1. Exercise 35 on page 269 of Folland.

2. Exercise 49 on page 277 of Folland.

3. Exercise 50 on page 277 of Folland.

4. Prove that in the topological vector space $X$, every Cauchy sequence is bounded and every convergent sequence is Cauchy.

5. Let $K \subseteq \mathbb{R}^d$ be compact. Prove that $E \subseteq D_K$ is bounded if and only if $\{\| \partial^\alpha \phi \|_{C(K)} : \phi \in E\}$ is bounded for every multiindex $\alpha$.

6. Show that the topology on $D(\Omega)$ given by the seminorms $\rho_N(\phi) := \max\{|\partial^\alpha \phi(x)| : x \in \Omega\}$ is not complete for any nonempty open set $\Omega \subseteq \mathbb{R}^d$.

7. Show that if $E \subseteq \mathbb{R}^d$ is any closed set, then there exists a nonnegative function $\phi \in C^\infty(\mathbb{R}^d)$ such that $E = \{\phi = 0\}$. More generally, if $E$ and $F$ are disjoint closed sets, there exists $\phi \in C^\infty(\mathbb{R}^d; [0, 1])$ such that $E = \{\phi = 0\}$ and $F = \{\phi = 1\}$. (You may find it helpful to reduce to the case when both $E$ and $F$ are compact, which can be done by using a partition of unity.)

8. Show that if $K, K'$ are compact and $K$ is contained in the interior of $K'$, then $D_K$ is nowhere dense in $D_{K'}$. 