

10. You intercept the ciphertext message “PWULPZTQAWHF”, which you know was encrypted using an affine map on digraphs in the 26-letter alphabet, where, as in the text, a digraph whose two letters have numerical equivalents x and y corresponds to the integer $26x + y$. An extensive statistical analysis of earlier ciphertexts which had been coded by the same enciphering map shows that the most frequently occurring digraphs in all of that ciphertext are “IX” and “TQ”, in that order. It is known that the most common digraphs in the English language are “TH” and “HE”, in that order.
- (a) Find the deciphering key, and read the message.
 - (b) You decide to have the intended recipient of the message incapacitated, but you don’t want the sender to know that anything is amiss. So you want to impersonate the sender’s accomplice and reply “GOODWORK”. Find the enciphering key, and determine the appropriate ciphertext.
11. You intercept the coded message “DXM SCE DCCUVGX”, which was enciphered using an affine map on digraphs in a 30-letter alphabet, in which A—Z have numerical equivalents 0—25, blank=26, ?=27, !=28, '=29. A frequency analysis shows that the most common digraphs in earlier ciphertexts are “M”, “U”, and “IH”, in that order. Suppose that in the English language the most frequently occurring digraphs (in this particular 30-letter alphabet) are “E”, “S”, and “T”, in that order.
- (a) Find the deciphering key, and read the message.
 - (b) Find the enciphering key, and encrypt the message “YES I'M JOKING!”
12. The same techniques apply, of course, if one is using some other alphabet besides the Latin alphabet. For example, this exercise uses the Russian alphabet (it is not necessary, or even helpful, to know Russian or the Cyrillic alphabet in order to do this exercise). Use the following numerical equivalents for the Cyrillic alphabet:

А	Б	В	Г	Д	Е	Ё	Ж	З	И	Й
0	1	2	3	4	5	6	7	8	9	10
К	Л	М	Н	О	П	Р	С	Т	У	Ф
11	12	13	14	15	16	17	18	19	20	21
Х	҃	Ч	Ш	҆	҄	҂	҅	҈	҉	Ҋ
22	23	24	25	26	27	28	29	30	31	32

Suppose that you intercept the coded message “ЦНТИ”, which was enciphered using an affine map on digraphs in the above 33-letter alphabet. A frequency analysis of earlier ciphertext shows that the most frequently occurring ciphertext digraphs are “ЦЯ” and “ЫТ”, in that order. Suppose it is known that the two most frequently occurring