1. Find the smallest complexity class containing the following language:
   Let $G = (V, E)$ be a directed graph. $G$ is in the language if $G$ contains 2013 paths, each of length 2013?

2. (Polynomial Hierarchy.)
   (a) Prove that for every $i$, if $\Sigma_i = \Pi_i$ then the polynomial hierarchy collapses to the $i$th level.
   (b) Prove that if there exists a language which is PH-complete then the hierarchy collapses.

3. (Randomized Computation - Part I.)
   (a) Show that if $NP \subseteq BPP$ then $NP = RP$.
   (b) Show that $BPP$ is closed under complement.

4. (Randomized Computation - Part II.)
   Prove or disprove the following statements:
   (a) $BPP(0.90 \cdot 0.905) = BPP$.
   (b) $BPP(0, 1 - \frac{1}{2^n}) = RP$.

5. (Search to Decision Reduction for Graph Isomorphism.)
   Suppose $A$ is an algorithm solving the Graph Isomorphism (GI) problem, i.e., given two graphs $G_1$ and $G_2$ it answers “yes” if the two graphs are isomorphic and “no” otherwise. Show a polynomial time oracle algorithm $B$, s.t. given any two graphs $G_1$ and $G_2$, $B^A$ outputs an isomorphism between $G_1$ and $G_2$ if one exists and “no isomorphism” otherwise.