Convergents of infinite sum

[Award] **9 pts**

[Category] **Math**

Define a sequence *bn* as below: *b*0 = *c*, *bn* = *bn*-12 – 2 (*n* >= 1), where *c* is a positive integer greater than or equal to 3.

Let infinite sum *s* be



It can be proved that the infinite sum is convergent and is an irrational number for all possible values of *c*.

*s* can be represented as an infinite [continued fraction](https://en.wikipedia.org/wiki/Continued_fraction) and corresponding convergents are denoted by *pn*/*qn* (n >= 0, *pn* and *qn* are coprime). For example, for c = 6, s = 0.1715728752…, and the first several convergents are *p*0/*q*0 = 0/1, *p*1/*q*1 = 1/5, *p*2/*q*2 = 1/6, *p*3/*q*3 = 5/29 and so on.

Let *P*(*c*, *n*) and *Q*(*c*, *n*) be numerator and denominator of the *n*th convergents *pn*/*qn* of *s* with value c, respectively. For instance, *P*(6, 3) = 5, *Q*(6, 3) = 29. Given Fibonacci sequence *fn* defined as *f*1 = 1, *f*2 = 1, *fn* = *fn*-1 + *fn*-2 (*n* >= 3). The value of this sequence is no less than 3 from the 4th item.

Let the sum *SP*(*m*, *n*) = sum(*i* = 4, *m*, P(*fi*, *n*)) and *SQ*(*m*, *n*) = sum(*i* = 4, *m*, Q(*fi*, *n*). You are given *SP*(5, 10) = 606, *SQ*(5, 10) = 2784, *SP*(10, 100) mod 1000000007 = 774200907, *SQ*(10, 100) mod 1000000007 = 830200702.

Find *SP*(105, 1018) and *SQ*(105, 1018), both modulo 1000000007.

Answer format: [*SP*(105, 1018)],[*SQ*(105, 1018)]

Example: 774200907,830200702 for *SP*(10, 100) and *SQ*(10, 100)

Thanks to **czp** for the idea.

[Answer] **919033472,10861745**