Halloween Auction

1. Find the tallest rectangular grid of letters so that each row is a word and the letters in each column are in alphabetical order. For example,

   C A L L
   K N O T

   is a solution of height 2.

2. Create a list of as many primes as possible such that the average of any two of the primes in your list is also a prime.

3. Given any number, reverse its digits and add the two together. Repeat this process with the sum until the number is a palindrome (meaning it is the same when read forwards or backwards). Find a number that takes the largest number of steps to become a palindrome.

   For example, the number 57 takes two steps to become a palindrome : $57 + 75 = 132$, then $132 + 231 = 363$.

4. Find the best approximation to π using the digits 0,1,2,3,4,5,6,7,8 and 9 each exactly once and the operations $+, -, \div, *, \sqrt{\ }$ and ! at most 1000 times.

5. Take a positive number and repeatedly take the sums of the squares of its digits. If this terminates at 1, call this number a decaying number. For example, 31 is a decaying number because $31 \to 3^2 + 1^2 = 10 \to 1^2 + 0^2 = 1$. Find a decaying number less than 10,000 that takes as long as possible to terminate.

6. In the grid below, color as many circles as possible so that no three of the colored circles lie on the same horizontal or vertical line.

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O

O O O O O O O O O O