Higher order recursive sequence

[Award] **7 pts**

[Category] **Math**

Define a sequence *an* as below: *a*1 = 17, (*n* >= 1). Then *a*2 = 10657/2465, *a*3 = 2134495165562497/1571545212141185, … Obviously all numbers in this sequence are rational.

For a prime *p* and a fully reduced fraction *a*/*b*, define *Q*(*a*/*b*, *p*) to be the smallest positive *q* for which *a* = *b q* (mod *p*). For example *Q*(3/5, 109) = 66, because 5·66 = 330 = 3 (mod 109) and 66 is the smallest positive such number.

You are given *Q*(*a*2, 1000000007) = 877890477, *Q*(*a*10, 1000000007) = 16332768.

Find the sum of *Q*(*a*1234567891011121314, *p*) over all primes *p* between 2000000000 and 2000100000.

Thanks to **czp** for the idea.

[Answer] **4823678408134**