

## 641 Do the Untwist

*Cryptography* deals with methods of secret communication that transform a message (the *plaintext*) into a disguised form (the *ciphertext*) so that no one seeing the ciphertext will be able to figure out the plaintext except the intended recipient. Transforming the plaintext to the ciphertext is *encryption*; transforming the ciphertext to the plaintext is *decryption*. *Twisting* is a simple encryption method that requires that the sender and recipient both agree on a secret key  $k$ , which is a positive integer.

The twisting method uses four arrays: *plaintext* and *ciphertext* are arrays of characters, and *plaincode* and *ciphercode* are arrays of integers. All arrays are of length  $n$ , where  $n$  is the length of the message to be encrypted. Arrays are origin zero, so the elements are numbered from 0 to  $n - 1$ . For this problem all messages will contain only lowercase letters, the period, and the underscore (representing a space).

The message to be encrypted is stored in *plaintext*. Given a key  $k$ , the encryption method works as follows. First convert the letters in *plaintext* to integer codes in *plaincode* according to the following rule: ‘\_’ = 0, ‘a’ = 1, ‘b’ = 2, ..., ‘z’ = 26, and ‘.’ = 27. Next, convert each code in *plaincode* to an encrypted code in *ciphercode* according to the following formula: for all  $i$  from 0 to  $n - 1$ ,

$$\text{ciphercode}[i] = (\text{plaincode}[ki \bmod n] - i) \bmod 28.$$

(Here  $x \bmod y$  is the positive remainder when  $x$  is divided by  $y$ . For example,  $3 \bmod 7 = 3$ ,  $22 \bmod 8 = 6$ , and  $-1 \bmod 28 = 27$ . You can use the C ‘%’ operator or Pascal ‘mod’ operator to compute this as long as you add  $y$  if the result is negative.)

Finally, convert the codes in *ciphercode* back to letters in *ciphertext* according to the rule listed above. The final twisted message is in *ciphertext*. Twisting the message “cat” using the key 5 yields the following:

Array	0	1	2
<i>plaintext</i>	‘c’	‘a’	‘t’
<i>plaincode</i>	3	1	20
<i>ciphercode</i>	3	19	27
<i>ciphertext</i>	‘c’	‘s’	‘.’

Your task is to write a program that can *untwist* messages, *i.e.*, convert the ciphertext back to the original plaintext given the key  $k$ . For example, given the key 5 and ciphertext ‘cs.’, your program must output the plaintext ‘cat’.

### Input

The input file contains one or more test cases, followed by a line containing only the number ‘0’ that signals the end of the file. Each test case is on a line by itself and consists of the key  $k$ , a space, and then a twisted message containing at least one and at most 70 characters. The key  $k$  will be a positive integer not greater than 300.

### Output

For each test case, output the untwisted message on a line by itself.

**Note:** you can assume that untwisting a message always yields a unique result. (For those of you with some knowledge of basic number theory or abstract algebra, this will be the case provided that the greatest common divisor of the key  $k$  and length  $n$  is 1, which it will be for all test cases.)

**Sample Input**

```
5 cs.  
101 thqpxw.lui.qswer  
3 b_ylxmlhzjsys.virpbkr  
0
```

**Sample Output**

```
cat  
this_is_a_secret  
beware._dogs_barking
```