As usual, we assume an underlying probability triple \((\Omega, \mathcal{F}, \mathbb{P})\).

1. **10 points** If \(\tau_1\) and \(\tau_2\) are two stopping times, show that \(\check{\tau}_+ \overset{\text{def}}{=} \max\{\tau_1, \tau_2\}\) and \(\check{\tau}_- \overset{\text{def}}{=} \min\{\tau_1, \tau_2\}\) are stopping times.

2. **30 points** Let \(b\) and \(\hat{b}\) be bounded and Lipschitz-continuous functions on \(\mathbb{R}\). Fix \(z_0 \in \mathbb{R}\) and for each \(\varepsilon \in (0, 1)\), consider the ODE
   \[
   \dot{Z}_t^\varepsilon = b(Z_t^\varepsilon) + \varepsilon \hat{b}(Z_t^\varepsilon) \quad t \geq 0 \\
   Z_0^\varepsilon = z_0.
   \]
   Show that for each \(T > 0\), \(\lim_{\varepsilon \to 0} \sup_{0 \leq t \leq T} |Z_t^\varepsilon - Z_0| = 0\).

3. **15 points** Fix \(\alpha \geq 0\) and \(\beta \geq 0\). Assume that \(X\) is a solution of the SDE
   \[
   dX_t = X_t^\alpha dt + X_t^\beta dW_t \quad t \geq 0 \\
   X_0 = 1
   \]
on the interval \((0, 2)\).
   
   (a) **10 points** For what \(\alpha\) and \(\beta\) is the origin 0 accessible (i.e., the process hits 0 with positive probability before hitting 2)?
   
   (b) **10 points** For what \(\alpha\) and \(\beta\) is the origin 0 inaccessible (i.e., the process does not hit 0)?