WISCONSIN MATHEMATICS, SCIENCE & ENGINEERING TALENT SEARCH

PROBLEM SET II (2026–2027) **Deadline: December 10, 2026**
November 2026

1. Maria set a secret 3-letter passcode using three distinct letters chosen from A, B, C, D, E, F. (The order of the letters does not matter.) Six of her friends attempted to crack the passcode and entered the following combinations:

$$ABD, ACE, ADE, BCE, BDE, CDE.$$

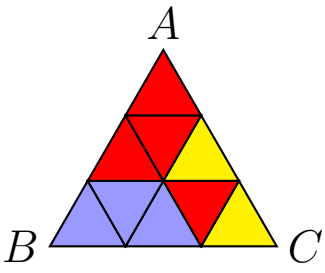
Afterwards, the security system reported that no one cracked the full code. However, 3 friends guessed 2 of the correct letters, 2 friends guessed 1 of the correct letters, and 1 friend guessed none of the correct letters. What were the three letters in Maria's secret passcode?

2. We write down the sequence of perfect squares in order: $1, 4, 9, 16, \ldots$ Is it possible to circle infinitely many of these numbers so that the difference between any two consecutive circled numbers is a perfect cube?

3. We have a machine that operates as follows. If you enter an integer $n \geq 2$, then it lists all the prime factors of n (repeated prime factors are included as many times as they occur), increases each of the factors by one, and prints out the product of these numbers. For example, if we enter 25, then it prints $36 = (5+1)(5+1)$. If we enter 14, then it prints $24 = (2+1)(7+1)$. We enter a number M in the machine, and we notice that the resulting number N is a multiple of M. Show that if we now enter N into the machine, then the printed out number K is a perfect square.

4. The six vertices of a convex hexagon lie on a circle. The hexagon has three sides with length a and three sides with length b (in some order). Find the radius of the circle in terms of a and b.

5. Equilateral $\triangle ABC$ is partitioned into 2026^2 identical smaller equilateral triangles by drawing 2025 equally spaced line segments parallel to each of the sides $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$. Color each of the smaller triangles either red, blue, or yellow in such a way that the small triangle with vertex A is colored red but no triangle with an edge on $\overline{BC}$ is colored red, the small triangle with vertex B is colored blue but no triangle with an edge on $\overline{AC}$ is colored blue, and the small triangle with vertex C is colored yellow but no triangle with an edge on $\overline{AB}$ is colored yellow. An example with 3^2 smaller triangles is shown. Prove that there must be a point inside or on the boundary of $\triangle ABC$ where triangles of all three colors meet.



- You are invited to submit a solution even if you solve just one problem.
- Remember that solutions require a proof or justification.
- Please carefully review the page at `https://talent.math.wisc.edu/how-to-participate/` about how to submit your solutions. Make sure to also review our policy on the use of AI: `https://talent.math.wisc.edu/ai-policy/`.
- Find old and current problems of the talent search at `http://www.math.wisc.edu/talent`.
- Find an introduction to techniques for solving problems like these at `https://go.wisc.edu/551pe6`.