1. **Compact sets in** \( \mathbb{R}^\infty \).  
   Show that \( A \subset \mathbb{R}^\infty \) has compact closure (in the usual topology of co-ordinatewise convergence) if and only if \( \pi_k(A) = \{ x_k \mid x \in A \} \) is bounded for each \( k \).

2. **\( \mathbb{P} \)-continuity sets form a field.**  
   Let \( \mathcal{F}_\mathbb{P} = \{ A \in \mathcal{B}(\mathcal{M}) \mid \mathbb{P}(\partial A) = 0 \} \). Show that \( \mathcal{F}_\mathbb{P} \) is a field.

3. **A necessary and sufficient condition for convergence in distribution.**  
   Suppose \( X_n, X \) are random variables. Show that \( X_n \xrightarrow{\text{w}} X \) if and only if one has \( \mathbb{E}F(X_n) \to \mathbb{E}F(X) \) for any continuous CDF \( F \).

4. **Relative compactness of point masses.**  
   Let \( A \in \mathcal{B}(\mathcal{M}) \). Let \( \Pi_A = \{ \delta_x \mid x \in A \} \). Show that \( \Pi_A \) is relatively compact if and only if \( \bar{A} \) is compact.