Part 3: Proof of your impossibility result

It is impossible to guarantee a mark of 100% for your significant other using any exam-cheat protocol. This is because the maximum number of bits that can be transmitted using the given honking code is 10, which is not enough to transmit all 20 bits of the correct answers. Therefore, it is inevitable that at least one of the answers will be incorrect, which means that a **perfect mark which is 20 cannot be guaranteed**. But here we need to find the lowest mark.

To see why this is the case, consider the following scenario:

- The correct answers to the exam are B = [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
- The encoded answers are H = [1, 0, 1, 0, 1, 0, 1, 0, 1, 0]

In this scenario, if the decoding function sets the first half of the decoded array D to 1's and the second half to 0's (based on the majority of elements in H), the resulting decoded answers will be D = [1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

However, the correct answers are B = [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0] which means that the decoded answers are incorrect for the last 10 questions. This means that it is **impossible to guarantee a mark higher than 90% with any exam-cheat protocol because there will always be scenarios where the decoded answers do not match the correct answers.**

Additionally, it is also impossible to guarantee a mark of 90% or higher. This is because there are **2^20 = 1048576 possible arrays of correct answers B, 2^10=1024 correct answer is there for decoding. and at least 104857 of these arrays have a Hamming distance of 10 or more** from any other array. This means that there will always be at least 104857 arrays of correct answers for which the maximum possible mark, even with the best possible exam-cheat protocol, will be less than 90%. Therefore, the best possible mark that can be guaranteed for your significant other using any exam-cheat protocol is less than 90%.
So Result <= 90% of the total marks

Result <= 90/100 * 20

Result <= 18

Answere: 18