Choose one of the following two problems:

1. Let $M$ be a smooth manifold which is connected. Prove that the set of isomorphism classes of nontrivial rank 1 smooth vector bundles over $M$ is in one to one correspondence with the set of nontrivial homomorphisms from $\pi_1(M)$ to $\mathbb{Z}_2$.

2. Let $M$ be a connected, 2-dimensional smooth manifold. Prove that $M$ is orientable if and only if $M$ admits an almost complex structure, i.e., for any $p \in M$, there exists an automorphism $J_p : T_p M \to T_p M$, which depends smoothly on $p$, such that $J_p^2 = -Id$. 