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Mathematical Note

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FLT. Formulas for Numbers A, B, C

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Throughout the text, coprime natural numbers A, B, C with the last positive digits a, b, c are written in the number system with a prime base $n > 2$,

1. Theorem. In the equality $A^n + B^n - C^n = 0$, starting from k=1, the k-digit endings of the numbers A, B, C are equal to the numbers $a^{n\wedge(k-1)}$, $b^{n\wedge(k-1)}$, $c^{n\wedge(k-1)}$ mod n^k, where each k generates the next value k, i.e. k+1. Without end.

2. Designations: $A_1, A_2, \ldots A_k$ – k-digit endings of the number A in the number system with base n.

k-end of the number – k-digit ending of a number $A = a^{n\wedge(k-1)}$.

The factors $A + B$ and R in the expansion of the sum of powers $A^n + B^n = (A+B)R$ are relatively prime, because the polynomial R can be represented as $(A + B)D \pm nAB$. Therefore, factors in numbers

3. $C^n = A^n+B^n = (A+B)R$, $A^n = C^n - B^n = (C - B)P$, $B^n = C^n - A^n = (C - A)Q$ are powers:

4. $A+B = d^n$, $R = r^n$. $C-B = e^n$, $P = p^n$, $C-A = f^n$, $Q = q^n$. And, according to the little theorem, $P_1 = Q_1 = R_1 = 1$.

5. According to Newton's binomial $(A°n+a)^n$, the penultimate digit of a two-digit number to the power of n (that is, the number an) does not depend on the penultimate digit of the base (that is, the last digit of $A°$).

6. **Consequence:** The k-th digit from the end in the number $A^{n\wedge k}$ does not depend on the k-th digit of the number

A. Numbers outside the (k+1)-ending of the form $a^{n\wedge k}$ are not used in the proof.
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7. Proof of the Theorem

For k=1 we have three identities:
$A_1 = a^{n\wedge(k-1)} = a$, $B_1 = b^{n\wedge(k-1)} = b$, $C_1 = c^{n\wedge(k-1)} = c$, (mod n) Let's write the numbers A, B, C in the form:

8. $A = A°n + a^n$, where $A° = (A - a^n)/n$; $B = B°n + b^n$, where $B° = (B - b^n)/n$; $C = C°n + c^n$, where $C° = (C - c^n)/n$, then we will substitute these values into equalities 2, in which the power numbers P, Q, R end in 01, and expand Newton's binomials in which the penultimate terms end in 2 zeros. Therefore, we obtain a system of three equalities mod n^2:

9. $A + B = c^{n\wedge1}$; $C - B = a^{n\wedge1}$; $C - A = b^{n\wedge1}$, solving which for A, B, C, we find:

10. $A_2 = a^{n\wedge1}$, $B_2 = b^{n\wedge1}$, $C_2 = c^{n\wedge1}$, (mod n^2) with value k=2.

And then we return to step 6, but with k=2, and carry out similar operations to obtain k-endings with the value k=3. And so on - WITHOUT END!

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https://docs.google.com/document/d/1IKEN4aunpT_eDA46L-wo7tnEOQNapTUxejBf6a4vm68/edit?tab=t.0

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