

**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

$$\int_0^{10} (x - 5) + (x - 5)^2 + (x - 5)^3 dx.$$

2. Water is flowing out through the smaller base of a hollow conical frustum formed by taking a downwards pointing cone of radius 12m and slicing off the tip of the cone in a cut parallel to the base so that the radius of the cross-section of the slice is 6m (meaning the smaller base has a radius of 6m). The height of the frustum is 10m. If the height of the water level in the frustum is decreasing at 3m/s and the current height is 5m, then the volume of the water in the frustum is decreasing at  $d$  m<sup>3</sup>/s. Compute  $d$ .

3. Compute the value of

$$\int_{-\pi}^{\pi} \frac{e^{x^2} - e^{-x^2}}{e^{x^2} - x\sqrt{2}} |x| dx.$$