

**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. Compute the maximum real value of  $a$  for which there is an integer  $b$  such that  $\frac{ab^2}{a+2b} = 2019$ . Compute the maximum possible value of  $a$ .
2. If  $P$  is a function such that  $P(2x) = 2^{-3}P(x) + 1$ , find  $P(0)$ .
3. There are two equilateral triangles with a vertex at  $(0, 1)$ , with another vertex on the line  $y = x + 1$  and with the final vertex on the parabola  $y = x^2 + 1$ . Find the area of the larger of the two triangles.