Time limit: 15 minutes.

Instructions: This tiebreaker contains 3 short answer questions. All answers must be expressed in simplest form unless specified otherwise. You will submit answers to the problem as you solve them, and may solve problems in any order. You will not be informed whether your answer is correct until the end of the tiebreaker. You may submit multiple times for any of the problems, but **only the last submission for a given problem will be graded**. The participant who correctly answers the most problems wins the tiebreaker, with ties broken by the time of the last correct submission.

No calculators.

1. Trina has decided to use a ternary counting system (base 3). If she read the expression of 2020 in ternary as a date, how many days from today would it be?

2. A pen is tethered to the corner of a square box of side length 2cm by a string of length 4cm. What is the area of the largest shape that can be drawn with the pen without breaking the string and without the string going through the box? (Do not count the area of the box.)

3. Suppose S is a set of functions with the property that, if $f(x)$ and $g(x)$ are in S, then $(f \circ g)(x) = f(g(x))$ is in S. Given that the functions $r(x) = \frac{x\sqrt{3}+1}{\sqrt{3}-x}$ and $s(x) = \frac{1}{x}$ are in S, compute the smallest possible size of S.