

Math Auction

1 Rules of the Math Auction

1. We divide into teams and work for a fixed amount of time to solve the problems below.
2. Each team is given \$200 to start.
3. The best solution to a problem is worth \$100.
4. The problems are put up for auction in the order given. The team with the highest bid is allowed to present its solution.
5. The problem is then put up for bid again (and again), but each time the solution must be better than the previous solution.
6. When no other team wants to buy the problem, the team with the best solution collects the value of the problem. Every team that "bought" the problem pays for its bid, even if it did not have the winning solution.

This week's problems are from *Mathematical Circle Diaries, Year 1* by Anna Burago, Mathematical Circles, the Russian Experience by Dmitri Formin et al., and Invitation to a Math Festival by Ivan Yashenko.

2 Problems

- Using for numbers as many dollar bills as you want of 1, 2, 5, and 10 dollar denominations, and using (for free) the four arithmetical operation symbols and parentheses, construct an expression that equals 2019 and costs the least possible amount of money. Example:

$$(10 \times 10 \times 10) + (10 \times 10 \times 10) + 10 + 5 + 1 + 1 + 1 + 1 = 2019 \text{ and costs } 79 \text{ dollars}$$

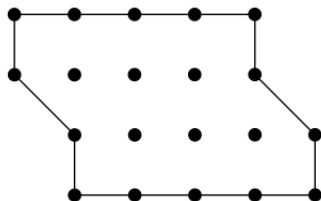
A team has a stronger solution for this problem if it is able to make 2019 in a way that costs fewer dollars

- Ali the trader has a heavy gold bracelet made of 11 links attached in a circle. During one of his trips, he decides to stay at a local inn for 11 days. The innkeeper asks him for one gold link per day as payment. The trader does not want to pay more that he owes, while the innkeeper wants to get his payment daily. However, the innkeeper is willing to trade the links to make even. For example, if Ali pays with the a single link on day one, he can give a chain with two links on day two and get the single link back. The trader will have to cut his bracelet into several pieces by breaking a few of its links. What is the minimum number of links Ali needs to cut?



A team has a stronger solution for this problem if it is able to demonstrate a way to pay making fewer cuts.

- Find as many different ways as possible to cut this figure into four pieces of the same size and shape, using straight line segments that begin and end at grid points.



A team has a stronger solution for this problem if it is able to demonstrate additional ways to cut the figure.

- Ten coins are arranged in the pattern below. What is the minimal number of coins we must remove so that no three of the remaining coins lie on the vertices of an equilateral triangle?

