Assembling Primes

Problem author: Paul Wild

A

- You are given a non-empty set of (decimal) digits.
- Construct a prime number that uses exactly those digits.
- Report "`impossible`" if no such prime number exists.
- Digits can be reused, but each digit needs to be used at least once.



`2 3 4 5 8 9` ⇝ `998244353`

`1` ⇝ `11`

`5` ⇝ `5`

`3 6` ⇝ `impossible`

`0 1 2 3 4 5 6 7 8 9` ⇝ `509118392752643`

Bicryption

Problem author: Yidi Zang

B

- This is a multi-pass problem!
- Anna and Ben each have a lowercase word w of length $\leq 10^5$.
- Each independently encrypts their input by outputting two lowercase words x and y of the same length as w, such that for each position i, w_i, x_i, and y_i are all pairwise distinct.
- In a third pass, Charlotte gets the two output words of either Anna or Ben in arbitrary order. She must then output who sent them and the decrypted original word.



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```
    Anna  koeri ⇝ curyr wrust
     Ben  plaintext ⇝ notreally encyrpted
Charlotte  wrust curyr ⇝ Anna  koeri
```

[kœri]wurstwerfen

Problem author: Maarten Sijm

C

- Conni, bored from waiting, throws a piece of [kœri]wurst in the air from 1 m above the ground, and catches it with her mouth (same height).
- If a [kœri]wurst takes t seconds to reach the apex of its trajectory, then the height difference in metres between its release point and the apex is given by

$$s(t) = \frac{1}{2}gt^2.$$



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- Assume that the gravitational constant g is $9.81\,\mathrm{m/s^2}$ and ignore atmospheric drag.
- Note that the [kœri]wurst spends the same amount of time moving upwards as downwards.
- The [kœri]wurst must *not* have positive vertical velocity when reaching the height of the ceiling, to avoid getting stuck.
- Given that the height of the ceiling is $h \leq 10^{15}$ metres, how long can the [kœri]wurst stay in the air?