Chapel Hill Math Circle – 4.27.19

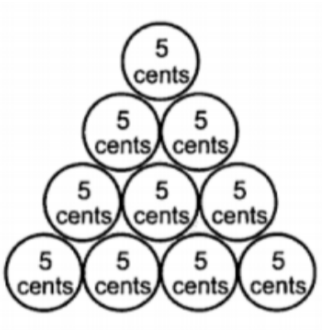
Math Auction 3

Rules of the game

1. We will divide into teams of 4-5 students each and work on the problems below for the first 40 minutes. *Note: We want students to work together in coming up with the answers, so parents please don't give away answers.*
2. Each time is given starting money of $1000. (we will keep track of $ on the board)
3. The best solution to a problem is worth $200.
4. The way the auction works is this:
    a. The problem is put up for auction, where each team will bid $ to present their answer(in increments of $10). Each team will have a leader who is responsible for bidding for their team.
    b. The team with the highest bid is allowed to present their solution to the class. One person from their team goes up to the board to share their answer. *Note: Each team member is only allowed to present 1 answer to a problem, then they must let each of their team members present an answer before going up again.*
    c. The problem is put up for auction again, however this time the solution must be better than the previous solution (we will describe what 'better' means below)
    d. If a team presents a better solution, they would get $200 *instead* of the first team.
    e. We keep auctioning & presenting solutions until there are no better solutions. The team with the best solution gets $200 added to their balance.
5. We're going to start with problem 1, go through the steps mentioned above, then move onto problem 2.

Problems

1. Ten coins are arranged in the pattern below. A triangle is formed when there are three coins for each vertice(a corner), and an unbroken line of coins on each edge. What is the minimal number of coins we must remove so that there are no more triangles?



A team has a stronger solution for this problem if they can remove fewer coins.

2. You have a straight wooden plank that is 20 inches long. You want to place several marks on it so that you can use this plank as a ruler. (You will be able to measure any length that can be represented as a distance between some pair of marks.) Place as few marks as possible in such a way as to be able to measure any distance from 1 to 20 inches.

A team has a stronger solution for this problem if its solution uses fewer marks.

3. King Arthur would like to design a flag with 4 vertical stripes. He has 4 colors to choose from: white, black, blue, green. If he can use the same color multiple times(but not right next to each other) how many choices does he have?

There is a right answer for this question. The closest team to the correct answer will get the points.

4. Six children sit around a circular table with 6 seats. How many ways can you re-arrange the children so that no child moves more than one seat to the right or to the left of his or her original position?

A team has a stronger solution for this problem if they can show a higher number of combinations.

5. **(Tiebreaker! We will only use this question if the score is tied.)**Express the number 100 using only the digit 8. Use as few digits 8 as possible. You can use operations $+, -, \times, \div$, exponentiation(raising to a power,) and parentheses. The same operation can be used several times, and you are not requires to use all of them. Do not combine 8's into multi-digit numbers such as 88 or 888. (Example: the number 16 can be expressed using four numbers 8 as 16 = 8 x ((8+8)/8), or using just two numbers 8 as 16 = 8+8.

A team has a stronger solution for this problem if it is able to express the number 100 using fewer 8's.