Question 1

ⓐ $28 = 7\cdot 4 = 7\cdot 2^2$

$\varphi(28) = 6\cdot 1\cdot 2 = 12$

$31^{120} \equiv 1\,[28]$

$31^{123} \equiv 31^3\,[28]$

$31 \equiv 3\,[28]$
$31^3 \equiv 27\,[28]$

so $31^{123} \equiv 27\,[28]$
$\equiv -1\,[28]$

ⓑ $7-9+4-3+2 = 3-9+7$

$= 1$

$1 \equiv 1\,[11]$

$10 \equiv -1\,[11]$ etc.

$100 \equiv 1\,[11]$

$23497 = 7+10\cdot 9+100\cdot 4+\dots$

Question 2

			$\tilde{v}$	$\tilde{u}$-
gcd(a,b)	$a=bq+r$	q	u	v
gcd(70,51)	$70=51\cdot1+19$	1		
gcd(51,19)	$51=\boxed{19\cdot2}+13$	2		
gcd(19,13)	$19=13\cdot1+6$	1		
gcd(13,6)	$13=6\cdot2+1$	2		
gcd(6,1)	$6=1\cdot6+0$	6	0	1
gcd(1,0)	$1=0\cdot0+1$	0	1	0

on cherche $1 = 1\cdot u + 0\cdot v$

$$1 = 51\cdot3 + 19\cdot(-8)$$

$$= 153 + - \overset{7}{8}2$$

$$= 153 - 152$$

$$= 1$$

Question 3

0 1

$\boxed{10011} = k$

$k' = (1, 1, 1, 0, 1)$

to cipher : 01001

onetime pad

10100

→ on peut avoir toutes les clefs possibles

Question 4

We went to find the inverse of

$[10]_{56}$

56
112
168
224
280

$560 - 56 = 504$
$- 56 = 448$

150

$= 392$

50

$10 \cdot 49 = 490$
$- 38$
$= 452$

$- 56 = 434$

$10 \cdot 41 = 410$
$- 38$
$\overline{372}$

$$\boxed{\begin{array}{lr} & 150 \\ - & 38 \\ \hline & 112 \end{array}}$$

Question 5

$24x = [4]_{45}$

$24 \cdot 0 \equiv 0\ [45]$

$24 \cdot 1 \equiv 24\ [45]$

$24 \cdot 2 \equiv 3\ [45]$

$24 \cdot 3 = 27\ [45]$

$24 \cdot 4 \equiv 6\ [45]$

$24 \cdot 5 \equiv 30\ [45]$

$24 \cdot 6 \equiv 9\ [45]$

$24 \cdot 7 = 33\ [45]$

12

36

15

39

18

42

↳ va se répéter car $[45]_{45} = [0]_{45}$

$\overset{1}{72}$

$\overset{1}{96}$

$\overset{2}{120}$

45
90
135
180

$\boxed{24 \cdot q} = \_\_ \boxed{+4}$

↓

on veut
que le fin
fait 4 ou 9

$\Rightarrow$ q finit par 6, 1

$1 \equiv$
11
16
21
26
31
36
41

$$[24]_{45}\, x = [4]_{45}$$

$$\Rightarrow [6]_{45}\,[4]_{45}\, x = [4]_{45}$$

$$\Rightarrow [3]_{45}\,[2]_{45}\,[4]_{45}\, x = [4]_{45}$$

$$\Rightarrow [3]_{45}\,[2]_{45}\, x = [1]_{45}$$

$$\Rightarrow [6]_{45}\, x = [1]_{45}$$

$\Rightarrow$ mais x n'est pas inversible modulo 45, donc il n'y a pas de solution x