1. Show that if you can factor $N$ then you can efficiently and classically find the period of a periodic function mod $N$.

2. Show that phase estimation is complete for BQP.

3. Let $v$ be the maximally entangled state on a $d$ dimensional space $H$, i.e. $v = \frac{1}{\sqrt{d}} \sum_{i=1}^{d} |i >$. Given two unitaries $U, V$ acting on $H$, conclusively establish the relationship between these two quantities: $<(U \otimes V)v, v >$ and $tr(UV)$, using tensor networks. (I.e. your thinking and proof should feature pictures!).

4. a. Recall that the given a vector $v \in H \otimes H$, the Schmidt decomposition of $v$ is of the following form:
   - $v = \sum_{i} d_{i} a_{i} \otimes b_{i}$, $a_{i}, b_{i} \in H$ and $d_{i}$ non-negative numbers, such that
   - $\{a_{i}\}$ and $\{b_{i}\}$ are each orthonormal sets.

   Draw the tensor network picture of the Schmidt decomposition and write down (as pictures) the conditions for orthonormality.

   b. Suppose you have a decomposition of the form $v = \sum_{i} f_{i} c_{i} \otimes d_{i}$, such that $\{c_{i}\}$ and $\{d_{i}\}$ are orthogonal sets but not normal, and $f_{i}$ are complex numbers. Can you easily realize this as a Schmidt decomposition. . . how do you do that?