Exercise 3

$K = 36203$

$c = 2003$

$d = 12$

$m = 1$

$x = 27$

① $\varphi(36203) = \varphi(41) \cdot \varphi(883) = 40 \cdot 882 = 35280$

$\varphi(2003) = 2002$

$\varphi(12) = \varphi(3) \cdot \varphi(4) = 2 \cdot 4\left(1 - \frac{1}{2}\right) = 4$

$\varphi(1) = 1$

$\varphi(27) = 3^3\left(1 - \frac{1}{3}\right) = 27 - \frac{27}{3} = 18$

② $(12+5)^{36203^1} \mod 27$

$17^{36203^1} \mod 27$

$17^{36203} \mod 27$

$\varphi(27) = 18$

$36203 \mid 18$

$36 \quad 2011 \Rightarrow 11111011011$

20

18

23

18

5

$17^{2011} \mod 18$

a	b	b^2	$b \cdot a$	$b \cdot a \pmod m$
1	1	1	~~17~~	17
1	17	289	4913	17
1	17	289	4913	17
1	17	289	4913	17
1	17	289	4913	17
0	17	289	289	1
1	1	1	17	17
1	17	289	4913	17
0	17	289	289	1
1	1	1	17	17
1	17	289	4913	(17) = 10001_2

$17^{17} \mod 27$

a	b	b^2	$b \cdot a$	$b \cdot a \pmod m$
1	1	1	17	17
0	17	289	289	14
0	19	361	361	10
0	10	100	100	19
1	19	361	6137	(8)

Ответ: 8

(3) $27^{12+36205} \mod 2003$

$27^{36215} \mod 2003$

$\varphi(2003) = 2002$

$18 = 10010_2$

$36215 : 2002$

$2002 \quad | \quad 18$

1619

1616

$\overline{3}$

$27^{18} \mod 2002$

a	b	b^2	$b^1 \cdot a$	$b^1 \cdot a \pmod m$
1	1	1	27	27
0	27	729	729	729
0	729	531441	531441	911
1	911	829921	2240867	1483
0	1483	2199289	2199289	1093

$1093 = 1000\,1000\,101_2$

$27^{1093} \mod 2003$

a	b	b^2	$b^1 \cdot a$	$b^1 \cdot a \pmod m$
1	1	1	27	27
0	27	729	729	729
0	729	531441	531441	646
0	646	417316	417316	692
1	692	478864	12929328	1966
0	1966	3865156	3865156	1369
0	1369	1874161	1874161	1356
0	1356	1838736	1838736	1485
1	1485	2940225	10638685	736
0	736	541696	541696	886
1	886	784996	21144892	1149

Ответ: 1149