1. What is the result of applying the QFT modulo 6 to the following superpositions:

   - $|\psi\rangle = 1/\sqrt{2}(|0\rangle + |3\rangle)$?
   - $|\psi\rangle = 1/\sqrt{2}(|1\rangle + |4\rangle)$?
   - $|\psi\rangle = 1/\sqrt{3}(|0\rangle + |2\rangle + |4\rangle)$?

   Did you need to actually apply the QFT to each superposition to work out the answers or could you just write them down from some general principle?

2. The goal of this question is to run through a simulation of the quantum factoring algorithm on a particular input. Assume that we are trying to factor $N = 21$, and we choose $x = 2$, and $M = 12$ (this choice of M makes all the calculations easier). Recall that the algorithm creates a periodic superposition modulo M and then computes the fourier transform modulo M.

   - What is the periodic superposition modulo M that your algorithm would set up?
   - What is the fourier transform modulo M of this superposition?
   - Now measure the superposition from the previous part (make a random choice) to get an index j_1.
   - Repeat the previous three steps a couple of more times to get two more indices j_2 and j_3.
   - Compute the gcd g of j_1, j_2 and j_3.
   - Check if M/g is even, and now compute $gcd(N, x^{M/2g} + 1)$. Is this a factor of N?