1) Maritime warfare (Points: 50)

In the great Battle of Margaux, General Zeni Shah of the 145th Battlement has assigned Vidhi with the trusted job of placing allied Battleships in the Eastern Sea, just off the coast of the main land. The sea has been divided into an N X N matrix, where the number of ships is exactly N. Since she is not yet a part of the high command, she is not privileged to information about each ships movements. She therefore has to assume that the ships are allowed to move along the grid either horizontal, vertical or diagonal and nothing else. She has to place ships such that they can move so from their initial location, in any of the three locations without crashing into another ship.

Smallest data set:
0 <= N <= 2

Largest data set:
0 <= N <= 25

Input: is one value T, indicating T number of test cases, followed by T number integers representing number of Battleships to place in a Grid of T x T

Sample:

Input:
Is one value T, indicating T number of test cases, followed by T number integers representing number of Battleships to lace in a Grid of T x T
2
5
4

Output:
0 0 0 1 0
0 1 0 0 0
0 0 0 0 1
0 0 1 0 0
1 0 0 0 0

0 0 1 0
1 0 0 0
0 0 0 1
0 1 0 0

//Ships are represented by 1's. Notice how no ship can collide with each other regardless of their movement. Separate each test case with a new line.

2) Panda’s & Triangles: (Points: 10)

Payal the Panda likes to play games. She’s exceptionally good at math, a God given gift. She Challenges Vidhi to a contest that involves Triangle numbers. The sequence of triangle numbers is generated by adding the natural numbers. So the 7^{th} triangle number would be 1 + 2 + 3 + 4 + 5 + 6 + 7 = 28.
Payal points out that the seventh Triangle number has five divisors, being: 1, 2, 4, 7, 14, 28

Payal requires Vidhi to find the smallest triangle number with 500 such divisors. Help Vidhi to win the contest!

3) The Mathematics of Treasure Hunts: (Points: 10)

Vidhi and her friend Jinal love treasure hunts. On Vidhi's 21th birthday, Jinal and all her friends gathered around and built her a little treasure map across the city which leads to her birthday gift and surprize party! They provide her with a map of the city that is obfuscated and hard to read. The trick is for Vidhi to find the 13-digit key that allows her to easily decode the obfuscated map to make her task of reading it easier.
The task in finding the thirteen digit key is as follows:

She is provided with a thousand digit number. The number is;

73167176531330624919225119674426574742355349194934
96983520312774506326239578318016984801869478851843
85861560789112949495459501737958331952853208805511
12540698747158523863050715693290963295227443043557
66896648950445244523161731856403098711121722383113
62229893423380308135336276614282806444486645238749
30358907296290491560440772390713810515859307960866
70172427121883998797908792274921901699720888093776
65727333001053367881220235421809751254540594752243
52584907711670556013604839586446706324415722155397
53697817977846174064955149290862569321978468622482
83972241375657056057490261407972968652414535100474
82166370484403199890008895243450658541227588666881
16427171479924442928230863465674813919123162824586
17866458359124566529476545682848912883142607690042
24219022671055626321111109370544217506941658960408
07198403850962455444362981230987879927244284909188
84580156166097919133875499200524063689912560717606
05886116467109405077541002256983155200055935729725
71636269561882670428252483600823257530420752963450

Vishi is expected to find the product of the thirteen adjacent digits in the 1000-digit number that have the greatest product. Help vidhi to decode the map!

4) Classroom Shenanigans: (Points: 20)

Vidhi hates Biology. She never pays attention in class but instead spends it day dreaming about backpacking across Africa and doodling about the Universe. Unfortunately, as much fun as she had in class by herself, when it came to the finals, she failed miserable. Her only chance of redemption is if she is if she solves a simple problem set by the Head Of Department. Apparently, if she solves it correctly, she gets a pass grade and can go to college.

Her challenge is find the sum of all amicable numbers up to 15,000. Let d(n) be defined as the sum of proper divisors of n (numbers less than n which divide evenly into n).
If d(a) = b and d(b) = a, where a ≠ b, then a and b are an amicable pair and each of a and b are called amicable numbers.
For example, the proper divisors of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110; therefore d(220) = 284. The proper divisors of 284 are 1, 2, 4, 71 and 142; so d(284) = 220.

Help Vidhi to write a program in any language to help her find the answer!

5) The Princess and The Troll: (Points: 5)

One fine day, Vidhi was taking a stroll in the enchanted woods after a nice cup of tea. As she walked through the forest, she came across a bridge with a giant Troll, Graunkel, Guarding the bridge. While not much could be said about his looks, no one could defy his affluent mathematical abilities.
He imposes a puzzle for vidhi to solve in order to let her pass through to the other side.
The puzzle is as follows:

“Find the difference between the sum of the squares of the first one hundred natural numbers and the square of their sum.”

Help Vidhi solve the riddle and safely pass to the other side.