1. In the Set Splitting problem, we are given a family of sets $\mathcal{F}$ over a universe $\mathcal{U}$ and a positive integer k, and the goal is to test whether there exists a coloring of $\mathcal{U}$ with two colors such that at least k sets in $\mathcal{F}$ are **non-**monochromatic. Show that the problem admits a kernel with at most $2k$ sets and $\mathcal{O}(k^2)$ universe size.

   We say that the coloring that witnesses a `Yes` instance *splits at least k sets.*

   Hint. Use the ~~Force~~ probabilistic method, Luke.

2. In the Minimum Maximal Matching problem, we are given an undirected graph G and a positive integer k, and the task is to decide whether there exists a maximal matching in G on at most k edges. Find a polynomial kernel for the problem (parameterized by k).

3. In the Connected Vertex Cover problem, we are given an undirected graph G and a positive k. The objective is to decide whether there exists a vertex cover C of G such that $|C| \leq k$ and $G[C]$ is connected.

   - Show that the problem admits a kernel with at most $2^k + \mathcal{O}(k^2)$ vertices.
   - Show that if G does not contain a cycle of length 4 as a subgraph, then the problem admits a kernel of size $\mathcal{O}(k^2)$.