Q1. If \((B_t)_{t \geq 0}\) is a standard BM, show that, as \(t \to \infty\),

\[
\left( \int_0^t e^{B_s} \, ds \right)^{1/\sqrt{t}} \xrightarrow{d} e^{M_1},
\]

where \(M_1 = \sup_{0 \leq s \leq 1} B_s\).

Q2. Let \((B_t)_{t \geq 0}\) be a standard BM and let \(R = \inf\{t \geq 1 : B_t = 0\}\) and \(L = \sup\{t \leq 1 : B_t = 0\}\).

(a) Using Markov property at time 1, show that \(R \sim 1 + \frac{\xi_1^2}{\xi_2^2}\) where \(\xi_1\) and \(\xi_2\) are two independent standard normals.

(b) Show that \(R = L^{-1}\) in distribution and recover the arcsine law for \(L\).

Q3-Q6. Durrett 8.1.3, 8.2.3, 8.2.4, 8.5.2.