

**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. A circle of radius 2 is inscribed in equilateral triangle  $ABC$ . The altitude from  $A$  to  $BC$  intersects the circle at a point  $D$  not on  $BC$ .  $BD$  intersects the circle at a point  $E$  distinct from  $D$ . Find the length of  $BE$ .
2. Points  $A$ ,  $B$ , and  $C$  lie on a circle of radius 5 such that  $AB = 6$  and  $AC = 8$ . Find the smaller of the two possible values of  $BC$ .
3. In quadrilateral  $ABCD$ , diagonals  $AC$  and  $BD$  intersect at  $E$ . If  $AB = BE = 5$ ,  $EC = CD = 7$ , and  $BC = 11$ , compute  $AE$ .