A. Suppose that m is a large positive integer. You don't know yet whether m is prime, the product of two primes, the product of three primes, etc., but you would like to factor m into its constituent primes. Explain how to address this problem using Grover's algorithm with unknown $k \geq 1$. Be sure to specify n and f carefully.

B. Suppose that Ariko wants to send $M = 1011$ to Babatope. She encodes it using the $(7, 4)$ Hamming code and sends the seven-bit codeword EM. Unfortunately, two errors occur during transmission, and Babatope receives $EM + N + L$, where

$$N = \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \text{ and } L = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}.$$

Does Babatope's error-checking protocol detect that the received message is erroneous? Does Babatope's error-correcting protocol correct the errors?

C. Suppose that Ariko sends the same EM to Babatope, but now three errors occur, so that Babatope receives $EM + N + L + K$, where N and L are as above and

$$K = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}.$$

Does Babatope's error-checking protocol detect that the received message is erroneous? Does Babatope's error-correcting protocol correct the errors?