 35

Decode this message.

Note: Since matrix A is a 3×3 matrix, you will have to divide the numbers in the encoded message into groups of 3 and use these groups to form the **columns** of a matrix B with **three** rows and as many columns as are needed. If necessary, add zeroes at the end to fill out the last column.