

# N.1a

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## 1 Conjectures

- Any instance where  $a_0 = 2^n$  where  $n$  is a positive integer will have only even outputs.

Proof: Let  $a_0 = 2^n$ , where  $n \in \mathbb{Z}$ .

Lemma:  $2^n$  will always be even for positive  $n \in \mathbb{Z}$ : let  $2^k = 2$ , thus  $k = 1$ , then  $2^{k+1} = 2^k * 2$ . By definition of even integer this is even. end lemma  
Thus since the collatz conjecture divides even elements by 2, and every even integer is divisible by 2, then the outputs will only be even.

- When  $a_0 = 2^n$  for some positive integer  $n$ , there will be  $n + 1$  terms.
- There is a situation, beginning where we have two lists, and the  $a_0$  of the first is 28, and  $a_0$  of the second is 29, where they output the same number of terms. The situation occurs again where  $a_0$  is 36 and 37. The pattern continues as the singles place decreases and the tens place increases. The pattern might not be exactly as so, since it restarts itself after 62 and 63, to 69 and 70, but it begins again with 78 and 79.