1. Let $M$ be the configuration space of two distinct points on the circle. Identify this with a well known 2-manifold.

2. Identify $\mathbb{R}P^1$ with a well known 1-manifold and give a diffeomorphism.

3. (Lee Exercise 1.46) Show that $\mathbb{C}P^1$ is diffeomorphic to $S^2$.

4. Suppose $M$ is a smooth manifold and $f : M \to \mathbb{R}$ is continuous. Prove for any $\varepsilon > 0$ there is a $C^\infty$ function $g : M \to \mathbb{R}$ such that $|f(x) - g(x)| < \varepsilon$ for all $x \in M$.
   Hint: Use the Stone-Weierstrauss theorem: If $K \subset \mathbb{R}^n$ is compact and $f : K \to \mathbb{R}$ is continuous, then for all $\varepsilon > 0$ there is a polynomial $g$ such that $|f(x) - g(x)| < \varepsilon$ for all $x \in K$.

5. Let $T^2$ be the 2-torus, given as $T^2 = \{(e^{i\theta}, e^{i\phi}) \in \mathbb{C}^2 | \theta, \phi \in \mathbb{R}\}$. For real numbers $\alpha, \beta$, there is an action of $\mathbb{R}$ on $T^2$ given by:
   $$ t \cdot (e^{i\theta}, e^{i\phi}) = (e^{i(\theta + t\alpha)}, e^{i(\phi + t\beta)}). $$
   For which $\alpha, \beta$ is the quotient space $C = \mathbb{R} \setminus T^2$ Hausdorff?
   (Bonus: When $C$ is Hausdorff, what is $C$?)

6. (Lee Ch 1 Exercise 14) The definition of a Lens space.