1. State and prove the weak maximum principle as it applies to the problem

$$-\Delta u \leq 0, \quad u \in \Omega,$$

where $\Omega$ is a bounded domain in $\mathbb{R}^n$.

2. Let $\varphi \in \mathcal{D}(\mathbb{R})$ and define $\varphi_\epsilon(x) = \frac{1}{\epsilon}(\varphi(x+\epsilon) - \varphi(x))$. Show that $\varphi_\epsilon \to \varphi'$ in $\mathcal{D}$ as $\epsilon \to 0$. Use this to give a possible definition for the derivative of a distribution, and show that your definition actually defines a distribution.

Text problems: 2.1.4, 2.1.9, 2.1.6